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(54) Title: DEVICE AND METHOD FOR DISPENSING LIQUIDS

(57) Abstract: The present disclosure relates to a multi-compartment container for dispensing multiple fluids simultaneously while at the same time keeping the un-dispensed fluids isolated from the air. There is an outer container that houses multiple inner containers containing separate fluids, each container with its own piston and pump assembly. The dispensing nozzle also contains a valve that does not allow air to mix with the fluids.

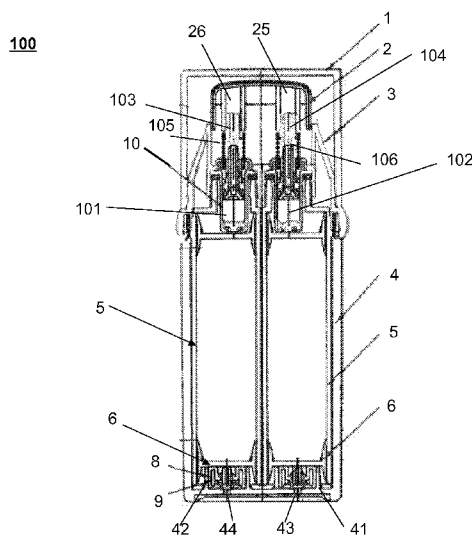


FIG. 1A

TITLE OF INVENTION

DEVICE AND METHOD FOR DISPENSING LIQUIDS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims the benefit of priority to U.S. Provisional Application Serial No. 61/490,912 filed 27 May 2011, which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] The present invention relates to a dual pump container, and more particularly, to a two compartment container for holding two fluids separate for coordinated dispensing.

BACKGROUND OF THE INVENTION

[0003] Typically, a two-compartment container has independent vessels or storage compartments that can hold various combinations of fluids, powders, or pastes that are stored in a separated state until the user decides to utilize the products. These types of containers are most useful in applications where keeping product ingredients separate until use extends shelf life or enhances product effectiveness over a product that is mixed prior to shipping. Applications for such containers include, but are not limited to, storage of cosmetic creams and lotions, skin cleaners, shampoos, conditioners and hair coloring. Another factor that shortens product life is oxidation from contact with the air. This frequently occurs through two different means, the first being through the dispenser nozzle where the nozzle is open and allows air to contact the ingredients. The second, is through air being forced into the container to replace the dispensed product. When a pump dispenser is utilized, if the pressure inside the container is not equalized a vacuum will form within the container and the pump will not be able to overcome the internal vacuum pressure created by the void created when the product is dispensed.

[0004] Accordingly, a need exists for a two compartment container that allows

ingredients to remain separated until the desired mixing time while at the same time allowing the ingredients to be dispensed without allowing air to contact the contents of the compartments through the pump or nozzle. Further a need exists for a dispenser that overcomes the vacuum created by the pump mechanism within the container without allowing air to contact the contents of the container. The present disclosure addresses those needs.

SUMMARY

[0005] The present disclosure relates to a container for storing at least two fluids comprised of a first compartment for holding a first fluid and a second compartment for holding a second fluid until such time as the user decides to mix the fluids.

[0006] The fluids may be liquids or gases or a combination of liquids and gases. Examples of fluids include water based liquids, alcohol based liquids, oil based liquids, petroleum based ointments, and viscous liquids, such as gels, oils, and ointments.

[0007] In one embodiment a container for dispensing two fluids simultaneously comprises an outer container for holding a first inner container and a first fluid and a second inner container and a second fluid. A pump assembly comprising a spring in communication with the first and second fluids, a first piston for adjusting the volume of the first inner container and a second piston for adjusting the volume of the second inner container. The container also contains a nozzle for mixing and dispensing the first and second fluid.

[0008] In one embodiment, the nozzle comprises a first solid lip and a second flexible lip. In another embodiment, the second flexible lip comprises TPE, NBR or silicone.

[0009] In another embodiment, the pump creates a vacuum to draw up the first and second fluids. In another embodiment, the nozzle comprises an inner nozzle and an outer nozzle. In still another embodiment, the nozzle contains an inner nozzle that is a one way valve.

[0010] In another embodiment, the first inner container further comprises a one way valve for equalizing the pressure below the first piston and the second inner

container further comprises a one way valve for equalizing the pressure below the second piston.

[0011] In another embodiment there is an outer container surrounding two or more inner containers containing fluids to be simultaneously dispensed utilizing a pump. The pump mechanism does not allow air to contact the fluids within the two or more containers. The inner containers contain a piston that slidably traverses the length of the inner containers to decrease the pressure on the fluids within the containers so as to prevent the creation of a vacuum within the containers.

[0012] In another embodiment, there is a container assembly for dispensing two fluids simultaneously comprising and an outer container for holding a first inner container and a first fluid and a second inner container and a second fluid and a pump assembly comprising a spring. The embodiment further comprises a first valve for maintaining pressure within the first and second inner containers and a second valve. In a further embodiment, the second valve is a nozzle valve.

[0013] In another embodiment, the outer container contains a valve that allows air to be drawn into the void surrounding the two or more inner containers thereby maintaining a balance of pressure on the pistons within the two or more containers.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The present disclosure, in accordance with one or more embodiments, is described in detail with reference to the following figures. The drawings are provided for purposes of illustration only and merely depict typical or example embodiments. These drawings are provided to facilitate the reader's understanding of the apparatus and methods and shall not be considered limiting of the breadth, scope, or applicability of the invention. It should be noted that for clarity and ease of illustration these drawings are not necessarily made to scale.

[0015] Some of the figures included herein illustrate various embodiments from different viewing angles. Although the accompanying descriptive text may refer to such views as "top," "bottom" or "side" views, such references are merely descriptive and do not imply or require that all embodiments be implemented or used in a particular spatial

orientation unless explicitly stated otherwise.

[0016] FIG. 1A is a cross sectional front view of the multi-compartment container in accordance with an embodiment of the present disclosure;

[0017] FIG. 1B is a front view of the multi-compartment container in accordance with an embodiment of the present disclosure;

[0018] FIG. 2 is a cross sectional side view of the multi-compartment container in accordance with an embodiment of the present disclosure;

[0019] FIG. 3A is a cross sectional top view of the nozzle button portion of the container in accordance with an embodiment of the present disclosure;

[0020] FIG. 3B is a front view of the nozzle button portion of the container in accordance with an embodiment of the present disclosure;

[0021] FIG. 4 is a cross sectional view of an inner container in accordance with an embodiment of the present disclosure;

[0022] FIG. 5 is a cross sectional view of a piston in accordance with an embodiment of the present disclosure;

[0023] FIG. 6 is a cross sectional view of a valve in accordance with an embodiment of the present disclosure;

[0024] FIG. 7 is a cross sectional view of a valve adapter in accordance with an embodiment of the present disclosure;

[0025] FIG. 8 is a cross sectional top and side view of a inner nozzle in accordance with an embodiment of the present disclosure;

[0026] FIG. 9 depicts multiple views of the nozzle tip of the multi-compartment container in accordance with an embodiment of the present disclosure;

[0027] FIG. 10 depicts a top view of the gasket of the multi-compartment container in accordance with an embodiment of the present disclosure; and

[0028] FIG. 11 depicts multiple views of an outer cap of a push button of the multi-compartment container in accordance with an embodiment of the present disclosure;

[0029] The figures are not intended to be exhaustive or to limit the embodiments

to the precise form disclosed. It should be understood that the various embodiment can be practiced with modification and alteration, and that the invention is limited only by the claims and the equivalents thereof.

DETAILED DESCRIPTION

[0030] The embodiments described herein are merely examples. Descriptions in terms of these embodiments are provided to allow the various features to be portrayed in the context of an exemplary application. As will be clear to one of ordinary skill in the art, the invention can be implemented in different and alternative embodiments without departing from the spirit of the disclosure.

[0031] Unless defined otherwise, all terms used herein have the same meaning as is commonly understood by one of ordinary skill in the art to which this invention belongs. All patents, applications, published applications and other publications referred to herein are incorporated by reference in their entirety. If a definition set forth in this section is contrary to or otherwise inconsistent with a definition set forth in applications, published applications and other publications that are herein incorporated by reference, the definition set forth in this document prevails over the definition that is incorporated herein by reference.

[0032] FIG. 1A depicts a multi-compartment container 100 in accordance with an embodiment. Multi-compartment container 100 is comprised of cap 1, push button 2, shoulder 3, outer compartment 4, inner containers 5, pistons 6, valve 8, valve adapter 9, pump assembly 10, and gasket 11. In an embodiment, multi-compartment 100 contains two inner containers 5 housed within outer container 4, although the actual number of inner containers may vary depending on the number of fluids that need to be dispensed. As will be appreciated by those skilled in the art, as the number of inner containers 5 varies, so do the number of pistons 6 and the valves and valve adapters 8 and 9 respectively.

[0033] In one embodiment, cap 1 is intended to cover push button 2 to prevent accidental discharge of the fluids contained within inner containers 5. Cap 1 is held in place on outer bottle 4 by pressure, notches, threads or any other known latching

techniques. Push button 2 as seen in FIG. 3 fits on top of pump assembly 10 and contains nozzle 20. Nozzle 20 may be comprised of nozzle tip 21 and inner nozzle 22. Push button 2 may be any shape that is conducive to pumping by a finger such as oval, square, rectangle, and may contain a depression on the surface or be flat. Push button 2 contains tubes 23 and 24 that can be molded into push button 2 or may be separate. A detailed view of an exemplary push button 2 may be seen in FIG. 11. Tubes 23 and 24 deliver the fluid contained in inner containers 5 to nozzle 20. Also integral in push button 2 are columns 25 and 26 that allow the pump assembly 10 to nest within push button 2 to communicate the fluid to the user via nozzle 20.

[0034] In an embodiment, shoulder 3 connects to outer compartment 4 and retains pump assembly 10 and push button 2 in place. Additionally or alternatively, shoulder assembly 3 may be integrated with outer container 4 and form a single unitary component.

[0035] In an embodiment, outer container 4 is oval in shape and may be composed of glass, polycarbonate such as PCTA, or any other suitable polymer or plastic. Further, outer container 4 may be any shape, including, round, square, triangular, or any other multi faceted shape without departing from the spirit of the disclosure. Outer container 4 must be large enough to house inner containers 5 and all the other components of multi-compartment container 100. It is to be understood, that outer container 4 does not contain any fluids directly, and merely serves as the outer layer of multi-compartment container 100. Outer container 4 may be molded from a single piece of material or may be composed of several assembled pieces. Additionally or alternatively, in one embodiment, outer container 4 may contain one or more window 49, through which a user may see the content and or level of the fluids within inner containers 5. The windows 49 therefore should be made out of transparent materials such as PCTA or other transparent plastics or polymers. Additionally or alternatively the windows 49 may be tinted a specific color to create the illusion of fluids within the inner containers.

[0036] In one embodiment, molded into the inner bottom surface of outer container 4 are valve cups 41 and 42. Valve cups 41 and 42 are of a size large enough

to hold valves 8 and valve adapters 9. Furthermore, within valve cups 41 and 42 are holes 43 and 44 through outer container 4. Holes 43 and 44 allow for ambient air to flow into outer container 4 during dispensing of the fluids contained in inner containers 5 as will be described more fully below.

[0037] In an embodiment multi-compartment container 100 contains two inner containers 5. Inner containers 5 contain the fluids that remain separated until dispensed through nozzle 20. As seen in FIG. 4, inner containers 5 are generally cylindrical and tube like in nature and may be made from glass, polypropylene, or any other polymer or copolymer or plastic material. Inner container 5 may be any shape as long as the other components, such as piston 6 and outer container 4 are adjusted accordingly to accommodate the various geometries. Inner container 5 contains a top opening 51 and a bottom opening 52. Top opening 51 must be of sufficient size to accommodate pump assembly 10 which nests inside or in contact with inner containers 5 via top opening 51. The diameter of bottom opening 52 must be of sufficient size to encase valve cups 41 and 42. Furthermore, in an embodiment, inner containers 5 are seated on gasket 11 and create an air tight seal around valve cups 41 and 42.

[0038] In an embodiment, at the base of outer container 4, may be a flexible gasket 11. Flexible gasket 11 may be made out of any flexible rubber such as NBR and is intended to create a seal at the base of inner containers 5. Flexible gasket 11 may be seen in an enlarged view in FIG.10.

[0039] In one embodiment, mounted within each inner container 5 is a piston 6. Piston 6 may be made of the same material as inner container 5 or made from a different material. In an embodiment, piston 6 is generally circular in shape and has “H” shaped cross section as seen in FIG. 5. The diameter of piston 6 is of sufficient size to fit snugly within inner container 5. Edges 61 of piston 6 are outwardly bowed so as to cause edges 61 to snugly fit within the inner walls of inner container 5 when piston 6 is inserted. Piston 6 must fit precisely within inner container 5 so as to ensure that the fluid contained within inner container 5 can not seep or leak past piston 6. Further piston 6 must fit such that it is slidably movable inside inner container 5 as the pressure inside inner container 5 is decreased. Also, piston 6 must be able to push the fluid

contained in inner container 5 as it slides up the inner container. In one embodiment, fins 62 may be added to piston 6 to provide additional strength although other strengthening techniques, such as material selection or material thickness may be used.

[0040] In an embodiment, valve 8 is a check valve that allows fluid to flow in only one direction. Valve 8 may be made from any natural or synthetic rubber such as nitrile butadiene rubber (NBR) or any other flexible rubber that is generally resistant to oils, liquids, and other chemicals. In one embodiment, K-NBR 2030 from Kumho Petrochemical of Korea was used. As seen in FIG. 6 valve 8 is generally torodial in shape and is molded to nest within valve adapter 9. Valve 8 contains outer wall 84 and is open at top opening 81 and bottom opening 83. Inner side wall 82 is inwardly tapered from bottom opening 83 to top opening 81, but other geometries may be utilized as long as valve 8 is designed to nest within valve adapter 9. In an embodiment, valve adapter 9 is nested together with valve 8 restricting fluid flow through bottom opening 83 and top opening 81. As fluid is drawn up through bottom opening 83, inner side walls 82 flex outwardly due to the compositional properties of valve 8 and allow the fluid to exit via top opening 81. As will be appreciated by one skilled in the art, due to the geometry and materials of valve 8, fluid can only flow in one direction and can not enter back through top opening 81.

[0041] FIG. 7 depicts an embodiment of a valve adapter 9 in an embodiment. Valve adapter 9 is generally cylindrical and is of a complementary geometry to valve 8 so as to nest in contact with valve 8. Valve adapter 9 may be composed of polypropylene or any other rigid plastic material. Valve adapter 9 contains perimeter wall 91, valve post 92 and base 93. In an assembled configuration, outer wall 84 and inner side wall 82 create space 85 into which perimeter wall 91 nests. Valve post 92 sits within inner side wall 82 and is in contact with inner side wall 82 to create a one way valve like configuration. Base 93 contains openings 93, through which fluid may be drawn up into bottom opening 83. The fluid then passes by valve post 92 forcing inner sidewall 82 to outwardly flex allowing the fluid to exit via top opening 81. When the force driving up the fluid is removed, inner side wall 82 returns to its normal state in contact with valve post 92, thereby preventing fluid from flowing back through top

opening 81.

[0042] In another embodiment, pump assembly 10 is a dual pump assembly for pumping two separate fluids, each contained within inner containers 5. Pump assembly 10 may be an out spring type bottle dispensing pump that typically dispenses about 10 to 15 cc of fluid per pump. Additionally or alternatively, pump assembly 10 may be any type of hand pump that does not introduce air into the inner containers when fluid is dispensed. In an embodiment, pump assembly 10 sits within shoulder assembly 3 with the pump inputs 101 and 102 in contact with the fluid within inner containers 5 and the outputs 103 and 104 of the pumps in contact with tubes 23 and 24 of push button 2. With each depression of push button 2, a vacuum is created within pump assembly 9 thereby drawing in fluid from inner containers 5. Pump assembly 10 is spring driven. In one embodiment, a spring with a thickness 0.55 mm and 11.5 cycles was utilized. In operation, the springs of pump assembly 9 are maintained in a semi compressed state. In one embodiment, the length of the spring at rest was 19.0 mm and 6.5 mm under compression. During operation, push button 2 is depressed, thereby further compressing the springs of pump assembly 10. In one embodiment, a spring with a pressure of 0.5 kg was utilized. After depression, the springs return to their semi-compressed state, creating the force necessary to draw the fluid from inner containers 5. No air is allowed to enter inner containers 5 to replace the volume of fluid dispensed, thereby a vacuum is created within inner container 5. The spring constant of the springs 105 and 106 in pump assembly 10, therefore must be sufficient so as to overcome any vacuum created within inner containers 5 as fluid is dispensed. To equalize the pressure within inner containers 5, pistons 6 are draw up into inner container 5 as fluid is dispensed, thereby reducing the volume of inner containers 5 and maintaining a constant pressure within inner container 5. As pistons 6 move up within inner containers 5, fluid, such as air is drawn into the void created by piston 6 to maintain ambient pressure below piston 6. The fluid, such as air, is drawn in though holes 42 and 43 in outer container 4 and is passed though the holes in valve adapter 9 past valve 8.

[0043] In an embodiment, the drawn up fluid is communicated to nozzle 20 via

tubes 23 and 24. Nozzle 20 is comprised of nozzle tip 21 and inner nozzle 22. Detailed views of inner nozzle 22 may be seen in FIG. 9. Inner nozzle 22 may be composed of a thermoplastic elastomer (TPE) or any other copolymer, silicone, rubber or plastic that displays properties of a thermoplastic rubber and with a hardness range of between 30 and 65 without departing from the disclosure. In one embodiment SR 9000T TPE with a hardness value of 65 was used. In other embodiments, materials such as SR 9000 TPE, Santoprene and TF3 (TPE) with hardness values of 42, 38 and 30 respectively were used. Inner nozzle 22 may be bill shaped with an upper portion 220 and a lower portion 221 as seen in FIG. 8. Inner nozzle 22 contains a slit 222 through which the fluids are dispensed. In a relaxed position, upper portions 220 and lower portion 221 substantially contact one another sealing slit 222 and preventing air from entering inner nozzle 22 and contacting the fluids remaining therein. This normally closed position is due to the geometry of inner nozzle 22 and the thermo elastomeric properties of the materials. During dispensing, the out pressure created by pump assembly 10 causes upper portion 220 and lower portion 221 to separate and open slit 222. Accordingly, the fluid is dispensed via slit 222. Surrounding inner nozzle 22 is nozzle tip 21. Nozzle tip 21 may be made from a more rigid material such as polypropylene and surrounds and protects inner nozzle 22, Nozzle tip 21 may have a tab, lip, or ridge or any other configuration that allows it to be inserted into nozzle 20 and withheld in push button 2.

[0044] In operation in an embodiment each of the inner containers 5 hold a separate fluid that are separately dispensed. After removing cap 1, a user may depress push button 2 to dispense the mixed fluids. Pump assembly 10 draws the fluids out of inner containers 5 and dispenses them through inner nozzle tip 21 of nozzle 20 to dispense to the user. The inner nozzle tip 21 includes a spacer 223 separating the nozzle tip 21 into two portions, each of the two portions for dispensing one of the fluids from inner containers 5. As the fluid is withdrawn from inner containers 5, a vacuum is created inside inner containers 5 due to the fact that no air enters the inner containers to replace the dispensed fluid. To overcome the vacuum created, piston 6 is drawn into, and slides up the inside of inner container 5, thereby reducing the volume of inner container 5. As will be appreciated by those skilled in the art, as the volume of the

inner containers decreases, the pressure inside the inner containers 5 is equalized. Because the pressure within inner container 5 remains constant, the springs of pump assembly 10 do not need to overcome any potential vacuum forces created within inner containers 5. To ensure that a second vacuum is not created below piston 6 as it is drawn up into inner container 5, valve 8 allows a volume of air to fill the void under piston 6. As piston 6 moves up, it causes outside or ambient air to be drawn in through openings 43 and 44 of outer container 4. That air is then allowed to flow through valve 8, filling the void created. Without this equalization of pressure below piston 6, the fluid within inner container 5 could be forced back down, causing piston 6 to slide downwardly, thereby increasing the vacuum within inner containers 5. This release of pressure throughout the system allows the fluids to be dispensed without having to increase the force used to depress push button 2 while at the same time keeping the fluids within the inner containers 5 from coming in contact with outside air. As a further precaution, nozzle 20 is designed with inner nozzle tip 21. Inner nozzle tip 21 acts as a type of valve, that prevents air from mixing with the fluids maintained within tubes 23 and 24. In such an embodiment, the fluids contained within inner containers 5 remain isolated until after dispensed, are not subject to contamination from outside air, and are easily dispensed.

[0045] Although the features and functionality are described above in terms of various exemplary embodiments and implementations, it should be understood that the various features, aspects and functionality described in one or more of the individual embodiments are not limited in their applicability to the particular embodiment with which they are described, but instead can be applied, alone or in various combinations, to one or more of the other embodiments, whether or not such embodiments are described and whether or not such features are presented as being a part of a described embodiment. Thus the breadth and scope of the present invention should not be limited by any of the above-described exemplary embodiments.

[0046] Terms and phrases used in this document, and variations thereof, unless otherwise expressly stated, should be construed as open ended as opposed to limiting. As examples of the foregoing: the term "including" should be read as meaning

"including, without limitation" or the like; the term "example" is used to provide exemplary instances of the item in discussion, not an exhaustive or limiting list thereof; the terms "a" or "an" should be read as meaning "at least one," "one or more" or the like; and adjectives such as "conventional," "traditional," "normal," "standard," "known" and terms of similar meaning should not be construed as limiting the item described to a given time period or to an item available as of a given time, but instead should be read to encompass conventional, traditional, normal, or standard technologies that may be available or known now or at any time in the future. Likewise, where this document refers to technologies that would be apparent or known to one of ordinary skill in the art, such technologies encompass those apparent or known to the skilled artisan now or at any time in the future.

[0047] As will become apparent to one of ordinary skill in the art after reading this document, the illustrated embodiments and their various alternatives can be implemented without confinement to the illustrated examples. For example, block diagrams and their accompanying description should not be construed as mandating a particular architecture or configuration.

CLAIMS

What is claimed is:

- Claim 1. A container assembly for dispensing two fluids simultaneously, comprising:
- an outer container for holding a first inner container and a first fluid and a second inner container and a second fluid;
 - a pump assembly comprising a spring;
 - a first piston for adjusting the volume of the first inner container;
 - a second piston for adjusting the volume of the second inner container; and
 - a nozzle.
- Claim 2. The container assembly of claim 1 wherein the pump assembly creates a vacuum.
- Claim 3. The container assembly of claim 1 wherein the nozzle comprises an inner nozzle and an outer nozzle.
- Claim 4. The container assembly of claim 3, wherein the inner nozzle is a one way valve.
- Claim 5. The container assembly of claim 1, wherein the nozzle comprises a first solid lip and a second flexible lip.
- Claim 6. The container assembly of claim 5, wherein the second flexible lip comprises TPE, NBR or silicone.
- Claim 7. The container assembly of claim 1, wherein the first inner container further comprises a one way valve for equalizing the pressure below the first piston and the

second inner container further comprises a one way valve for equalizing the pressure below the second piston.

Claim 8. A container assembly for dispensing two fluids simultaneously comprising:
an outer container for holding a first inner container and a first fluid and a second inner container and a second fluid;
a pump assembly comprising a spring;
a first valve for maintaining pressure within the first and second inner containers;
and
a second valve.

Claim 9. The container assembly of claim 6, wherein the second valve is a nozzle valve.

Claim 10. The container assembly of claim 9, wherein the nozzle valve comprises a first solid lip and a second flexible lip.

Claim 11. The container assembly of claim 10, wherein the second flexible lip comprises TPE, NBR or silicone.

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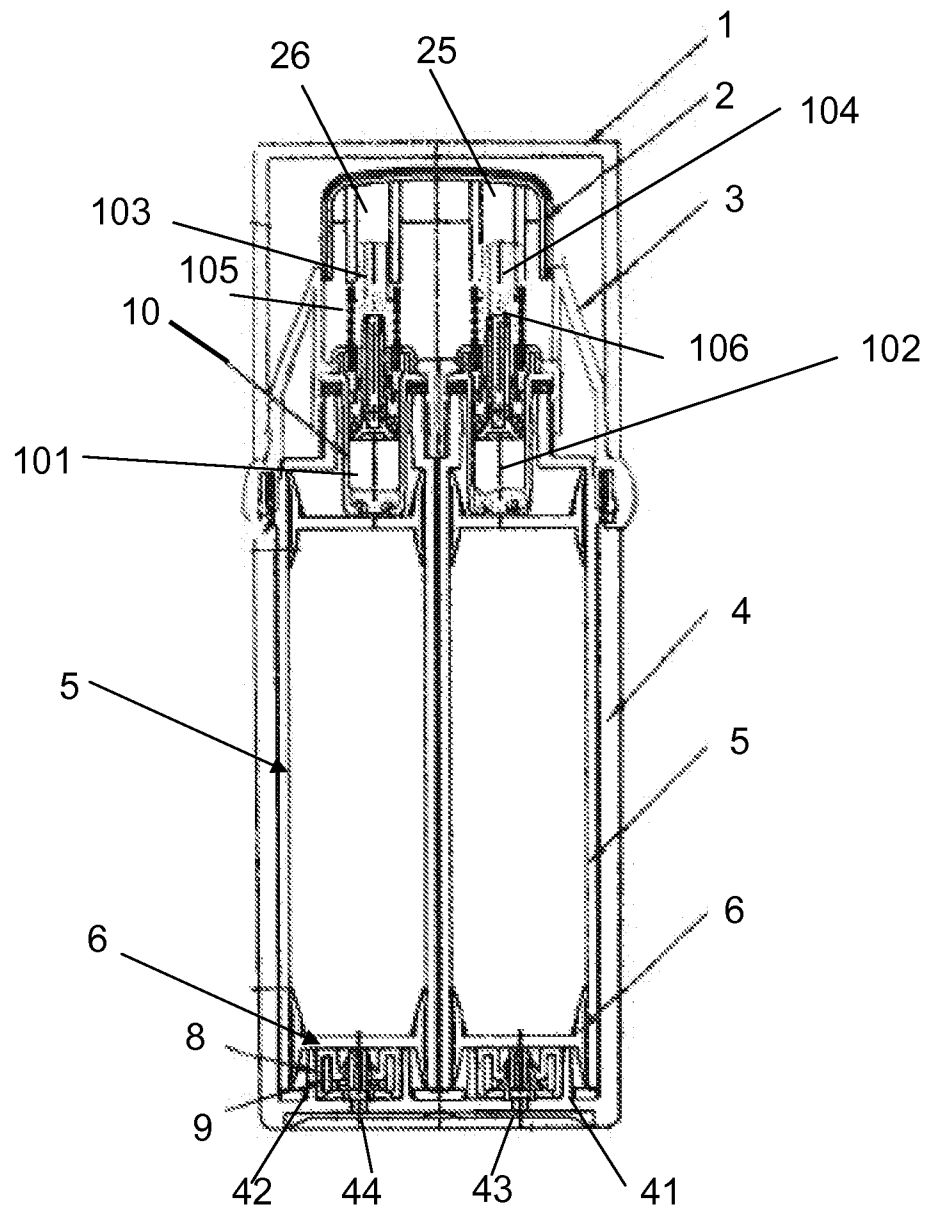


FIG. 1A

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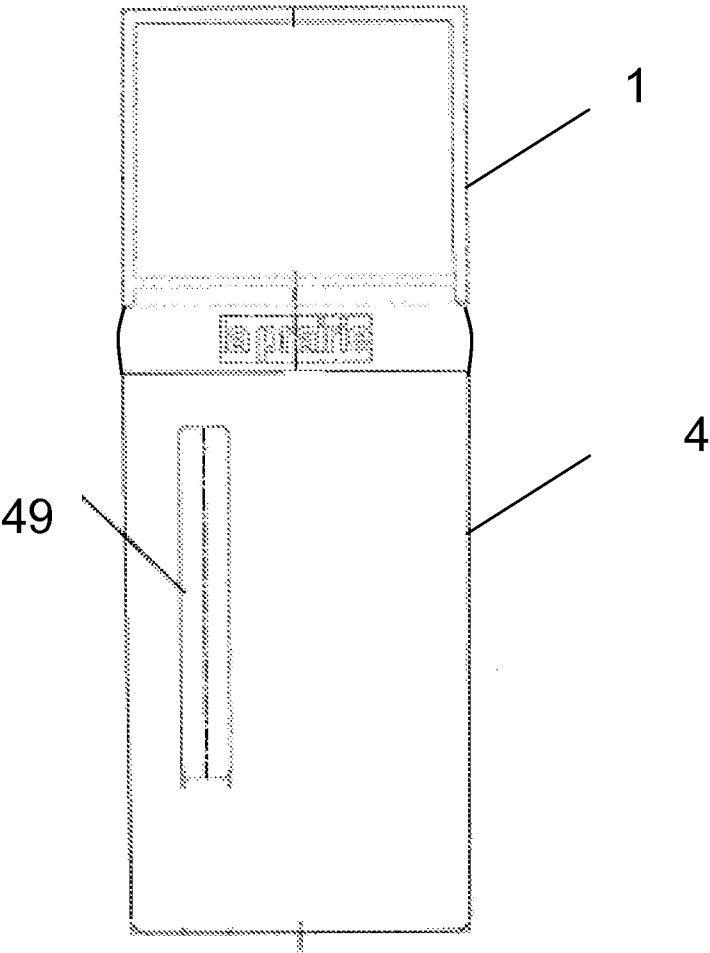


FIG. 1B

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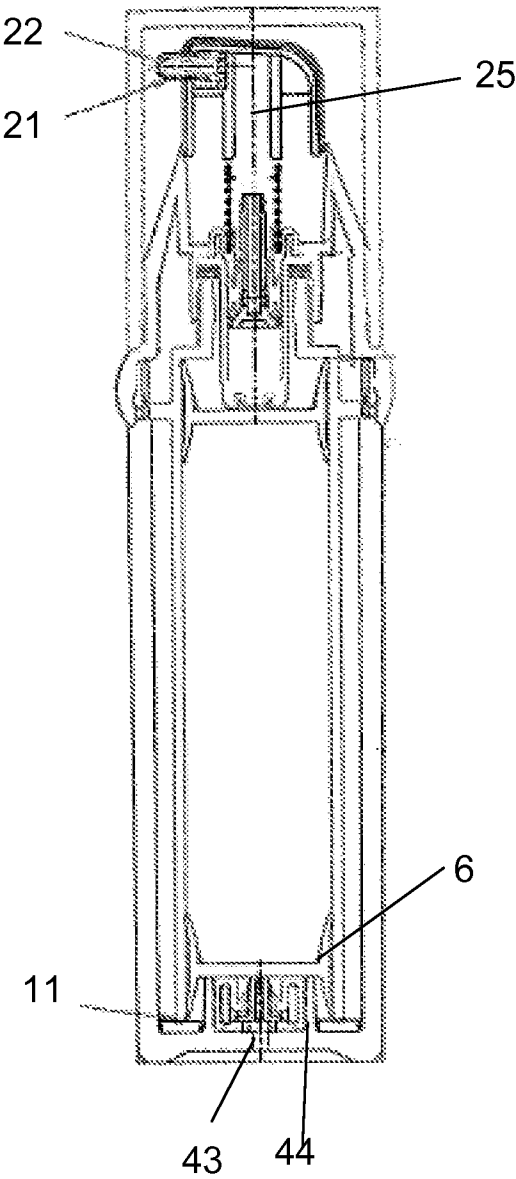


FIG. 2

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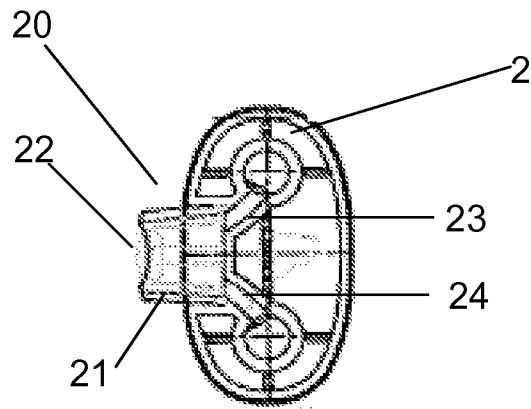


FIG. 3A

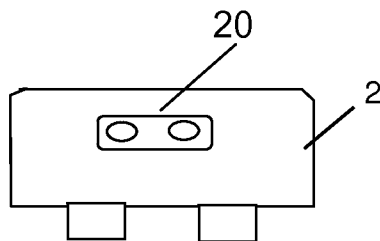


FIG. 3B

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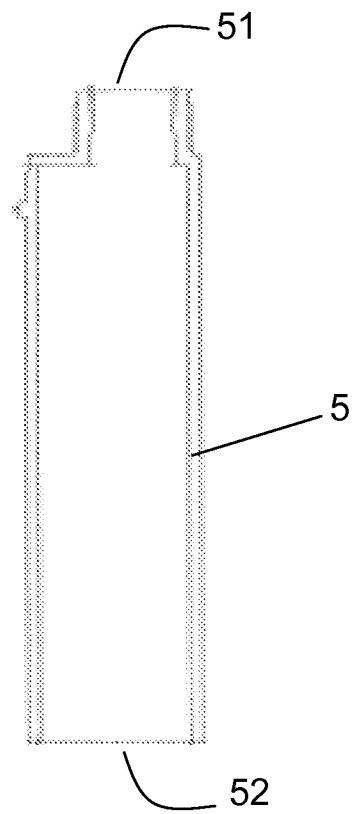


FIG. 4

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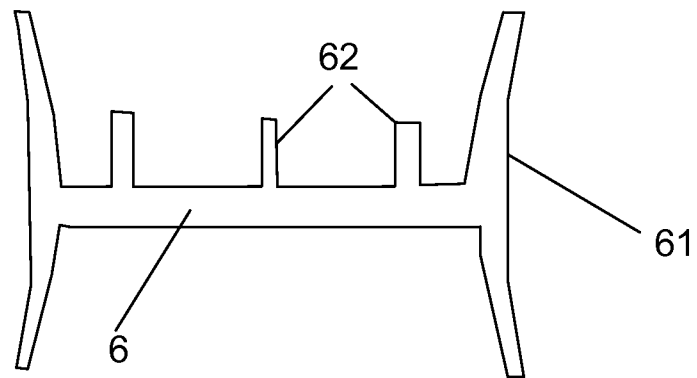


FIG. 5

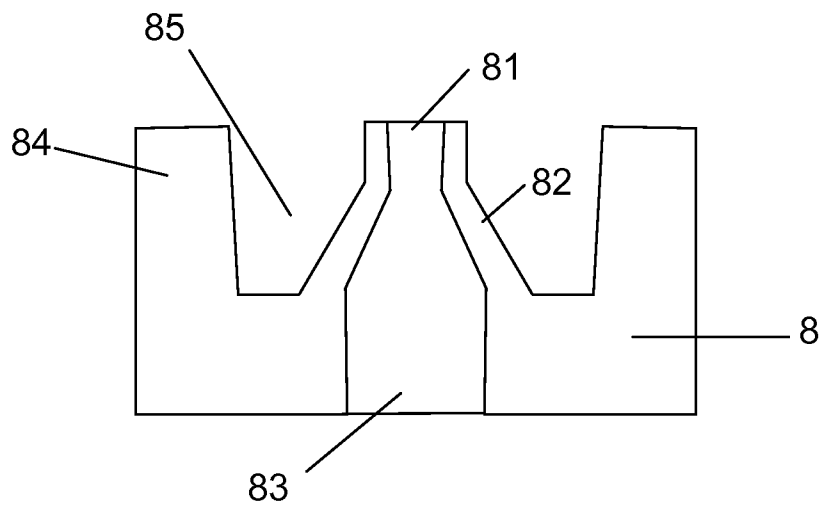


FIG. 6

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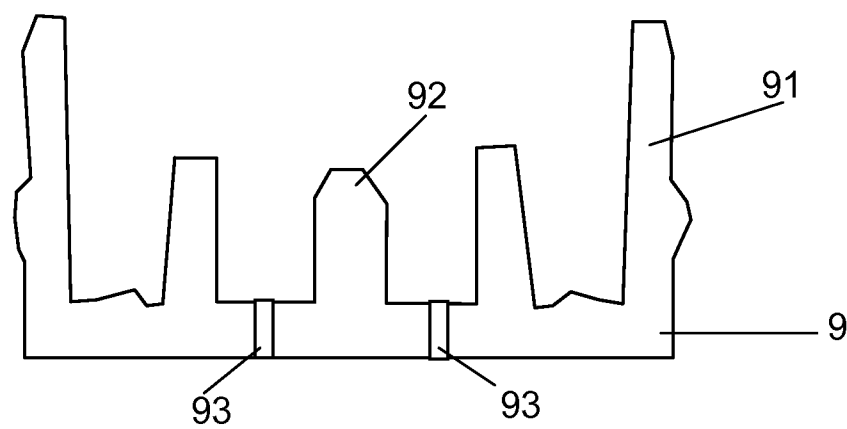


FIG. 7

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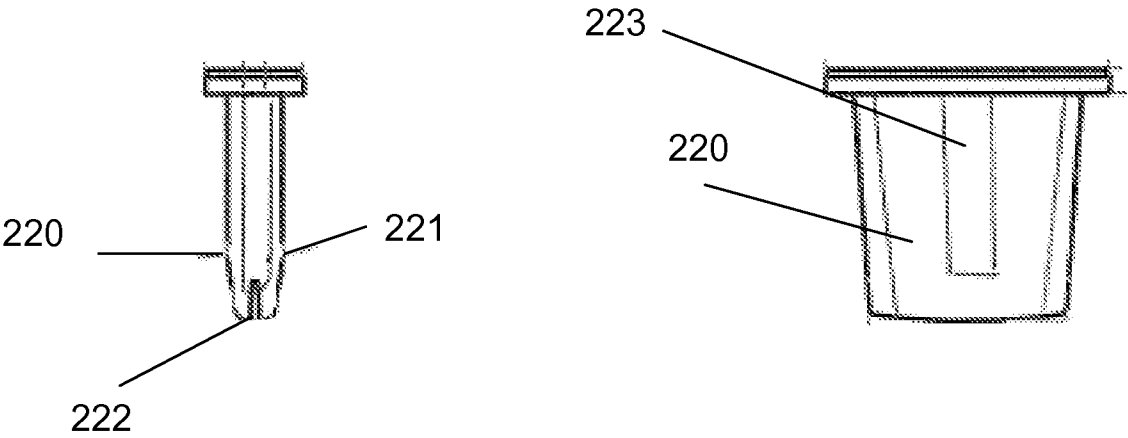


FIG. 8

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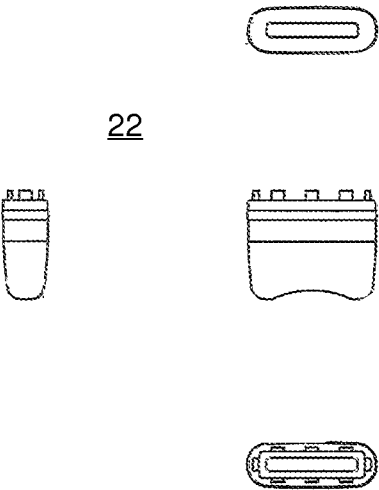


FIG. 9

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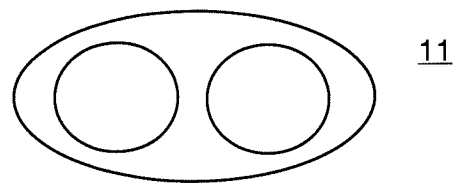


FIG. 10

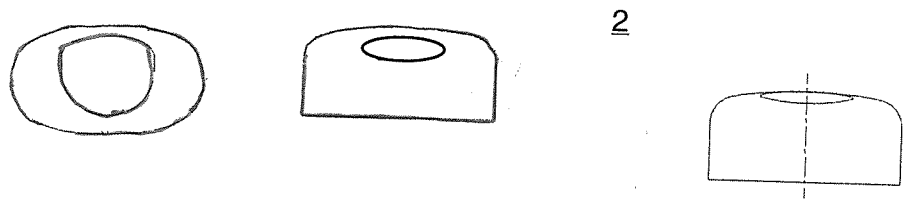


FIG. 11

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2012/039535

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - B65D 83/00 (2012.01)

USPC - 222/129

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8) - B65D 81/32, 83/00, 83/68, 83/76; F04B 13/02 (2012.01)

USPC - 222/129, 134, 135, 136, 137, 145.1, 145.5, 145.8

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PatBase

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4,773,562 A (GUERET) 27 September 1988 (27.09.1988) entire document	1-11
Y	WO 2005/087616 A1 (MCARDLE et al) 22 September 2005 (22.09.2005) entire document	1-11
Y	US 2002/0000452 A1 (IIZUKA et al) 03 January 2002 (03.01.2002) entire document	5, 6, 8-11
Y	US 2003/0201339 A1 (FOSTER et al) 30 October 2003 (30.10.2003) entire document	4

☐ Further documents are listed in the continuation of Box C.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

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"P" document published prior to the international filing date but later than the priority date claimed

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Date of the actual completion of the international search

22 July 2012

Date of mailing of the international search report

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