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DESCRIPTION
DISPENSER WITH FLOW CONTROL

Technical Field

5 This invention relates to dispensers for liquids and more particularly to dispensers capable of storing and dispensing medium to higher viscosity products such as shampoo, hand soap and the like.

Background Art

10 Dispensers have been developed which consist of an inverted container for receiving the liquid and having a bottom outlet positioned inside a reservoir. A pool of the liquid accumulates under atmospheric pressure in the reservoir around the bottom outlet to thereby trap the liquid in the container with a negative pressure above
15 the liquid. Various structures have been provided to disturb the balance of the liquid and the negative pressure in the container to thereby cause controlled flow from the dispenser through an outlet associated with the reservoir. Such dispensers can be seen in applicant's prior patents, namely U.S. Patents 4324349, 4635828,
20 4645097, 5033653, and 5217147.

 The principles of operation of the dispensers are described in some detail in U.S. Patent 5033653 which includes diagrams illustrating the the conflicting parameters associated with providing temperature compensation. As demonstrated in that patent, the liquid must not
25 flow from the dispenser when temperature rises, and yet the dispenser must have a response rate which will allow the user to dispense almost instantaneously upon applying a force to the dispenser. U.S. Patent 5033653 also provides structures which overcome these disadvantages satisfactorily by separating the two parameters so that response rate
30 will not be so dependent on the amount of temperature compensation

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provided in the structure. However it has been found that when liquids of higher viscosities are used, there is a disadvantage in all of the prior structures which was not apparent earlier. It has now been found that when the dispenser recovers from dispensing by receiving
5 air from outside, instead of liquid returning into the container from the reservoir, air will tunnel directly through the viscous liquid and find its way into the container. This results in excessive build up of liquid in the reservoir and eventual dripping and improper dispensing.

A second cause of the same difficulty results from the rate of
10 recovery of the dispenser after squeezing the container to dispense. The initial force driving the recovery rate is greatest when the container is at its maximum deflection where the most energy is available to drive the recovery. As a result, air will initially be inspired into the dispenser at a high rate and this will cause the air to tunnel
15 through the liquid and into the container.

These disadvantages are exacerbated in smaller structures such as those used to contain hand soap or shampoo. Inherently with these structures the distances and dimensions are such that both of these disadvantages take place at the same time.

20 It has now been found that different approaches to the relationship between temperature compensation and response rate have to be considered if higher viscosity liquids are to be dispensed, particularly from small dispensers.

25 Disclosure of Invention

Dispensers of the present type include a flow path through which liquid must pass to leave the dispenser. After the dispenser is actuated to dispense, the flow path then receives reverse flow as the dispenser recovers ready for the next dispensing. This is an inherent and
30 desirable part of dispensers of the present type because this reverse

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flow limits the possibility of dripping from the dispensing outlet. The present invention places a flow controller in the flow path which automatically adjusts to have little or no interference with the flow of liquid leaving the dispenser and then positions itself to slow down the rate of reverse flow into the dispenser. This slowing down of the rate ensures that the energy which would otherwise be available for sudden recovery, is available to drive the viscous liquid through a restricted path. Consequently during recovery, liquid is cleared from the outlet portion of the dispenser, relatively slowly before air meets the flow controller. At this point there is less energy available because the dispenser has recovered to some extent. Also, the procedure ensures that the liquid level in the reservoir has an opportunity to drop as liquid is drawn from the reservoir into the container and this minimizes the risk that the liquid will build up in the reservoir and make the dispenser inoperable.

Accordingly, in one of its aspects, the invention provides a dispenser for liquids of the type having a resilient container for containing the liquid to be dispensed and an outlet structure for containing a pool of the liquid at ambient air pressure to support the liquid in the container with a zone of negative pressure above the liquid, the dispenser being operated by deforming the container to cause liquid to flow outwardly along the flow path and to cause flow inwardly upon relaxing the container to discontinue dispensing, the dispenser being characterized by a flow controller positioned in the flow path and operable automatically in response to movement of liquid outwardly along the flow path to move the flow controller into a first condition in which the controller exhibits minimal resistance to flow, and then in response to movement of liquid inwardly along the flow path to move the flow controller into a second condition in which the controller exhibits increased resistance to flow sufficient to

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reduce the natural rate of flow into the container.

Brief Description of the Drawings

Fig. 1 is a side view, partly in section, of a preferred embodiment of a dispenser according to the invention;

Figs. 2 and 3 illustrate exemplary forms of flow controller which could be used in the embodiment, the flow controllers being drawn to a larger scale than the scale used in Fig. 1;

Fig. 4 is a view similar to Fig. 1 of part of a second embodiment of the dispenser;

Figs. 5 and 6 are views similar to Fig. 4 of further embodiments of the dispenser; and

Fig. 7 is a view similar to Fig. 1 and illustrating a further embodiment of the invention.

Best Mode of Carrying Out the Invention

Reference is first made to Fig. 1 which shows an exemplary dispenser 20 according to one of the preferred embodiments of the invention. The dispenser includes a resilient, deformable container 22 holding a supply of liquid 24 and having an inverted bottom outlet 26 in a neck 28. At the bottom of the outlet a flow controller 30 is immersed in a pool of liquid 32 which maintains a zone 33 of negative pressure above the liquid 24. The pool is contained in an outlet structure 31 having a reservoir 34 which is attached by threaded engagement 36 to a suitably formed portion of the container 22. A pivoted closure element 38 (shown in a closed position) blocks a discharge opening 40 and can be moved into an open position 42 (shown in ghost outline) for storage when the dispenser is in use.

The operation of the dispenser is similar to that described in the aforementioned patents. The negative pressure in the zone 33 above

the liquid 24 retains the column of liquid in the container because the liquid can not inspire air to displace the liquid due to the fact that the neck 28 of the container meets the pool of liquid 32 in the reservoir 34. However if the user changes this balance, then liquid can be made to leave the dispenser. This is conveniently done by making the container 22 sufficiently flexible and resilient that the user can squeeze it thereby changing the pressure balance and causing liquid to flow downwardly past the flow controller 30 (which will be described later) and into the reservoir. The level in the reservoir will rise until such time as the level meets the discharge opening 40 and the liquid will leave the dispenser. At this point the container 22 is sufficiently deformed that significant energy has been stored in the container to return it to its original shape. This energy can be brought into play simply by releasing the container whereupon the container will suck back liquid from the reservoir 34 and at the same time inspire air into discharge opening 40 thereby clearing the opening and allowing the contents of the dispenser to return to the position shown in Fig. 1.

The arrangement also provides space for volumetric change of the zone 33 caused by ambient temperature fluctuations.

If an increase in temperature causes the level of the pool of liquid 32 to rise, there is adequate space in the reservoir to minimize the risk that the liquid will rise and escape through discharge opening 40. Also, as will be described, suck back after discharge will tend to return the liquid in the reservoir to the level shown in Fig. 1.

As previously mentioned, a disadvantage that has been found with liquids having higher viscosities is that the suck back does not quite happen in that order. What effectively happens is that because air can move more readily than the viscous liquid, air will enter the discharge opening 40 and proceed through the liquid towards the opening 26 at

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the end of the neck of the bottle. At this point in time the reservoir 34 is full of liquid so that if the air gets to the container 22 first, it will rise to the zone 33 above the liquid in the container before liquid can be purged from the reservoir 34. As a result when the pressures are equalized, the level of liquid in the reservoir is higher than it was originally. If this process continues, the level will be almost at the opening 40 and there will be no temperature compensation.

The flow controller 30 is added to the structure to minimize the likelihood of air tunnelling through the liquid. The flow controller shown in Fig. 1 consists of an anchor ring 44 which is a push fit inside the bottle neck. Attached to the anchor ring to the left of Fig. 1 is a flap 46 connected at a living hinge 48. There is minimal strength in the hinge so that as a result, under normal circumstances the flap will tend to fall into a first condition or open position 50 (shown in ghost outline). In this position the flow controller offers minimal resistance to flow out of the container, and through the reservoir to the discharge opening 40. On the other hand, as soon as the user stops dispensing, the energy stored in the walls of the container 22 will be at a maximum and provide maximum force to draw liquid and air back into the container 22. Because the flow is reversed, the flap will automatically take up a second condition or closed position shown in Fig. 1 and the only access to the container is then through a central opening 52 in the flap.

As a result, the pressure drop across the opening 52 in the controller is such that the energy available to draw air into the container through the discharge opening 40 is reduced. The rate of flow is therefore reduced relative to the natural flow without the flow controller and the air has little chance to drive its way through the liquid. Consequently the level of liquid in the reservoir 34 will drop slowly as liquid is drawn through the opening 52 in the flow controller

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flap 46. This will result in the pool of liquid 32 in the dispenser returning essentially to the position shown in Fig. 1 where it was before dispensing took place. Of course the level of liquid in the container 22 will have dropped.

5 In general the flow controller 30 is lying in a flow path through which liquid must flow as it travels from the container and passes through the reservoir and issues through the discharge opening. The effect of this is an increase in the resistance to liquid flow when the flow is reversed.

10 Fig. 2 illustrates an alternative form of flow controller which differs only in that instead of having a central opening 52, the flap is waisted to define access openings 54, 56 to either side of a short living hinge 58.

Other forms of flow controller can be used such as that shown in
15 Fig. 3. In this case the flow controller is illustrated in sections and is made up of first and second parts 60, 62 which are located and attached to one another to contain a free ball 64 (shown in the reverse flow position). The part 60 defines a conical opening which closes upwardly and terminates in several radial ribs 66 defining between the
20 ribs space for flow past the ball. The second (or lower part 62) has four radial fingers 68 (three of which can be seen) which support the ball and provide minimal resistance to flow during discharge. When the flow is reversed, the ball rises into the position shown in Fig. 3 and flow then takes place around the ball and between the radial ribs 66.

25 As mentioned with reference to Fig. 1, the flow controller lies in a flow path. This flow path will vary in form depending upon the type of structure in use. For instance in Fig. 4, a neck 70 ends in a pool 72 of liquid in a reservoir 74. A discharge structure 76 forms part of the reservoir and defines an upwardly extending tube 78 which
30 terminates at a discharge opening 80. At the bottom of the tube, a

flow controller 82 is provided having a flap 84 somewhat like the flap described with reference to Fig. 1.

The structure shown in Fig. 4 allows for temperature compensation because the level of liquid in the reservoir can rise freely through a vertical distance indicated by "A" and after that, air will be trapped in the reservoir and further increase in pressure will tend to cause the liquid to rise through the tube 78 towards the discharge opening 80. The amount of temperature compensation can be varied by changing the height "A".

When a user discharges the dispenser, the liquid will rise through a distance "B" because there will be a certain amount of compression of air in the reservoir. Once this compression is complete, all of the energy subsequently applied forces liquid to flow past the flow controller and out through the discharge opening 80.

Once the discharge is complete, the reverse flow will be restricted by the flow controller so that there will be a tendency for the liquid in the reservoir to enter the container at least initially and then, as that level drops below the height indicated by "A" the air will come into the reservoir above the level of liquid. Consequently air can no longer tunnel through the liquid but simply apply a pressure to the complete surface of the liquid to push it back into the container. In this case, the flow path is from the container through the reservoir and then through the tube 78 and out through the discharge opening 80.

Reference is next made to Fig. 5 which is very similar to Fig. 4 except that the flow controller is placed in a different position in the flow path. In this case, a reservoir 90 is shaped to locate a disk 92 which engages about a container neck 94 to essentially close off the reservoir annularly about the neck 94. In at least one location on the disk, a flap 96 is attached to create a flow controller at that location. The flap will open upwardly when discharge takes place to offer

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minimal resistance to flow and then, the flap will drop back to the position shown in Fig. 5 where the only flow will be through a central opening 98 thereby restricting the flow and ensuring that air coming into the dispenser will not tunnel through the liquid. In fact the air will end up above the liquid applying a pressure on the surface of the liquid to cause the liquid to return to the retainer.

Yet another structure is shown in Fig. 6. In this instance, a reservoir 100 is formed in a wall 102 of a container 104. Again there is a pool of liquid at atmospheric pressure and in this case a pool 106 is in the reservoir 100 and open to atmosphere through a discharge opening 108.

The flow path of the structure shown in Fig. 6 is from the container 104, through the reservoir 100, and out via the discharge opening 108. The same operation is used in the Fig. 6 embodiment as is used in previous embodiments in that the container is deformed to change the balance of pressures in the dispenser and cause liquid to flow upwardly and out through the discharge opening 108. A flow controller 110 allows almost unrestricted outward flow and then moves to slow down flow during reverse flow.

It will be appreciated that numerous structures can be designed within the scope of the invention as claimed. In general the invention includes all dispenser structures which establish a first level of liquid below a zone of negative pressure and a second level at atmospheric pressure, and which can be caused to dispense by disturbing the balance in the dispenser. A flow controller is in the flow path to permit flow outwardly and to restrict reverse flow.

Reference is next made to Fig. 7 to illustrate a further embodiment of the invention which may be preferable in some situations.

In the embodiments already described, the flap of the flow control opens to release liquid at the level of the flap, and the opening in the

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flap which controls return flow is at this level also. Some liquids are not only viscous, but they also have a "stickiness" which results in build up on surfaces. Such liquids will tend to coat the inside walls of the reservoir 34, (Fig. 1) and neck 28. As a result the level in the reservoir will be slow to return to the level shown in Fig. 1. Consequently, after the flap closes, liquid may flow upwardly through flap opening 52 faster than the liquid falls off the walls. In this condition, air can pass through the opening to equalize the pressure before the liquid falls off the walls. The level will then slowly rise above the level shown in Fig. 1 reducing the volume available for temperature compensation. To reduce the risk of such a failure, the embodiment shows in Fig. 7 how it can be used.

As seen in Fig. 7, a dispenser 112 has a container 114 and reservoir 116. A neck 118 of the container has a flow controller 120 which differs from controller 30 (Fig. 1) in that a flap 122 includes a tubular downward projection 124 terminating in a floor 125 defining a flow return opening 126.

The operation of the structure shown in Fig. 7 differs from that in Fig. 1 because the dispensing flow takes place at one level and the return flow at a lower level.

When the dispenser 112 is actuated, the flap 122 will open and liquid will exit the container 114 and then rise through the reservoir (or other exit structure) before leaving the dispenser. This leaves the pool below the flap intact. Consequently, upon suck-back, the flap will close and liquid will be drawn from the level of opening 126. If the liquid level falls temporarily below the level of the flap, it will have no effect on the re-establishment of equilibrium which can be achieved only by drawing liquid through the openings. No air will be entrapped in this flow.

These and other embodiments are within the scope of the claims.

Industrial Applicability

In use, dispensers according to the invention are first filled by separating the container, inverting it (relative to the drawings) and filling it with liquid. While still in this position, the reservoir is assembled and the dispenser is then returned to an upright position as shown in the drawings. Dispensing can then take place by first releasing the closure element and applying a pressure to change the equilibrium existing in the dispenser. This is done conveniently by using a resilient container which can be squeezed. However, any structure which permits the user to disturb the equilibrium will result in dispensing.

Index of Reference Signs

	20 Dispenser	22 Container
	24 Liquid	24 Bottom outlet
5	28 Neck	30 Flow Controller
	31 Outlet structure	32 Pool of liquid
	33 Zone	34 Reservoir
	36 Threaded engagement	38 Closure element
	40 Discharge opening	42 Open positions
10	44 Anchor ring	46 Flap
	48 Living hinge	50 Open position
	52 Opening	54,56 Access openings
	58 Living hinge	60 First part
	62 Second part	64 Ball
15	66 Radial ribs	68 Radial fingers
	70 Neck	72 Pool
	74 Reservoir	76 Discharge structure
	78 Tube	80 Discharge opening
	82 Flow controller	84 Flap
20	90 Reservoir	92 Disc
	94 Neck	96 Flap
	98 Opening	100 Reservoir
	102 Reservoir	102 Wall
	104 Container	106 Pool
25	108 Discharge opening	110 Flow controller
	112 Dispenser	114 Container
	116 Reservoir	118 Neck
	120 Controller	122 Flap
	124 Downward projection	125 Floor
30	126 Return opening	



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Claims

1. A dispenser (20,112) for liquids of the type having a resilient container (22,104,114) for containing the liquid to be dispensed and an outlet structure (31) for containing a pool of the liquid (32) at ambient
5 air pressure to support the liquid in the container with a zone (33) of negative pressure above the liquid (24), the dispenser being operated by deforming the container to cause liquid to flow outwardly along the flow path and to cause flow inwardly upon relaxing the container to
10 discontinue dispensing, the dispenser being characterized by a flow controller (30,120) positioned in the flow path and operable automatically in response to movement of liquid outwardly along the flow path to move the flow controller into a first condition in which the controller exhibits minimal resistance to flow, and then in response
15 to movement of liquid inwardly along the flow path to move the flow controller into a second condition in which the controller exhibits increased resistance to flow sufficient to reduce the natural rate of flow into the container.
2. A dispenser as claimed in claim 1 in which the outlet structure
20 includes a reservoir for containing the pool of liquid (32).
3. A dispenser as claimed in claim 1 in which the container
(22,104,114) includes a downwardly extending neck (28,118) for
extending into the pool of liquid (32) and in which the flow controller
25 (30,120) is attached to the neck of the container.
4. A dispenser as claimed in claim 3 in which the flow controller
(30,120) includes a flap defining an opening (52,54,56,126).
- 30 5. A dispenser as claimed in claim 4 in which the flap further includes



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a tubular downwardly extending projection (124) and a floor (125) defining said opening (126).

5 6. A dispenser as claimed in claim 1 in which the outlet structure (31) includes a tube (78) and in which the flow controller (30,130) is attached to the tube.

10 7. A dispenser as claimed in claim 1 in which the container (22,104,114) includes a downwardly extending neck (28,118) for extending into the pool of liquid (32) and in which the flow controller includes a disc (92) surrounding the neck (28,118).

15 8. A dispenser as claimed in claim 7 in which the flow controller further includes a flap (96) attached to the disc and defining an opening in the flap.



This Sheet Has Been Replaced

