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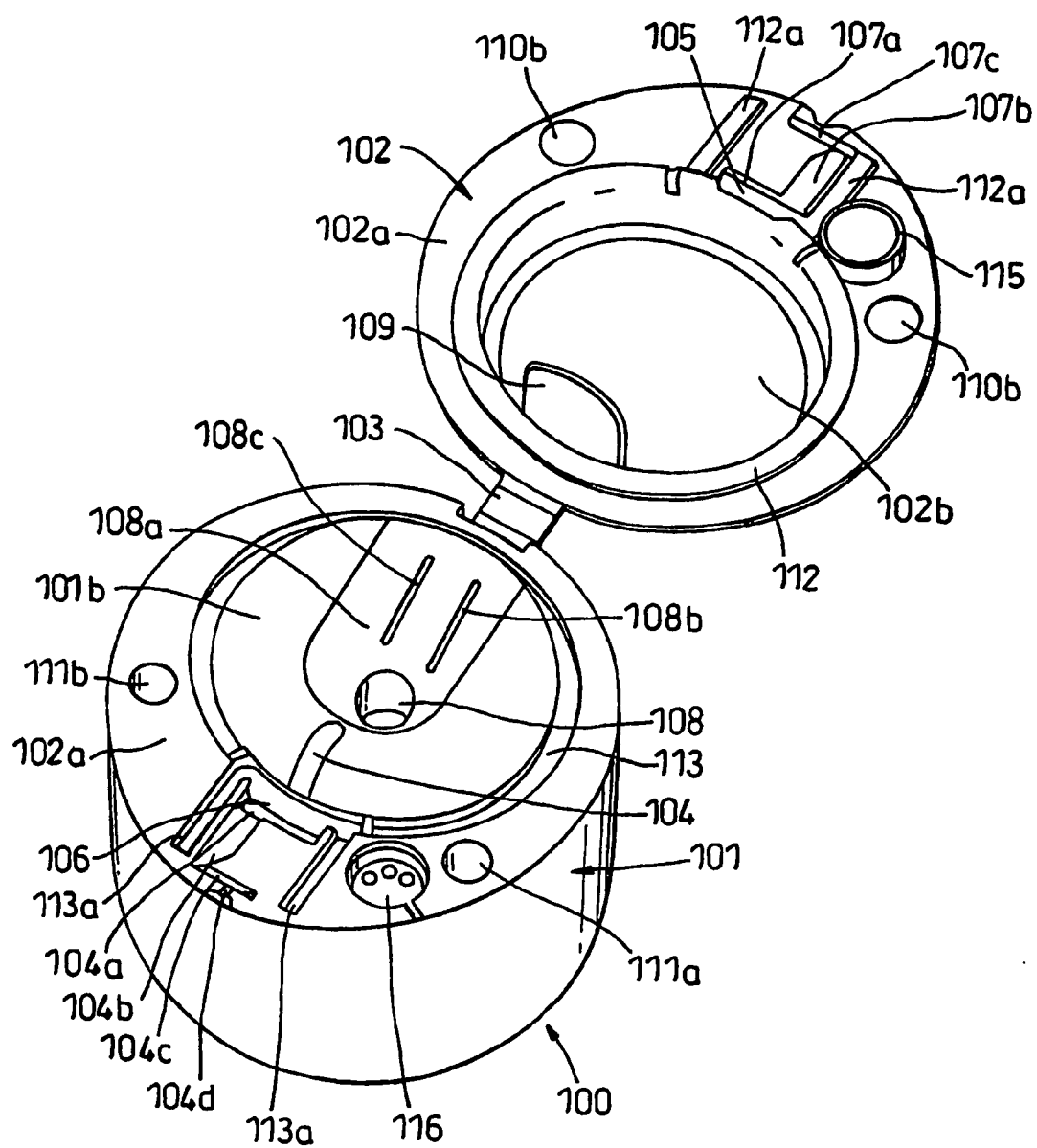


Fig. 1A

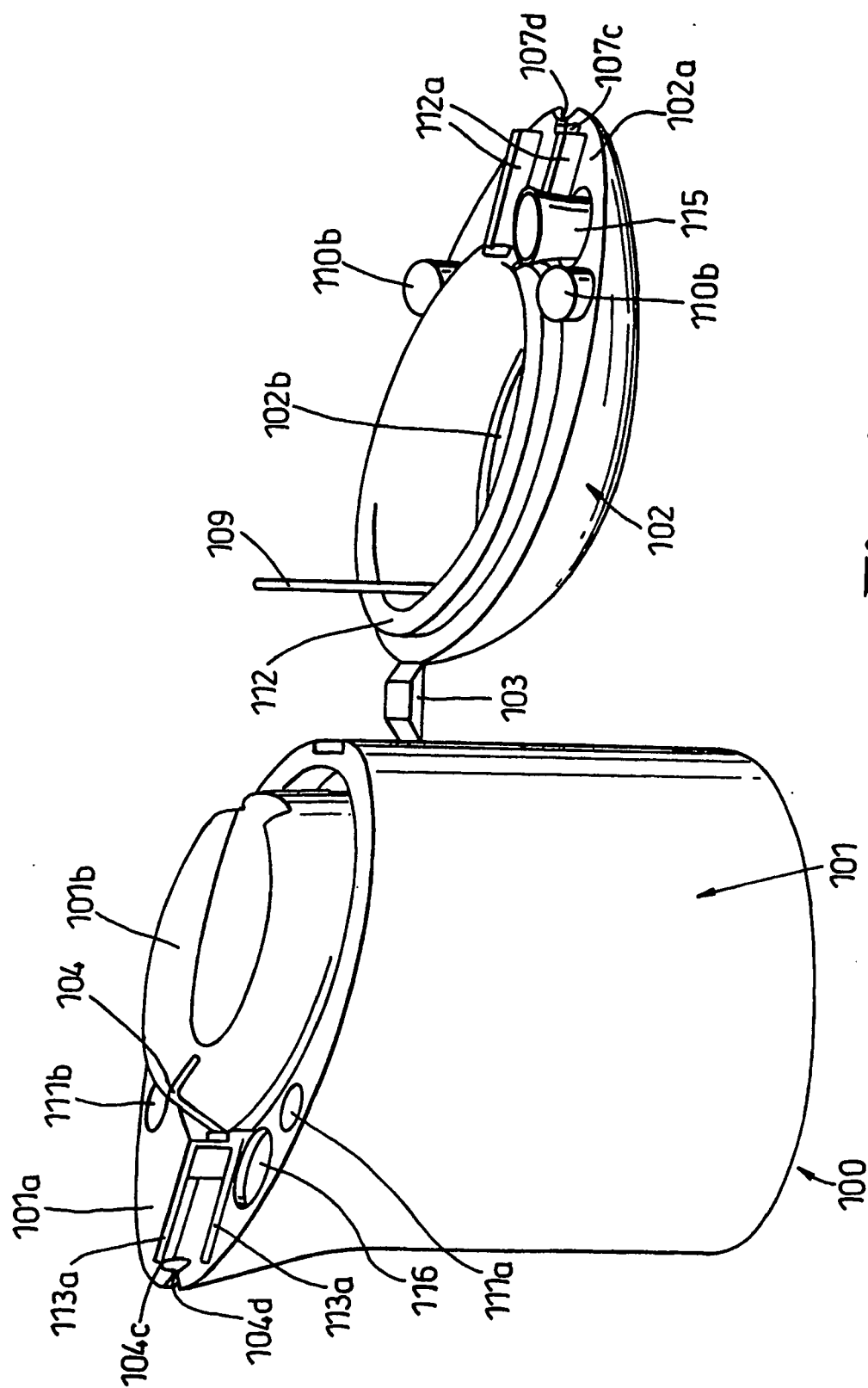


Fig. 1B

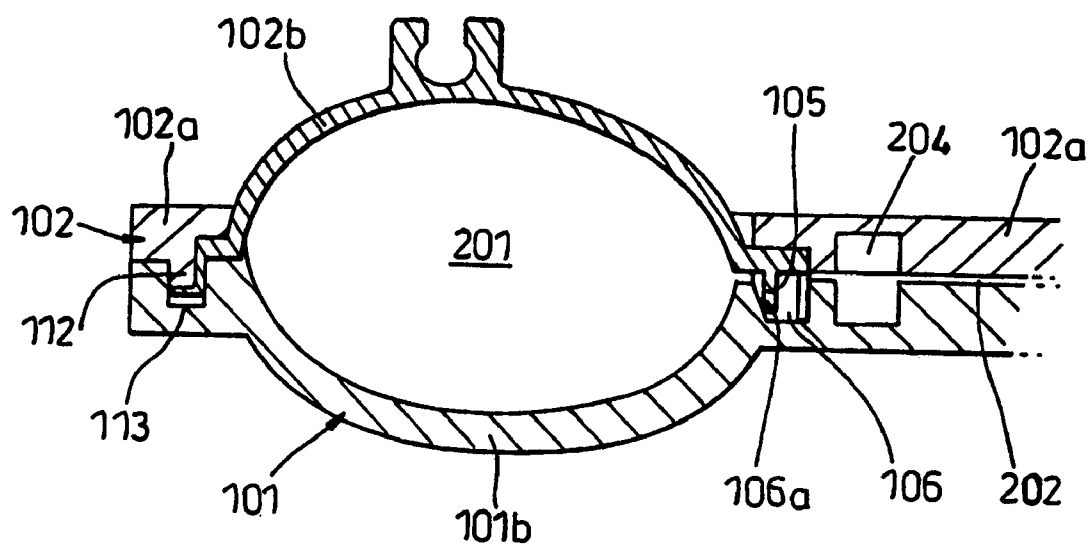
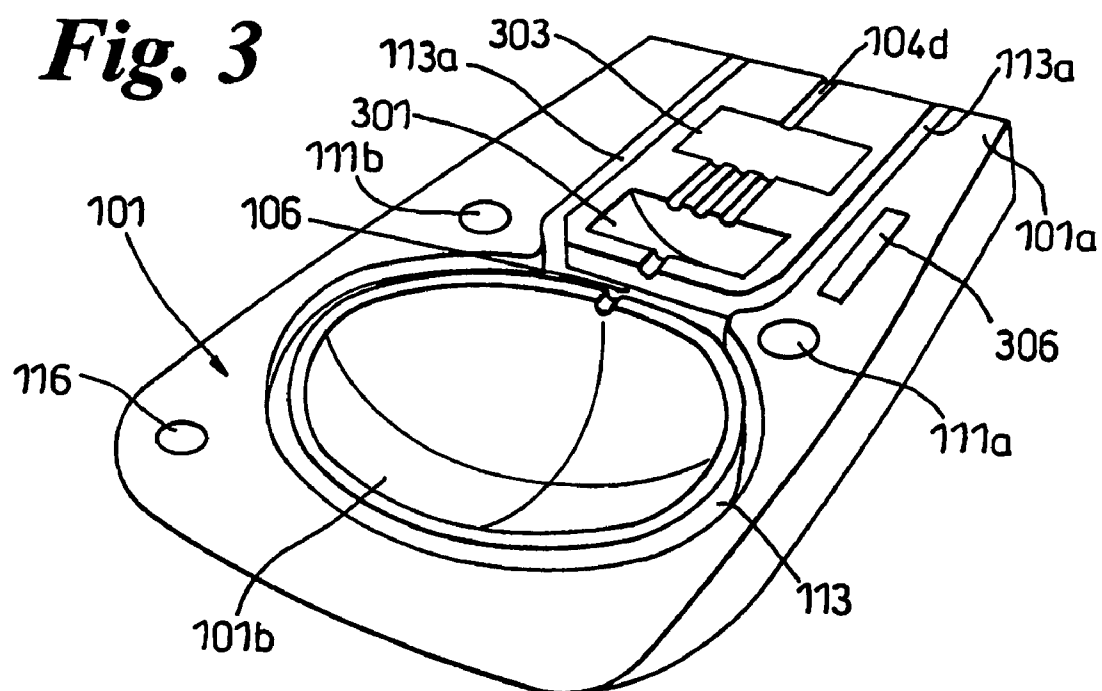
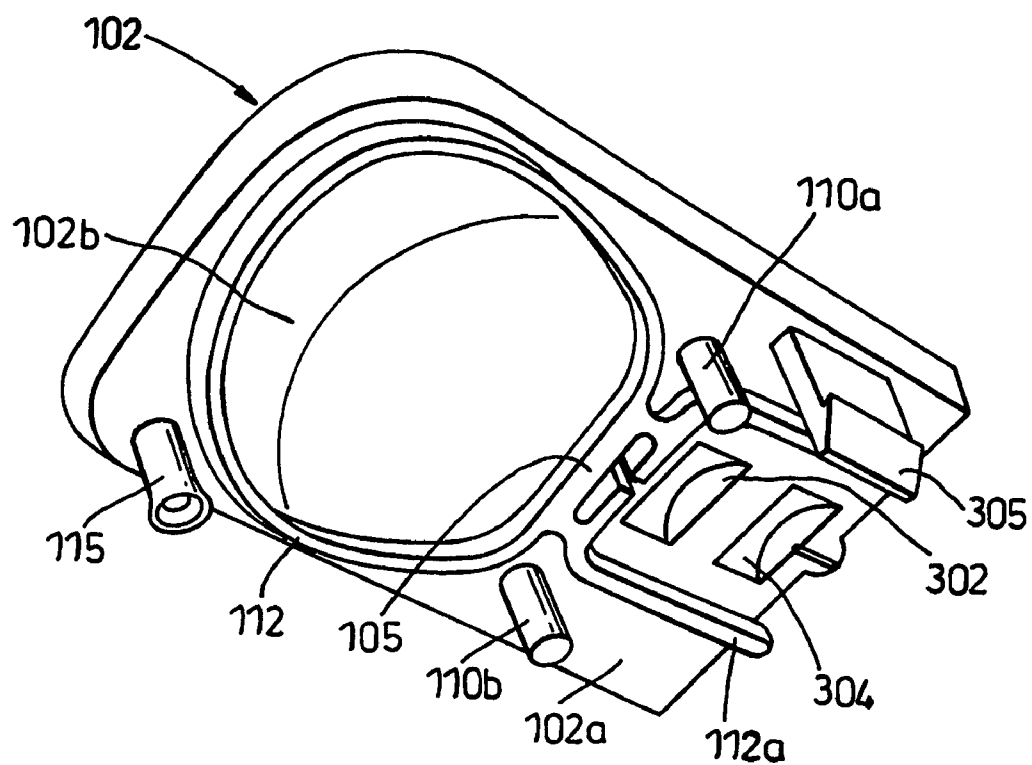


Fig. 2



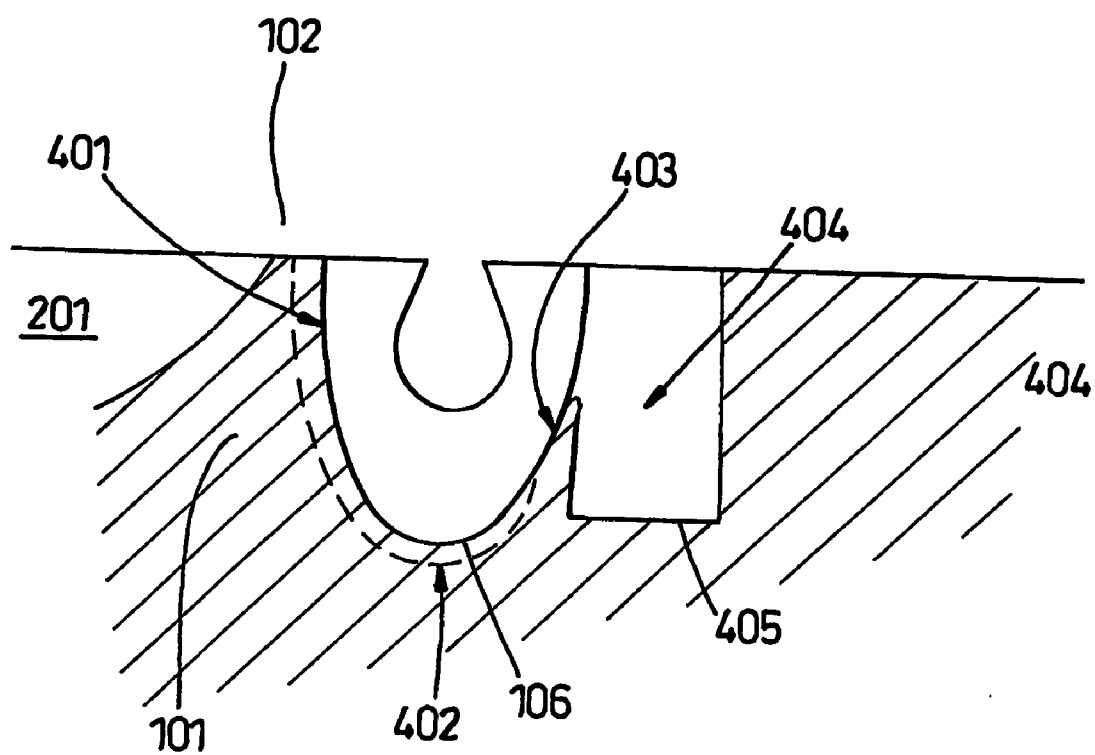


Fig. 4

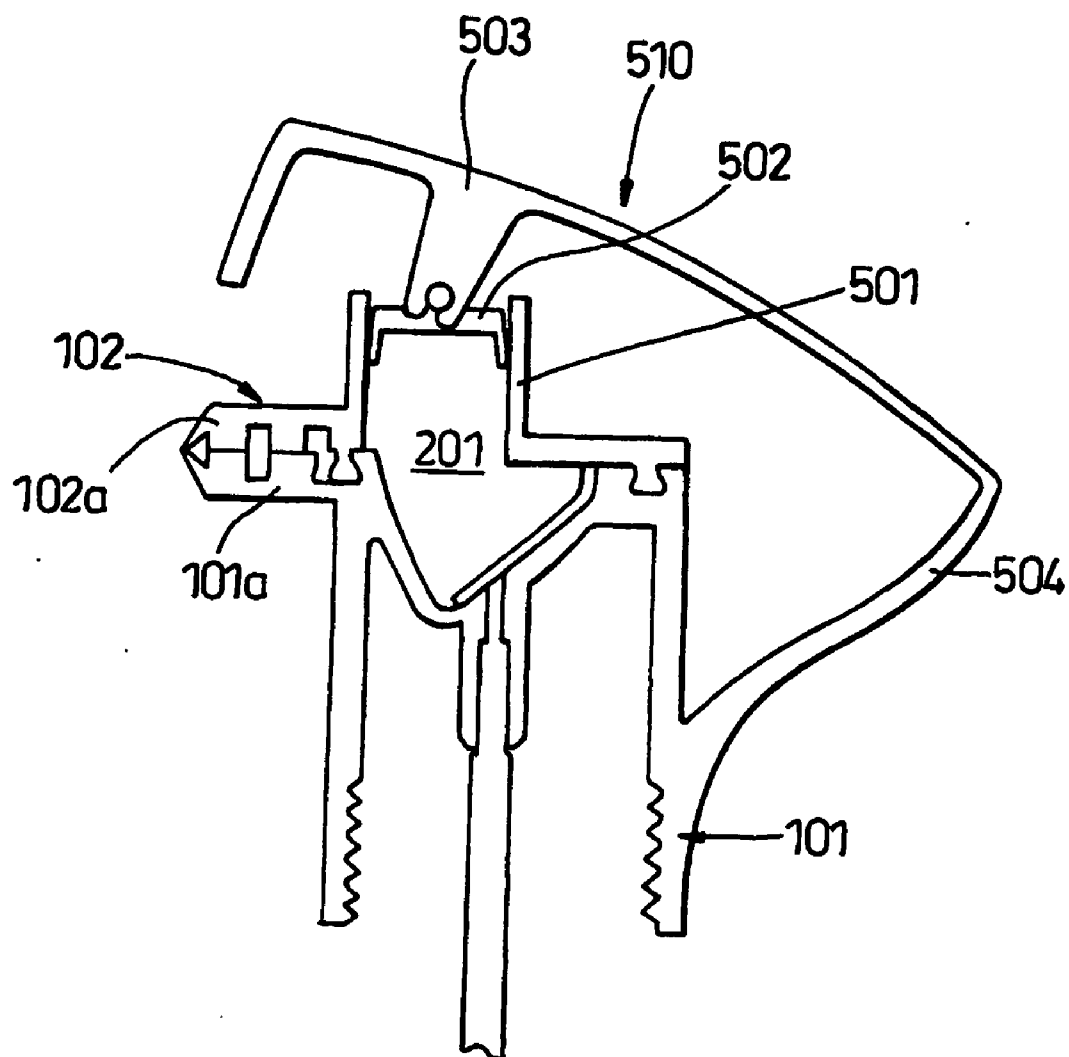


Fig. 5

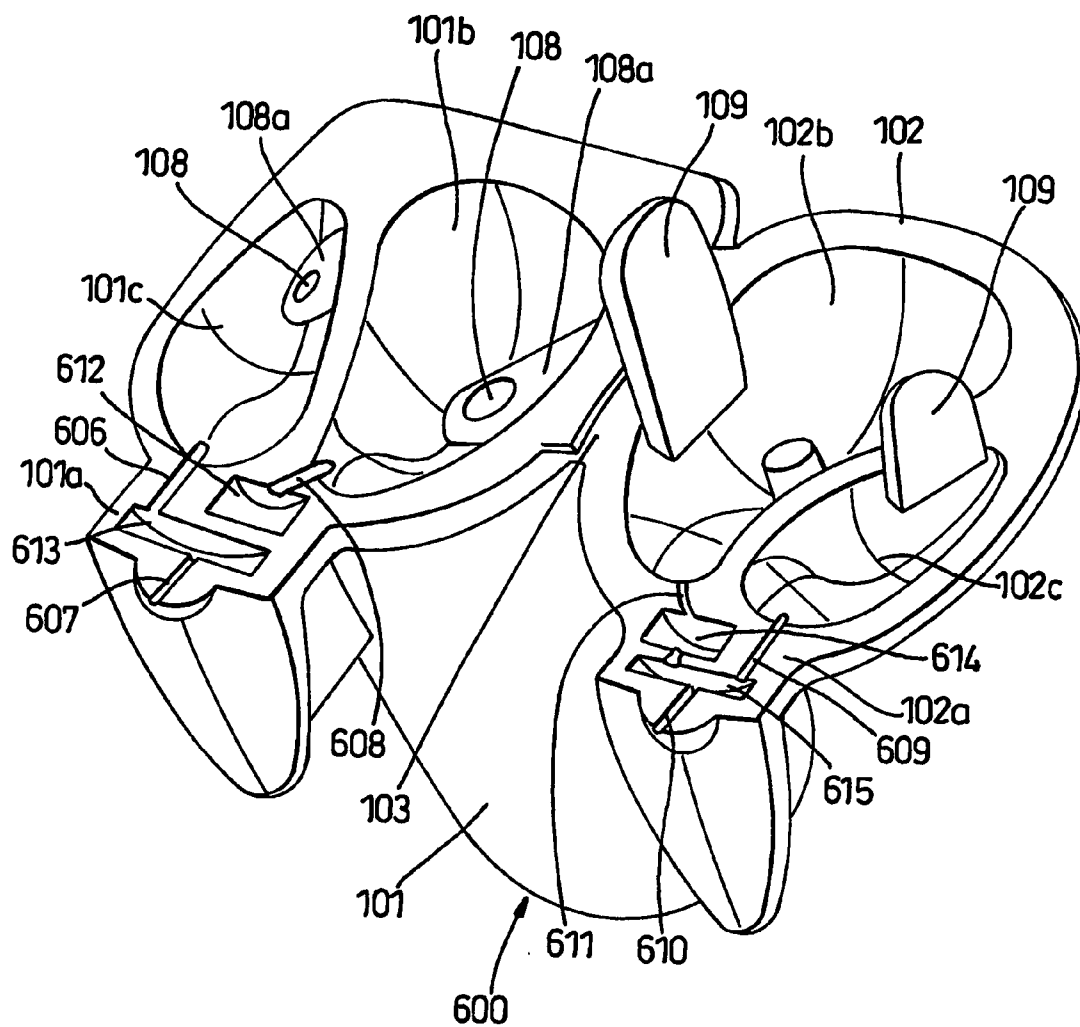


Fig. 6

SPRAY NOZZLE

[0001] This invention relates to a spray nozzle and, more particularly but not exclusively, this invention relates to a pump-action spray nozzle and methods of making the same.

[0002] Pump-action spray nozzles are commonly used to provide a means by which fluids can be dispensed from a non-pressurised container, or other fluid source, in the form of a spray.

[0003] Conventional pump-action spray nozzles tend to be extremely complex in design and typically comprise numerous component parts (usually between 8 and 10 individual components in pump nozzle devices and between 10 and 14 individual components in trigger-actuated nozzle devices). As a consequence, these nozzle devices can be extremely costly to manufacture due to the amount of material required to form the individual components and the assembly processes involved. In addition, many of the conventional nozzle devices tend to be bulky (which again increases the raw material costs) and a proportion of this bulk is invariably disposed inside the container to which the device is attached. This is a further drawback because the nozzle takes up a proportion of the internal volume of the container, which can be a particular problem in small containers where the available space inside the container is limited. Finally, the size of the pump-action device is also dictated to certain extent by the size of the container to which it is attached. Thus, the size of the device is usually restricted in small containers, and especially in small containers with narrow necks, and this limits the amount of pressure that can be generated by the device as well as the volume of fluid that can be dispensed, and, for this reason, can be detrimental to the performance of the device.

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

- (i) simple in design;
- (ii) utilises less component parts; and
- (iii) is easy to operate and functions effectively.

[0005] The present invention provides a solution to the problems associated with conventional nozzle devices by providing, in a first aspect, a pump-action nozzle device configured to enable fluid to be dispensed from a container in the form of a spray, said nozzle having a body which defines an internal 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 container by at least a predetermined 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 within the chamber exceeds the external pressure at the outlet by at least a predetermined threshold amount, and wherein at least a portion of the body which defines said chamber is configured to:

[0006] (i) resiliently deform from an initial resiliently biased configuration to a distended or deformed configuration in response to the application of a pressure, whereby the volume of said chamber defined by said portion of the body

is reduced as said portion of the body is deformed from said initial configuration to said distended or deformed configuration, said reduction in volume causing the pressure within the chamber to increase and fluid to be ejected through the outlet valve; and

[0007] (ii) subsequently return to its initial resiliently biased configuration 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;

[0008] characterised in that the outlet of the device is adapted to generate a spray of the fluid ejected through the outlet valve during use.

[0009] The nozzle device of the present invention solves the aforementioned problems associated with many conventional 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.

[0010] The outlet of the device may be adapted to generate a spray 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 droplets.

[0011] Preferably, 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. It is known that the inclusion of the aforementioned features, either alone or in combination, contributes to the break up or "atomisation" of liquid droplets caused to flow through the outlet passageway during use. The net effect is the production of finer sprays at the outlet of the nozzle device. 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.

The Body of the Device

[0012] The chamber defined by the body may be defined between two or more interconnected parts of the body. It is especially preferred that the chamber 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 chamber.

[0013] In preferred embodiments of the invention in which the outlet comprises the outlet valve, an outlet orifice and an outlet passageway that connects the outlet valve to the outlet orifice, it is also preferred that the at least two interconnected parts that define the chamber also define at least a portion of the outlet passageway. Most preferably, the two interconnected parts form the outlet valve between them and also define the entire outlet passageway and the outlet orifice.

[0014] 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 defined at the end of the outlet passageway. In preferred embodiments where one or more spray modifying features are present in the outlet passageway, the features may be formed by aligning recesses or other formation formed on the abutment surfaces, as illustrated and described in International Patent Publication Number WO 01/89958.

[0015] 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. As previously indicated above, however, it is preferable that the body is formed from a single material.

[0016] 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.

[0017] As a further alternative, the two parts could be connected together within the moulding tool and a plastic or other suitable material could then be moulded over the join

to the two parts 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.

[0018] 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.

[0019] It is most preferred that the two parts of the body of the nozzle device that define the chamber 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 chamber to the outlet orifice in preferred embodiments.

[0020] The upper part is adapted to be fitted to the base so that between them they define the chamber 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 chamber.

Material

[0021] The body of the nozzle arrangement may be made from any suitable material.

[0022] In preferred embodiments where the body comprises two interconnected parts which fit together to define the chamber, 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 resiliently deformable portion of the body defining the chamber and can readily be depressed by an operator to actuate the ejection of fluid present in the chamber in the form of a spray. The flexible material can also provide a soft touch feel for the operator. Preferably, the base part will be formed from a rigid plastic and the upper part will be formed from a resiliently deformable material. 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.

[0023] 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 aluminum foil or a flexible material such as rubber. Preferably, however, the body of the device is formed entirely from a rigid plastic material or a flexible plastic material.

[0024] The pump-action nozzle device is preferably formed from a single rigid or flexible plastic material.

[0025] 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.

[0026] 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.

[0027] Forming the body of the device from a single material provides an advantage in that the entire nozzle device can be moulded in a single tool in a single moulding operation, as discussed further below.

[0028] 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.

[0029] For most applications the nozzle device would need to be made from a rigid material to provide the necessary strength 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.

[0030] The 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. Alternatively, the portion of the body concerned may comprise a substantially rigid portion sur-

rounded by a deformable portion such that pressure applied to the rigid portion causes the surrounding resiliently deformable portion to deform and thereby enables the rigid portion to be displaced to compress the chamber. For example, the surrounding resiliently deformable portion could resemble a bellows, i.e. a rigid portion is surrounded by a deformable side wall that comprises a number of folded segments of rigid plastic which is configured such that applying a pressure to the rigid portion causes the folds of the sidewall to resiliently compress together to reduce the volume of the chamber. Once the applied pressure is removed, the side walls return to their original configuration.

[0031] In all 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

[0032] In order to function optimally, it is necessary that the outlet of the chamber is provided with, or is adapted to function as, a one-way valve. The one-way valve enables product stored in the 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 chamber caused by the displacement of the resiliently deformable wall from its initial resiliently biased configuration), and closes the outlet at all other times to form an airtight seal. The closure of the valve when the pressure in the chamber 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.

[0033] Any suitable one-way valve assembly that is capable of forming an airtight seal may be provided in the outlet. However, it is preferable that the valve is formed by the component parts of the body of the nozzle device. Most preferably, the valve is formed between the abutment surfaces that define outlet passageway.

[0034] In certain embodiments of the invention, the outlet valve is formed by one of the abutment surfaces being resiliently biased against the opposing abutment surface to close off a portion of the length of the outlet passageway. In this regard, the valve will only open to permit fluid to be dispensed from the chamber when the pressure within the 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 the 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.

[0035] 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.

[0036] In embodiments where the body is made entirely from a rigid plastic material, the resilience of the resiliently biased surface (which will be a thin section of rigid plastic) may not be sufficient to achieve the required minimum pressure threshold for the optimal functioning of the device. In such cases, a thickened rib of plastic, which extends across the passageway, may be formed to provide the necessary strength and resistance in the outlet passageway/valve. Alternatively, a rigid reinforcing rib could be provided above part of the outlet passageway/valve.

[0037] In an alternative preferred embodiment, the outlet valve is 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 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 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.

[0038] 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 exceeds a predetermined threshold value, the post or plug can be deformed to define an opening through which fluid can flow through the outlet.

[0039] The predetermined minimum pressure that must be achieved within the chamber 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

[0040] To ensure that fluid is only ejected through outlet when the chamber is compressed by displacing the resil-

iently 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.

[0041] Any suitable inlet valve may be used.

[0042] 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 its 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.

[0043] 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.

[0044] 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.

[0045] For these reasons it is preferable that flap valve comprises a number of further 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.

[0046] 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. 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.

[0047] 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

[0048] The nozzle device may also be provided with a locking means to prevent the fluid being dispensed accidentally.

[0049] 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 valve from opening.

[0050] The locking means may also comprise a rigid cover that can be placed over the resiliently deformable portion of the body 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. Alternatively, the rigid cover may be a slidable over cap that can be slid downwards to compress the chamber during use. The cover can be twisted to lock it and thereby prevent the accident actuation of the device.

Air Release/Leak Valve

[0051] 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.

[0052] Most preferably, the air leak valve is formed between the upper part and base which define the chamber of the dispenser nozzle.

[0053] Preferably, the air leak valve comprises a valve member disposed within a channel that is defined by the body of the device and connects the interior of the fluid

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

[0054] 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.

[0055] 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.

[0056] 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.

[0057] 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.

[0058] 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.

[0059] With certain products stored in containers over time there is a problem associated with gas building up inside the bottle over time. To release the build up of pressure, which can inevitably occur, a release valve is

required. The air leak valve described above can be modified to additionally perform this function by providing one or more fine grooves in the side of the channel. These fine groove(s) will permit gas to slowly seep out of the container, bypassing the seal formed by the contact of the valve member with the sides of the channel, but prevent or minimise the volume of liquid that may seep out. Preferably, the groove or grooves formed in the side walls of the channel is/are 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.

[0060] 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

[0061] In preferred embodiments of the invention comprising at least two component parts, it is preferred that a seal is disposed at the join between the at least two interconnected parts to prevent any fluid leaking out of the nozzle device. Any suitable seal would suffice. For instance, the two parts could be 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.

[0062] 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.

[0063] 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.

[0064] 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.

[0065] 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

[0066] In most cases, a dip tube may be integrally formed with the nozzle device, or alternatively the body of the nozzle device 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.

[0067] 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 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.

Chamber

[0068] The chamber of the nozzle device may be of any form and it shall of course be appreciated that the dimensions and shape of the dome will be selected to suit the particular device and application concerned. Similarly, all the fluid in the chamber may be expelled when the dome is compressed or, alternatively, only a proportion of the fluid present in the chamber may be dispensed, again depending on the application concerned.

[0069] In certain preferred embodiments of the invention, the chamber is defined by a generally dome-shaped resiliently deformable region of the body. Preferably, the dome-shaped region is formed on the upper surface of the body so that it is accessible for operation by a person using the nozzle. One problem with dome-shaped chambers can be that a certain amount of dead space exists within the chamber when it is compressed by an operator, 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 wall of chamber can be depressed such that it contacts an opposing wall of 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.

[0070] In some cases, the resiliently deformable portion of the body 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.

[0071] 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”.

Two or More Chambers

[0072] The nozzle device of the invention may comprise two or more separate internal chambers.

[0073] Each individual chamber may draw fluid into the nozzle device through a separate inlet from different fluid sources, e.g. separate fluid-filled compartments within the same container.

[0074] Alternatively, one or more of the additional chambers may not comprise an inlet. Instead a reservoir of the second fluid may be stored in the chamber itself and the additional chamber or its outlet may be configured to only permit a predetermined amount of the second fluid to be dispensed with each actuation.

[0075] As a further alternative, one or more chambers of the additional chambers may draw air in from outside the nozzle device. 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 outlet by simultaneously compressing both chambers together. The contents of the respective chambers will then be mixed within the outlet, either on, after or prior to, ejection from the nozzle device. 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.

[0076] Where 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 chamber to deform back to its original expanded 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. not providing this additional chamber with an airtight outlet valve) or, more preferably, drawing air in through an inlet hole in the body defining the chamber. In the latter case, the inlet hole 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.

[0077] In most cases, it is desirable to co-eject the air and fluid from the container at approximately the same pressure. This will require the air chamber to be compressed more (e.g. 3-200 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.

[0078] As an alternative, the nozzle device may also be adapted in such a way that the air pressure may be higher or lower than the liquid pressure, which may be beneficial for certain applications.

[0079] 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.

[0080] Preferably, the fluid present in each chamber are ejected simultaneously. However, it shall be appreciated that one chamber may eject its fluid before or after another chamber in certain applications.

[0081] 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.

Spray Insert

[0082] In an alternative embodiment 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.

Integrally Formed with the Container

[0083] 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 is preferably moulded as a single material and, therefore, can be integrally moulded with containers made from the same or a similar compatible material.

[0084] 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.

[0085] 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.

[0086] According to another aspect of the present invention, there is provided a pump-action nozzle device configured to enable fluid to be dispensed from a container in the form of a spray, said nozzle having a body which defines an internal 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 container 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 predetermined threshold amount, and wherein at least a portion of the body which defines said chamber is configured to:

[0087] (i) be displaceable 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 valve; and

[0088] (ii) subsequently return to its initial resiliently biased configuration 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;

[0089] characterised in that the outlet of the device is adapted to generate a spray of the fluid ejected through the outlet valve during use.

[0090] Preferably the nozzle device is as defined above.

[0091] 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.

[0092] Preferably, the nozzle device comprises a means for displacing the piston inwards from its initial position and then subsequently returning it to its initial position. This may be achieved by any suitable means, such as, for example, a trigger or over cap connected to the piston which can be operated to displace the piston, when desired. Preferably, the means for displacing the piston inwards from its initial position is resiliently biased so that the piston will be returned to its initial position after use.

Method of Manufacture

[0093] The nozzle devices of the present invention may be made by any suitable methodology known in the art.

[0094] 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.

[0095] 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 said method comprising the steps of:

[0096] (i) moulding said parts of the body; and

[0097] (ii) connecting said parts of the body together to form the body of the nozzle device.

[0098] Each part of the body may be a separate component part, in which case the component parts are initially formed and then assembled together to form the nozzle device.

[0099] Alternatively, and more preferably, the two parts of the body or one of the parts of the body and the trigger actuator 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. Thus, the entire device will be formed in a single moulding step from a single material. Once formed, the upper part can be folded over and connected to the base to form the assembled nozzle device.

[0100] As an alternative, the nozzle device may be formed by a bi-injection moulding process whereby a first component part the body is formed and a second part is then moulded onto the first part. Each part may be moulded from the same or a different material. As before, the trigger actuator 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.

[0101] 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

[0102] 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 said method comprising the steps of:

[0103] (i) moulding a first of said parts of the body in a first processing step; and

[0104] (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.

[0105] 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.

[0106] 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 said method comprising the steps of:

[0107] (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

[0108] (ii) over-moulding onto the framework or base to form the second of said parts of the assembled nozzle device.

[0109] The framework for the second part may be fitted to the base prior to the over-moulding step.

[0110] Alternatively, the over-moulding may take place before the framework for the second part is fitted to the first part.

[0111] 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.

[0112] 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.

[0113] 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 said method comprising the steps of:

[0114] (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

[0115] (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.

[0116] 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 wherein said parts 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:

[0117] (i) moulding the parts of the body together with said connection elements in a single moulding step; and

[0118] (ii) moving said parts of the body into engagement with one another to form the body of the nozzle device.

[0119] The dispenser nozzles of the present invention may be made by a number of different moulding techniques.

Blowing Agent

[0120] 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.

[0121] How the invention may be put into practice will now be described by way of example only, in reference to the accompanying drawings, in which:

[0122] FIG. 1A is a perspective view of a nozzle device of the present invention in which the two component parts of the body are separated to illustrate the internal features of the device;

[0123] FIG. 1B is a further perspective of the device shown in FIG. 1A;

[0124] FIG. 2 is a cross-sectional diagrammatic view of the further embodiment of the present invention;

[0125] FIG. 3 is a perspective view of the upper part 102 shown in FIG. 1;

[0126] FIG. 4 is a cross-sectional diagrammatic view of an alternative construction of an outlet valve that may be present in the nozzle devices of the present invention;

[0127] FIG. 5 is a cross-sectional view of a dispenser nozzle comprising a piston assembly for compressing the chamber;

[0128] FIG. 6 is a perspective view of a dispenser nozzle of the present invention comprising two internal chambers; and

[0129] FIG. 7 is a perspective view of further embodiment of the invention that comprises two internal chambers.

[0130] In the following description of the figures, like reference numerals are used to denote like or corresponding parts in different figures, where appropriate.

[0131] The embodiment of a nozzle device shown in FIGS. 1A and 1B comprises a body 100 formed of two parts, namely a base part 101 and an upper part 102, which are connected to one another by a foldable connection element 103.

[0132] In this embodiment the body 100 is formed from a single rigid plastic material in a single moulding operation. The device will be moulded in the configuration shown in FIGS. 1A and 1B and then 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 assembled nozzle arrangement. Once the base 101 and the upper part 102 are fitted together, the portion 102a of the under surface of the upper part 102 abuts the abutment portion/surface 101a of the upper surface of the base 101. The elevated portion 101b of the upper surface of the base 101 is received within recess 102b formed in the under surface of the upper part 102 to define an internal chamber.

[0133] A groove **104** formed in the elevated portion of the base **101b** forms an initial portion of an outlet passageway in the assembled nozzle arrangement that leads from the internal chamber to an outlet valve. The outlet valve is formed by a resiliently deformable flap **105** formed on the under surface of the upper part **102** which is received within a recess **106** formed in the opposing abutment surface **101a** of the base. The flap **105** extends over the end of the groove **104** when the base and upper parts are connected together to close the outlet passageway. The flap **105** is configured to resiliently deform away from the end of the groove **104** when the pressure within the internal chamber exceeds a predetermined minimum threshold to define an open passageway, as described further below. The flap **105** is also formed as a continuation of the ridge protrusion **112** discussed further below.

[0134] The remainder of the fluid flow passageway is defined by the alignment of grooves and or recesses **104a**, **104b** and **104c** formed in the abutment surface **101a** of the base **101** with corresponding grooves and/or recesses **107a**, **107b** and **107c**, respectively. The portions **104c** and **107c** are semicircular recesses which align to form a circular swirl chamber which induces rotational flow into liquid passing through the outlet passageway during use. Liquid is ejected from this chamber during use through an outlet formed by the alignment of grooves **104d** and **107d** respectively.

[0135] The base **101** also defines an inlet orifice **108**, which is positioned within a recess **108a** formed in the elevated portion **101b**. A resiliently deformable flap **109** formed on the under surface of the upper part **102** is received within the recess **108a** in the assembled nozzle arrangement and is resiliently biased against the inlet opening to close off the inlet. The flap **109** is configured to resiliently deform away from the inlet opening to permit fluid to be drawn into the chamber when the pressure therein falls below the pressure in the attached container by at least a predetermined minimum threshold amount. The opening of the inlet **108** is provided with a lip against which the flap **109** abuts to form a seal. Supporting ribs **108b** and **108c** prevent the flap **109** exerting too much force on the lip.

[0136] Locating posts **110a** and **110b** formed on the under surface of the upper part **102** are received within holes **111a** and **111b** formed in the base and assist in holding the base and the upper part in tight abutment with one another. In addition, a ridge protrusion **112**, which extends around the recess **102b** is received within, and forms a sealing engagement with, a correspondingly shaped groove **113**, which is formed in the upper surface of the base **101** and extends around the elevated portion **101b**. The ridge **112** and groove 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 chamber and seeping between the upper part and the base. This seal also extends to encompass the outlet passageway and the outlet orifice by virtue of portions **112a** and **113a**.

[0137] The body also comprises an air leak valve which consists of a resiliently deformable member **115** formed on the under surface of the upper part **102**, which is received within an opening **116** formed on the abutment surface **101a** of the base when the nozzle arrangement is assembled. The opening **116**, together with the groove **115** defines a pas-

sageway through which air may flow into the container from the outside in the assembled nozzle arrangement. The tip of the resiliently deformable member **115** is provided with a flared rim, the edges of which abut the internal walls of the opening **116** to form an airtight seal. If a reduced pressure exists in the container as a consequence of expelling fluid through the nozzle arrangement, the pressure differential between the interior of the container and the external environment causes the flared rim of the member **115** 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 original configuration resiliently biased configuration to prevent any further flow through the opening **116**. It shall also be appreciated that if the container is inverted, the product cannot leak past the rim of the resiliently deformable member **115** 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 **116**.

[0138] 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.

[0139] In a further alternative, the resiliently deformable upper part **102** could comprise a fine slit above an opening similar to opening **116**. This slit could be configured to open when a pressure differential exists.

[0140] In yet another alternative, the air release may be positioned closer to the resiliently deformable upper part **102** and configured such that, when the upper part is pressed downwards to expel the contents present in the chamber, the resiliently deformable member deforms in such a way that the air valve is opened, and air may flow into or out of the chamber to equalise any pressure differential that may exist.

[0141] During use, an operator will press the outer surface of the portion **102b** of the upper part inwards, which is the resiliently deformable portion of the body defining the chamber. This portion of the upper part can be easily pressed into abutment with the upper surface of the portion **101b** of the base and thereby compresses the internal chamber defined there between and causes the pressure therein to increase. When the pressure exceeds a predetermined minimum threshold value, the flap **105** will be displaced from its resiliently biased position to define an opening through which liquid can flow through the remainder of the outlet passageway to the outlet orifice where it is ejected in the form of a spray. As soon as the pressure within the chamber falls back below the predetermined minimum threshold value, the flap **105** will return to its resiliently biased configuration to close of the outlet passageway. When the applied pressure is removed from portion **102b** of the upper part **102** it will return to its resiliently biased position and the volume of the chamber will increase. This causes the pressure within the chamber to decrease and the flap **109** of the inlet valve to be displaced to permit more liquid to be drawn into the chamber through the inlet valve.

[0142] A further alternative embodiment of the invention is shown in FIG. 2. In this embodiment, only the internal chamber **201** and outlet passageway **202** are shown for the purpose of illustration. An inlet, although not shown, would usually be present in practice.

[0143] The embodiment shown in FIG. 2 comprises a base made from a rigid plastic and an upper part 102 which comprises an abutment surface portion 102a formed from a rigid plastic, and a resiliently deformable portion 102b, which defines the chamber 201 together with portion 101b of the base 101 is made from a resiliently deformable material. This embodiment of the nozzle device may be formed by a bi-injection moulding process whereby the base and the portion 102a of the upper part 102 are moulded from a rigid plastic and the portion 102b, which is formed from a resiliently deformable plastic is then moulded onto the portion 102a. The base 101 and upper part 102 are then fitted together to form the assembled nozzle device. Optionally, the portion 102a and the base may be moulded from the same material and connected to one another by a foldable connection element.

[0144] In the embodiment shown in FIG. 2, the outlet valve again comprises flap 105 received within a recess 106 formed on the opposing abutment surface of the upper part. The side 106a of the recess is angled so that the flap 105 is resiliently biased to abut the edge to form a tight seal at its lower end.

[0145] The flap is deflected from the side 106a to define an opening through which fluid can flow when the required pressure is achieved in the chamber 201. Fluid then flows along the outlet passageway to the outlet orifice (not shown) and on its way passes through an expansion chamber 204 formed by aligned recesses formed on the opposing abutment surfaces 102a and 101a.

[0146] FIG. 3 shows the upper part 102 and base 101 of the embodiment shown in FIG. 2. Again, although not shown, the upper part also comprises a flap projection 109 which covers an inlet 108 formed in the base 101 to form the inlet valve, as discussed above. In this embodiment, the upper part 102 comprises a frame of rigid plastic material, which forms portion 102a of the upper part and which surrounds a region of resiliently deformable material, which forms portion 102b of the upper part 102, as previously described. The rigid plastic portion 102a abuts the portion 101a of the base (as shown in FIG. 2) to define the outlet passageway. As can be seen in FIG. 3, outlet passageway 202 comprises a first expansion chamber 204 formed by the alignment of recesses 301 and 302, and a second outlet chamber formed by the alignment of recesses 303 and 304.

[0147] The clip 305 formed on the abutment surface of the upper part 102 engages with the recess 306 formed in the abutment surface 101a of the base to locate and secure the upper part and the base together.

[0148] FIG. 4 is a cross-sectional view of an alternative outlet valve assembly that may be incorporated into the nozzle devices of the present invention. Instead of a flap 105, the alternative valve comprises a plug 401, which is received within a recess 106 formed in the base 101. A feed channel 402 is formed in the recess so that fluid can flow from the chamber as far as the member 403 formed in the base, which closes off the feed channel. If the pressure within the chamber, and hence the feed channel 402, exceeds a predetermined minimum threshold value, then the plug will either resiliently deform to define a channel between it and the member 403 through which fluid can flow, or the member 403 will be resiliently deformed/deflected away from the plug to define a channel, or both. The cavity 404 formed by

the cut-out portion 405 of the base provides a spray modifying expansion chamber as well as a space into which the member 403 can be resiliently deformed/deflected.

[0149] FIG. 5 shows a further alternative embodiment of the invention that, instead of utilising a resiliently deformable portion of the body to enable the chamber to be compressed, incorporates a piston cylinder 501 as an integral portion of the body defining the chamber. A piston 502 is slidably mounted within the piston cylinder 501. Movement of the piston to compress the chamber 201, and thereby expel the contents stored therein, is facilitated in the embodiment shown in FIG. 5 by depressing arm portion 503, to which the piston 502 is mounted, in the direction of arrow 510. The arm portion is connected to the base 101 by a resilient deformable hinge 504. When the pressure applied to the arm portion 503 is subsequently released, it will return to the position shown in FIG. 5 due to the inherent resilience of the hinge 504.

[0150] FIG. 6 shows another embodiment of a dispenser nozzle of the present invention. The device, which is adapted to dispense fluids in the form of a spray, comprises a body 600 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.

[0151] 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.

[0152] In this embodiment, the body 600 is formed from a single rigid plastic material in a single moulding operation. The device will be moulded in the configuration shown in FIG. 6 and then 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 assembled nozzle device. Once the base 101 and the upper part 102 are fitted together, the portion 102a of the under surface of the upper part 102 abuts the abutment portion/surface 101a of the upper surface of the base 101. The recessed portions 101b and 101c of the upper surface of the base 101 are aligned with corresponding recessed portions 102b and 102c respectively, that formed in the under surface of the upper part 102 to define two separate internal chambers.

[0153] Each chamber comprises an inlet orifice 108 formed in the base. Each inlet orifice is disposed within a respective recess 108a, as shown in FIG. 6. When the upper part 102 is fitted to the base 101, the resiliently deformable flaps 109 are received within the respective recesses 108a. The flaps 109 are resiliently biased against the respective openings of the inlet orifices 108 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 108 to permit fluid to flow into chambers. Each inlet orifice 108 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 from the external environment.

[0154] The outlet comprises an outlet passageway and outlet orifice defined by the abutment surfaces 101a and

102a when they are contacted together. The passageway is formed by the alignment of grooves **606**, **607** and **608** with grooves **609**, **610** and **611** respectively, and chambers formed within the outlet passageway are formed by the alignment of recesses **612** and **613** with recesses **614** and **615** respectively.

[**0155**] Therefore, fluid dispensed from the chamber formed by recesses **101b/102b** during use travels through the chamber formed by the alignment of recesses **612/614** and then into the chamber formed by the alignment of recesses **613/615** before being ejected through the outlet orifice. Fluid dispensed from the chamber formed by recesses **101c/102c** during use travels through to the chamber formed by the alignment of recesses **613/615**, where it mixes with the fluid dispensed from the other chamber prior to ejection through the outlet orifice.

[**0156**] The provision of the chambers formed within the passageway has been found to contribute to the break up of liquid droplets dispensed from the dispenser nozzle, thereby enabling a fine spray to be produced.

[**0157**] The outlet passageway leading from each chamber will also comprise an outlet valve (not shown) positioned upstream 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.

[**0158**] 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. 6, 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**.

[**0159**] 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.

[**0160**] During use, fluid is dispensed from the dispenser nozzle by depressing the portions **102b** and **102c** on the upper surface of the assembled device. These portions form the resiliently deformable portion of the body. When the applied pressure is removed, the portion **102b** and **102c** return to their initially biased configurations, thereby causing the volume of the chambers to increase and fluid to be drawn into each chamber through the respective inlets **108**.

[**0161**] In embodiments where one chamber, for instance the chamber formed by the alignment of recesses **101c/102c**,

contains air, the compression of the chambers together causes the air stream ejected from this chamber to mix with a liquid dispensed from the other chamber. This mixing will break up the droplets of liquid and assist in the formation of a fine spray when the liquid is dispensed through the outlet.

[**0162**] FIG. 7 shows an alternative embodiment of the invention adapted to dispense two liquids simultaneously in the form of a spray. This embodiment is in many respects similar to that shown in FIG. 6 (as shown by the like reference numerals). However, there are some differences. Firstly, the upper part **102** is connected to the base **101** at the front, rather than at the side, as shown in FIG. 7. 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 dispenser nozzle.

[**0163**] The device shown in FIG. 7 is also configured to dispense two liquids separately so that they only mix outside of the dispenser nozzle 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. 6.

[**0164**] The outlet passageways also differ in that a passageway is formed by the alignment of grooves **701** and **702**. The passageway extends to a swirl chamber formed by the alignment of semi-circular recesses **703** and **704**. Thus, fluid dispensed from each chamber during use flows along the passageway and into the swirl chamber whereby rotational flow is induced into the fluid stream prior to ejection through the outlet orifice. Swirl chambers are known in the art and are again used to break up fluid droplets prior to ejection through the outlet.

[**0165**] A further difference over the embodiment shown in FIG. 6 is that the embodiment shown in FIG. 7 also comprises two air release valves. The air release valves are formed by valve members **115a** and **115b** formed on the under surface of the upper part **102** being received within openings **116a** and **116b** respectively formed on the abutment surface **101a** of the base when the nozzle device is assembled. The openings **116a** and **116b** both define passageways through which air may flow into separate compartments of the container from the outside in the assembled nozzle arrangement. The tip of the resiliently deformable member is provided with a flared rim, 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 arrangement, 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.

[**0166**] 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 be construed as limiting the scope of the invention.

1. A pump-action nozzle device configured to enable fluid to be dispensed from a container in the form of a spray, said nozzle having a body which defines an internal chamber having an inlet through which fluid may be drawn into said chamber and an outlet separate from the inlet 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 container 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 predetermined threshold amount, and wherein at least a portion of the body which defines said chamber 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 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 valve; and
- (b) subsequently return to its initial resiliently biased configuration 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;

characterized in that the outlet of the device comprises an outlet orifice and an outlet passageway that connects the outlet valve and the outlet orifice and is adapted to generate a spray of the fluid ejected through the outlet orifice during use, and in that the body of the device is formed entirely from a rigid material or entirely from a flexible material or is at least partly formed as a bi-injection molding, and in that the device is arranged such that, in use, a user can apply pressure directly to a portion of the body defining the chamber in order to deform said deformable portion of the body from its initial configuration to its deformed configuration.

2. A nozzle device according to claim 1, wherein the outlet valve is disposed within said outlet passageway.

3. A nozzle device according to claim 1, wherein the outlet passageway comprises one or more internal spray-modifying features excluding the final spray orifice and the final swirl chamber configured to reduce the size of the liquid droplets dispensed through the outlet orifice of the nozzle device during use.

4. A nozzle device according to claim 3, wherein the internal spray-modifying features are selected from the group consisting of one or more expansion chambers, one or more swirl chambers, one or more internal spray orifices adapted to generate a spray of fluid flowing through within the outlet passageway, and one or more venturi chambers.

5. A pump-action nozzle device according to claim 4, wherein the internal spray modifying features include one or more expansion chambers.

6. A pump-action nozzle device according to claim 4, wherein the internal spray modifying features include two or more expansion chambers.

7. A pump-action nozzle device according to claim 4, wherein the internal spray modifying features include two swirl chambers.

8. A pump-action nozzle device according to claim 4, wherein the internal spray modifying features include three or more swirl chambers.

9. A pump-action nozzle device according to claim 4, wherein the internal spray modifying features include two internal spray orifices.

10. A pump-action nozzle device according to claim 4, wherein the internal spray modifying features include three or more internal spray orifices.

11. A pump-action nozzle device according to claim 4, wherein the internal spray modifying features include one or more venturis.

12. A 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.

13. A nozzle device according to 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.

14. A 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.

15. A nozzle device according to claim 1, wherein the chamber of the nozzle device is defined between two interconnected parts.

16. A nozzle device according to claim 14, wherein the at least two interconnected parts that define the chamber also define at least a portion of the outlet passageway.

17. A nozzle device according to claim 15, wherein the at least two interconnected parts form the outlet valve between them and also define the entire outlet passageway and the outlet orifice.

18. A nozzle device according to any claim 16, 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.

19. A nozzle device according to claim 18, 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.

20. A nozzle device according to any claim 15, wherein one of said parts is a base part and other of said parts is an upper part.

21. A nozzle device according to claim 20, wherein said base part is adapted to be fitted to the opening of said container.

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

23. A nozzle device according to claim 20, 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.

24. A nozzle device according to claim 20, wherein the upper part forms the resiliently deformable portion of the body defining the chamber.

25. A nozzle device according to claim 14, wherein the outlet valve is integrally formed between the component parts of the body of the nozzle device.

26. A nozzle device according to claim 25, wherein the outlet valve is formed by a portion of one of said parts being resiliently biased against the other of said parts to close the outlet or 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.

27. A nozzle device according to claim 16, 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, and the outlet valve is formed between the abutment surfaces of the at least two interconnected parts.

28. A nozzle device according to claim 27, wherein the abutment surface of one of the component parts comprises a resiliently deformable valve member that is resiliently biased against the abutment surface of the other of the component parts to close the outlet orifice or a 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.

29. A nozzle device according to claim 28, wherein said valve member is in the form of a flap or a plug.

30. 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.

31. A nozzle device according to claim 30, wherein the resiliently deformable flap is formed as an integral extension of the resiliently deformable portion of the body which defines the chamber.

32. A nozzle device according to claim 30, wherein a second reinforcing flap or member contacts the opposing surface of the resiliently deformable flap.

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

34. A nozzle device according to claim 33, wherein locking means is integrally formed with the body.

35. A nozzle device according to claim 1, wherein the device further comprises an air leak valve 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.

36. A nozzle device according to claim 35, wherein the air leak valve is integrally formed within the body of the nozzle device.

37. A nozzle device according to claim 36, wherein the air release valve is defined between two component parts of the body of the nozzle device.

38. A nozzle device according to claim 35, wherein 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 container to the external environment.

39. A nozzle device according to claim 38, wherein 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, said 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.

40. A nozzle device according to claim 38, wherein 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.

41. A nozzle device according to claim 40, wherein the plunger is mounted on to a deformable base or flap which is capable of some movement when pressure is applied to the resiliently deformable portion of the body to reduce the volume of the chamber so as to prevent the build up and hardening of any residue in the air release valve.

42. A nozzle device according claim 41, wherein a protective cover is provided over the opening of a 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.

43. A nozzle device according to claim 35, wherein said air leak valve is further adapted to permit a gas to flow out of the container when the pressure therein exceeds the predetermined threshold value.

44. A nozzle device according to claim 43, wherein said valve member is configured to deform when the pressure within the container when the pressure therein exceeds the predetermined threshold value so as to expose one or more fine grooves formed in this sides of the channel, said groove(s) being configured to permit a gas to slowly seep out of the container.

45. A nozzle device according to claim 1, 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.

46. A nozzle device according to claim 45, wherein the at least two parts are welded to one another.

47. A nozzle device according to claim 45, wherein the at least two parts are configured to snap fit into a sealing engagement with the one another.

48. A nozzle device according to claim 45, wherein one of said at least two parts possesses a flange that fits tightly around the upper surface of the other part to form a seal therewith.

49. A nozzle device according to claim 45, wherein the seal comprises a male protrusion formed on an abutment surface of one of the at least two parts that is received in a sealing engagement with a corresponding groove formed on an opposing abutment surface of the other part when the two parts are connected together.

50. A nozzle device according to claim 48, wherein the seal extends around the entire chamber and also the outlet so

that fluid leaking from any position in the nozzle device defined between the at least two parts is prevented from seeping between the join formed between the two component parts.

51. A nozzle device according to claim 50, wherein the two parts of the body define an outlet passageway leading from the chamber to the outlet orifice and the protrusion member of said seal extends across the passageway and form a resiliently deformable valve member of the outlet valve.

52. A nozzle device according to claim 1, wherein the body is adapted to receive, or is integrally formed with, a dip tube to enable fluid to be drawn from deep inside the container during use.

53. A nozzle device according to claim 1, wherein said device consists of a maximum of three separate component parts that are interconnected to form the assembled nozzle device.

54. A nozzle device according to claim 1, wherein said device consists of two separate component parts that are interconnected to form the assembled nozzle device.

55. A nozzle device according to claim 1, wherein said device consists of a single integrally formed component part.

56. A nozzle device according to claim 55, in which the integrally formed component part comprises two or more portions interconnected by means of flexible hinge members that enables the portions to be assembled to each other to form the completed nozzle device.

57. A nozzle device according to claim 51, wherein the outlet passageway and outlet orifice may be in the form of a separate unit or insert, which is connected to the outlet of the chamber to form the outlet of the nozzle device.

58. A nozzle device according to claim 57, wherein said insert is 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.

59. A nozzle device according to claim 57, wherein the outlet passageway comprises one or more internal spray-modifying features configured to reduce the size of the liquid droplets dispensed through the outlet orifice of the nozzle device during use.

60. A nozzle device according to claim 59, wherein the internal spray-modifying features are selected from the group consisting of one or more expansion chambers, one or more swirl chambers, one or more internal spray orifices, adapted to generate a spray of fluid flowing through within the outlet passageway, and one or more venturi chambers.

61. A pump-action nozzle device according to claim 60, wherein the internal spray modifying features include one or more expansion chambers.

62. A pump-action nozzle device according to claim 60, wherein the internal spray modifying features include two or more expansion chambers.

63. A pump-action nozzle device according to claim 60, wherein the internal spray modifying features include two swirl chambers.

64. A pump-action nozzle device according to claim 60, wherein the internal spray modifying features include three or more swirl chambers.

65. A pump-action nozzle device according to claim 60, wherein the internal spray modifying features include two internal spray orifices.

66. A pump-action nozzle device according to claim 60, wherein the internal spray modifying features include three or more internal spray orifices.

67. A pump-action nozzle device according to claim 60, wherein the internal spray modifying features include one or more venturis.

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

69. A container having a pump-action nozzle device according to claim 1 being 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.

70.-83. (canceled)

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

85. A nozzle device according to claim 1, wherein said 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.

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

87. A nozzle device according to claim 86, wherein the at least one component part 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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