

PATENT SPECIFICATION

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- (21) Application No. 5699/78 (22) Filed 13 Feb. 1978
(31) Convention Application Nos. 773 549 (32) Filed 2 March 1977
831 270 7 Sept. 1977 in
(33) United States of America (US)
(44) Complete Specification published 28 Oct. 1981
(51) INT. CL.⁸ B05B 7/28
(52) Index at acceptance
B2F 204 302 322 350 D



(54) AEROSOL DISPENSER

(71) I, ROBERT HENRY ABPLANALP, a citizen of the United States of America, of 10 Hewitt Avenue, Bronxville, Westchester County, New York, United States of America, do hereby declare the invention, for which I pray that a patent may be granted to me and the method by which it is to be performed, to be particularly described in and by the following statement:-

The most successful aerosol dispenser systems for spray application of products heretofore have been systems in which the propellant is present in a gaseous and liquid phase and the liquid propellant is commingled with the liquid product when under pressure in the container either by being miscible or soluble with or emulsified in the liquid product. The propellant is chosen to be one which rapidly vaporizes at ambient conditions. The static pressure provided by the propellant in the container forces the solution or emulsion of propellant and product through a discharge orifice when the dispensing valve is opened. At the discharge orifice the propellant rapidly vaporizes as the stream issues thereby assisting in breaking the stream into fine droplets of product which are essentially free of residual propellant.

The most common propellants used in spray systems are compounds of the chlorofluorocarbon type (hereafter fluorocarbons). Of late, these materials have been the focus of an environmental controversy regarding the adverse effect that said materials may have on the ozone depletion of the atmosphere.

Because of the uncertainty of the impact of fluorocarbons on the so-called ozone layer, the aerosol industry must contend with the possible elimination of or a reduction in the reliance upon these materials as useable propellants. While non-fluorocarbon liquid propellants are available, namely, certain hydrocarbons such, for example, as propane butane and isobutane, their use with solvent-based products, such as alcohol, have presented flammability problems. These flammability problems can

be alleviated by the use of aqueous systems, with the propellant present as a separate liquid phase or as an emulsion, but prior dispensing systems of that type require high percentage of propellant and have not provided the desired spray characteristics. The problem has to do with large and uneven droplet size and an unacceptably slow drying rate. Thus, in a system wherein the propellant and product are essentially immiscible there is a pressing need for a dispenser that will produce a spray having characteristics similar to that achieved by soluble propellant product systems.

In systems employing an insoluble propellant, resort has been made to mechanical means for effecting a break-up for finer dispersion of the product. For example, a common mechanical means is the disposition of a chamber at or near the discharge orifice to centrifugally swirl the product before discharge. Also, dispensing valves having vapor taps or ports in communication with the propellant vapor present in the head space of the container serve to assist the mechanical break-up by introducing propellant vapor into the product stream prior to entering the swirl chamber. In the case of insoluble systems, generally, the spray characteristics such as small droplet size, uniformity of distribution, and pattern of a mechanically created spray are inferior to those of a soluble system spray.

Another approach to dispensing products as a fine dispersion under conditions such that the propellant is not soluble in the product, is to employ the venturi principle, as shown in U.S.A. Patents Nos. 3,326,469 and 3,437,272. Product and propellant are kept in separate containers, with the product stored under atmospheric pressure and the propellant at a different but considerably higher pressure. A stream of propellant gas, by virtue of the Bernoulli effect, creates a vacuum which draws the product to a venturi device where the product stream is sheared into droplets as it meets the propellant stream. Such venturi spray devices can give many acceptable spray characteristics, but the handicap of such venturi spray

devices is the need to keep product and propellant in different containers, making the handling of product and system more complicated for producers and customers.

5 There are no known valved aerosol dispensers providing simultaneous and separate release of product and propellant from a single container to a dispersing outlet, wherein the product and propellant are in
10 contact within the container; and further wherein the valve and actuator are disposed in or contiguous to the container closure member.

The present invention provides a single
15 container aerosol spray dispenser wherein the product and propellant may be immiscible and wherein the spray characteristics are satisfactory. The present invention makes practical the use of inexpensive hydrocarbon propellants such as butane,
20 isobutane and propane and permits the spray dispensing of aqueous product formulations with spray qualities at least equalling those of the soluble systems of the past.
25 Flammable propellants can be used safely to dispense aqueous products since the flammability is obviated by the presence of water in the spray. Further, ratio of propellant to product required for excellent spray quality
30 is greatly reduced, effecting cost savings when compared with soluble systems. For example, common hairsprays require a weight of fluorocarbon propellant equal to that of the other components of the formulation, whereas, according to the present
35 invention a weight of propellant 1/ to 1/10 the weight of the other components of the formulation can be employed with equivalent spray qualities. From the exterior, the aerosol dispenser of the present invention
40 looks and operates the same as the soluble system aerosol dispensers with which the consumer is familiar. Further, its design is such as to permit the use of existing equipment for filling.
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While the present invention has application to systems wherein the liquid propellant and product are mutually soluble or emulsifiable, and it is expected that the application
50 of the present invention to such systems would enhance the spray characteristics of the discharged product, the invention has its most needed application in systems wherein the propellant is immiscible in the liquid
55 product, and, in particular and with added significance, in a system wherein the propellant is immiscible and the product is water-based.

In accordance with the invention there is
60 provided a valve unit operable to dispense a liquid product from a single container in which the product is stored with a pressurized gaseous propellant comprising separate individual conduits for the liquid product
65 and the gaseous propellant communicating

with an impact mixing chamber wherein unobstructed streams of the product and propellant flowing from the conduits are impacted and mixed so as to form a fine dispersion, one of the conduits including a
70 venturi constriction; a discharge orifice for the dispersion; and valve means for controlling each stream, and simultaneously operable by a single actuator, or for controlling the mixed stream; the mixing chamber being
75 of cylindrical shape and having an axially directed inlet port for one of the streams and, in its cylindrical wall, at least one inlet port for the other stream directed tangentially to the axially directed inlet port, the
80 axially directed inlet port being located at the end of the conduit which includes the venturi constriction.

The invention further comprises a pressurized aerosol spray dispenser comprising a
85 single container for containing liquid and propellant under pressure, and a valve unit as described. Preferably the liquid is aqueous in nature and the propellant is a hydrocarbon.
90

In a preferred embodiment the mixing chamber is fed by either the propellant or product through a central passage or conduit and the other is fed through an annular
95 passage which surrounds the first passage.

The impact mixing chamber may be positioned in the valve actuator or in the valve body or in the valve stem or there may be a chamber in the actuator and another at any position within the valve.
100

As noted the mixing chamber may be located within the actuator. However, surprisingly it was found that a chamber located within the valve will produce very acceptable sprays. Therefore, in one embodiment of the present invention, the chamber is placed in the valve housing, a location which does not require that the separate propellant and product passages be valved.
105 This does permit the use of any existing valves by simply attaching the venturi mixing chamber to it, making manufacturing rather easy. Whereas the chamber may be placed in the form of a plug into the lower portion of the housing, normally receiving the dip
110 tube, a further embodiment foresees to position it inside the valve housing.

In still a further embodiment the chamber is placed within the valve stem directly in the area of the valve seal. Although this
120 arrangement requires separate valved passages for product and propellant, such passages may be terminated within the valve seal area. In all embodiments there is sufficient residual propellant in the dispersions
125 to purge the passages on the downstream side of the valve and thus prevent caking or drying of the product in the discharge passages. In order to provide a convenient and efficient means for moving propellant
130

(12)

and product from the container in which both are present under equal pressure, the invention provides in the preferred form a valve unit comprising a valve housing which contains a single moveable cored-out valve body, and a single annular resilient valve gasket and a spring to bias the valve body upwardly toward closure. The valve body may comprise a valve stem having a central passage surrounded by an annular passage and a neck having a smaller diameter than the stem, the neck having a transverse orifice in communication with the annular passage of the stem and another orifice in communication with the central passage of the stem, and further, the valve body may have an off-centre axial orifice in communication with the cored-out portion and the valve stem. The neck of the valve body is encompassed by the inner periphery of the annular gasket, enabling the gasket to close all three orifices and to be deflected away from them when the valve body is depressed against the action of the spring.

In one embodiment the neck can be provided with suitable means such as ridges, for isolating the product and propellant orifices from one another when the gasket is deflected. In a second and preferred embodiment, the separation is not achieved by mechanical means, but by placing the gaseous propellant orifice and the axial off-centre orifice in the shoulder of the valve body as proximate as feasible to the respective transverse orifices intended for the product and gaseous propellant discharge. To control the amount of propellant, a propellant flow throttle device is provided on the outer wall of the valve body in the form of ribs, flanges and/or apertures.

In the description below the invention is set out in conjunction with an immiscible propellant/product system. Three separate stratified phases are present in a container in contact with one another, i.e., propellant vapor, liquid propellant, and liquid product. The liquid phase of the propellant is usually less dense than the liquid product and the mutually insoluble propellant and product liquid phases stratify in the container with the propellant floating on top of the product.

The accompanying drawings illustrate exemplifying embodiments of the invention.

In the drawings:-

Figure 1 is an elevational view in section of a valve and actuator according to a first embodiment of the invention.

Figure 2 is an elevational view in section of a valve and actuator according to a second embodiment of the invention.

Figure 3 is an isometric view in partial section, exploded for clarity, of the inner parts of the actuator used in some embodiments and further shows the actuator in

phantom outline.

Figure 4 is an elevational view in section of a valve and actuator according to a third embodiment of the invention.

Figure 5 is an elevational view of the valve body of Figure 4.

Figure 6 is a top view of the upper end of the valve body of Figure 5.

Figure 7 is an isometric view of the valve body of Figure 5, and

Figure 8 is an elevational view in section of a valve and actuator according to a fourth embodiment of the present invention.

Figure 9 is an elevational view in section of modifications of the embodiment of Figure 8.

Figure 10 is an enlarged perspective view of the wall of the valve body and valve stem as shown within the ellipsoid designation "A" of Figure 9.

Figure 11 is an enlarged perspective of the valve body and valve stem shown within the circular designation "B" of Figure 9.

Figure 12 is an enlarged perspective of a further modification of the embodiment of Figure 8.

Figure 13 is an elevational view in section of a valve and actuator according to a fifth embodiment of the present invention.

Figure 14 is a plan sectional view along the line 14-14 of Figure 13.

Figure 15 is an elevational view in section of a modification of the valve body and spring of the embodiment of Figure 13.

Figure 16 is a partial elevational view in section of a modification of the embodiment of Figure 15.

Figure 17 is a view in elevation, partly cut away of a further modification of the embodiments of Figures 13-16.

Figure 18 is an elevational view in section of a valve and actuator according to a sixth embodiment of the present invention. Figure 18a is an under sectional view along the line 18a-18a of Figure 18.

Figure 1 shows an opened discharge valve unit comprising a valve and actuator assembly according to a first embodiment of the present invention. The valve is a double valve having a separate product and propellant passageways which are opened upon depression of the actuator. The valve housing 10 is affixed to the pedestal portion 70 of a conventional valve mounting cup by crimps 72. The valve mounting cup (an element of the container closure) is affixed to the mouth of a vessel or container which holds the supply of product and propellant, in any conventional way, thus providing a closure for the vessel or container. A typical aerosol container and closure structure is shown, for example, in United States Patent No. 3,735,955. The valve housing 10 has a product eduction tube 18 frictionally fitted to an inlet nipple 12 at the bottom and has

propellant inlet ports 14 extending through the sidewall of the housing. A vertically moveable valve body assembly is formed in two pieces; a lower valve body member 20 and an upper valve body member 30. The valve body assembly is biased upwardly toward closure by a compression spring 40. The upper valve body member 30 is integral with a valve stem 34 which extends through an aperture in the pedestal 70 of the mounting cup and upon which the actuator button 50 is frictionally fitted. The valve stem 34 includes a central passage 36 concentrically surrounded by an annular passage 38.

The lower valve body member 20 includes a central passage 24 in communication with the annular passage 38 of the upper valve body member 30. The lower valve body 20 includes a transverse valve orifice 26 which is blocked by an annular resilient gasket 42 when the valve is closed and is exposed, as shown, when the valve is actuated by depression of the actuator 50 against the bias of spring 40.

The upper valve body 30 includes a transverse valve orifice 32 which is blocked by a second annular resilient gasket 44 when the valve is closed and is exposed, as shown, when the valve is actuated.

The actuator 50, further shown in Figure 3, is in the form of a button having a body 52 provided with a valve stem receiving socket 54 on its lower face for frictional retention of the actuator on the valve stem 34.

The body 52 includes a first passage 56 in communication with the central passage 36 of the valve stem 34 and a second passage 58 in communication with the annular passage 38 of the valve stem. A two piece insert 60, 80 is frictionally fitted in the actuator body. The inner insert member 80 is concentrically surrounded by the outer insert member 60. A passage 88 having a constricted portion in its downstream end extends axially of the cylindrical inner insert member and terminates coaxially of the discharge orifice 64 of the outer member 60. Passage 88 is in communication with passage 58 of the actuator body 52. A groove in the inner wall of the outer insert member 60 forms a passage 66 in communication with passage 56 of the actuator body 52. An annular rabbet is formed in the end of insert member 80 to form an annular chamber 86 when the inner and outer insert members 80, 60 are assembled. Annular chamber 86 is in communication with passage 66. An impact mixing chamber 84 formed in the end face of inner insert member 80 is in communication with the annular chamber 86 through a plurality of grooves 82 in the end face of insert 80 which grooves extend tangentially of the circular periphery of chamber 84 and intercept the annular chamber 86. At the entrance to chamber 84

the grooves 82 thus have a wall of the chamber on either side and directly opposite to them. The passage 88 terminates centrally of the rear wall of the chamber 84. Discharge orifice 64 commences centrally of the front wall of the chamber 84.

The relationship of the configuration of the end of inner insert member 80 with the outer insert member 60 is shown in the isometric view of Figure 3 wherein the tangential deployment of grooves 82 extending between annular chamber 86 and the chamber 84 is apparent.

In operation, depression of actuator button 50 causes the moveable valve body 30, 20 of Figure 1 to move downwardly against the bias of spring 40 to open the valves by causing deflection of the resilient gaskets 42, 44 to expose valve orifices 26, 32. A product path is established extending from the product in the container through education tube 18, through the inlet passage 13 of the nipple 12, and through the exposed valve orifice 26 into the passage 24 in the lower valve body 20. The product ascends passage 24 and enters the annular passage 38 of the upper valve member 30. The product then enters passage 58 of the actuator and enters the axial passage 88 of the inner insert member 80. It passes through the venturi constriction at the downstream end of passage 88, and into impact mixing chamber 84. The chamber 84, being in communication with the atmosphere through discharge orifice 64, is at a lower pressure than the interior of the container holding product and propellant. Concurrently, valve orifice 32 of the upper valve member 30 is opened to establish a propellant vapor path extending from the head space of the container through ports 14 into the interior of valve housing 10. Propellant vapor passes through the open valve orifice 32 and travels upwardly through the central passage 36 of the valve stem 34 to passage 56 of the actuator body 52. The propellant travels through passage 66 to the annular chamber 86. The propellant then travels through tangential passages 82 to enter chamber 84 tangentially to swirl about in chamber 84. Here it is imparted by the product stream from the venturi constriction. The venturi ejector action occasioned by the relative dimensions and positioning of the product and the propellant exits imparts greater velocity to the issuing or discharge stream than would be imparted by internal container pressure alone. The issuing propellant, having been spun in the swirl chamber, continues to spin as it impacts with product. The mixture of finely dispersed propellant and product thus moves to discharge orifice 64, and emerges therefrom in a conical spray pattern.

Figure 2 shows a second embodiment

similar to that of Figure 1, but with the product and propellant interchanged in the actuator passages. Parts which are identical with those of the embodiment of Figure 1 bear the same numbers. Parts which are modified bear the number of their counterparts with one hundred added.

To interchange the product and propellant in the actuator 50, the structure of the upper valve body 130 is changed. Valve stem central bore 136 is in communication with the central passage 24 of the lower valve body 20. Valve stem annular passage 138 is in communication with upper valve orifice 132. The actuator 50 and lower valve remain unchanged.

The operation of the embodiment of Figure 2 is similar to that of Figure 1 but with reversed flow stream. Upon depression of the actuator 50 against the bias of spring 40 product flows up the eduction tube 18, through the lower valve orifice 26, up passage 24, through passage 136 of the valve stem 134 and into actuator passages 56, 66 to the impact mixing chamber 84 and out the discharge orifice. Propellant flows through housing ports 14 and through upper valve orifice 132 into the annular passage 138 of the valve stem 134 into actuator passages 58, 88 to issue through the discharge orifice 64. Since the product enters the chamber 84 through tangential passages 82, the product spins as it issues from the discharge orifice 64 whereby centrifugal force acts to break the emergent stream into a fine spray. The velocity of the propellant issuing from the constricted passage 88 interior of the discharge orifice 64 causes a reduction in pressure at the annular exit of the chamber 84 to further accelerate the product. The impact of the high velocity propellant and product on one another and the centrifugal force acting on the product all serve to divide the product into a fine dispersion of uniform size and even distribution.

Figures 4-7 illustrate a third embodiment of the present invention in which a one piece valve body, shown in detail in Figures 5-7, serves to separately valve the product and propellant by a single gasket. The actuator 50 is identical to that of the embodiments of Figures 1 and 2 and bears the same part numbers.

The valve body 330 shown in Figures 4-7 is integral with a valve stem 334 having a central passage 336 surrounded by an annular passage 338. Three radial ribs 339 in the annular passage 338 support the inner tubular portion 337 which includes the central passage 336. A first valve orifice 326 communicates with passage 336 and, when opened, is in communication through opening 341 with the product eduction tube 318. A second valve orifice 332 is located

diametrically opposite the first valve orifice 326. The second orifice 332 is in communication with the annular passage 338 and, when opened, is in communication with the interior of the housing 310 which is open to propellant vapor in the head space of the container through propellant ports 314.

Figure 5 shows the exterior configuration of the valve body 330 as would be seen looking from right to left in Figure 4. Between the valve stem portion 334 and the enlarged lower portion 331 of body 330 is a reduced diameter neck portion 333 which is encompassed by the periphery of the central aperture of the annular resilient gasket 344 to seal the first and second valve orifices 336, 332, when the valve is closed. A pair of ridges or ribs 335 of V shape bite into the periphery of the central aperture of the gasket 344 to form seals which keep the product separate from the propellant when the gasket is deflected to peel the gasket aperture periphery away from the first and second valve orifices 336, 332 when the valve is opened as is shown in Figure 4. Ribs 335 divide the annular separation between the gasket aperture periphery and the neck 333 into a pair of semi-circular spaces, one for each valve orifice. A shallow groove 332a on the top of body portion 331 in alignment with the second valve orifice 332 assures a path for propellant past the inner edge of the gasket 344 when the valve is opened as is shown in Figure 4.

The operation of the embodiment of Figures 4-7 is similar to that of the embodiment of Figure 2. Depression of actuator 50 causes the moveable valve body 330 to move downwardly against the bias of spring 340 thereby deflecting the periphery of the central aperture of annular gasket 344 away from valve orifice 326 to open a product path extending from the product eduction tube, through orifice 326 and through valve stem passage 336 to actuator passage 56. Concurrently the gasket is moved away from valve orifice 332 to establish a propellant path extending from the container through the port 314 of the housing 310 through the orifice 332, and through valve stem annular passage 338 to actuator passage 58. The operation of the actuator is identical with that described in connection with Figure 2.

Figure 8 shows an embodiment similar to that of Figures 4-7, but with the product and propellant passages interchanged. The actuator 50 remains unchanged. In this embodiment valve orifice 432 is arranged to supply propellant to central passage 336 of the valve stem 334 and valve orifice 436 is arranged to supply product to the annular passage 338 of the valve stem 334 with the result of product in actuator passage 58 and propellant in actuator passages 66, 86, 82, 130

84 such that the product is surrounded by propellant as was the case with the embodiment of Figure 1.

Figure 9 shows the embodiment of Figure 8, but with modifications to the valve body and stem. The actuator 50 remains unchanged as do the other components of the valve unit except where noted hereafter. In this modification the ridges or ribs 335 (shown in Figures 5-7) are not present. Also note that when the valve is in open position the gasket 334 need not engage the top shoulder 330a of the valve body 330.

The exterior wall of the valve body 330 has spaced vertical guide posts 438 which extend from an annular flange 439 located on the bottom of the exterior wall of the valve body 330. Located in the flange 439 in substantial vertical alignment with the groove 441 and the valve stem orifice 432 is the throttling opening 440. The opening 437 in the top shoulder 330a of the valve body 330 is located proximate to the orifice 436 in the valve stem and is in communication through interior passage 330b with the product education tube 318.

The details of the aforescribed modifications are best shown in Figure 10 and 11.

Upon actuation of the valve unit of Figure 9, it has been found that the gaseous propellant and liquid product will pass without substantial comingling through the valve stem orifice contiguous to the respective passage of propellant and product within the valve stem since the throttling effect of the opening 440 balances the gaseous and liquid pressures at the gasket 334.

In a further modification shown in Figure 12, the flange 439 is moved upward of the lower end of the valve body. The lower edge of the valve body extending beneath the flange may be castellated or otherwise shaped to provide a surface to abut the spring 340 and yet permit free flow of gaseous propellant around the spring even if the spring shifts laterally. The control of the flow of the gaseous propellant is effected through the opening 440a in the flange 439, as in the embodiment shown in Figure 9.

It should be understood that the modifications of Figure 9-12 can be readily adapted to the system of Figure 4 wherein the product and propellant flow through the valve stem are reversed.

Figure 13-16 shows an embodiment in which an impact mixing chamber effecting a venturi action is disposed in the bottom of the valve housing.

In Figure 13 the actuator 50 is constructed as in the earlier embodiments. The valve housing 501 is affixed to the pedestal portion 70 of a conventional mounting cup by crimps 72. The valve housing 501 has a hollow nipple 503 which defines a recess 505. Extending through the bottom wall of

the housing 501 is an opening 507. A vertically moving valve body 509 is biased upwardly toward closure by a compression spring 511. The valve body 509 is integral with a valve stem 513 which extends through an aperture in the pedestal 70 of the mounting cup and upon which the actuator 50 is frictionally fitted. The valve stem 513 includes a central passage 515 concentrically surrounded by an annular passage 517. The valve stem 513 has transverse orifices 519 and 521 which communicate with the central passage 515 and the concentric annular passage 517, respectively.

The orifices 519 and 521 are obturated by the resilient gasket 523 when the valve is in closed position and are both open to the flow therethrough when the valve is in the actuated or open position.

In the recess 505 is friction fitted, an impact mixing chamber in the form of plug member 525. Plug member 525 has a central opening 527 terminating in a venturi constriction 529, which empties into an impact mixing chamber. The plug member 525 has a knob portion 533 which is exterior to the recess 505 and is shaped to receive, in friction-fit relationship, the product dip tube 536.

The knob portion 533 of the plug member 525 is spaced from the end of the walls of the recess 505 to provide an annular spacing 535. The interior wall of the nipple 503 has several vertical grooves 537 extending its length, the grooves 537 communicating interiorly with an annular groove 539 in the top portion of the plug member 525 interiorly and the opening 535 exteriorly of the recess.

The top surface of the plug member 525 is best shown in Figure 14. Nipple 503 has grooves 537. The grooves 537 communicate with the annular groove 539 in plug member 525. From the annular groove or passage 539 extends transverse grooves or passages 542, which passages 542 connect to the impact mixing chamber 541. The opening 507 in the bottom of housing 501 acts as a discharge orifice from the chamber 541.

In operation, depression of the actuator button 50 causes the moveable valve body 509 to move downwardly against the bias of spring 511 to open the orifices 519 and 521 by causing deflection of the resilient gasket 523. Upon opening of the valves, gaseous propellant passes successively through the openings and passages 535, 537 and 542 to the mixing chamber 541. The pressure in the mixing chamber 541, which was substantially that in the entrance prior to actuation is substantially lowered as the chamber is put into communication with the atmosphere through the valve body 501, orifices 519 and 521 passages 515 and 517 and

actuator 50. In the mixing chamber 541, the swirling gaseous propellant impacts product entering the chamber through the dip tube 535 and the venturi constriction 529 in the plug member 503, and forms a fine dispersion of gas in liquid. The dispersion passes through the opening 507, through the interior of the valve housing 501 and then through the orifices 519 and 521 to the passages 515 and 517 in the valve stem 513.

As shown in Figure 13, the admixed propellant and product pass through an actuator 50 having an additional impact mixing chamber as that described in the plug member 533.

It should be noted, as shown in Figure 14, that each of the grooves 542 is disposed such that an extension thereof intercepts the chamber 541 in an off-center spatial relation, causing a vortical or swirling motion therein.

Figure 15 is the same as the embodiment of Figure 13, except that the valve body 543 is a hollow inverted cup-like member. A plurality of openings 545 are provided in the shoulder 545a of the valve body 543 to facilitate flow of the admixed gaseous propellant and product to the valve stem or orifices and passages. The spring 511 is held by the annular bead 547.

Figure 16 is the same as the embodiment of Figures 13 and 15 except that the valve stem 513 has a single passage 515, which may be fitted with any conventional aerosol spray actuator.

A further embodiment of the subject invention, shown in Figures 17, is to dispose the impact mixing chamber 601, inside the valve housing 600. As in Figure 15, the housing has a central aperture 602 with a venturi constriction for product feed into the chamber 601. The chamber 601 and its feed passages are defined by the bottom wall 606 of the housing and a disc-like member 603 abutting the bottom wall of the housing. The bottom wall 606 is cut out to form the mixing chamber 601 transverse passages 607 and an annular recess 604 patterned like those in Figure 14. Openings 609 for feeding the gas propellant to the annular recess and thence to the transverse passages are in the bottom wall outside the product feed passage 602. A spring 605 is positioned atop the disc-like member 603 and during actuation forces the disc member against the inner bottom wall of the housing.

Disposing the impact mixing chamber inside the container precludes drying or other adverse change of the product in the discharge passages of the unit. Inside the container side the product in the passage is in the environment of the container contents and thus will not dry and is not exposed to atmospherically induced changes. After the valve is closed any residue of propellant-

product mix residing in the atmosphere side of the valve port will be purged from swirl passages due to the force generated by the expanding propellant.

Figures 18 and 18a show a further embodiment of the invention wherein the impact mixing chamber is disposed in the lower region of the valve stem. In Figure 18 the lower portion 631 of the valve body 630 is similar to that of Figure 9, having a flange 639 with a slot or opening 640 for the passage of gas through the flange. Splines or guide posts 638, are also provided, as are grooves 641 in the shoulder of the valve body. An opening 637 is also provided in the shoulder of the valve body, communicating with the product education tube 650.

The valve body of Figure 18 has a stem 642 that has a central bore 643 into which is placed an insert 644. The insert 644 has a central conduit 645 and 645a. The bottom face of the insert 644 has an annular groove 646, a centrally disposed mixing chamber 648 and transverse grooves 650, each of which 646, 648 and 650 are best shown in Figure 18a. Proximate to the groove 641 in the shoulder of the valve body is lateral conduit 652 and vertical conduit 654, the upper end of the latter communicating with the annular groove 646. The opening 637 in the shoulder of the valve body communicates with the lateral conduit 656, which conduit 656 communicates at one end with the axially central conduit 658, said conduit 658, communicating at the other end with the mixing chamber 648. The valve stem 642 having a single central bore 643 may be fitted with any conventional aerosol spray actuator.

In operation, depression of the actuator button causes the moveable valve body 632 to move downwardly against the bias of the spring 660 to open the conduits 652 and 656 by causing deflection of the resilient gasket 662. Upon opening of the valve, gaseous propellant passes successively through the opening 640, the groove 641, the lateral conduit 652 and the vertical conduit 654, the annular and the transverse grooves 646 and 650, respectively to the mixing chamber 648. In the mixing chamber 648, the swirling gaseous propellant impacts product entering the chamber through the dip tube 650 and the venturi constriction or axial central conduit 658, and forms a fine dispersion of gas in liquid. The dispersion passes through the central conduit 645, 645a, through the central bore 643 of the valve stem 642 to the discharge orifice.

WHAT WE CLAIM IS:

1. A valve unit operable to dispense a liquid product from a single container in which the product is stored with a pressurised gaseous propellant, comprising separate individual conduits for the liquid pro-



actuator 50. In the mixing chamber 541, the swirling gaseous propellant impacts product entering the chamber through the dip tube 535 and the venturi constriction 529 in the plug member 503, and forms a fine dispersion of gas in liquid. The dispersion passes through the opening 507, through the interior of the valve housing 501 and then through the orifices 519 and 521 to the passages 515 and 517 in the valve stem 513.

As shown in Figure 13, the admixed propellant and product pass through an actuator 50 having an additional impact mixing chamber as that described in the plug member 533.

It should be noted, as shown in Figure 14, that each of the grooves 542 is disposed such that an extension thereof intercepts the chamber 541 in an off-center spatial relation, causing a vortical or swirling motion therein.

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A further embodiment of the subject invention, shown in Figures 17, is to dispose the impact mixing chamber 601, inside the valve housing 600. As in Figure 15, the housing has a central aperture 602 with a venturi constriction for product feed into the chamber 601. The chamber 601 and its feed passages are defined by the bottom wall 606 of the housing and a disc-like member 603 abutting the bottom wall of the housing. The bottom wall 606 is cut out to form the mixing chamber 601 transverse passages 607 and an annular recess 604 patterned like those in Figure 14. Openings 609 for feeding the gas propellant to the annular recess and thence to the transverse passages are in the bottom wall outside the product feed passage 602. A spring 605 is positioned atop the disc-like member 603 and during actuation forces the disc member against the inner bottom wall of the housing.

Disposing the impact mixing chamber inside the container precludes drying or other adverse change of the product in the discharge passages of the unit. Inside the container side the product in the passage is in the environment of the container contents and thus will not dry and is not exposed to atmospherically induced changes. After the valve is closed any residue of propellant-

product mix residing in the atmosphere side of the valve port will be purged from swirl passages due to the force generated by the expanding propellant.

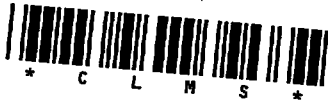
Figures 18 and 18a show a further embodiment of the invention wherein the impact mixing chamber is disposed in the lower region of the valve stem. In Figure 18 the lower portion 631 of the valve body 630 is similar to that of Figure 9, having a flange 639 with a slot or opening 640 for the passage of gas through the flange. Splines or guide posts 638, are also provided, as are grooves 641 in the shoulder of the valve body. An opening 637 is also provided in the shoulder of the valve body, communicating with the product education tube 650.

The valve body of Figure 18 has a stem 642 that has a central bore 643 into which is placed an insert 644. The insert 644 has a central conduit 645 and 645a. The bottom face of the insert 644 has an annular groove 646, a centrally disposed mixing chamber 648 and transverse grooves 650, each of which 646, 648 and 650 are best shown in Figure 18a. Proximate to the groove 641 in the shoulder of the valve body is lateral conduit 652 and vertical conduit 654, the upper end of the latter communicating with the annular groove 646. The opening 637 in the shoulder of the valve body communicates with the lateral conduit 656, which conduit 656 communicates at one end with the axially central conduit 658, said conduit 658, communicating at the other end with the mixing chamber 648. The valve stem 642 having a single central bore 643 may be fitted with any conventional aerosol spray actuator.

In operation, depression of the actuator button causes the moveable valve body 632 to move downwardly against the bias of the spring 660 to open the conduits 652 and 656 by causing deflection of the resilient gasket 662. Upon opening of the valve, gaseous propellant passes successively through the opening 640, the groove 641, the lateral conduit 652 and the vertical conduit 654, the annular and the transverse grooves 646 and 650, respectively to the mixing chamber 648. In the mixing chamber 648, the swirling gaseous propellant impacts product entering the chamber through the dip tube 650 and the venturi constriction or axial central conduit 658, and forms a fine dispersion of gas in liquid. The dispersion passes through the central conduit 645, 645a, through the central bore 643 of the valve stem 642 to the discharge orifice.

WHAT WE CLAIM IS:

1. A valve unit operable to dispense a liquid product from a single container in which the product is stored with a pressurised gaseous propellant, comprising separate individual conduits for the liquid pro-



duct and the gaseous propellant communicating with an impact mixing chamber wherein unobstructed streams of the product and propellant flowing from the conduits are impacted and mixed so as to form a fine dispersion, one of the conduits including a venturi constriction; a discharge orifice for the dispersion; and valve means for controlling each stream, and simultaneously operable by a single actuator, or for controlling the mixed streams; the mixing chamber being of cylindrical shape and having an axially directed inlet port for one of the streams and in its cylindrical wall, at least one inlet port for the other stream directed tangentially to the axially directed inlet port, the axially directed inlet port being located at the end of the conduit which includes the venturi constriction.

2. A valve unit according to claim 1 including a valve body reciprocally movable within a housing and having a stem projecting from the housing, the conduits being formed within the body and the stem, inlet orifices communicating with the conduits, sealing means for opening and closing the inlet orifices by reciprocal movements of the valve body, and a valve actuator to produce movement of the body and stem.

3. A valve unit according to claim 2 wherein the actuator is mounted on the stem and contains the discharge orifice.

4. A valve unit according to claim 3 wherein the impact mixing chamber is located within the actuator.

5. A valve unit according to claim 3 wherein the impact mixing chamber is located within the valve body.

6. A valve unit according to claim 5 including an additional impact mixing chamber for re-mixing separated streams of product/propellant mixture and located within the actuator.

7. A valve unit according to any of claims 2-4 wherein the conduits within the valve stem are formed by a central bore and an annular section passage the bore and the passage being respectively in communication with the inlet orifices which are spaced apart in the valve body and which are closed by annular flexible gaskets which provide the sealing means.

8. A valve unit according to claim 7 wherein the valve body has a central bore forming a duct from one of the inlet orifices to the annular passage within the valve stem.

9. A valve unit according to claim 7 wherein the valve body has a central bore forming a duct from one of the inlet orifices to the central bore of the valve stem.

10. A valve unit according to any of claims 2-4 wherein the inlet orifices are located within a circumferential groove in the valve body which is closed by an annular

gasket forming the sealing means, and which is divided into two separated parts in communication with respective ones of the orifices and with a central bore and an annular section passage respectively within the valve stem forming the conduits.

11. A valve unit according to claim 10 wherein the groove is divided into two separated parts by ribs which contact the annular gasket.

12. A valve unit according to claim 10 or 11 wherein one part of the groove has a recess in register with its respective orifice to produce a path for one of the streams, and the other part of the groove has an entry passage in communication with a bore in the valve stem to provide a path for the other of the streams when the gasket is unseated from the groove by movement of the valve body.

13. A valve unit according to any of claims 2-12 wherein one of the inlet orifices opens into the interior of the housing which has an aperture through a wall thereof to form a flow path to one of the conduits, and the other inlet orifice communicates with an eduction tube mounted on the valve body to form a flow path to the other conduit.

14. A valve unit according to claim 13 wherein the valve body has an enlarged lower portion, a flange extending from the lower portion to abut the interior of the valve housing and a throttling opening in the flange in alignment with one of the inlet orifices.

15. A valve unit according to claim 14 wherein the lower edge of the lower portion of the valve body has castellations to form a return spring abutment.

16. A valve unit according to any of claims 2-15 wherein a return spring is located between the valve body and the valve housing for moving the valve body into a position at which the inlet orifices are closed.

17. A valve unit according to any of claims 1-4 or 7-16 wherein there is provided an inner insert member surrounded by an outer insert member, an inlet passage which contains the venturi constriction extending through the inner insert member into a cylindrical space between opposed end walls of the two insert members and forming the impact mixing chamber, a passage between the insert members leading to an annular chamber between the insert members, a plurality of passages between the annular chamber and the impact mixing chamber directed tangentially to the cylindrical space, and an aperture in the end wall of the outer insert member co-axial with the inlet passage and forming the discharge orifice.

18. A valve unit according to claim 5 or 6 wherein the impact mixing chamber in the valve body is formed at the inner end of a

plug member closely fitting within a recess in the valve body, the inner end of the plug member being peripherally recessed to form an annular chamber which communicates with the impact mixing chamber by transverse grooves in the inner end of the plug member, the annular chamber being intersected by axially aligned conduits in the surface of the recess adjoining the plug member, said plug member having an interior passage leading to the impact mixing chamber.

19. A dispenser for a pressurised liquid product comprising a single container to receive the product and a gaseous propellant and a valve unit according to any of the preceding claims mounted on the container for discharge of the contents of the container.

20. A dispenser according to claim 21 containing, under pressure, a liquid product and a liquid propellant and vapour of the liquid propellant, the liquid propellant being

of a type that maintains a constant pressure within the container substantially during the entire storage and use of the dispenser.

21. A dispenser according to claim 20 wherein the product is an aqueous composition.

22. A dispenser according to claim 20 or 21 wherein the propellant is immiscible with the product.

23. A dispenser according to any of claims 20-22 wherein the propellant is a hydrocarbon.

24. A valve unit for a pressurised dispenser constructed and arranged substantially as hereinbefore described and shown in Figures 1, 2, 4, 9, 13 and 14, 15 or 18 and 18A, or with reference to Figures 3, 5-7, 8, 10-12, 16 or 17 of the accompanying drawings.

For the Applicants
D. YOUNG & CO.,
Chartered Patent Agents.



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