ABSTRACT: A dip tube assembly for an aerosol or similar fluid dispensing valve, wherein the assembly incorporates gravity operated shuttle valve means secured to the dip tube at substantially its effective midpoint to provide a first inlet point, and wherein a portion of the tube is effectively folded back upon the rest of the tube to provide a second inlet point remote from the first.
DIP TUBES FOR AEROSOL VALVE ASSEMBLIES

The present invention relates to improvements in valve assemblies for controlling the dispensing of a liquid product from a pressurized container, i.e., a so-called aerosol package. It is more particularly directed to improvements in dip tubes for such valve assemblies in order to provide for normal dispensing of a liquid product regardless of whether the container is held in an upright or in an inverted position.

In the usual aerosol package, a valve assembly is sealed in the mouth of a container and manual actuation of a valve member controls the dispensing of the product. In the process, the particle of the container is held under the pressure of a propellant gas above the surface of the liquid up through an education or dip tube whose lower end is disposed below the surface of the liquid, and the product is ultimately discharged through a spout or nozzle in the valve assembly. So long as the inlet end of the education tube is below the surface of the liquid product in the container, the product will be supplied to the valve assembly for discharge by the propellant pressure, normally a vaporized portion of this propellant occupies a head space in the container above the surface of the liquid product.

If, however, the package is inverted, the inlet end of the education or dip tube will no longer be in contact with the product but instead will be disposed in a region occupied only by gasous propellant. Dispensing of the liquid product, therefore, cannot be continued in this inverted position of the container.

Various arrangements have been proposed heretofore to overcome this difficulty. In general such arrangements incorporate a shuttle valve located in the valve housing or in the dip tube immediately adjacent to the valve housing. This shuttle valve is gravity operated on inverting the container, and so doing opens an inlet port for entrance of liquid to the dispensing valve at a location close to what would normally be the top of the container. Thus in the inverted position of the container, the port is below the surface of any liquid product in the container. Liquid can therefore enter the port and be discharged as before. In the normal upright position of such prior aerosol packages, the shuttle valve closes this port so that the valve assembly and education tube work in normal manner.

The difficulty with such arrangement is that with the container in inverted position no provision is made for simultaneously opening the inlet end of the education tube to allow propellant gas and does enter the normal inlet end of the dip tube. This gas mixes with the fluid product entering through the shuttle-controlled bypass port and not only does this change the character, e.g., foam, spray or stream, of the product discharged from the package, but it also causes rapid depletion of the propellant. As a result there may not be enough propellant available completely to exhaust the liquid contents of the container, and it is wasted.

It is a principal objective of the present invention to provide improvements in valve assemblies adapted for use with aerosol containers where it is necessary or at least desirable that the container be capable of operating in an inverted as well as a normal, upright position with substantially equal effectiveness. In connection with this, it is an objective of the invention to accomplish the foregoing automatically without requiring any manipulation on the part of the user. Another objective in certain modifications of the basic design include automatic purging of the discharge valve in each cycle of operation. Still other objectives will appear in the following description.

In brief, the invention accomplishes these objectives by interposing a gravity-operated auxiliary valve at the inlet end of the usual dip tube, i.e., the end normally adjacent the bottom of the container, and by connecting into such auxiliary valve an additional or secondary dip tube which is directed back upon the normal or first dip tube to terminate adjacent to the main or dispensing valve assembly. Thus the auxiliary valve is effectively positioned at substantially the midpoint of the total length of education tubing. In the normal upright operation of the aerosol package, the auxiliary valve is positioned by gravity to open a port allowing fluid to enter the auxiliary valve housing and be fed up to the dispensing valve in normal manner. In this condition, the flow of fluid product from the container outwardly through the dispensing valve normally bypasses the secondary dip tube and it will retain fluid product in equilibrium with the bulk of the fluid within the container provided the flow rates and restriction imposed by the auxiliary valve are properly correlated. However, when the package is inverted, the auxiliary valve automatically positions itself by gravity to close off the normal inlet port and to connect the normal and secondary dip tubes in series. The only inlet to the dispensing valve under this assumed position of the container then becomes the remote end of the secondary dip tube. Since this is disposed adjacent the main valve assembly, it will be located below the liquid level in the inverted container.

In this arrangement it will be seen that the disadvantage of the prior construction, whereby propellant gas could enter and mix with the fluid product dispensed from the container in its inverted position, is eliminated.

As mentioned above, operation of the auxiliary valve in the manner just discussed depends on proper correlation of the flow rate and restriction imposed by the valve member itself. By suitable design changes, either of these variables may be altered to produce a different operation of the auxiliary valve. Thus, the valve design may be made to cause closing of the normally open inlet intermediate the main and secondary dip tubes by the normal flow of product through that inlet. Only fluid product which is contained in the two dip tubes will then be discharged, followed by a blast of propellant gas. This modified arrangement provides a cycle of operation in which a metered or measured amount of fluid product is dispensed, followed by a purging blast of propellant, on each actuation of the discharge valve. This arrangement is useful for certain types of products to be dispensed, such as certain pharmaceuticals to prevent contaminated residual product discharge on second or any subsequent dispensing cycles. It is also useful with fluid products having substantial amounts of dissolved solids, as in antiperspirant aerosols, where clogging of the discharge orifices by residual product presents a probe problem.

The invention is illustrated by the devices shown in the accompanying drawings and described in detail hereinafter.

In the drawings,

FIG. 1 is a schematic representation of a vertical cross section of a typical aerosol container and valve assembly, including an improved dip tube of the present invention;

FIG. 2 is a similar view in which the aerosol container is inverted;

FIG. 3 is a similar view in which the aerosol container is tipped on its side;

FIG. 4 is an enlarged view in vertical cross section of an auxiliary valve member used with the dip tube shown in FIGS. 1 through 3, the auxiliary valve being shown here in its open position;

FIG. 5 is a view similar to that of FIG. 4 but showing the auxiliary valve in its closed position;

FIG. 6 is a side view of a modified dip tube and auxiliary valve assembly, partly being shown in section and broken away;

FIG. 7 is a cross-sectional view of the dip tube taken on line 7-7 of FIG. 6;

FIG. 8 is an end view of the auxiliary valve housing shown in FIG. 6, looking from the right in that view but with the ball check and cage removed;

FIG. 9 is a sectional view of the auxiliary valve housing taken on line 9-9 of FIG. 6;

FIG. 10 is a fragmentary side view of still another form of dip tube and auxiliary valve assembly;

FIG. 11 is a view similar to that of FIG. 10 but in a plane perpendicular to the plane of section in FIG. 10 and showing a ball check in place adjacent the dip tube;

FIG. 12 is a cross-sectional view of a dip tube taken on line 12-12 in FIGS. 10 and 11;

FIG. 13 is an end view, looking from the left in FIGS. 10 and 11, of the auxiliary valve housing with the dip tubing removed;
FIG. 14 is a side view in cross section of still another form of auxiliary valve housing; FIG. 15 is a plan view of the underside of the unit shown in FIG. 14, parts broken away and shown in section; and FIG. 16 is an end view looking from the right in FIG. 14 but with the end closure disk and ball check removed. A front view of the auxiliary valve housing 22 is shown somewhat schematically in FIGS. 1—3, in which there is incorporated at one end a valve assembly 22 of conventional form. A valve and mounting arrangement in the end of the aerosol container such as that shown in U.S. Pat. No. 3,254,677, is eminently suitable, but the improved dip tube assembly of the present invention is not limited to use with that particular valve design.

Valve 22 is equipped with a dip tube assembly indicated generally at 24 which is connected by means of a tailpipe (not shown) on valve 22 and extends downwardly from the outer end of the auxiliary valve housing 22 and thus close off communication between well 38 and interior chamber 36. This is shown in greater detail in FIG. 5.

Communication between the dispensing valve 22 and the liquid in the container is then established by an alternate or second dip tube 50 which is received in a socket 52 likewise provided in housing 32 and communicating with interior chamber 36. Dip tube 50 extends back along the first tube 30, generally parallel thereto, to terminate adjacent the discharge valve 22. Since the remote or free end of dip tube 50 is thus disposed below the level L of the liquid in the container, fluid now enters dip tube 50 when valve 22 is operated, and travels upwardly through tube 50, thence into interior chamber 36 and back down through the first tube 30 to valve 22 for ultimate discharge.

In this manner, the escape of propellant gas is avoided when the container is in inverted position. A similar condition prevails where the container is held on its side, as seen in FIG. 3. In conventional prior valves and dip tube assemblies, it could well happen that the inner end of the tube corresponding to portion 30 of the new arrangement is disposed above level L of the liquid in the container, depending on the particular direction of curl or bend normally occurring in the typical flexible plastic tubing used as dip tubing. Again, therefore, a situation could arise where all of the propellant gas would be bled off without dispensing liquid from the container. Advantage can be taken of the arrangement here described by using a very flexible dip tube and weighting the auxiliary valve housing 32 and ball check 44 sufficiently to cause the dip tube 30 to bend downwardly at its inner end and thus insure that it is disposed below the surface L of the liquid. This arrangement obviates the need for orienting the direction of product discharge relative to the natural curvature of the dip tube in conventional arrangements.

In the two positions of the container shown in FIGS. 1 and 3, the secondary dip tube 50 serves no active part in conducting fluid product but it in no way interferes with or modifies the normal dispensing operation, assuming the flow rate and restriction imposed by fluid flow through housing 32 are so designed as to avoid lifting of ball 44 to the closed position.

A different form of dip tube and auxiliary valve assembly is shown in FIGS. 6—9 in which a single dip tube 124 having two ducts or passages is employed. In this case dip tube 124 comprises an integrally molded first duct portion 130 of essentially circular cross section and an adjacent second portion 150 of substantially crescent cross section.

At the end of the tube assembly to be attached to the usual dispensing valve 22, the first duct portion 130 is extended beyond the adjacent second portion 150 and is adapted to be received on the usual tailpiece of the valve assembly 22. The second duct 150 therefore terminates in an open end closely adjacent the normal dispensing valve.

At the opposite end of the dip tube 124, it is secured to an auxiliary valve housing 132. This is specially formed to provide tail members 134 and 156 to receive and make fluid tight communication with the respective duct portions 130, 150, as seen more particularly in FIGS. 6 and 9. Ports 135 and 157 communicate the respective tail members and duct portions to an interior chamber 136 of valve housing 132. Again valve housing 132 is provided with a cage portion defining a well 138 open at one end and communicating with interior chamber 136 through an aperture having a shoulder 142 to form a seat for ball check 144. Ball check 144 is retained in well 138 in this instance by a separate cage member 146 inserted in the well and having inwardly bent detent fingers 147.

The operation of the dip tube assembly illustrated in FIGS. 6 through 9 is identical with that already described in connection with the embodiment shown in FIGS. 1 through 5 above.

In the further modification shown in FIGS. 10—13, a dip tube and auxiliary valve housing assembly is shown in which a dip tube 224 of tandem configuration is employed. In this arrangement, first and second duct portions 230 and 250 are molded in an integral flexible plastic tube of generally oval
cross section, as seen more particularly in FIGS. 10 and 12. Again, duct portion 130 is adapted to be secured at one end of the tailpiece of the conventional valve assembly 22, while the adjacent end of the second duct portion 150 is terminated in open condition closely adjacent the dispensing valve. The opposite end of again duct assembly 130 is attached to auxiliary valve housing 232, provided with suitable tail members 234 and 256 arranged to receive the respective duct 230 and 250. These tail members in turn communicate through respective passages 235 and 257 with an interior chamber 236 of the auxiliary valve housing 232. And again the housing 232 is provided with a caje portion defining a well 238 which is open at one end and communicates with interior chamber 236, forming a valve seat 242 at the junction therewith. Ball check 244 is loosely received in well 238 for shuttle movement between a seated position on seat 242 and an open position which in this instance is defined by inwardly bent tabs 246 formed integrally on housing 232.

The operation of this embodiment is also identical with that described in connection with FIGS. 1 and through 5.

The auxiliary valve 332 shown in FIGS. 14 to 16 is again similar to the foregoing designs but is so formed as to dispose the main body of the valve at an angle to the axis of the dip tubes. The purpose of this is to facilitate movement of the ball check 344 to the closed position against seat 342 when the container is disposed in positions between horizontal and where it is only slightly below horizontal. To this end, the projecting duct or tail members 334, 356, are inclined to the axis of chamber 236, and communicate with it interiorly through ports 335, 357. (FIG. 14, 15).

This last embodiment incorporates a closure disk 346 for the open end of well 338 defined by the caje portion, and a bypass chamber 348 provides lateral access for fluid product to enter the housing. Disk 346 is retained in any suitable manner by tail tubes 347. In lieu of the closure disk any other form of closure may be used, such as an integral flap molded on the housing and subsequently folded over and heat sealed to cover the open end of the well, or simply by extending the walls of the well and then pinching them together.

The design permits greater flexibility in adapting the auxiliary valve to special dispensing control requirements for different fluid products. For example, by appropriating closure disk 346 to provide openings of different diameters, the flow rate over and around ball check 344 can be changed to alter the lifting effect on the ball check. Thus the ball may be caused to move more or less easily and quickly to seated position against its seat 342 for a given rate of fluid product flow. In this way, the metering and purging mode of operation referred to before may be accomplished. This design retains the advantage of that shown in FIGS. 6 and 10 in respect to placing the normal inlet opening near the bottom of the container, yet avoids the condition present in those designs whereby the ball check is directly interposed in the main flow of fluid product during dispensing in upright position. To prevent lifting of the ball check to shut off position in those other designs, a heavier (hence larger) ball and greater clearance of it relative to the side walls must be provided than is necessary for the unit shown in FIGS. 14 to 16.

The invention accordingly provides a very simple structural arrangement in a dip tube and auxiliary valve assembly for use in connection with a standard aerosol dispensing valve to ensure that normal dispensing of fluid product from an aerosol container can be obtained in whatever position the container may be held by the user, whether upright, inverted or on its side. The invention further provides a way of imparting a metering-purging mode of operation in dispensing a fluid product, if this is desired.

1. A valve and dip tube assembly for controlling the dispensing of a fluid product from a pressurized container, comprising:
   manually operable first valve means adapted to be mounted in one end of the container and normally confining fluid product therein and operable to allow such product to be dispensed therefrom only upon manual actuation of the valve means;
   dip tube means comprising a first tube portion secured to said first valve means;
   auxiliary valve means connected to said first tube portion at a point remote from said first valve means, said auxiliary valve incorporating a gravity-operated check valve member and a bypass port opened and closed by said member to provide communication at that point between the dip tube and the interior of the container;
   said dip tube means including a second tube portion interconnected with the first through said auxiliary valve means and double back on said first tube portion to terminate in an open end adjacent said first valve means;
   said auxiliary valve port being open in normal upright position of said valve assembly to bypass said second tube portion, but being closed by said gravity-operated check valve member when the valve assembly is inverted to close the bypass of said second tube portion.

2. A valve and dip tube assembly as defined in claim 1, wherein said auxiliary valve means is interposed at substantially the midpoint in the effective length of said dip tube means.

3. A valve and dip tube assembly as defined in claim 2, wherein said dip tube means comprises separate lengths of tubing interconnected by said auxiliary valve means.

4. A and dip tube assembly as defined in claim 2, wherein said dip tube means comprises integrally formed tandem tubing providing separate ducts which are interconnected by said auxiliary valve means.

5. A valve and dip tube assembly as defined in claim 2, wherein said dip tube means comprises integrally formed tubing providing separate ducts disposed one within the other which are interconnected by said auxiliary valve means.

6. A valve and dip tube assembly as defined in claim 1, wherein said auxiliary valve means is said auxiliary valve means is said辅助 valve means comprising a molded plastic housing having an interior chamber, said auxiliary valve means comprises at said interior chamber; said housing having a caje portion defining an elongated enclosure in which said gravity operated check valve member is confined for axial movement under the influence of gravity with change of position of said assembly; a transverse wall in said housing intermediate said interior chamber and said cage portion, said bypass port being locate in said wall and having a valve seat with which said gravity-operated check valve member coacts to close and open said port, and detent means projecting inwardly of said cage portion in spaced relation to said valve seat to limit axial movement of said shuttle member away from said seat.

7. A valve and dip tube assembly as defined in claim 6, wherein said detent means comprises a disk closing off the terminal end of said cage portion, said housing having a bypass intermediate said valve seat and closure disk providing lateral access to the interior of said housing.

8. A valve and dip tube assembly as defined in claim 6, wherein said housing is disposed at an angle to the axis of said first and second dip tube portions.

9. An auxiliary gravity-operated check valve for an aerosol valve and dip tube assembly, comprising:
   a hollow molded plastic housing having an open ended cage portion defining an elongated enclosure;
   a transverse wall in said housing forming an interior chamber therein and constituting an end wall of said cage portion to retain said check valve member therein; and duct means projecting from said housing and communicat- ing interiorly with said interior chamber for external connection of dip tube means to said housing.
10. An assembly as defined in claim 9, wherein the axes of said projecting duct means, said interior chamber and said cage portion are substantially coextensive.

11. An assembly as defined in claim 10, wherein the axes of said duct means are inclined to that of said cage portion.

12. An assembly as defined in claim 9, wherein said housing is formed to provide a lateral opening in said cage portion.