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3,240,431

COMBINATION VALVE SPOUT AND SPRAY HEAD ASSEMBLY

Filed May 27, 1964

2 Sheets-Sheet 1

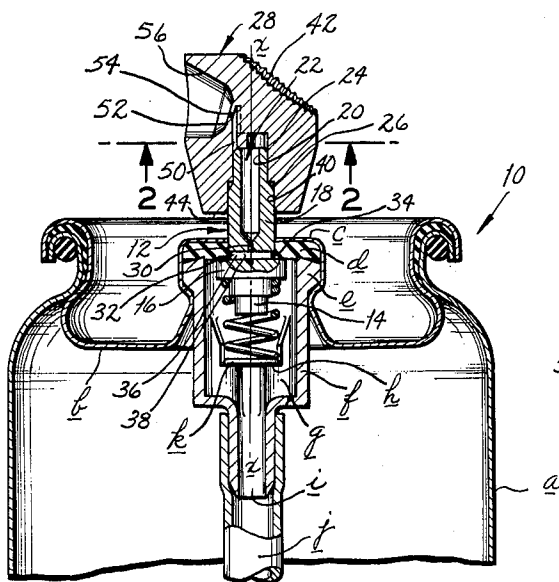


FIG. 1

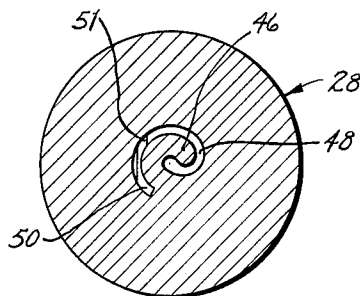


FIG. 2

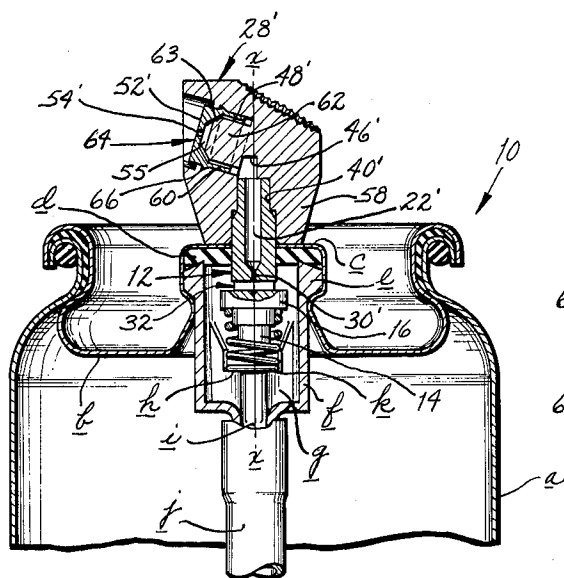


FIG. 3

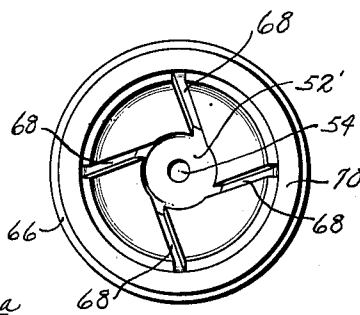


FIG. 4

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2 Sheets-Sheet 2

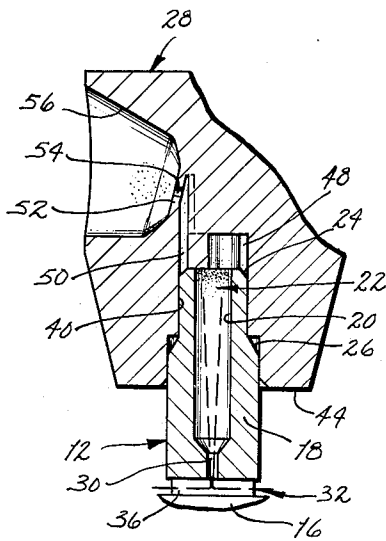


FIG. 5a

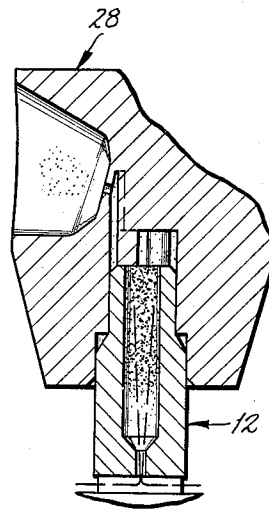
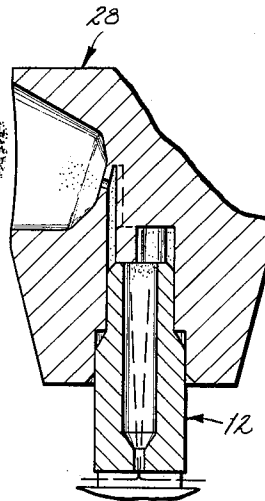


FIG. 5b



FIG. 5c



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COMBINATION VALVE SPOUT AND SPRAY HEAD ASSEMBLY

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12 Claims. (Cl. 239-101)

The present invention relates generally to spray head actuators for valved pressurized dispensers, and more particularly to a valve spout and spray head assembly for spraying atomized liquid particles propelled by gases which may not be miscible with the liquid.

In the field dealing with pressurized dispensing of liquids, efforts have been made to develop low-cost spray heads to "break-up" the liquid into spray droplets by swirling centrifugally against walls in a swirl chamber. Droplets of liquid, so broken up, may have their velocities greatly diminished by repeated contact with such walls; allowing the droplets to re-combine and thus increase their size, to defeat the desired atomization.

The prior art has generally utilized similar valves for spray containers as for the discharge of expanded forms. It has not apparently been realized that the valve itself may be constructed to give favorable velocity and stream characteristics to the liquid to be sprayed and thereby improve the atomization of the spray.

The general purpose of this invention is to provide a unique valve spout and spray head assembly for pressurized liquid dispensers which utilizes the greatest pressure available to "break-up" the liquid into atomized particles and which further discharges the droplets in pulsating pressure waves. To this end, some of the objects of the present invention include the following:

Providing a valve spout and spray head assembly for a pressurized dispenser which accelerates the liquid by utilizing the maximum pressure available, to propel it in a stream against a "break-up" surface located in close proximity to the spray orifice;

Providing a valve spout in combination with a spray head wherein internal resonant fluctuations of pressure cause liquid passing therethrough to be sprayed in pulsating waves from the spray orifice;

Providing a spray head for a pulse-generating valve spout which transmits pressure pulsations to the outside atmosphere; and

Providing a spray head which is interposed to break up a jet stream of liquid accelerated by a valve spout and spirally swirl it through a spray orifice.

In the present invention these purposes (as well as others apparent herein) are achieved generally by providing a pressurized liquid dispensing container with a valving discharge spout yieldably mounted within and urged to its closing position. The valving spout has a valve head portion within the container and a hollow stem portion extending outwardly from the container. The hollow stem portion defines the outer wall of a resonance chamber. Valve ports lead inwardly to a jet orifice in axial alignment with the resonance chamber, whereby liquid passing therethrough is accelerated in an axial stream. A spray head is mounted on the hollow stem portion of the valving spout so as to present a top inner portion to the accelerated stream of liquid traversing the resonance chamber from the jet orifice. The spray head has a forward spray orifice and a passage connecting the resonance chamber with such spray orifice. Resonant fluctuations of pressure within the resonance chamber serve to modulate the discharge rate of the atomized particles through the spray orifice in pulsating waves, thereby to increase the extent of atomization.

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Utilization of the invention will become apparent to those skilled in the art from the disclosures made in the following description of the preferred embodiment of the invention as illustrated in the accompanying drawings, in which:

FIG. 1 is a cross-sectional view of a valved dispenser, which reveals in detail the internal structure of the valving spout member and spray head member of the present invention mounted on the dispenser and shown in their normally closed position, the spray head member being of one-piece construction;

FIG. 2 is an enlarged cross-sectional view of the spray head member of FIG. 1 taken along the line 2-2;

FIG. 3 is a cross-sectional view similar to that of FIG. 1 of a modified spray head member of two-piece construction;

FIG. 4 is an enlarged view of the insertable smaller part of the two-piece spray head as seen from its aft end edge; and

FIGS. 5a, b and c are schematic sketches illustrating in sequence the pulsed operation of the present invention.

Referring now to the drawings, wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in FIG. 1 a pressurized dispenser 10 with which the present invention is advantageously utilized. The pressurized dispenser 10 is of the general type for dispensing atomized liquids which are propelled by gases that are immiscible with such liquids. Conveniently such a dispenser may be provided with a metal container, shown partially at a, and a container top member b, including a centrally apertured dome portion c through whose aperture a valving spout member, generally designated 12, projects.

The valving spout member 12, which forms a portion of the present invention and will be set forth in detail hereinafter, is mounted in a rubber sealing washer d which is clamped against the under surface of the dome c by the flanges e of a plastic molded nipple f. The nipple f has internal flutes g leading downward to a mounting seat h and a bottom inlet i which is received in the upper end of a dip tube j in conventional fashion. Container contents flow to the valving spout member 12 through the dip tube j and nipple f. The mounting seat h is provided with a compression spring k based therein, and whose top coils encompass a bottom projection 14 of the valving spout member 12, and yieldably urge the spout member 12 to its closed, sealed position (see FIG. 1) and yet permit tiltable or depressible movement to its open, content-flow position (see FIG. 3).

Valving spout member 12 is formed integrally by molding plastic material of sufficient rigidity to permit tilting or depressing. The spout member 12 is generally symmetrical about a central axis x-x. It includes, as its lower portion, an imperforate cylindrical valve head 16 which is of substantially larger diameter than the bottom projection 14 and the aperture of the sealing washer d. The valve head portion 16 is seatable against the under surface of the sealing washer d within the dispenser container.

As its upper portion, the valving spout member 12 has a generally cylindrical hollow stem portion 18 which extends outwardly of the valve head portion 16 and projects upwardly from the dispenser container top dome portion c. The hollow interior of the hollow stem 18 defines the outer wall 20 of a resonance chamber 22. The purpose of such a resonance chamber 22 will be more fully understood with reference to the operation of the valve spout set forth hereinafter. The cylindrical hollow stem 18 is provided along its outer surface with two downwardly and outwardly sloping annular shoulders 24 and 26 respectively for accommodating a spray head member

28 upon the upper portion of the valving spout member 12.

The resonance chamber 22 may be small enough not to add unduly to the practical size requirements of the spout member 12; for example, in the embodiment illustrated, the resonance chamber 22 has a diameter of approximately 0.07 inch and an axial length approximately four to five times as great. Toward its lower end the resonance chamber 22 tapers to a generally cylindrical jet orifice 30 which extends vertically and whose axis is the central axis $x-x$ of the valving spout member 12. At its lower end the jet orifice 30 communicates with a lateral flow passage, generally designated 32, at the level between the stem portion 18 and the head portion 16 of the valving spout member 12. The lateral flow passage 32 consists of an undercut annular groove 34 interrupted by two oppositely disposed flow ports 36 having side walls 38. The flow ports 36 meet at the central axis $x-x$ below the jet orifice 30. Together with the annular groove 34, these ports permit the lateral flow of container contents to the jet orifice 30 when the valving spout 12 is tilted or depressed. In contrast to these valve constructions in which the flow apertures penetrate through a side wall, the jet orifice fed by the lateral flow passage 32 causes stream flow acceleration outwardly along the central axis $x-x$.

In combination with the valving spout member 12 of the present invention, there is provided a spray head member 28 having a generally cylindrical bore 40 in its bottom portion, by which it is press-fitted onto the stem portion 18 of the valving spout member 12. The spray head member 28 of FIG. 1 is a one-piece, integrally molded plastic material which is provided with a contoured and knurled finger contact portion 42 along its upper surface. The cylindrical bore 40 of the spray head member 28 extends upwardly from a bottom rim 44 and follows the general outline of the hollow stem 18. At its upper end the cylindrical bore 40 terminates in a flat top inner portion 46 of the spray head member 28. The top inner portion 46 is presented in stream-breaking relationship along the central axis $x-x$ to break-up the accelerated liquid stream traversing the resonance chamber 22 from the jet orifice 30.

Spray head member 28 has a horizontally presented passageway 48 of smaller cross-sectional area than the resonance chamber 22, which curves spirally toward the aft portion of spray head member 28 and then forwardly to communicate with a substantially vertical, shallow, antechamber 50 provided forward of the central axis $x-x$. The spiral passageway 48 has its entrance at the central axis $x-x$ where it communicates with the resonance chamber 22. From this point it leads aft and thence forwardly in a spiral path to open into the antechamber 50 at the point designated 51, thereby to provide fluid flow communication between the resonance chamber 22 and the antechamber 50. Broken up liquid particles leaves the resonance chamber 22 at the entrance of the passageway 48 and are re-accelerated through it in pulsating waves.

Formed integrally with the spray head member 28 and forming the upper forward boundary of the antechamber 50 is a spray orifice wall 52. The spray orifice wall 52 is relatively thin, at least adjacent to the orifice itself so that it responds in diaphragm-like fashion to pressure fluctuations within the resonance chamber 22. A forward spray orifice 54 having a diameter of substantially the same order of magnitude as the jet orifice 30, is provided in the spray orifice wall 52. The orifice 54 sprays the contents of the antechamber 50 out into a forward cavity 56, indented in the forward portion of the spray head member 28 so as to render the spray orifice wall 52 sufficiently thin. Preferably the thickness of the spray orifice wall 52 is the same order of magnitude as the diameter of the spray orifice 54. In the illustrated embodiment both the jet orifice and spray orifice diameters

are approximately .018 inch. Where these relative orifice diameters are substantially maintained and the spray orifice wall 52 has a thickness of the same general order of magnitude as their diameters, pressure fluctuations within the resonance chamber 22 are transmitted thereby to the outside atmosphere. This action further increases the thoroughness of atomization.

With the valving spout member 12 and spray head member 28 depressed to the actuation position (see, for purposes of analogy, the position of the two-piece spray head member 28' of FIG. 3) the liquid contents of the metal container *a* will flow through the dip tube *j*, around the valve head 16 and into the lateral flow passage 32. Next the liquid contents are forced into the jet orifice 30 in response to the pressure within the container, by which it is accelerated and directed upwardly along the central axis $x-x$ and caused to impinge upon the top inner portion 46 in the manner shown schematically in FIG. 5a. The acceleration of the liquid stream through the jet orifice 30 greatly increases the effect of impact with the top inner portion 46. A charge of the broken-up liquid is re-accelerated and carried by the spiral passageway 40 to the antechamber 50, from which it is discharged to the cavity 56 by means of the spray orifice 54, see FIG. 5a. Pressure build-up accompanies further atomization of the liquid within the resonance chamber 22, as is shown schematically in FIG. 5b.

After the pressure reaches some magnitude within the resonance chamber 22, there appears to be what is in effect an avalanche of the liquid particles from the chamber, through the re-accelerating spiral passageway 48 and out through the spray orifice 54. This somewhat pulsed action of the resonance chamber 22 which may in effect flush it of a built-up charge is repetitive as shown schematically in FIG. 5c.

Since the thickness of the wall 52 adjacent to the spray orifice 54 is relatively thin, such pressure fluctuations apparently cause the spray orifice wall 52 to act, somewhat in the manner of a diaphragm, to transmit the pressure fluctuations of the resonance chamber 22 to the atmosphere in the vicinity of the jet orifice 54.

The observable results are pulsating waves of discharged atomized particles as illustrated. The frequency of discharge is readily measured by a stroboscope. Lowered frequency of pulsation apparently results in higher amplitude; in any event, the lower frequencies yield better spray "patterns," that is, more even distribution of finely atomized particles.

Even lower frequencies and better spray patterns are achieved with the two-piece spray head construction of FIG. 3. Referring now to this figure, there is shown a two-piece spray head member 28' mounted upon the valving spout member 12 in the same manner as the spray head 28 of FIG. 1. In contrast to FIG. 1, however, the member 28' is of two-piece construction with the cylindrical bore 40' in the larger spray head part 58. The bore 40' further terminates in downwardly presented top inner portion 46' and communicates with an antechamber 55 of circular cross-section through a passageway 48' to be described hereinafter. This antechamber 55 is in fact formed by the interfit of the larger spray head part 58 with a smaller part 64. A recess 60 is molded within the heads larger part 58. The recess 60 is shaped like an annular well, encompassing at its bore a forwardly and upwardly extending integral core 62 having a beveled edge forward face 63.

Within the annular recess 60 and about the core 62 there is mounted the smaller spray head part 64, whose spray orifice wall 52' defines the forward side of the antechamber 55. The smaller spray head part 64 is retained in the annular recess 60 by means of a retention ridge 66 which engages a corresponding groove in the annular recess wall. As may best be seen with reference to FIG. 4, the smaller spray head part 64 has four curved, converging, channels 68 molded in the aft side of a forward spray ori-

ifice wall 52' which is otherwise spaced from the beveled edge of the core forward face to define the antechamber 55. These channels converge swirlingly toward the antechamber 55 and central spray orifice 54' in the smaller part 64. The channels 68 extend forwardly along the radially inner surface of the annular rim portion 70 of this smaller part, which rim portion otherwise fits sealedly within the recess 60 around the core 62. The interfit of the larger and smaller parts 58, 64 defines the re-acceleration passageway 48' of the spray member 28'. It divides the path of flow from the resonance chamber 22' evenly into the four channels 68 which converge to the antechamber 55 and then to the central spray orifice 54'. Similar to passageway 48 the total cross-sectional area of the four channels 68 is less than that of the resonance chamber 22'. Spray orifice wall 52', like wall 52, has a thickness substantially the same as the diameter of forward spray orifice 54' and jet orifice 30'.

The operation of the present invention, as described, with reference to the one-piece spray head member 28 of FIG. 1 applies to the analogous parts of the two-piece spray head member 28' of FIG. 3. In stead of utilizing a spiral path (as in FIG. 1) from resonance chamber to spray antechamber, the plurality of channels is employed, to converge as the spray orifice 54'. Such a plurality of converging channels is not itself new; however in the FIG. 3 construction it is employed for the first time as a passage means of finite length, separating and communicating between the resonance chamber and the antechamber, much as does the horizontal spiral passage of the FIG. 1 embodiment. The finite length of such passage appears to aid in the pulsing charge cycling method of operation described above.

Obviously, many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that the invention consists of providing the combination valve and spray head structure as hereinabove illustrated and as defined in the claims.

We claim:

1. For use with a pressurized dispensing container for atomizable liquids, a valve spout and spray head assembly comprising

a valving spout member yieldably mounted within and urged to closing position within the container, said spout member having a central axis and including a valve head portion within the container, a hollow stem portion extending outwardly of said head portion whereby to project outward from the container and to define the outer wall of a resonance chamber,

a lateral flow passage at a level between the stem portion and the head portion and communicating to the axis of the spout member,

a liquid flow-accelerating jet orifice communicating outwardly along said axis from the lateral flow passage to the resonance chamber in a stream along said axis of the resonance chamber,

in combination with

a spray head member mounted on said hollow stem portion of said spout member and having

a top inner portion presented in stream-breaking relationship to the accelerated liquid stream traversing said resonance chamber from said jet orifice,

a forward spray orifice, and

a passage connecting said resonance chamber with said spray orifice,

whereby resonant fluctuations of pressure within the resonance chamber discharges the liquid contents of the containers through the spray orifice in pulsating waves and thereby increases the extent of atomization thereof.

2. For use with a pressurized dispensing container for atomizing liquids, a valve spout and spray head assembly comprising

a valving spout characterized by

a hollow cylindrical stem portion, whereby to serve as a resonance chamber, and

a liquid flow-accelerating jet orifice communicating axially into said resonance chamber whereby to accelerate the flow of liquid from such dispensing container into the resonance chamber in a stream along said stem axis,

in combination with

a spray head member mounted on said tubular stem portion across its axis in stream-breaking relationship, and having

a spray orifice and

a passage connecting said resonance chamber with said spray orifice,

whereby resonant fluctuations of pressure within the resonance chamber discharges the liquid contents of the container through the spray orifice in pulsating waves and thereby increases the extent of atomization thereof.

3. The valve spout and spray head assembly of claim 2, further defined by

said passage being curved passage means, of smaller cross-sectional area than the resonance chamber, communicating between it and the spray orifice to re-accelerate the pulsating waves of liquid contents.

4. The valve spout and spray head assembly of claim 3, further defined by

said spray orifice being formed in a diaphragm-like spray orifice wall of said spray head member, whereby to aid in transmitting pressure fluctuations within the chamber to the outside atmosphere.

5. The valve spout and spray head assembly of claim 4, further defined by

said spray head member having an antechamber behind the spray orifice wall and in the path of flow from said resonance chamber to said spray orifice.

6. The valve spout and spray head assembly of claim 5, further defined by

the spray orifice having a diameter of the same order of magnitude as the jet orifice.

7. The valve spout and spray head assembly of claim 5, further defined by

the spray orifice having a diameter of the same order of magnitude as the jet orifice, and

the thickness of the spray orifice wall being of the same order of magnitude as such diameter.

8. The valve spout and spray head assembly of claim 5, further defined by

the spray head having a horizontally presented passageway leading spirally aft from the upper portion of said resonance chamber and thence forwardly around to communicate with said antechamber.

9. The valve spout and spray head assembly of claim 5, further defined by

the spray head member comprising two separate parts, the spray orifice wall being formed in the smaller of said parts and having an annular rim portion extending aft and interfitted into an annular recess within and defining the outer surface of a core portion of the larger spray head part,

the interfit of the said rim portion and core portion of said spray head parts being channeled convergingly toward the spray orifice whereby to divide the path of flow from the resonance chamber into a plurality of flow portions converging at said antechamber.

10. For use with a pressurized dispensing container for atomized liquids,

a valve spout and spray head assembly comprising

a valving spout characterized by

a hollow cylindrical stem portion, whereby to serve as a stem chamber,

a liquid flow-accelerating jet orifice communicating axially into said stem chamber whereby to accelerate

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the flow of liquid from such dispensing container into the stem chamber in a stream along said stem axis, in combination with
 a spray head member mounted on said stem portion across its axis in stream-breaking relationship and having
 a spray orifice wall including a spray orifice, an antechamber behind the spray orifice and communicating therewith, and
 a passage connecting the stem chamber with the spray head antechamber,
 said passage being of smaller cross-sectional area than the stem chamber,
 whereby liquid accelerated through the jet orifice into the stem chamber is re-accelerated in its flow between the stem chamber and the spray head antechamber.
 11. The valve spout and spray head assembly of claim 10, further defined by
 the spray head having a horizontally presented passageway leading spirally aft from the upper portion of said stem chamber and thence forwardly around to communicate with said antechamber,
 12. The valve spout and spray head assembly of claim 10, further defined by
 the spray head member comprising two separate parts,

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the spray orifice wall being formed in the smaller of said parts and having an annular rim portion extending aft and interfitted into an annular recess within and defining the outer surface of a core portion of the larger spray head part,
 the interfit of the said rim portion and core portion of said spray head parts being channeled convergingly toward the spray orifice whereby to divide the path of flow from the said stem chamber into a plurality of flow portions converging at said antechamber.

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