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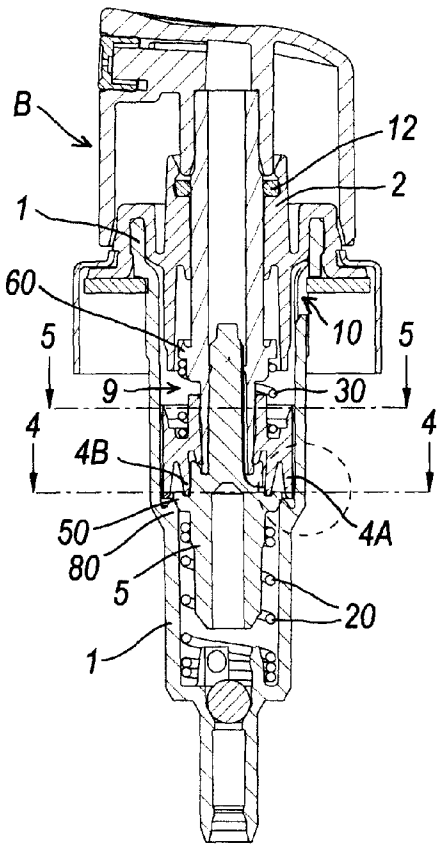
(54) Title: PUMP FOR MANUALLY DISPENSING A FLUID SUBSTANCE SEALED IN A CONTAINER



(57) Abstract: A pump enabling a fluid substance to be manually dispensed through a hollow stem (5) projecting from a hole in a ring cap sealedly applied to one end of a pump, the stem (5) being sealedly translate within said hole in the ring cap, which in its turn can be sealedly mounted on the mouth of a container containing the fluid substance to be dispensed.

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PUMP FOR MANUALLY DISPENSING A FLUID SUBSTANCE SEALED IN A CONTAINER

The present invention relates to an improved manually operable pump for dispensing quantities of a fluid substance in the form of liquids, creamy substances or the like through the hollow operating stem of the pump. The pump enables the substance to be dispensed while preventing, in any position and under normal conditions of use, the passage of fluids (air, gas or liquid) between the outer surface of the stem and the adjacent surface of the hole in the pump ring cap through which said stem extends and is translatable.

Many types of manually operable pumps are known for externally dispensing, through the cavity of a stem during its operation, quantities of fluid substances (liquid or creamy) drawn from a container on which the pump is mounted; the hollow stem extends to the outside of the pump body by passing through a hole provided in a ring cap forming part of the pump and defining one end of said pump. The term “ring cap” means any body or element for closing the pump body at one end and for enabling the stem to pass. Known pumps are mounted on containers in which the pressure under rest conditions is substantially equal to atmospheric pressure.

Examples of known types of pumps are those described in detail in US 3,583,605A, US 4,960,230A, EP-B-0301615 and EP-A-1334774, the teachings of which are incorporated herein for reference. DE 1728199A also describes a pump very similar to those illustrated in the four aforesaid patents.

To prevent a vacuum forming in the container when fluid is withdrawn therefrom and dispensed by the pump, a passageway or aperture must be provided in the pump to enable atmospheric air to penetrate into the container in order to maintain the pressure substantially constant at atmospheric pressure therein. In the known art, air passes through a passageway provided in the pump body or between the pump and the ring cap on which the pump is mounted, the air always passing between the outer surface of the hollow stem and the opposing surface of the hole provided in the pump ring cap through which the stem passes.

This is clearly specified in all the aforesaid prior patents, for example in lines 62-67 of column 2 of US 3583605A, in lines 2-5 of column 4 of US 4960230A, in the last three lines of column 4 and the first two lines of column 5 of EP-B-0301615, in lines 14-22 of column 1 of EP-A-1334774, and in the first paragraph of page 8 of DE 1728199A. The passageway existing between the outer surface of the pump hollow stem and the surface of the hole in the ring cap through which the stem passes presents problems, one of which is that the external air which penetrates into the container can deteriorate the characteristics of the fluid substance contained therein, another being the fact that the fluid can seep or leak to the outside of the container through the said passageway when the container and pump lie in a horizontal position or with the pump facing downwards from the container.

These problems cannot be prevented with known pumps because atmospheric air must be able to enter the container to prevent the pump blocking (and hence no longer usable) if a vacuum forms within the container on dispensing a portion of the fluid contained therein.

In a different embodiment, the fluid substances to be dispensed by dispensers for their use can be contained in containers in which a pressurized gas is also present to normally expel the substances under pressure through dispensing devices acting similar to manually operable aerosol valves, the opening or closure of which enables or prevents dispensing of the substance.

However, pumps are also known for dispensing a fluid substance and a pressurized gas from a container containing the substance and the pressurizing gas hermetically sealed therein. Such pumps have structures which seem similar to those of the pumps commonly used on containers which are not internally pressurized, but which are clearly different from them.

Some of these pumps are described for example in US 3,211,346A, US 4,511,069A and GB 1537436A, the teachings of which are incorporated herein for reference.

These pumps present problems which have made them difficult to use, and in fact have prevented their practical utilization. In this respect, such pumps have substantially a form similar to that of a traditional pump but differ therefrom by

comprising a cup-shaped body, the cavity of which is sealed by a ring cap sealedly applied to the mouth of a container in which a fluid substance and a pressurized gas are contained. The cup-shaped body presents a chamber with a hole through which the fluid substance rises into the chamber by the effect of the pressure present in the container. This chamber is bounded by a piston sealedly translatable along the inner surface of the cup-shaped body: a hollow stem connected to the piston emerges from and is sealedly translatable through a hole provided in the pump ring cap. Under rest conditions, the cavity in the pump stem is closed by the piston urged by a compressed spring reacting against the cup-shaped body, which is closed by a unidirectional valve.

When the pump is at rest, the pressurized fluid substance present in the pump interior acts on the piston in the sense of maintaining the pump closed, no hole or aperture or passageway being provided in the pump body which would enable the fluid substance or pressurized gas to come into contact with that piston upper surface distant from that facing the interior of the pump body. The consequence of this is that when the pump-type dispenser is to be operated to dispense a substance, a pressure must be exerted on the pump stem which is greater than that required to operate the common pumps used to dispense substances not under pressure, i.e. in order to overcome the thrust of the spring acting on the piston and to overcome the thrust exerted on the same piston by the pressurized fluid substance present within the pump cavity. Pump operation is hence more difficult the higher the internal pressure in the container on which the pump is mounted.

The main object of the present invention is to provide a pump which does not allow air, gas or liquids to pass between the outer surface of the respective stem and the surface of the hole in the pump ring cap, under any condition in which the pump is used.

Another object is to provide a pump which can be sealedly mounted on a container to define therewith a hermetically sealed space, from which however the pump can withdraw and dispense quantities of the fluid substance.

A further object is to provided a pump which can be easily primed (to enable, on initial use, the fluid substance to be withdrawn from the container on which the pump is mounted).

These and further objects are attained by a pump for manually dispensing a quantity of fluid substance sealedly contained in a container, comprising a cup-shaped body having an open end on which a ring cap is sealedly applied, and a closed end in which there is a hole provided with a unidirectional valve through which the fluid substance can enter a lower pump chamber from which the substance can be withdrawn to be dispensed to the outside by the pump, said lower chamber being bounded by an annular piston having a lip 4A sealedly translatable along the inner surface of the cup-shaped body and a lip 4B slidable along the outer surface of a hollow pump operating stem for dispensing the fluid substance through the free end of the stem 5 projecting from the pump, the cavity of the stem 5 opening at an aperture 70 provided in an intermediate region of the stem length in proximity to a lower collar 50 projecting from the stem into said pump lower chamber 8, from the stem 5 there also projecting an upper collar 60 on which there acts one end of a spring 30, the other end of which acts on said piston 4 to urge its lip 4B towards and against said lower collar 50 in order to close said aperture 70, said stem extending and being axially translatable through a hole provided in said ring cap which with said piston defines an upper pump chamber in which said stem upper collar 60 is positioned, characterised in that, under any condition in which the pump is used, the outer surface of the stem seals against the opposing surface of the hole in the ring cap, there being provided in the cup-shaped body at least one passageway which connects said upper chamber to the outside of said cup-shaped body, from the cup-shaped body 1 there projecting into said chamber 8 a stop element 80 on which said lower collar 50 rests and halts when the stem 5 is pressed to its end-of-travel position, whereas the lip 4B of the piston 4 slidable along the outer surface of the stem 5 the is kept urged by the spring 30 towards and against said lower collar to close said stem aperture 70, from the inner surface of the cup-shaped body in proximity to and above said stop element 80 there projecting at least one short longitudinal rib 90 on which the

lower edge of the piston lip 4A rests and is deformed to leave free a passageway between the lip and the opposing surface of the cup-shaped body.

A new and particularly interesting utilization of the pump of the present invention is that when the pump is mounted on a container such as to define therewith a hermetically sealed space in which the fluid substance present generates a pressurized gaseous phase; in particular there being present in this hermetically sealed space at least one low-boiling liquid having a saturated vapour pressure less than 1.00 kg/cm^2 at 15°C and less than 2.8 kg/cm^2 at 37.8°C, which generates a slight vapour pressure at an ambient temperature of 21°C.

Low-boiling liquids are fluid chemical substances which at 760 mm/Hg have boiling points between +15°C and +85°C.

Advantageously usable low-boiling liquids are those chosen from the group consisting of isopentane, isohexane, N-pentane, N-hexane, dichloromethane, monochloropropane, 1-1-dichloroethane, 2-chlorobutane, trichloro-fluoro-ethane CFC 11, trichloro-trifluoro-ethane CFC 113, ethyl ether, methylene-dimethylether, dimethoxymethane and acetone.

The structure and characteristics of the pump according to the invention will be more apparent from the description of one embodiment thereof, given by way of non-limiting example with reference to the accompanying drawings, in which:

Figures from 1 to 3 are longitudinal sections through a pump shown in its rest state, at the commencement of the dispensing stage and at the end of its dispensing stroke;

Figure 3A shows on an enlarged scale that portion of the pump bounded by a dashed-line circle in Figure 3; and

Figures 4 and 5 are enlarged cross-sections through the pump, taken on the lines 4-4 and 5-5 respectively of Figure 3.

Figures from 1 to 3 show a pump the general structure of which is of known type, except for the following details. To give a specific example, the pump has a structure totally similar to that of the pumps illustrated in the prior patents specified in the introduction to this description, and of which the teachings are incorporated herein for reference: the pump structure operation will therefore not be described in detail for brevity.

The pump comprises a cup-shaped body 1 closed at one end by a ring cap 2 and presenting at its other end a hole 3 which opens into the hollow space defined by a container (not shown in the drawings) on the mouth of which the pump ring cap 2 is mounted and sealed in any known manner (for example by seam-joining, or in another way).

The interior of the cup-shaped body houses an annular piston 4 having an annular lip 4A which is translatable along and seals against the inner surface of the cup-shaped body, and respectively an annular lip 4B which is translatable along and seals against the outer surface of a hollow stem 5 (on the free end of which an operating and dispensing pushbutton B of any known type is mounted) translatable axially through a hole provided in the flange 2 and along the cavity of which the fluid substance can be expelled to the outside (and hence used), having been previously drawn into a lower pump chamber 8 lying between the lower surface (with respect to the drawings) of the piston 4 and the pump intake hole 3 which houses a unidirectional valve consisting of a ball 11 (or other seal element) movable between a sealing seat provided at the upper end of the hole 3 and stop elements 13 forming part of the pump body. An upper chamber 9 is defined in the cup-shaped body between the top of the piston 4 and the flange 2 and communicates with the outside of the cup-shaped body 1 via a hole or passageway 10 provided directly in the cup-shaped body: in this manner, when the pump is sealedly mounted on the mouth of a container, the pressure in the upper pump chamber 9 is always equal to the pressure in the container on which the pump is sealedly mounted (i.e. the pressure existing outside the cup-shaped body 1).

In all conditions under which the pump is used or at rest, a hermetic seal exists between the outer surface of the stem 5 and the opposing surface of the hole in the ring cap 2 through which the stem extends and is translatable, and in the case of the embodiment shown in the figures is provided by a gasket or O-ring 12 of rubber or a suitable elastomeric material (although the seal between the stem and the hole in the ring cap can be provided in a different manner, for example by simply providing a lip, (not shown for simplicity), forming part of the

ring cap 2, (which can be formed of deformable plastic material, such as polyethylene, polypropylene etc.).

An important characteristic of the pump of the present invention is that its hollow stem 5 is always housed and sealedly translatable (in all conditions under which the pump is used or is at rest) within the guide hole in the ring cap 2, and that additionally in the cup-shaped body 1 of the pump there is provided the hole or passageway 10 at the upper chamber 9 of the pump body.

The result is that as the upper pump chamber 9 cannot enable liquids, air or gas to seep between the outer surface of the stem 5 and the ring cap hole through which this stem extends, if the ring cap 2 is mounted hermetically sealed on the mouth of a container (not shown for simplicity), there are no undesirable leakages or seepages of gas-phase product, air or fluids between the stem 5 and the gasket 12 of the ring cap 2. Moreover it should be noted that the pressure in the upper pump chamber 9 is always equal (because of the presence of the passageway 10) to the pressure in the container on which the pump is sealedly mounted.

Consequently, assuming that the pump is sealedly mounted on the mouth of a known cylindrical container closed at its other end by a movable base which moves whenever the substance contained in the container is dispensed, air cannot penetrate into the container in any condition under which it is used, so that the product or substance contained therein does not become contaminated by the air, or cannot harden or dry.

The same applies if the pump is mounted on a deformable bag which is squeezed by atmospheric pressure; or if the pump is mounted on a rigid container.

A particularly interesting and advantageous use of the pump is that in which a rigid container (on which the pump is mounted such as to define a hermetically sealed space in the container interior) contains a fluid, semidense or pasty substance mixed with low-boiling liquids able to generate a slight vapour pressure under normal conditions of use, i.e. at about 21°C.

Low-boiling liquids are liquids having a saturated vapour pressure less than 1.00 kg/cm^2 at 15°C and less than 2.8 kg/cm^2 at 37.80°C.

Low-boiling liquids are fluid chemical substances which have boiling points between +15ºC and +85ºC and develop a pressure of 1 atm (about 760 mm/Hg).

Low-boiling liquids particularly advantageous for the aforestated use are those chosen from the group consisting of isopentane, isohexane, N-pentane, N-hexane, dichloromethane, monochloropropane, 1-1-dichloroethane, 2-chlorobutane, trichloro-fluoro-methane CFC 11, trichloro-trifluoro-ethane CFC 113, ethyl ether, methylene-dimethylether, dimethoxymethane and acetone.

When using a low-boiling liquid of this type, as the fluid mixture is dispensed by the pump, the low-boiling liquid present in the container evaporates from its liquid phase present in the mixture and automatically restores the desired pressure within the container (slightly higher than atmospheric), to prevent formation of a vacuum in the container which would hinder continuation of mixture dispensing from the rigid container.

A characteristic of the pump described with reference to the drawings is that, when at rest, the pressure in the pump lower chamber 8 is equal to that in the upper chamber 9, so that the pressure acting on the upper and lower surfaces of the piston 4 is the same. It follows that to dispense the fluid substance through the cavity in the stem (on which the button B is mounted) the pressing force which has to be exerted on the stem (examining the figures from Figure 1 to Figure 3) is only that required to overcome the thrust of the two springs 20 and 30 and to compress the fluid substance collected and contained in the chamber 8 to cause the lip 4B of the piston 4 to separate from a corresponding seal seat provided in a collar 50 projecting from the lower part of the stem 5 within the pump chamber 8. In a manner already known in the art, the lip 4B of the piston 4 is urged (by the spring 30 which rests on the collar 60 projecting from the upper part of the stem 5) against and onto the collar 50 to sealedly close the stem aperture 70, the purpose of which is to enable compressed fluid to pass from the chamber 8 to the stem cavity during fluid dispensing. Pump operation therefore does not require a large force, and is equal to that required to dispense by pumps of known type mounted in known unsealed manner on fluid substance containers.

At the end of the delivery stroke, when the stem is pushed down to its travel limit, the collar 50 rests against a stop element 80 consisting of a constriction in the cross-section of the cup-shaped body 1 (Figure 3), while the piston lip 4B remains resting on the adjacent upper surface of the collar 50, still sealedly closing the access aperture 70 to the stem cavity.

The return of the pump from the position reached at the end of its operating travel to its rest position (Figure 1) by passing through an intake stage (Figure 4) also takes place smoothly merely under the thrust of the springs, and not with extreme difficulty as would occur with the pump-type dispensers of US 3,211,346A, US 4,511,069A and GB 1537436A, in which a hermetically sealed upper chamber is provided above the piston of each chamber (i.e. an aperture such as that indicated by the number 10 in the accompanying drawings does not exist).

On being initially used, the pump has to be primed, i.e. the air initially contained in the chamber 8 has to be expelled therefrom, to enable a vacuum to be formed in this chamber for drawing into it, through the hole 3, the fluid present in the container on which the pump is mounted. This means that in passing from the rest position of Figure 1 to the end-of-travel position with the stem lowered (of Figure 3), if only air is present in the chamber 8 this air is compressed by the piston 4 and has to be expelled from said chamber, to enable the necessary vacuum to be created in the chamber for allowing the fluid to penetrate into said chamber through the hole 3.

For this purpose, short longitudinal ribs 90 (shown as four in number in the drawings) project from the inner surface 8 of the cup-shaped body 1 in proximity to the stop element 80 provided therein, the bottom of the lip 4A resting on these to undergo deformation (when the pump is pressed to its travel limit, shown in Figures 3, 3A and 4), to leave free those passageways (not numbered for simplicity but clearly visible in Figure 4) which enable the compressed air possibly present in the chamber 8 to rise upwards between the opposing surfaces of the piston and cup-shaped body 1, and discharge into the chamber 9 (and from there into the container, through the aperture 10), possibly causing inward flexure of the thin upper part of the lip 4A, at which recesses 100 visible

in the cross-section of Figure 5 can be provided to allow free passage of air above the piston.

In this manner, the pump can be easily primed.

The pump of the present invention is advantageously usable for dispensing pressurized fluids developing a saturated vapour pressure less than 2.8 kg/cm^2 at 54.4°C.

CLAIMS

1. A pump for manually dispensing a quantity of fluid substance sealedly contained in a container, comprising a cup-shaped body having an open end on which a ring cap is sealedly applied, and a closed end in which a hole is provided through which, via a unidirectional valve, the fluid substance can enter a lower pump chamber from which the substance can be expelled to be dispensed to the outside by the pump, said lower chamber being bounded by an annular piston having a lip sealedly translatable along the inner surface of the cup-shaped body and a lip slidable along the outer surface of a hollow pump operating stem for dispensing the fluid substance through the free end of the stem projecting from the pump, the stem cavity opening at an aperture provided in an intermediate region of the stem length in proximity to a lower collar projecting from the stem into said pump lower chamber, from the stem there also projecting an upper collar on which there acts one end of a spring, the other end of which acts on said piston to urge its lip towards and against said lower collar in order to close said aperture, said stem extending and being axially translatable through a hole provided in said ring cap which with said piston defines an upper pump chamber in which said stem upper collar is positioned, characterised in that, under any condition in which the pump is used, the outer surface of the stem seals against the opposing surface of the hole in the ring cap, there being provided in the cup-shaped body at least one passageway which connects said upper chamber to the outside of said cup-shaped body, from the cup-shaped body there projecting into said chamber a stop element on which said lower collar rests and halts when the stem is pressed to its end-of-travel position, whereas the lip of the piston slidable along the outer surface of the stem is kept urged by the spring towards and against said lower collar to close said stem aperture, from the inner surface of the cup-shaped body in proximity to and above said stop element there projecting at least one short longitudinal rib on which the lower edge of the piston lip rests and is deformed to leave free a passageway between the lip and the opposing surface of the cup-shaped body.

2. A pump as claimed in claim 1, characterised in that at least one longitudinal groove is provided in the outer upper part of the piston lip to locally distance said lip from the adjacent surface of the cup-shaped body.

3. A pump as claimed in claims 1 and 2, characterised in that said ring cap is mounted and sealedly fixed on the mouth of a rigid container containing said fluid substance.

4. A pump as claimed in claim 3, characterised in that said fluid substance is mixed with at least one low-boiling liquid having a saturated vapour pressure less than 1.00 kg/cm^2 at 15ºC and less than 2.8 kg/cm^2 at 37.8ºC and having boiling points at 760 mm/Hg between +15ºC and +85ºC.

5. A pump as claimed in claim 4, characterised in that said low-boiling liquid is chosen from the group consisting of isopentane, isohexane, N-pentane, N-hexane, dichloromethane, monochloropropane, 1-1-dichloroethane, 2-chlorobutane, trichloro-fluoro-methane CFC 11, trichloro-trifluoro-ethane CFC 113, ethyl ether, methylene-dimethylether, dimethoxymethane and acetone.

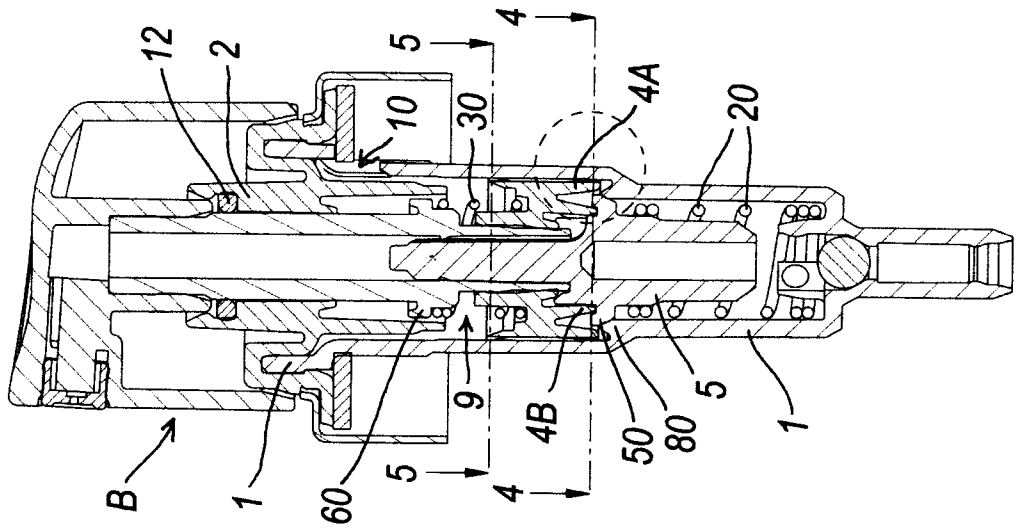

FIG. 3

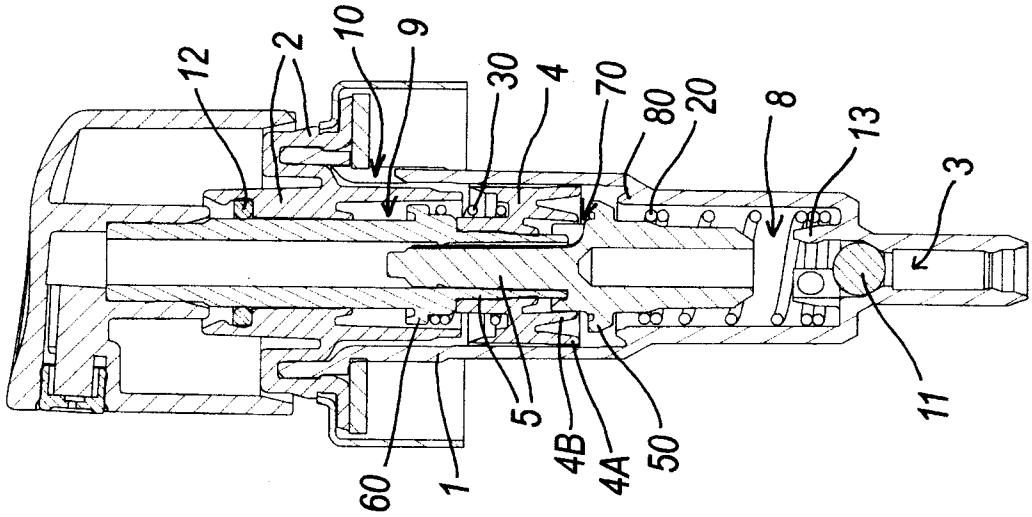

FIG. 2

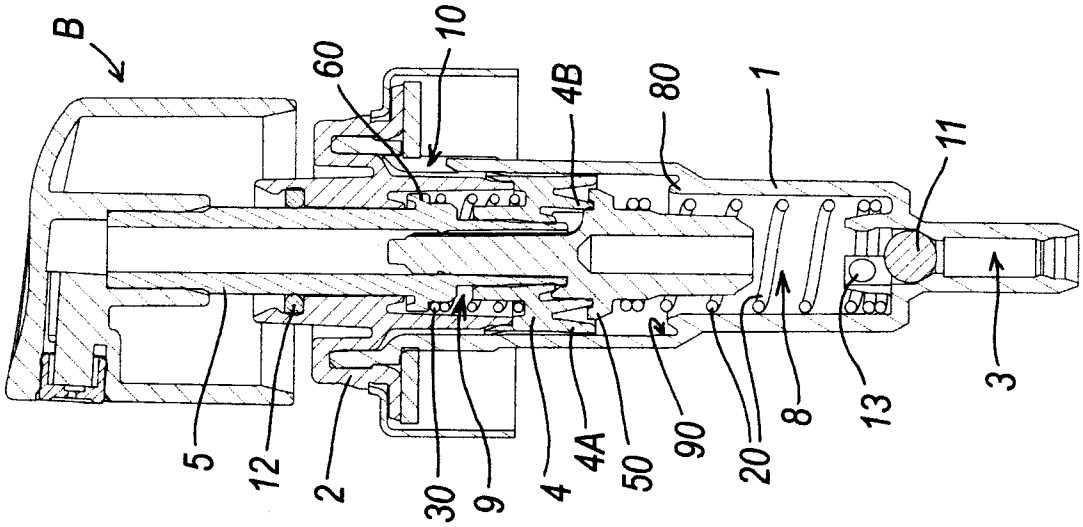

FIG. 1

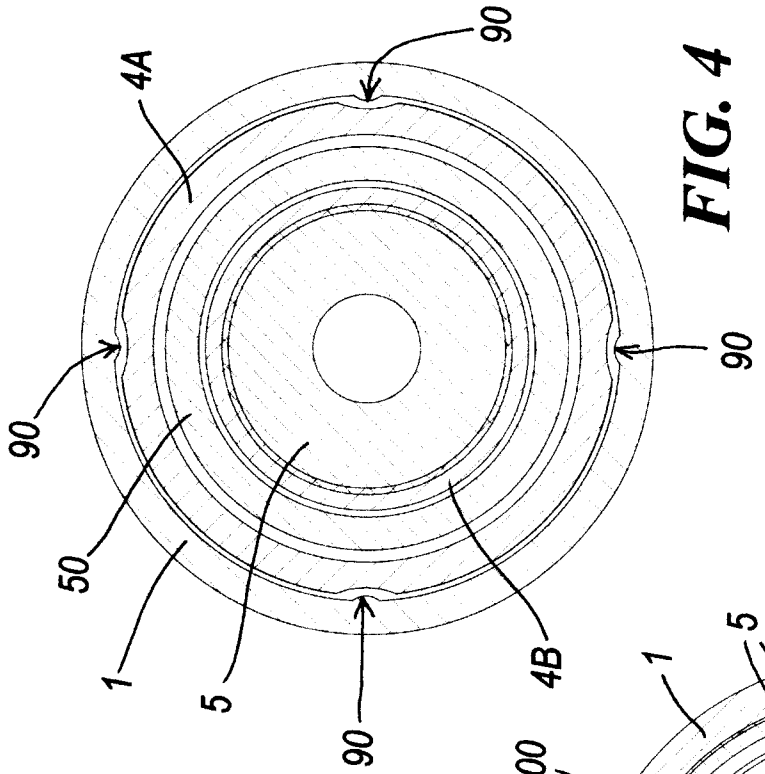

FIG. 4

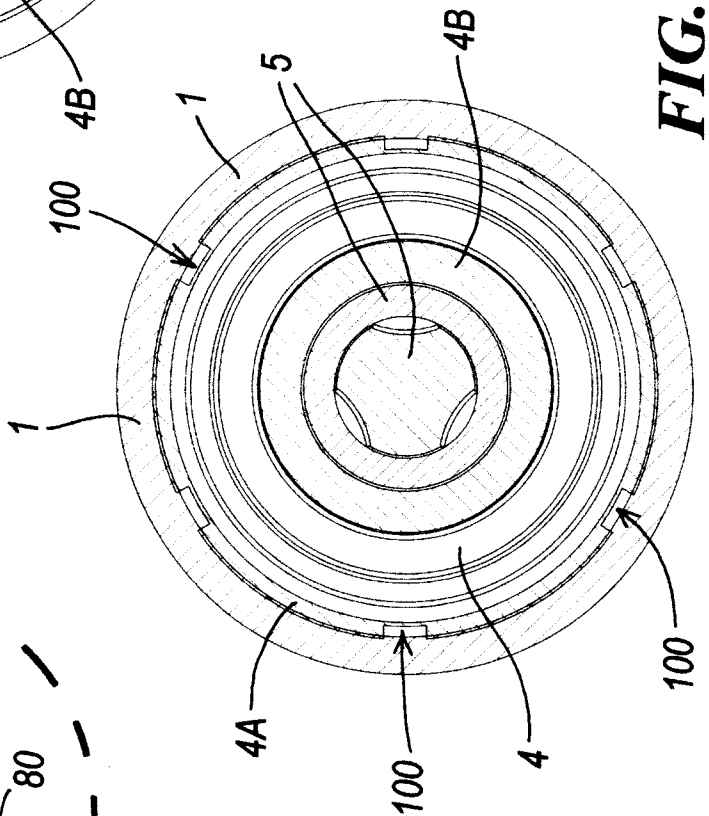

FIG. 5

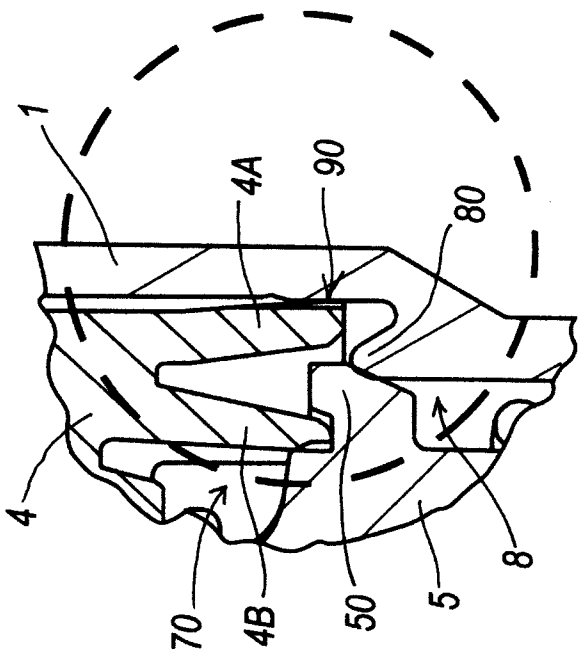

FIG. 3A

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2006/069558

A. CLASSIFICATION OF SUBJECT MATTER
INV. B05B11/00

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)
B05B

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 practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 511 069 A (KALAT EDWIN F [US]) 16 April 1985 (1985-04-16) cited in the application the whole document	1
A	FR 2 842 875 A1 (VALOIS SA [FR]) 30 January 2004 (2004-01-30) the whole document	1
A	US 4 230 242 A (MESHBERG PHILIP) 28 October 1980 (1980-10-28) the whole document	1
A	WO 98/18564 A (PROCTER & GAMBLE [US]) 7 May 1998 (1998-05-07) the whole document	1

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

☒ See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
8 March 2007	23/03/2007

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Eberwein, Michael

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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