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AN IMPROVED AEROSOL VALVE

Background of the Invention

This invention relates to an improved aerosol valve system whereby flow through the discharge conduit is terminated when the aerosol container is sufficiently rotated away from an acceptable discharge orientation that gaseous phase propellant is discharged rather than the desired product. More particularly, the invention relates to any aerosol valve system having a principal product flow valve and a ball valve shut-off valve disposed in the product flow path which terminates through the product flow path during unacceptable orientation of the aerosol container and a mechanism for equalizing the pressure on each side of the ball valve such that the ball will promptly dislodge from its valve seat and return to its unseated position upon closing of the principal valve and the return of the aerosol container to an acceptable orientation.

Aerosol containers generally comprise a valve unit mounted in the opening of the aerosol container, the valve unit having a gasketed hollow valve stem and integral valve body which reciprocates within the valve housing upon application of finger pressure and return spring pressure to open (discharge) and closed positions. Extending from the base of the valve housing is a product eduction tube, commonly referred to as a dip tube. Product is discharged by applying finger pressure through an actuator, atop the valve stem, to depress the valve stem and thereby open the valve; the product passing through the dip tube into the valve housing and then through the hollow valve stem to the discharge orifice. The dip tube extends to the bottom of the container and is usually curved such that during



discharge of the product, the dip tube will remain immersed in the product, usually liquid, to be discharged.

5 However, in an aerosol unit of the type described above, when the container is rotated sufficiently away from its designed operational position (normally upright), the terminus of the dip tube will not remain immersed in the product, but rather will be exposed to the gaseous phase, often a compressed gas propellant, within the container. The consequence of this exposure is that gaseous propellant
10 is discharged rather than the desired product. In the case where a compressed gas is used as the propellant, this is particularly intolerable for the reason well known to those skilled in the art.

To avoid the unwanted discharge of gaseous propellant,
15 aerosol containers have been provided with valve systems wherein a gravity-actuated member moves to close a valve in the discharge path of the product when the orientation of the aerosol container reaches the point of propellant gas discharge. Commonly used for the purpose of providing a
20 shut-off valve when the container is improperly oriented is a ball valve which will move by gravity to a valve seat and shut-off flow through the product discharge conduit. Illustrative of such product shut-off systems is the aerosol system disclosed in French Patent Application 2,680,161.

25 In French 2,680,161, a ball is disposed in the dip tube. Upon inversion of the container, the ball will move by gravity through the dip tube to seat on the opening of the valve housing extension and thereby block flow through the product discharge conduit of the container.

30 In aerosol systems utilizing the ball valve system of the above-referred to French application, it has been found that the ball does not readily unseat from its sealing position with the valve seat even though the container is returned to an upright position. Consequently, the product discharge
35 path remains blocked and product will not be discharged. The failure of the ball to unseat and move by gravity to a



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position it normally occupies when the container is in an upright position is due to unequal pressure on opposite sides of the ball valve; the upstream side of the ball valve, when the container is in an upright position, being subject to the aerosol container pressure and the downstream side of the ball valve, in the upright container position, being subject to a considerably reduced pressure. The reduced pressure on the downstream side of the ball valve results from the ball valve closing prior to the closing of the principal product flow valve.

French Patent Application 2,680,161 attempts to obviate the problem of unseating the ball from its valve seat by providing a micro-orifice in the top surface of the valve housing that communicates at one end with the interior of the container and at the other end with the interior of the valve housing, and, consequently with the downstream side of the ball valve. See Fig. 1 and Fig. 2 of the French application. In another embodiment, a micro-orifice is disposed in the sidewall of the main valve housing. See Figures 5-7 of the French application. In both embodiments the micro-orifice (F) is isolated from the product discharge conduit when the main product discharge valve is moved to an open position and product discharge ensues. When the main or product discharge valve closes, the micro-orifice (F) allows transmission of the container pressure to the downstream side of the ball valve and thereby equalizes the pressure on opposite surfaces of the ball valve with the consequent movement of the ball to its normal position when the container is disposed in an upright position.

The configuration of Figs. 1 and 2 of the French application has been found to be an unsatisfactory solution for reason that the micro-orifice F is, in an unacceptable number of instances, closed by the gasket when the principle product flow valve is closed and thus the pressure on the downstream side of the ball valve is not in communication with the pressure within the container. As a result,



pressure equalization on each side of the ball valve is not attained and the ball remains lodged on the valve seat. It is believed that the micro-orifice F of Figs. 1 and 2 remains closed, even when the gasket returns to its position to close the principal product flow valve, due to swelling of the gasket and/or due to disposing the micro-orifice F within the underside of the gasket during crimping of the valve assembly to the pedestal of the mounting cup.

United States Patent No. 4,116,370 is illustrative of aerosol valve systems having a vapor tap in the housing for allowing passage and blending of gaseous propellant and product within the valve housing to enhance the spray characteristics of the discharged product and more specifically, a secondary valve mechanism, for example, a ball valve, to provide a shut-off of the vapor tap orifice in the valve housing when the aerosol container is in an inverted position.

United States Patent No. 3,018,023 describes an aerosol dispensing system having a product shut-off system wherein a spray-based piston is disposed in the product flow path such that the piston moves to close a port in the product flow path during inversion of the container. When the container is inverted and the syphon tube 15 is exposed to gaseous propellant, the gaseous propellant enters the space between the tubular body 17 and the cylinder 21 through inlet 18. The gaseous propellant then passes through ports or apertures 27 and capillary tubes 34, tubes 34 being pervious to gas and impervious to liquid, to provide a pressure on the back side of the piston equal to the container pressure with the consequence that the spring 32 expands and moves the piston to close off the outlet port 19. Venting of the gaseous propellant through capillary tube 35 and opening of the principal product flow valve with the container in an upright position subjects the top side of the piston to the pressure of the product and effects a collapse of the spring and a dislagement of the piston from outlet port 19.



Summary of the Invention

In an aerosol valve system having a ball valve disposed in the product flow path to shut off product flow when the aerosol container is sufficiently rotated to cause gaseous propellant to move through the product flow path, the present invention provides an improvement in the pressure equalization structure for unseating and returning the ball to a normally occupied position by the ball in the product discharge flow path when the aerosol container is in an upright position.

The aerosol valve assembly of the present invention includes the conventional components of a valve housing, valve body and attached valve stem, spring means and a ball valve disposed in the product discharge path, the housing being configured to be permanently affixed to a mounting cup in a manner well known to those skilled in the art.

To achieve pressure equalization on opposite sides of the ball valve, the present invention provides a passage through the valve housing which is, at least in part, isolated from contact with the underside of the gasket when the principal product flow valve is in the closed position and which passage is sufficiently proximate to the gasket that the radially interior terminus of the passage will be sealed by the gasket when the principal product flow valve is in the open position; the said passage having its radially outer terminus communicating with the interior of the aerosol container and its radially inner terminus communicating with the interior of the valve housing and consequently with the downstream side of the ball valve.

As noted above, the prior art, French Patent Application No. 2,680,161, has a passage in the upstanding interior wall which is intended to provide passage for gaseous propellant to the downstream side of the ball valve. In fact, due to the swelling, the Shore hardness of the gasket and/or the unevenness of the crimp force between the pedestal of the



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mounting cup and the housing, the gasket may seal either or both termini of the micro-orifice F. In the present invention, the passage is sufficiently remote from the gasket that at least a portion of the outer terminus of the passage is constantly open to the inside of the aerosol container. Further, the passage is sufficiently proximate to the gasket that the inner terminus of the passage is sealed when the principal valve is open and the gasket deflected, and at least a portion of the inner terminus is constantly open when the principal valve is in a closed position.

In a preferred form, the valve housing of this invention has one or more peripheral slots disposed on the upper sidewall of the valve housing, said slot(s) extending downwardly along the sidewall of the housing beneath the crimp zone between the valve housing and the mounting cup. Further, the housing has an upstanding annular wall radially interior to its peripheral sidewall, which interior upstanding sidewall compresses the gasket and provides a sealing force against container leakage between the valve housing and gasket. Additionally, the valve housing has a passage extending at its outer terminus from a slot in the peripheral sidewall of the valve housing and at the inner terminus with a space between the underside of the gasket and the top surface of the valve housing radially within the upstanding interior wall; the said passage being remote from the gasket when the principal valve is in the closed position to provide an open flow passage between the gaseous phase of the aerosol container and the interior of the valve housing and being sufficiently proximate to the gasket at its inner terminus such that upon opening the principal product flow valve a sealing of the inner terminus of the passage by the gasket will be effected.

Description of the Drawings



Fig. 1 is a longitudinal sectional view, with limited perspective, of the valve assembly of the present invention, absent the dip tube, with the principal valve in closed position and an unsealed pressure equalization passage.

5 Fig. 1(a) is an enlarged sectional view of the encircled portion of Fig. 1.

Fig. 2 is a longitudinal sectional view, with limited perspective, of the valve assembly of this invention with the principal valve in an open position, a truncated dip tube, and with the radially internal terminus of the pressure equalization passage sealed.

10 Fig. 2(a) is an enlarged sectional view of the encircled portion of Fig. 2.

Fig. 3 is a longitudinal sectional view, with limited perspective, of a further embodiment of the valve assembly of this invention, absent the dip tube, with the principal valve in the closed position and an unsealed pressure equalization passage.

15 Fig. 3(a) is an enlarged sectional view of the encircled portion of Fig. 3.

Fig. 4 is a longitudinal sectional view, with limited perspective, of a further embodiment of the valve assembly of this invention with the principal valve in an open position, a truncated dip tube and with the radially internal terminus of the pressure equalization passage sealed.

20 Fig. 4(a) is an enlarged sectional view of the encircled portion of Fig. 4.

Fig. 1 is a longitudinal sectional view of the valve assembly of the present invention. This valve assembly is crimped in a manner well known to those skilled in the art to the pedestal portion (not shown) of a mounting cup (not shown), which mounting cup is clenched in a manner well known to those skilled in the art to an aerosol container bead defining the opening of the container.



The valve assembly of Fig. 1 is generally designated as 10. The assembly comprises a valve housing 12 having a ball valve chamber 14 extending from the base 16 of the housing 12. The chamber 14 has an opening 18 through its length of sufficient diameter to receive a ball 20; the chamber 14 at its terminus contiguous to base 16 of the housing 12 having an opening 22 the shape of a truncated cone to provide a valve seat 24 for the ball 20 when the valve assembly is sufficiently inverted to effect a gravitational movement of the ball 20 to a position abutting the valve seat 24. Ball 20 is shown in phantom in Figures 1-4 abutting the ball valve seat 24. This is the position of the ball 20 when the aerosol container is sufficiently inverted to cause the ball 20 to move by gravitational force toward the valve seat 24. Extending from the valve seat 24 is a cylindrical portion 25 which opens into a recess 27 in the base of the valve housing 12. Disposed radially exterior to the recess 27 and extending circumferentially about the interior of the valve housing 12 are a plurality of spaced apart projections 29 for receiving the lower end of a spring 62. Ports 26 are provided in the sidewall of the chamber 14. Further, an annular flange 28 extends outwardly from the upper portion of chamber 14; the purpose of the flange 28 being to provide a gripping surface for the dip tube 32 (shown in Figs. 2 and 4) and to provide a spacing 34 between the inner wall of the dip tube 32 and the outer wall of the 14. A plug 35 having a segmented circumferential shoulder 36 is inserted in the bottom end 38 of the chamber 14. The plug 35 further has a hollow recess 40 terminating at its innermost portion in a frusto-conical surface 42.

Disposed for reciprocal movement within the valve housing 12 is a valve body 43 having an integral hollow valve stem 44. The valve stem 44 has an entry orifice 46. Encircling the entry orifice 46 is a resilient deflectable gasket 48 which is disposed in a recess 50 bounded circumferentially by an upstanding wall 52, which wall 52 extends outwardly



and upwardly from the upper sidewall 54 of the housing 12, and the top surface 53 of the valve housing 12. The upstanding wall 52 is circumferentially segmented to provide a plurality of openings or slots 56 which extend from the top 58 of the upstanding wall 52 through the clinch zone 60 whereat the mounting cup (not shown) is attached to the valve assembly 10.

An inner annular wall 64 extends upwardly from the top surface 53 of the valve housing 12, as best shown in Figures 1(a), 2(a), 3(a) and 4(a).

A conduit 65 communicates at one end with the slot 56 and at the other end with the space 68 above the opening 70 between the valve housing 12 and the valve body 43.

A spring 62 is disposed between the base of the valve body 43 and the base of the valve housing 12. The structure of the valve housing described herein, absent the conduit 65, is more fully described and shown in German Patent No. 2,559,444; the specification of which is hereby incorporated into and made a part of the subject specification.

In Fig. 1(a) components shown are similarly numbered as in Fig. 1 and represent the component as described herein in the discussion of Fig. 1.

Fig. 2 has the same components as Fig. 1 except that a truncated dip tube 32 is shown in place on the chamber 14. All other components are as described herein in the discussion of Fig. 1 and as shown in Fig. 1 except the principal valve is shown in open position and the radially inward terminus of the conduit 65 is sealed by the deflecting gasket 48.

In operation, to discharge product when the container is in an acceptable orientation, the valve stem 44 and the integral valve body 43 is depressed thereby deflecting the gasket 48 away from the entry orifice 46 in the valve stem 44. As a consequence, pressure within the container (not shown) will force product through the dip tube 32, through the space between the inner wall of the dip tube 32 and the



outer wall of the chamber 14, then through the ports 26 into the interior of the housing 12 and ultimately through the entry orifice 46, the hollow valve stem 44 and the discharge nozzle (not shown) located in an actuator or button (not shown). During discharge of the product with the container disposed in an upright or other acceptably oriented position, the ball 20 will not seat on the valve seat 24 and thus product will continue to flow and be discharged from the aerosol container. Also during the period that the valve stem 44 and valve body 43 is depressed or actuated to release product from the container, the inner terminus of the conduit 65 is sealed by the deflected gasket 48 from communication with space 68, thereby precluding passage of gaseous phase propellant from the container to the interior of the housing 12 and the discharge orifice of the container (not shown).

Should the container be inverted or rotated to a degree that the ball 20 will move by gravity and/or product flow to seat on the ball valve seating surface 24, product flow past the ball/valve seat will be terminated and remain that way until such time as the ball 20 is dislodged from the valve seat 24.

To again initiate product discharge, the principal product flow valve is closed, whereupon the gasket 48 will return from the position shown in Figure 2 to that shown in Figure 1 and encircle and seal the valve stem orifice 46. When the principal product flow valve is in a closed position, the gasket 48 is removed from the inner terminus of the conduit 65 and the conduit 65 is able to transport the gaseous phase of the propellant in the aerosol container to the interior of the valve housing, and consequently, to the downstream side of the ball valve to provide an equalization of the pressure on each side of the ball valve. The equalization of the pressure on each side of the ball valve results in, when the aerosol container is moved to a sufficiently upright position, the ball 20 dislodging from

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the valve seat 24 and returning to a position at the base of the chamber 18.

Absent the conduit 65, the pressure on the upstream side of the ball 20 would normally be greater than on the downstream side of the ball 20 with the consequence that the ball 20 tends to be held against the valve surface 24 and product flow, even with the container in an upright position, is thwarted. However, by providing the conduit 65, pressure equalization is attained on each side of the ball valve and the ball is returned by gravitational forces to its unseated position.

In the embodiment shown in Figs. 3, 3(a), 4 and 4(a), the components are the same as shown in Figs. 1, 1(a), 2, and 2(a), respectively, except that the conduit 65 of Figs 1, 1(a), 2 and 2(a) is a slot 72 which extends from the peripheral slot 56 through the sidewall of the valve housing 12 the upstanding interior wall 64 and a portion of the upper surface of the valve housing 12 radially within the upstanding interior wall 64.

In operation, the slot 72 functions as does the conduit 65 to provide a passage communicating the interior of the aerosol container and the product flow path conduit when the principal product flow valve is closed to thereby equalize the pressure on both sides of the ball valve situated in the product flow conduit.

It has been found that a conduit 65 having a diameter of .013-.020 inches will provide a sufficient pressure on the downstream side of the ball valve to cause a dislodgement and return of the ball when the container is in an upright position. A slot 72 having its smallest dimension comparable in area to the conduit 65 is satisfactory.

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I claim:

1. In an aerosol valve assembly comprising a valve housing adapted for permanent affixment to a mounting cup, and having an upstanding wall portion for compressing a valve gasket, a principal product flow valve comprising a valve body with attached valve stem disposed within the valve housing, said valve stem having a product entry orifice, a deflectable gasket circumscribing and sealing the valve stem entry orifice when the principal valve is in a closed position, said gasket extending across the upper surface of the valve housing and being downwardly and radially outwardly deflected when the principal valve is opened, a product eduction tube for carrying the container contents to the interior of the valve housing, and a ball valve disposed in the product flow path of the valve assembly, which ball valve is open when the container is in an orientation for discharge of product and closed when the entry port of the product eduction tube resides in the gaseous phase of the container contents, the improvement comprising a passage which extends from the sidewall of the valve housing through the top surface of the valve housing interior of the upstanding wall portion of the valve housing, the termini of the passage, when the principal valve is closed, being remote from the gasket to provide a constantly open passage and the inner terminus of the passage, when the principal valve is open, being sufficiently proximate to the deflectable portion of the gasket that the inner terminus of the passage will be sealed.

2. The improved valve assembly of claim 1, and further wherein the valve housing has a peripherally disposed slot extending along the sidewall of the housing above and below the crimp zone on the housing.

3. The improved valve assembly of claim 1, and further wherein the passage is a conduit.



4. The improved valve assembly of claim 3, and further wherein the conduit is a diagonal bore traversing from a lower peripheral terminus to an upper radially interior terminus.

5. The improved valve assembly of claim 1, and further wherein the passage is a slot through the sidewall of the housing, the interior upstanding wall of the housing and the top surface of the housing interior to the upstanding interior wall.

6. The improved valve assembly of claim 5, and further wherein the slot through the housing has a right triangle configuration, the hypotenuse of which traverses from a lower peripheral terminus to an upper interior terminus.

7. The improved valve assembly of claim 2, and further wherein the passage is a conduit.

8. The improved valve assembly of claim 7, and further wherein the conduit is a diagonal bore traversing from a lower peripheral terminus to an upper radially interior terminus.

9. The improved valve assembly of claim 2, and further wherein the passage is a slot through the sidewall of the housing, the interior upstanding wall of the housing and the top surface of the housing interior to the upstanding interior wall.

10. The improved valve assembly of claim 9, and further wherein the slot through the housing has a right triangle configuration, the hypotenuse of which traverses from a lower peripheral terminus to an upper interior terminus.





11. In an aerosol valve assembly including a valve housing adapted for attachment to an aerosol mounting cup and having a top recess for receiving a gasket, which recess is peripherally bounded by an outer upstanding sidewall on the upper portion of the housing having at least one slot, said slot extending above and below the crimp line on the outer sidewall of the housing 1, said recess further having an upstanding wall radially interior of the slotted sidewall, which interior wall is designed to press into the underside of the gasket, a principal valve normally biased to the closed position and free to reciprocally move to an open and closed position within the valve housing, said valve comprising a valve body and attached hollow valve stem, said valve stem communicating through an entry orifice with the interior of the valve housing, a downwardly and outwardly deflectable gasket circumscribing and sealing the entry orifice of the valve stem in the closed position of the valve and extending radially across the top recess of the housing, a ball valve disposed in the container discharge flow path, which ball valve is open when the container is in an orientation to discharge product and closed when the aerosol valve is in an orientation that will discharge the gaseous phase of the container contents, the improvement which comprises a passage which extends from a slot in the outer upstanding sidewall of the housing through the valve housing sidewall and through the top surface of the valve housing radially within the interior upstanding wall of the housing, the terminus of the passage through the top surface of the valve housing being sufficiently proximate to the deflectable portion of the gasket that the passage will be sealed when the entry orifice of the valve stem is open and the termini of the passage both being remote from the gasket such that under the passage will remain open when the principal valve is in the closed position.

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12. The improved valve assembly of claim 11 and further wherein the passage extending from a slot in the upstanding sidewall through the sidewall and top surface of the housing is a conduit.

13. The improved valve assembly of claim 12 and further wherein the conduit is a diagonal bore transversing from a lower peripheral terminus to an upper radially interior terminus.

14. The improved valve assembly of claim 11 and further wherein the passage extending from a slot in the peripheral upstanding sidewall through the top surface of the housing radially within the interior upstanding wall is a slot
5 through the sidewall and top surface of the housing which extends radially within the interior upstanding wall.

15. The improved valve assembly of claim 14 and further wherein the slot through the housing has a right triangle configuration, the hypotenuse of which traverses from a lower peripheral terminus to an upper interior terminus.

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