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Corsette

[11] **3,794,247**

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[54] **SPRAY FITMENT FOR SQUEEZE BOTTLES**

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[51] **Int. Cl.** **B67d 5/58**

[58] **Field of Search** 239/327, 343, 344; 222/211, 222/215, 190, 189

[56] **References Cited**

UNITED STATES PATENTS

3,361,304	1/1968	Thompson	239/327 X
3,369,713	2/1968	Godschalk, Jr.	239/327 X
3,622,049	11/1971	Thompson	239/327 X

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Assistant Examiner—Michael Y. Mar

[57] **ABSTRACT**

A spray fitment for squeeze bottles including a generally cylindrical plug for sealing reception in the neck opening of a conventional, flexibly resilient squeeze bottle. The plug has an axial opening therethrough, in which is supported a dispensing valve housing, between which and the inner wall of said opening is defined an axial air inlet port controlled by an air inlet valve carried by the valve housing. Formed through the valve housing are separate product and air discharge passages opening into a mixing chamber adjacent to a discharge orifice. There is provided a flexible resilient spray discharge valve in the form of a diaphragm which automatically closes the orifice at the conclusion of each squeeze or discharge stroke to prevent back-flow of air into the container. When thus closed, the spray discharge valve isolates the air discharge passage from the product discharge passage, to thereby prevent backflow of product and thus to maintain the product passage constantly primed in readiness for ejecting a full charge of product on each squeeze stroke, while preventing clogging of the air discharge passage by the product.

13 Claims, 5 Drawing Figures

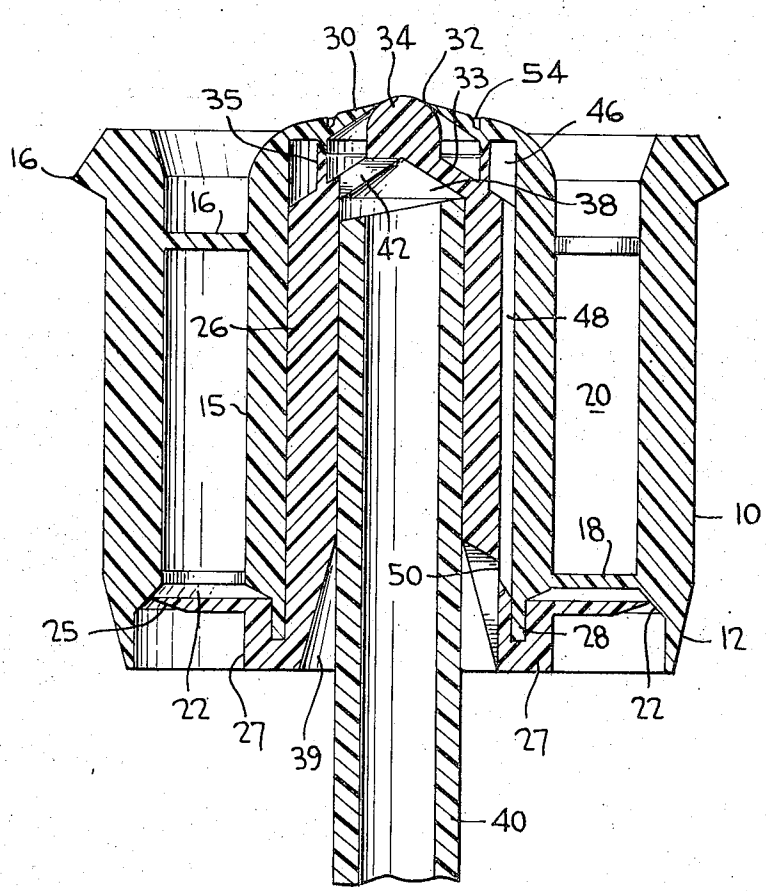


FIG. 1

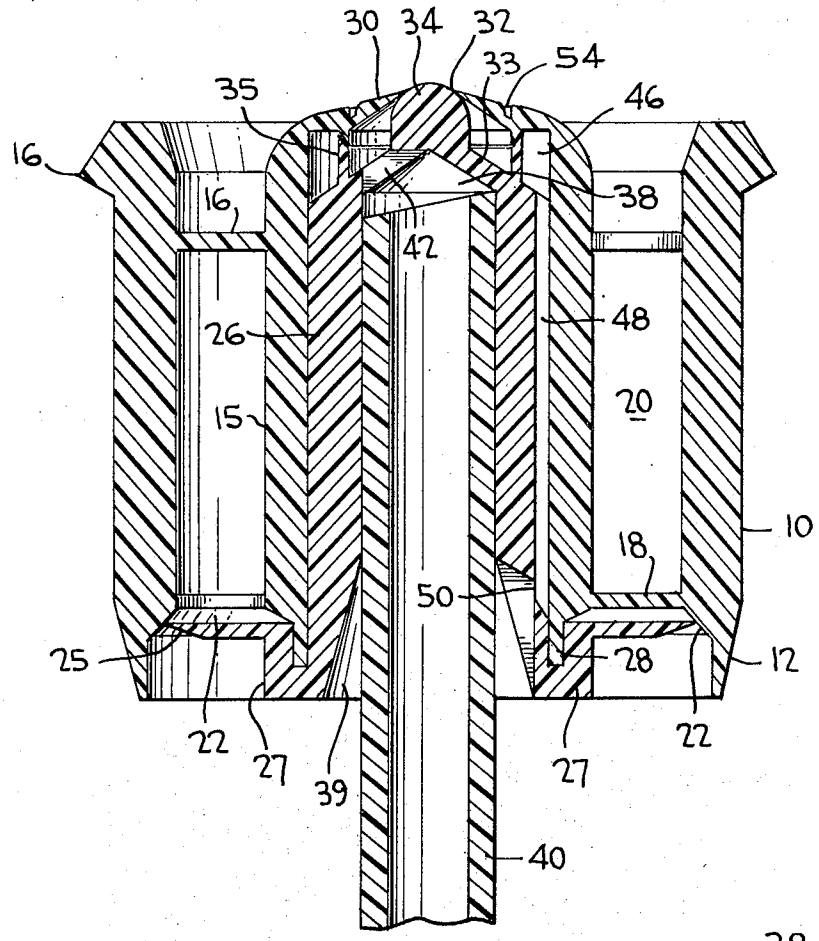

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FIG. 2

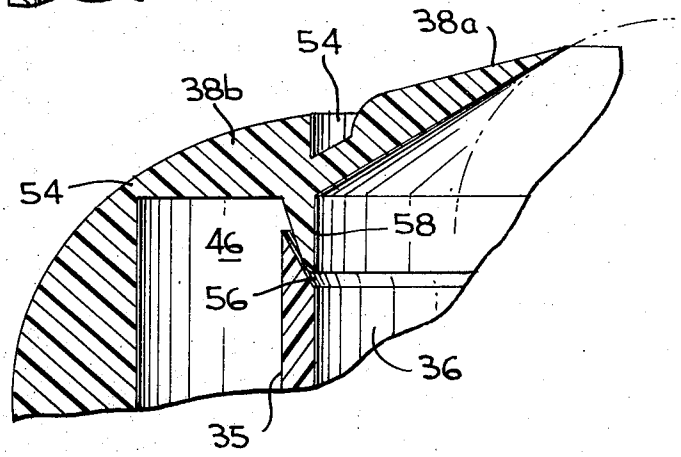

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FIG. 3

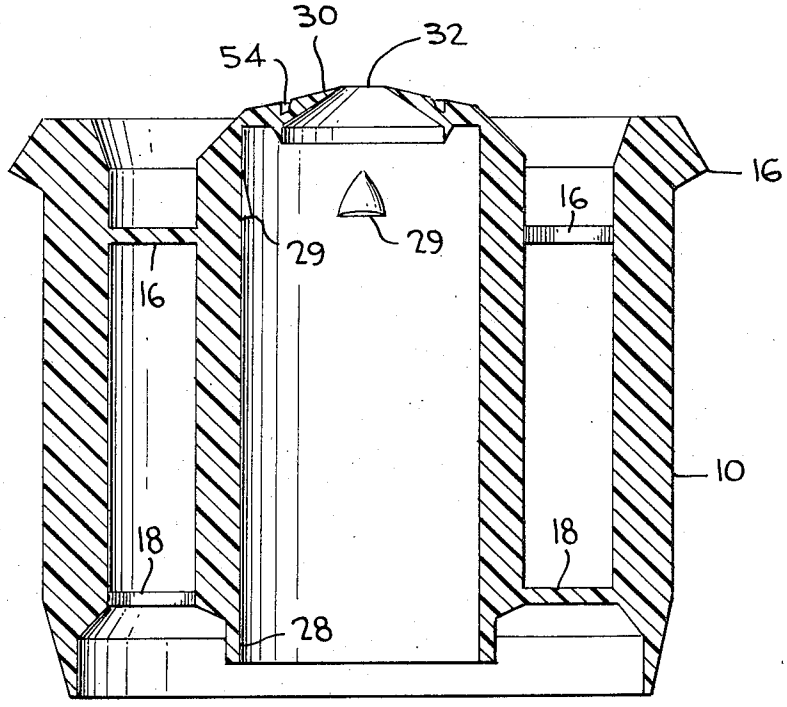


FIG. 4

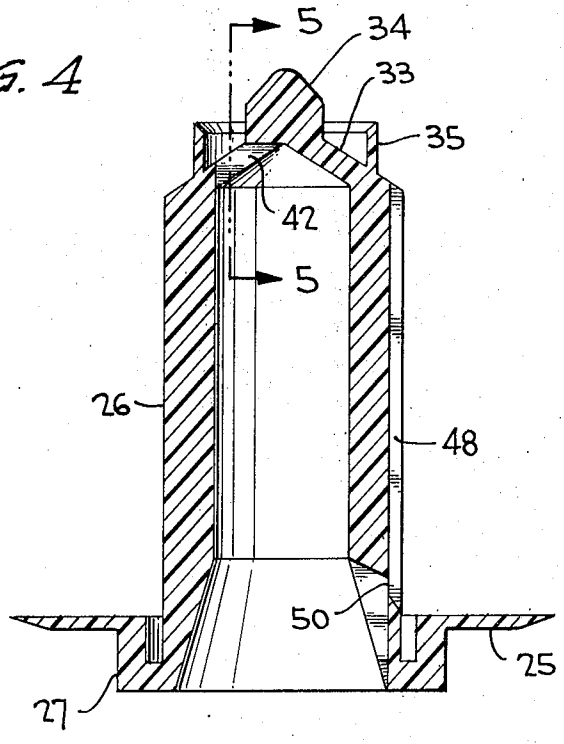
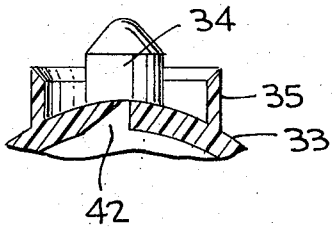


FIG. 5



SPRAY FITMENT FOR SQUEEZE BOTTLES

This invention relates to an improved spray fitment and closure for squeeze bottles.

More particularly, this invention relates to improvements in spray fitments of the rapid recovery type, such as are generally exemplified in the disclosures of the U.S. Pats. of Marchant Nos. 3,519,208 and 3,679,137, and McDonnell Nos. 3,409,182 and 3,474,936.

In such prior spray fitments, provision has been made for the rapid admission of atmospheric air into the container to permit rapid reexpansion of the squeeze bottle as it is released after each squeeze or discharge stroke. In such prior fitments, however, air from the atmosphere, as well as from the interior of the container is permitted to enter at the upper end of the product discharge passage after each squeeze stroke, thus permitting the column of product therein to drop down to or toward the level of the product within the container. Thus, a portion of each squeeze stroke or compression of the squeeze bottle is utilized in merely restoring the product column to its former level, before any discharge of the product can occur. Further, such prior devices instead of having self contained valve means, require special configurations and/or modification of the squeeze bottles and rely upon such special features of the bottles as part of the valve means.

SUMMARY OF THE INVENTION

With the foregoing considerations in mind, the present invention has among its objects to provide a self-contained spray fitment adapted for use with any conventional commercially available squeeze bottle and comprising but a minimum of parts. In addition to providing an air inlet port or passage controlled by a suitable air inlet check valve, the fitment also includes an automatically actuated and normally closed diaphragm valve controlling the spray orifice and automatically actuated in direct response to variations in pressure of the fluid within the squeeze bottle arising from a manual squeezing thereof to permit discharge of the product in the form of a well defined spray and in which the valve automatically closes at the conclusion of the squeeze stroke to thereafter maintain the discharge orifice sealed against either discharge of the product or influx of atmospheric air.

It is a further object to provide such a fitment in which the discharge valve cooperates with an air outlet valve seat in a manner to normally isolate the air infusion passage from the product passage, at the same time that it closes the discharge orifice, whereby to prevent backflow of air either from said air infusion channel or from the atmosphere into the upper end of the product discharge passage, and thus to maintain the product passage primed full of product in readiness for discharge of a maximum volume of product on each squeeze stroke, while barring the product from the air infusion passage to prevent clogging of the latter.

It is thus an ultimate object of the invention to provide a fitment for squeeze bottles, in which the fitment incorporates means for rapid recovery or reexpansion of the squeeze bottle between squeeze strokes, while maintaining the product passage fully primed between such strokes to substantially increase the spray emitting capacity of the fitment.

It is further an important object to form such a fitment of but two separately formed unitary parts, exclusive of the dip tube.

Further, it is an object to provide alternate exemplifications of such a spray fitment in which the air inlet valve is capable of either of two alternative modes of operation, depending on whether the valve assembly is fixed or resiliently axially displaceable with respect to its supporting closure plug. In the event the valve assembly is fixed, resilient flexing of the air inlet valve may be relied upon for seating and unseating thereof in response to changes in differential pressure on its opposite sides. However, where the valve assembly is resiliently supported for axial displacement, such displacement of the valve assembly in its entirety may be relied upon primarily for seating and unseating the air inlet valve in response to differential pressure on opposite sides of such valve.

Further, objects and advantages of the invention will be apparent from the following specification in conjunction with the accompanying drawings, and appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

FIG. 1 is a vertical axial cross section through the preferred embodiment of spray fitment in accordance with the present invention.

FIG. 2 is an enlarged fragmentary detail view of the structure enclosed within the Circle A of FIG. 1.

FIG. 3 is a view of the integral closure plug and valve body of the preferred embodiment.

FIG. 4 is a cross section on the same plane as FIG. 1 through the valve core of the preferred embodiment and

FIG. 5 is a fragmentary detail section taken on line 5—5 of FIG. 4 looking in the direction of the arrows.

DETAILED DESCRIPTION

Referring now in detail to the accompanying drawings, the spray discharge fitment there illustrated includes a suitable closure element **10** by means of which it is supported in the discharge or dispensing opening of a container having a resiliently flexible wall or wall portion which may be alternately squeezed or indented to expel a portion of its contents and then released. Such a container is commonly termed a "squeeze bottle."

In the present instance the closure **10** is in the form of an annular plug or stopper which is shown as having a slightly tapered portion **12** at its lower end to adapt it for insertion and press fitting within the neck opening of the squeeze bottle. At its upper end there is provided an encircling flange **14** for engagement with the upper end of the bottle neck to determine the final position of the fitment.

Disposed within and through the annular plug is a downwardly opening cylindrical valve housing **15** which is supported from the plug by a series of upper and lower spaced webs **16** and **18**, the webs of each series **16** and **18** being circumferentially spaced in the manner of spokes and preferably staggered with respect to each other whereby to afford minimum obstruction to the annular inlet port **20** which extends between the plug and the valve housing to permit inflow of air from the atmosphere to the interior of the

squeeze bottle on each recovery stroke, or in other words, each time the squeeze bottle is released and permitted to reexpand to its normal volume after being squeezed. In order to prevent the outflow of air through the ports **20**, the annular plug **10** is formed with a downwardly directed valve seat **22** for cooperation with a flexible inlet valve **25** in the form of a radially outwardly projecting flange encircling and integral with the downwardly projecting external lower end of the valve core **26**, which is secured in fluid light manner within the downwardly opening valve housing **15**.

Preferably, the projecting lower end of the core **26** is formed with an upwardly or reversely turned cuff **27** defining between it and the main body of the valve core an angular groove for snug reception of a reduced thickness lower end extremity **28** of the core. The valve housing **15** and core may be secured in assembled relation by friction, by cementing or in other conventional manner. In the embodiment now being described, the supporting webs **16** and **18** which connect the core to the surrounding plug **10** are substantially rigid so as to maintain the core and plug against relative axial displacement. Therefore, the valving movement of the inlet valve **25** consists in axial movement of its outer periphery into and from seating engagement with the valve seat **22** thereabove. Accordingly, creation of a super atmospheric pressure within the container or squeeze bottle as by manual squeezing or deformation will press the valve **25** firmly against its seat **22**, whereas reduction of pressure within the container below atmospheric incident to reexpansion or recovery thereof will permit inflow of air through port **20** into the squeeze bottle.

For the purpose of precisely locating the core **26** within the valve body to achieve proper positions and relationships between the various valve components, it is desirable to provide within the cylindrical bore of the valve housing **15** one or more precisely located positioning lugs **29**, as illustrated in FIG. **3**, for abutment with the upper end wall of the core **26** as the core is inserted within the housing **15** during assembly of the parts.

Extending across and closing the upper end of the valve housing **15** is a resiliently flexible diaphragm **30** formed with a central discharge orifice **32** therethrough. It will be noted that the upwardly presented end wall **33** of the valve core **26** is spaced axially below the diaphragm and is formed with a centrally projecting valve member **34** having a rounded or other suitably shaped free upper end for sealing reception in the discharge orifice **32** of the diaphragm when the diaphragm is in its normally relaxed or unstressed position.

In the preferred embodiment, the cylindrical valve core **26**, its upwardly projecting valve member **34**, and the discharge port **32** through the diaphragm are all located coaxially with respect to the cylindrical valve housing **15**.

A similarly coaxial annular wall **35**, which encircles and is spaced outwardly from the valve member **34**, has its upper end edge adapted for sealing engagement with the diaphragm, whereby the valve core and the diaphragm jointly define an annular mixing chamber **36** which is adapted to communicate with the atmosphere through the orifice **32** when the diaphragm is unseated from the valve member **34**, in response to the creation of a super-atmospheric pressure within the chamber **36** arising from squeezing of the bottle or from other causes.

For delivering the dispensed product from the squeeze bottle into the chamber **36**, the valve core **26** is provided with an axial passage **38** therethrough. This passage is preferably downwardly flared at its lower end **39** for snug reception of a conventional dip tube **40** adapted to extend to a location near the bottom of the squeeze bottle. At its upper end the passage **38** communicates with the chamber **36** through one or more inlet ports **42**. Preferably the inlet ports **42** have a spiral component or inclination at their juncture with the chamber **36** so that the incoming liquid or flowable product enters the chamber in a generally tangential direction to thus pursue a spiral or circular path around the valve member **34** and concentric to the discharge orifice **32**, so as to issue through the orifice **32** in a finely divided spray. In other words the chamber **36** with its associated passages **42** functions as a generally conventional swirl or spin chamber in a manner well known in the art.

To facilitate a more complete breaking up and dispersal of the spray, air under pressure from the upper portion of the squeeze bottle, above its liquid contents, is delivered into the liquid chamber **36** separately from the liquid, to be there mixed and expelled through the orifice **32** together with the liquid.

For this purpose, the upstanding wall **35** is radially inwardly spaced from the outer surface of the cylindrical valve core **26** and the socket or passage **38** which receives it within the valve housing **15**, so that there is defined around the wall **35** and between the outer peripheries of the wall **33** and the diaphragm **30** an air chamber **46**, which encircles the wall **35** and, in the upwardly deflected open position of the diaphragm, communicates with the mixing chamber **36** over the top of the said wall.

The air chamber **46** is part of an air discharge or infusion passage which is separate from the product passage and which extends downwardly through the fitment from the mixing chamber **36** through a connecting portion **48** into the upper portion of the squeeze bottle. In the embodiment here illustrated, the passage portion **48** is simply formed as a groove in the outer wall of the valve core **26** opening upwardly into the chamber **46** and opening downwardly at **50** into the enlarged or downwardly fleared lower end of the socket **38**.

As is shown in FIG. **2**, concentric portions **38***a* and **38***b* of the flexible diaphragm **38** are in axial registry respectively with the mixing chamber **36** and with the air chamber **46**. In order to facilitate simultaneous seating as well as to ease the pressure requirements for opening of these concentric diaphragm portions, it is desirable to provide an annular weakened zone **52** in the diaphragm between the two diaphragm portions **38**a and **38**b so as to permit a certain amount of relative flexing between them. Also, around the outer periphery of the outer diaphragm portion **38**b, there is provided a thin or reduced thickness portion **54** about which the entire diaphragm may flex with respect to the rest of the valve core to which it is integrally connected at **54**.

Further, in the preferred embodiment it will be observed that the upper end edge **56** of the wall **35** between the chambers **36** and **46** is bevelled or inclined to serve as a valve seat in cooperation with the annular valve or seal **58** which depends from the diaphragm **38**

preferably in registry with the inner periphery of the diaphragm portion 38*b*. This seal 58 constitutes an integral portion of the diaphragm 38 and is of downwardly converging cross section whereby its lower end may be radially inwardly deflected to maintain a sealing engagement with the bevelled edge 56 of the wall 35 throughout a substantial range of axial movement. Moreover, the slope of the outer face of the seal is preferably at a smaller angle to the vertical than is the end edge 56.

The dissimilar face angles of the cooperating valve or seal 58 and the upper end edge of the wall 35 provide a measure of flexibility to ease the tolerance requirements in molding and assembly of the plastic valve components, while adding valving efficiency by facilitating conformity of the valving surfaces to each other when closed. In particular that there is achieved a substantial line contact between the cooperating surfaces or faces and the radial flexibility of the valve or seal 58 will maintain sealing engagement between these parts throughout a substantial range of axial movement between them. Because of these tolerances, and also because of axial flexibility of the quite thin inner perepheral portion of the diaphragm around and adjacent to the orifice 32, it will be possible to achieve and maintain simultaneous seating of the valve member 34 within the orifice 32, and of the seal 58 with respect to the wall 35, even though one normally seats somewhat prior to the other. In other words the arrangement is such as to accommodate practical manufacturing tolerances.

In the operation of the preferred embodiment of the invention, as pressure is applied to the deformable container or squeeze bottle, as by means of a manual squeeze stroke, such pressure is transmitted to the flowable product to be dispensed from the container as well as to the air therewithin, escape of the air through the port 20 being prevented by seating of the inlet air valve 25 against seat 22. Such pressure will raise the liquid or flowable contents of the container upwardly through the dip tube 40 into the mixing chamber 36 under pressure, while forcing air under super atmospheric pressure, upwardly through passages 50 and 48 into the air chamber 46. Such super atmospheric pressure acting against the under surface of the diaphragm 30 will manifestly raise the latter to unseat it substantially simultaneously from the valve member 34 and from the wall 35, whereby the air from the chamber 46 flows radially inwardly from all sides into the chamber 36 to be intimately intermixed with the liquid therein, while the liquid, being admitted through the spirally inclined port or ports 42, will undergo a rapid swirling action in the chamber 36 and the intermixed air and liquid will be expelled under pressure through the orifice 32 in the form of a finely divided spray.

It will be manifest that the spray will be intermittently ejected through the orifice each time the container is compressed as by manual squeezing. Between squeeze strokes, when the pressure is released and the container is permitted to reexpand, the reexpansion tendency will produce a sub-atmospheric pressure within the container interior so that the atmospheric pressure acting against the air inlet valve 25 will flex the latter downwardly to unseat or open it and permit air freely to enter the container through a path which is quite separate from that of the liquid product discharged. The comparatively large circumference of the valve 25 will permit quite rapid recovery or reexpansion of the bottle between strokes. Moreover, the concentric encircling relation of the inlet port 20 with respect to the orifice 32 enables the port to return any drip from the orifice back into the containers. In the preferred embodiment of the invention, as above described, the valve housing 15 is fixedly supported within the closure or plug 10 by the substantially rigid supporting webs or straps 16 and 18, while axial flexing of the air inlet valve 25 is relied upon for opening and closing of the latter in response to differential air pressures on its opposite sides.

However, in a modified embodiment of the invention, the air inlet valve 25 may be formed of substantially rigid construction, while the supporting webs or straps 16 and 18 may be proportioned and/or formed of suitable plastic material having sufficient flexibility to permit relative resilient axial displacement of the entire valve housing and its contents from a normally unstressed and seated position of the valve 25, as in FIG. 1, 2, to an opened and downwardly displaced unseated position of that valve. The construction and arrangement of parts will otherwise be identical to that hereinbefore shown and described.

In either embodiment of the invention, it is important to note that during each recovery stroke or reexpansion of the container, as well as upon completion thereof prior to a repeated squeeze stroke, the discharge orifice 32 is closed to maintain the product passage and dip tube 40 primed full of the product in readiness for discharge of a maximum volume of product on the next squeeze stroke. At the same time, the sealing engagement of the wall 35 with the diaphragm isolates the air discharge or infusion passage 46, 48, 50 from the product so as to prevent clogging of the passage. The same advantages are achieved during storage.

Accordingly, in addition to providing for rapid recovery, the present fitment provides for maintaining the product passage fully primed between squeeze strokes to substantially increase the spray emitting capacity of the fitment, while avoiding clogging of the air discharge passage.

Such a fitment is adapted for economical mass production by conventional plastic molding techniques and comprises only two separately formed unitary parts, other than the dip tube.

In the present application there has been specifically shown and described only a single embodiment of the invention, together with a slight modification. However, it is recognized that the invention is capable of other and different embodiments within the scope of the appended claims.

Having thus described my invention, I claim:

1. A spray discharge fitment for fluid tight association with the outlet opening of a squeeze bottle containing a product to be dispensed:

said fitment defining a mixing chamber therewithin and separate product and air discharge passages for establishing communication between said chamber and the interior of the squeeze bottle to which the fitment is applied;

said fitment including a resiliently flexible diaphragm having an outer side thereof exposed to atmospheric pressure and an inner side thereof exposed to the pressure within said mixing chamber;

said diaphragm being formed with a discharge orifice therethrough to establish communication between said mixing chamber and the atmosphere;

a valve member positioned in said mixing chamber for seating and unseating in said orifice in response to flexing of the diaphragm.

said diaphragm normally being biased toward a closed position in which said valve member is seated in said orifice when the pressure within said mixing chamber is equal to or below atmospheric pressure, and being deflected to an open position in which said member is unseated from the orifice when the pressure within said mixing chamber exceeds atmospheric pressure.

2. A discharge fitment as defined in claim **1**, in which said fitment includes an outwardly projecting wall encircling said mixing chamber and having a free outer end edge positioned to sealingly engage said diaphragm, said air discharge passage being disposed outside of said wall and communicating with said chamber over said end edge in the open position of the diaphragm, and being isolated by said wall from the said chamber in the closed position of the diaphragm.

3. A discharge fitment as defined in claim **2**, in which said mixing chamber and said wall are of annular shape concentric to said valve member and said orifice.

4. A discharge fitment as defined in claim **2**, in which said mixing chamber and said wall are of annular configuration concentric to said valve member and said orifice, and a portion of said air discharge passage comprises an air chamber encircling said wall so that in the open position of the diaphragm, air is directed radially inwardly toward said orifice from all sides, between said diaphragm and said end edge of the wall.

5. A discharge fitment as defined in claim **2**, in which said mixing chamber includes an inner end wall spaced axially from said diaphragm, said valve member being affixed to said inner end wall and projecting outwardly toward said diaphragm, said product discharge passage including a portion opening through said inner end wall tangentially to said chamber.

6. A spray discharge fitment for a squeeze bottle; said fitment comprising an annular plug for fluid tight reception in the neck opening of a squeeze bottle;

a generally cylindrical valve housing supported coaxially within said plug to define an annular air inlet port from the atmosphere to the interior of a squeeze bottle to which said fitment is applied;

an annular air inlet valve carried by said housing assembly and means resiliently urging said inlet valve outwardly sealing engagement with an inwardly directed valve seat on said plug;

means within said valve housing defining an annular spin chamber adapted for operative communication with the interior of a container to which the fitment is applied;

there being a resiliently flexible diaphragm forming the outer wall of said spin chamber and having a discharge orifice therethrough from the spin chamber to the atmosphere;

a central post being coaxially disposed in said spin chamber and having a free outer end positioned for sealing reception in said orifice;

and means resiliently biasing said diaphragm toward a normal closed position wherein said port is sealingly received in said orifice, said diaphragm being yieldable in response to pressure within said spin chamber to open said orifice.

7. A discharge fitment as defined in claim **1**, including an outwardly projecting wall encircling said spin chamber, said wall having a free edge directed axially toward said diaphragm and functioning as an annular valve seat positioned for sealing engagement by said discharge valve in the normal closed position of the latter; and means defining an air chamber encircling said wall and communicating with the interior of the squeeze bottle.

8. A spray discharge fitment for a squeeze bottle comprising: an annular plug for sealing reception in the outlet opening of a squeeze bottle containing a product to be dispensed; a downwardly opening hollow cylindrical valve housing supported within said plug in radially spaced relation thereto to define therewith an annular air inlet port between the atmosphere and the interior of the squeeze bottle; said annular plug being formed with an annular downwardly directed valve seat concentric thereto; a cylindrical valve core secured within said valve housing and having a portion projecting downwardly therefrom; an air inlet valve carried by said portion and projecting radially outwardly therefrom for cooperation with said valve seat in response to changes in pressure within said squeeze bottle; an axially flexible diaphragm extending across the upper end of said valve housing and formed with a central discharge orifice therethrough; said valve core being spaced axially below said diaphragm within the housing to define a mixing chamber between said diaphragm and said valve core; a valve member projecting upwardly through said mixing chamber from the valve core in position for sealing reception in said orifice in a normally downwardly flexed closed position of said diaphragm; said diaphragm being deflectible upwardly to an open position by super atmospheric pressure on its lower surface within said mixing chamber; there being a product passage opening downwardly through said core from the mixing chamber, and a dip tube constituting a downward continuation of said passage; said housing and core jointly defining an air discharge passage separate from the product passage opening downwardly through said fitment from the mixing chamber.

9. A spray discharge fitment as defined in claim **8** in which said core includes an upwardly projecting wall encircling said mixing chamber; and having a free upper end edge for sealing engagement with the diaphragm in the closed position of the latter; said air discharge passage being outside of said wall and thereby isolated from the mixing chamber in the closed position of the diaphragm; but communicating with the mixing chamber over the upper edge of said wall in the open position of the diaphragm in which said diaphragm is disengaged from the said encircling wall.

10. A spray discharge fitment as defined in claim **9**, in which said mixing chamber and said wall are of annular configuration concentric to said valve member and said orifice; and a portion of said air discharge passage comprises an air distribution chamber encircling said wall so that, in the open position of the diaphragm, air flows radially inwardly across the mixing chamber from all sides toward the orifice.

11. A spray discharge fitment as defined in claim **9**, in which said diaphragm includes an integral resiliently flexible annular seal projecting downwardly from its lower surface concentrically to said annular wall, for

conforming sealing engagement therewith throughout a limited range of relative axial movement between said wall and said seal.

12. A spray discharge fitment as defined in claim **9**, in which concentric portions of said diaphragm are in axial registry respectively with said mixing chamber and with said air distribution chamber, said diaphragm being formed with an annular weakened zone between said concentric portions to permit relative axial flexing of said concentric portions with respect to each other.

13. A spray discharge fitment as defined in claim **12**, in which said concentric portion of the diaphragm in axial registry with the air distribution chamber is encircled by and connected to the valve housing along a weakened zone for facilitating axial flexing of said last mentioned portion.

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