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(54) Manual pump for dispensing liquid substances contained in bottles and comprising a non-return valve with a socket-shaped or double socket-shaped valving member.

(57) In a manual pump (10) for dispensing predetermined quantities of liquid substance contained in bottles, the valving member (36; 136) of the non-return valve, which prevents the liquid substance present in the pressure chamber (28) from returning to the bottle, is in the form of a solid of revolution and has a socket-shaped lateral surface (37; 137) comprising a coaxial frusto-conical sealing portion (38; 138) which mates with the corresponding frusto-conical surface (40) of the valve seat. The valving member is of injection-mouldable plastics material, of a kind not attacked by commonly dispensed substances.

The valving member (136) can comprise a second socket-shaped lateral surface part (137') arranged specular to the first (137).

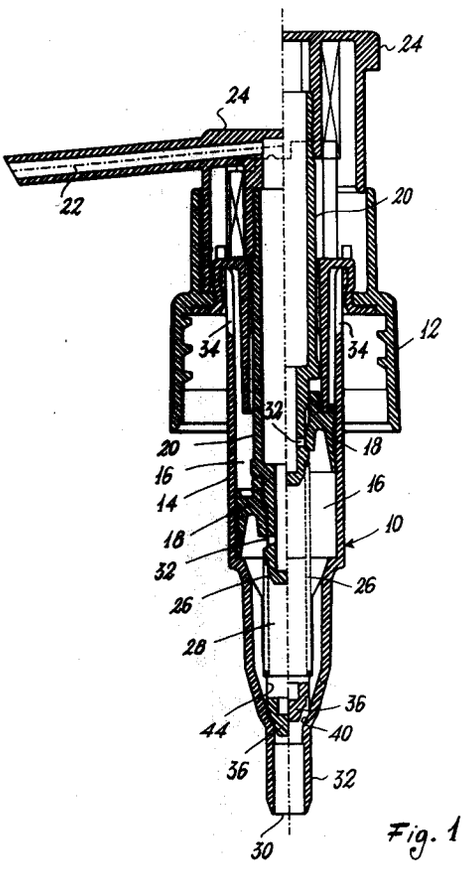

Fig. 1

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This invention relates to manual pumps for dispensing a predetermined quantity of liquid or pasty substance contained in bottles.

Pumps of this type are well known. They are fitted onto the mouth of the bottle containing the liquid substance to be dispensed. Such pumps have a hollow main body of overall cylindrical shape and arranged vertically. A piston element can move under sealed conditions within this main body in both directions between two predetermined positions, and is connected to the lower end of a hollow coaxial shaft, the upper end of which, projecting a certain distance beyond the main body of the pump, carries a dispensing knob for its operation.

When at rest, the unit comprising the piston element, the shaft and the dispensing knob is retained in its highest position (of maximum elevation of the dispensing knob) by elastic return means. The piston element and the lower part of said cavity of the main body define a pressure chamber which is filled with the predetermined quantity of the substance to be dispensed. At the lower end of the pressure chamber there is an aperture which is connected to a tube dipping into the liquid substance contained in the bottle. This aperture is closed by a non-return valve of ball type, to prevent the liquid substance which has entered the pressure chamber by the suction produced by the upward movement of the piston element from returning to the bottle.

The ball valving member of this valve is of stainless steel and seals against a frusto-conical seat provided in the main body of the pump. Hence the seal between the ball and its frusto-conical seat is effected along the circular line of contact between the ball and seat. These briefly described known pumps have the drawback that the ball, conventionally of stainless steel, can be chemically attacked by some of the substances for which such pumps are commonly used. In this respect it should be noted that the pump manufacturer has no previous knowledge of the type of liquid substance to be dispensed, as the pump is mounted on the relative bottle by the producer of the substance, who makes up the bottle. Consequently, the pump must prove to be suitable for any of the possible substances for which it can be used.

The chemical attack of the stainless steel ball has two consequences, namely the contamination of the substance to be dispensed and the poor sealing of the non-return valve, so that the quantity of substance effectively dispensed is less than the predetermined quantity.

To overcome this drawback it has been suggested to use glass balls instead of stainless steel balls, glass being a material which is not subject to such chemical attack.

However, glass balls have a considerably higher cost (about three times) than stainless steel balls. Hence although solving the problem, there is a significant increase in the pump production cost.

An object of the present invention is to provide a pump of the aforesaid type in which in addition to not being chemically attacked by normal substances to be dispensed by the relative pump, the non-return valve has a decidedly lower cost not only than glass ball valves but also than stainless steel ball valves. A further object of the present invention is to provide a non-return valve which provides a decidedly better seal than known ball valves, but which uses the same conventional frusto-conical seat as known ball valves. Thus no modification to the main body of conventional pumps is required. The valve of the invention can therefore be reliably used in otherwise conventional pumps. The only difference compared with known pumps is the valving member of the valve.

A further object is to provide a non-return valve, the valving member of which is automatically positioned in its seat by gravity fall.

Said objects are attained by the manual pump of the present invention, characterised in that the valving member of the non-return valve is in the form of a solid of revolution and has a lateral surface comprising a coaxial frusto-conical sealing portion which mates with the corresponding frusto-conical surface of the valve seat, the valving member being of injection-mouldable plastics material, of a kind not attacked by substances commonly dispensed by pumps of this type.

The fact of constructing the valving member of injection-mouldable plastics material, together with its particular shape, means that a valving member can be obtained at a cost many times less than that of stainless steel balls. In addition, the particular shape of its sealing portion means that a decidedly better seal can be obtained than with ball valves.

A suitable material of construction for said valving member and which is not chemically attacked by the liquid substances commonly contained in bottles fitted with said pump can for example be nylon or an acetal resin.

In one embodiment of the pump according to the present invention, the lateral surface of the valving member comprises a cylindrical guide portion coaxial to the valving member and slidingly engageable with a corresponding surface forming part of the main body of the pump, said sliding surface being already present in the main body of known pumps comprising a ball valve.

Preferably, the valving member of the non-return valve of the pump according to the present invention comprises a coaxial taper for the correct

positioning of the valving member in the corresponding valve seat.

The presence of said centering taper means that the dimensional tolerances do not have to be too stringent for the valving member, in particular for the diameter of its guide surface, or for the corresponding sliding surface provided in the main body of the valve. In his respect, because of said centering taper, even if there is fairly wide clearance between the guide surface of the valving member and the relative sliding surface of the main body of the pump, the valving member always assumes the correct position relative to the valve seat. This eliminates the risk of the valving member assuming a position with a certain inclination to the axis of the valve seat, and preventing the valve forming a perfect seal.

Conveniently, the valving member can be hollow, its cavity being coaxial and opening to the outside at one of its two ends. This cavity can be used to facilitate its extraction from the mould if the valving member is produced by injection moulding. The cavity can also be used for its handling by a device for automatically assembling the valving member in the pump, the gripping element of such a device being inserted with slight forcing into said cavity so that the valving member remains attached to it.

A further function of said cavity in the valving member is to limit the thickness of the plastics material to be moulded, so preventing shrinkage during moulding, which would cause undesirable deformation of the moulded piece, such deformation possibly falling outside the specified dimensional tolerances. The described valving member must be placed in its seat in the right direction, with its tapered part facing the valve seat. As assembly is by automatic machines, it would be convenient to be able to mount the valving member by simply allowing it to fall into its seat without the need to firstly position it in the right direction. For this purpose, according to a further embodiment of the present invention, the lateral surface of the valving member comprises a second sealing portion which also mates with the frusto-conical surface of the valve seat and is arranged specular to the first.

In this manner a valving member is obtained which whatever its direction falls automatically into the correct position in its seat, the seal being achieved with one or other of the two frusto-conical sealing portions.

The invention will be more apparent from the following description of one embodiment thereof. In this description reference is made to the accompanying drawing, in which:

Figure 1 is an axial vertical section through a manual pump according to the invention for dispensing liquid substances contained in relative bottles (not shown);

Figure 2 is a partly sectional enlarged side view of the socket-shaped valving member of the non-return valve of the pump of Figure 1;

Figure 3 is a side view, to the same scale as Figure 2, of a double socket-shaped valving member.

Figure 1 shows a pump 10 of the stated type, for fitting by an internally threaded ring nut 12 to the neck of a bottle or container (not shown) containing the substance to be dispensed. The pump 10 comprises a main body 14 of overall cylindrical shape defining a cavity 16. A piston element 18 of substantially elastic material can move in both directions within this latter between two end positions. The piston 18 is shaped to seal against the wall of the cavity 16 of the main body 14. The piston 18 is connected to the lower end of a hollow shaft 20, to the upper end of which a knob 24 is fixed for operating the pump. In this respect, the piston 18 is able to undergo a certain movement relative to the shaft 20 to open and close the apertures 32 which connect the pressure chamber 28 to the interior of the shaft 20. The unit comprising the piston element 18, the shaft 20 and the dispensing knob 24 can move vertically in both directions between two positions, of which the lower is shown on the left side of Figure 1, and the upper is shown on the right side of the same figure.

The dispensing knob 24 comprises a delivery channel 22 which connects the outside to the interior of the shaft 20. The right side of Figure 1 shows the normal rest state of the pump, to which it always returns by virtue of the return spring 26.

As is well known, the pump 10 is operated by pressing the dispensing knob 24 completely downwards, the pump 10 then assuming the state shown on the left of Figure 1, in which the pressure chamber is connected to the interior of the shaft 20 via the apertures 32.

On releasing the dispensing knob, by which the piston 18 automatically returns to the position shown on the right side of Figure 1, a vacuum is created in the pressure chamber 28 to allow the liquid substance contained in the bottle to be drawn in. This drawing takes place through the aperture 30 provided at the lower end of the main body 14 of the pump 10. In reality, the aperture 30 is at the lower end of a cylindrical portion 32 on which a flexible tube (not shown) is externally mounted to dip into the liquid substance contained in the bottle.

When the pump has returned to its rest state (right side of Figure 1, in which the apertures 32 are closed), the pressure chamber 28 has assumed its maximum size and is filled with a predetermined

quantity of substance drawn from the bottle for dispensing. Dispensing occurs during the next compression stage of the dispensing knob 24, the substance to be dispensed, contained in the pressure chamber 28, passing through the apertures 32 (which open following a small downward movement of the shaft), the interior of the shaft 20 and the delivery channel 22. A corresponding quantity of air, which penetrates into the bottle through the slots 34, takes the place of the quantity of substance which has emerged. To prevent the liquid substance which has been drawn into the pressure chamber 28 from returning to the bottle by gravity, a non-return valve is normally provided. Specifically, in Figure 1 instead of the conventional stainless steel ball valve which seals against a frusto-conical valve seat provided in the main body of the pump, according to the present invention there is provided a valve with a socket-shaped valving member 36. In Figure 1 the valving member is shown in the two positions which it can assume, ie with the valve open (to the right of the figure) and with the valve closed (to the left).

The valving member is shown in greater detail in Figure 2. From this it can be seen that the valving member has a socket-shaped lateral surface comprising a coaxial frusto-conical sealing portion which mates with the relative frusto-conical seat 40 (Figure 1) of the valve. The seat 40 is of the type conventionally used for known pumps with a non-return valve of ball type, and is integral with the main body of the pump. The surface of the sealing portion 38 is polished to obtain a perfect valve seal. The lateral surface 37 of the valving member 36 also comprises a coaxial cylindrical guide portion 42 arranged to slidingly engage the corresponding sliding surface 44 (Figure 1) provided in the main body 14 of the pump 10. This sliding surface is of the conventional type for ball valves, consisting of the vertical surface of radial ribs 44 (visible in Figure 1), which is formed in the main body of conventional pumps with a non-return valve of ball type.

The guide portion 42 keeps the valving member 36 coaxial to the relative valve seat 40.

To avoid the need for constructing a valving member with too stringent dimensional tolerances, as already stated the valving member comprises in its lower part facing the seat 40 a centering taper 46 which enables it to be correctly positioned in the relative valve seat 40 even if a certain clearance exists between the guide portion 42 and the sliding surface 44. In this respect, because of the centering taper 46, even if the valving member should assume a position inclined to the axis of the valve seat 40, it automatically returns to its correct axial position for closing the valve.

As can be seen from Figure 2, the socket-shaped valving member 36 is internally hollow.

As already stated, the valving member is constructed of a thermoformable plastics material which is not attacked by the substance to be dispensed. By way of example, a plastics material suitable for this purpose has been found to be nylon or an acetal resin, which withstand all common liquid substances normally dispensed by pumps of this type.

The socket shape and the substantially uniform thickness of its various parts also prevent the said shrinkage arising during moulding.

The presence of the inner cavity 39 in the valving member 36 facilitates its extraction from the mould in which it is produced.

This cavity also enables the valving member to be withdrawn by the slightly forced insertion into it of the gripping element of an automatic mounting device (not shown) for mounting the valving member in the pump, the valving member being brought into the required position, where it is automatically released from said gripping element, to thus fall into the correct position. Figure 3 shows a double socket-shaped embodiment of the valving member according to the invention, provided with two specular sealing portions (138 and 138'). As already stated, this avoids having to orientate the valving member 136 during automatic mounting. In this respect it is sufficient merely to drop the valving member 136 in any orientation into the main body 14 of the pump 10 for it to automatically assume one of the two possible positions, both of which provide proper operation.

As can be seen from Figure 3, the overall lateral surface of the valving member 136 is symmetrical about a horizontal plane indicated in the same figure by the dashed and dotted line A-A. This lateral surface is in fact formed from two specular half-surfaces 137 and 137'.

In this specific case the symmetry is limited to the lateral surface of the valving member 136. The rest of the valving member 136 is not symmetrical about said horizontal plane, as can be seen from Figure 3. In this respect it has a coaxial cylindrical cavity 139 which opens to the outside at one of the two ends of the valving member, namely at its upper end (Figure 3). Because of the particular shape of the double socket-shaped valving member 136 its centre of gravity is below the line A-A of Figure 3. Consequently while falling freely during its automatic mounting, the valving member will tend to assume the orientation shown in Figure 3.

The sealing portions 138 and 138' of the respective lateral half-surfaces 137 and 137' and the other details of these half-surfaces of the valving member 136 are identical to those of the valving member 36 of Figure 2 and indicated in Figure 3 by the same reference numeral plus 100, and

further plus an apex if relating to parts of the upper lateral half-surface 137'.

Claims

1. A manual pump (10) for dispensing predetermined quantities of liquid substance contained in bottles, characterised in that the valving member (36; 136) of the non-return valve is in the form of a solid of revolution and has a lateral surface comprising a coaxial frusto-conical sealing portion (38; 138) which mates with the corresponding frusto-conical surface (40) of the valve seat, the valving member (36; 136) being of injection-mouldable plastics material, of a kind not attacked by substances commonly dispensed by pumps of this type.

2. A pump (10) as claimed in claim 1, wherein the lateral surface of the valving member (36; 136) comprises a cylindrical guide portion (42; 142) coaxial to the valving member and slidingly engageable with a corresponding surface (44) forming part of the main body (14) of the pump.

3. A pump (10) as claimed in claim 1 or 2, wherein the socket-shaped lateral surface of the valving member (36; 136) comprises a centering taper (46; 146) for the correct positioning of the valving member in the corresponding valve seat (40).

4. A pump (10) as claimed in any one of the preceding claims, wherein the valving member (36) comprises a coaxial cavity opening to the outside at one end of the valving member.

5. A pump (10) as claimed in any one of claims 1 to 3, wherein the lateral surface of the valving member (136) comprises a second sealing portion (137') which also mates with the frusto-conical surface (40) of the valve seat and is arranged specular to the first sealing portion (137).

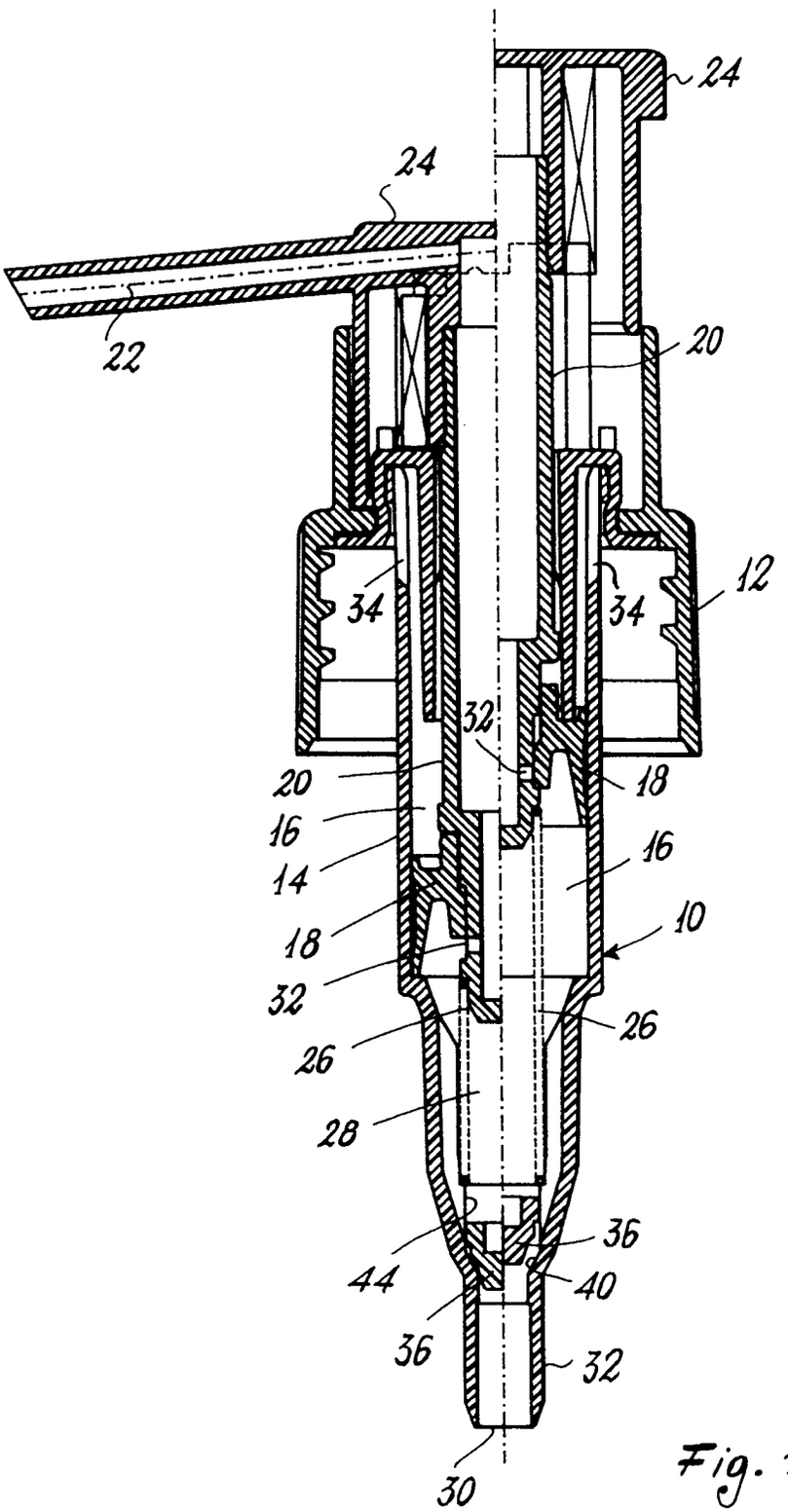
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Fig. 1

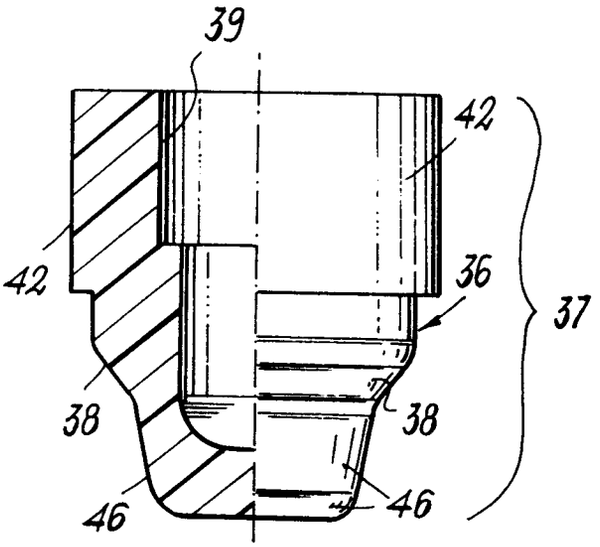
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Fig. 2

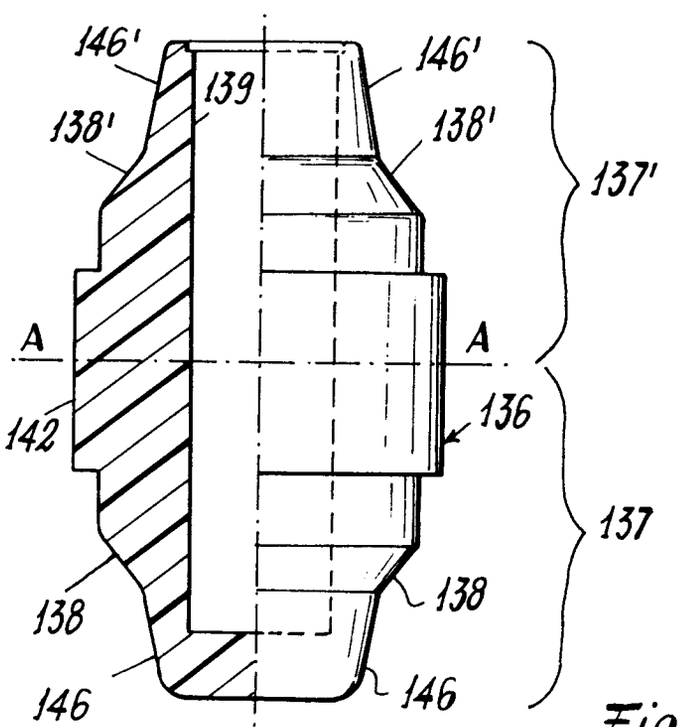
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Fig. 3