A low delivery rate aerosol valve including a valve body comprising an enlarged upper portion having a valve body cavity formed therein and an elongated lower portion having a plurality of expansion chambers therein which are interconnected in series by a plurality of restricted interconnecting channels that lead to the valve body cavity. The valve further includes an elongated dip tube fitted over the elongated lower portion of the valve body which are disposed relative to one another so that the plurality of expansion chambers may be formed on the outer surface of the elongated portion and in the inner wall of the elongated dip tube tail such that product flows through the series of expansion and restrictive channels to the valve body cavity and valve stem discharge orifice and thence dispensed through the terminal orifice.

14 Claims, 9 Drawing Figures
LOW DELIVERY RATE VALVE

BACKGROUND OF THE INVENTION

1. Field of the Invention
This invention relates to a low delivery rate aerosol valve comprising a plurality of expansion chambers interconnected by a corresponding plurality of interconnecting passages to deliver product at a reduced rate.

2. Description of the Prior Art
Aerosol dispensers generally comprise a container having valve means mounted in the upper portion thereof to control the discharge of product therefrom. Such valve means are commonly spring biased to seal the discharge opening when the dispenser is not in use. A dip tube generally extends downwardly into the liquid product to a point adjacent to the container bottom.

A gaseous propellant normally occupies the head space at the top of the container adjacent the valve means. When the container is full, product and propellant are located beneath the head space as product is dispensed. The head space increases causing some of the propellant to vaporize. The vaporization of propellant maintains the internal pressure substantially constant. As a result, the dispensing rate of the product remains relatively constant.

With the advent of the use of compressed gasses, such as NO₂, CO₂, and N₂, which frequently dissolve in the product, as the only propellant, the internal pressure is much higher. Therefore, a low delivery rate valve is needed to avoid undue expenditure of product and to avoid jet stream dispensing of product. For example, a rate of approximately 0.2 grams per second versus the customary 0.8 grams per second is now needed to provide a soft spray when such gases are used as the propellant.

Several methods have been developed to provide a slow discharge rate in aerosol dispensers. One such method employs the use of a capillary dip tube of very small inner diameter. This effectively slows the discharge rate of the liquid product. An even simpler technique to slow the discharge rate is to reduce the diameter of the discharge orifice. A third method is the use of a vapor tap which creates a leak from the head space into the discharge stream to reduce the pressure drop across a valve body orifice thereby reducing the flow of liquid into the valve body and out the terminal orifice.

Unfortunately, each of these methods exhibits certain disadvantages.

Specifically, it is difficult to maintain proper dip tube orientation when using a capillary dip tube. As a result, when the dispenser is used in the inverted position, the lower end of the dip tube is exposed to vapor rather than to the product to be dispensed. In addition, the limited dip tube capacity results in exhaustion of the liquid contents in the dip tube after which vapor is exhausted from the dispenser.

The reduced diameter discharge orifice is particularly susceptible to clogging with a product having a high solid content. In addition, the use of such small reduced diameter orifices can result in large discharge rate fluctuations because proportionally large variations in cross-sectional area result from variations in the orifice diameter which are within normal production tolerances.

The use of a vapor tap is not feasible when the product comprises large particles or droplets since vapor in the product stream tends to agitate and break up the fluid product into small particles defeating the possibility of the desired large particles in the spray.

Thus, there is a need for an effective means of producing a low delivery rate.

SUMMARY OF THE INVENTION
This invention relates to a unique low delivery rate aerosol valve. More specifically, the aerosol valve comprises a valve body including an enlarged upper portion and an elongated lower portion having a plurality of expansion chamber formed therein which are interconnected by a plurality of interconnecting passages which lead to the valve body cavity. The term elongated in referring to the elongated lower portion of the valve body is meant to describe a dimension and configuration of the lower portion being sufficient to have at least the upper portion of the dip tube attached thereto.

The valve body cavity formed in the enlarged upper portion communicates with a recess formed in the upper end of the elongated lower portion of the valve body. The lower end of the elongated lower portion includes restricted feed passage means comprising a plurality of restricted orifices and feed passages. The lower end of the restricted feed passage means is in communication with the interior of the aerosol dispenser while the upper end is in direct communication with the recess formed in the upper end of elongated lower portion of the valve body. A valve stem including an enlarged tail portion and a valve stem discharge orifice is movably disposed within the valve body cavity. A spring biased means disposed with the cavity normally biases the valve stem against a valve seal to close the valve.

In an alternate embodiment, the expansion chambers are formed on the outer wall of the elongated lower portion which is in cooperation with a dip tube tail secured to the outer surface of the elongated lower portion to cooperatively form the expansion chambers previously described.

In operation, product is dispensed by depressing the valve button and valve stem affixed thereto. As the button is depressed, the discharge orifice of the valve stem is exposed to the interior of the valve body allowing product to flow from the interior of the aerosol dispenser through the restricted orifice and feed passages through the recess and cavity. From there, the product flows through the discharge orifice of the valve stem and out the terminal orifice formed in the face of the valve button. The flow of product through the series of restricted orifices and expansion chambers flows along a circuitous route due to the relative dispositions and orientations of the successively arranged restricted orifices or channels and expansion chambers. This permits delivery at a low rate even with the use of extremely high pressure propellants such as compressed gas and the like. The structure of the restricted feed passage means also continuously reblends the product during the dispensing cycle.

The invention accordingly comprises the features of construction combination of elements and arrangement of parts which will be exemplified in the construction hereinafter set forth and the scope of the invention will be indicated in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS
For a fuller understanding of the nature and objects...
of the invention, reference should be had to the following
detailed description taken in connection with the
accompanying drawings in which:

FIG. 1 is a cross-sectional side view of one embodi-
ment of the invention mounted in an aerosol dispenser.
FIG. 2 is a side sectional view, partly broken away
and in section, of the valve body of the invention.
FIG. 3 is a partial side view of the invention.
FIG. 4 is a partial side view of an alternate embodi-
ment of the subject invention.
FIG. 5 is a cross-sectional view taken along line 5—5
of FIG. 2.
FIG. 6 is a cross-sectional side view of another embodi-
ment of the invention.
FIG. 7 is a partial side view of the alternate embodi-
ment of FIG. 6.
FIG. 8 is a partial side view of still another embodi-
ment of the invention.
FIG. 9 is a partial cross-sectional side view of the embodi-
ment of FIG. 8 taken along line 9—9 of FIG. 8.

Similar reference characters refer to similar parts
throughout the several views of the drawings.

DETAILED DESCRIPTION OF THE PREFERRED
EMBODIMENT

FIG. 1 shows the aerosol valve of the present inven-
tion generally indicated as 10 in combination with a
typical aerosol dispenser generally indicated as 12.
Aerosol dispenser 12 includes container 14 and mount-
ing cup 16 attached thereto.

Aerosol valve 10 comprises valve body 18 which in-
cludes sealing means 20 which is positioned in sealing
engagement with and tubular valve stem 22, also con-
sidered a part of valve body 18. Valve body 18 com-
prises an enlarged upper portion 24 having valve cavity
26 formed therein and an elongated lower portion 28
having a recess 30 formed therein. Formed in the lower
end of elongated portion 28 is restricted feed passage
means generally indicated as 32.

As best shown in FIGS. 1, 2, and 5, 3, restricted feed
passage means 32 comprises a plurality of expansion
chambers 34 each comprising a pocket bracket inter-
connected by a plurality of restricted feed channels 36.
The plurality of expansion chambers are arranged in
substantially successive relation to one another and
each two successively arranged chambers are intercon-
ected by at least one restricted feed channel. The ini-
tial expansion chamber 34a communicates with the in-
terior of container 14 through passage 38 while the last
expansion chamber 34b communicates with recess 30
through passage 40 as best shown in FIG. 2. It should
be noted that expansion chambers 34 are arranged rel-
ative to each other to provide extreme changes of di-
rection of the fluid as it passes through the restricted
feed passage means 32 to cause a continuous rebend-
ing of the fluid as it is dispensed from the dispenser.
The restricted feed channels 36 with expansion cham-
ber 34 in combination with the circuitous routing of the
fluid also creates a low delivery rate.

As best shown in FIG. 1, valve 10 is contained within
the central turret portion of mounting cup 16. Tubular
valve stem 22 extends through aperture 42 formed in
sealing means 20. Valve stem 22 includes discharge or-
ifice 44. Valve stem 22 is disposed within cavity 26, and
is spring biased to the normally closed position by the
valve spring 46. In this position discharge orifice 44 is
disposed in sealing engagement with sealing means 20.

Spring 46 is compressed between the lower portion 48
of stem 22 and ledge 50 formed by the lower end of of
recess 30. Button actuator 52 including terminal orifice
44 is affixed to the upper portion of valve stem 22.
Sealing means 20 is wedge formed between the upper portion
of valve body 18 and mounting cup 16.

FIG. 4 shows an alternate embodiment identical to
the embodiment of FIGS. 1 through 3 except at least
two sets of restricted feed channels 36 and expansion
chambers 34 disposed in substantially parallel planes
are arranged vertically along elongated lower portion
28.

FIGS. 6 and 7 show an alternate embodiment of the
present invention. The valve body generally indicated
as 56 comprises enlarged upper portion 58 extending
downward to a reduced elongated lower portion 60.
Valve body cavity 62 is formed in upper portion 58
while recess 64 in direct communication therewith ex-
tends downward into the upper end of elongated lower
portion 60. Recess 64 includes stepped recess 66. Dip
tube 68 is attached to the outer surface of elongated
lower portion 60 as best shown in FIG. 6. Restricted
feed passage means comprises expansion chamber 70
formed by recesses 72 and the inner wall 74 of dip tube
68 interconnected by restricted feed channels 76. Re-
stricted feed channels 76 may comprise a constant di-
ameter passage or a stepped diameter as shown in FIG.
5. The interior of container 14 communicates directly
with the lower most expansion chamber 70a while the
uppermost expansion chamber 90b communicates with
the stepped recess 66. As previously described, the en-
tire valve body 56 is mounted to mounting cup 16 and
includes the valve stem 22 and bias means 46.

FIGS. 8 and 9 shown still another alternate embodi-
ment of the low delivery rate valve wherein a restricted
feed passage means comprises a plurality of diagonally
disposed expansion chambers 78 formed about the
outer surface of the elongated lower member 80 inter-
connected by a series of restricted feed channels 82
formed transversely across member 80 to the next adja-
cent diagonally disposed expansion chamber 78.

It should be noted that in the last alternate embodi-
ment, expansion chamber 78 may be angular, V-shaped
or oval shaped.

By varying the shapes and relative sizes of both the
expansion chambers and restricted feed channels the
discharge characteristics of the product may be varied.

With reference to FIGS. 1 through 5, button actuator
52 is depressed and discharge orifice 44 is exposed to
the interior valve body cavity 26. This allows product
to flow from the interior of container 14 through
expansion chambers 34 and restricted feed channels 36
of restricted feed passage means 32 and into valve body
cavity 26. The product flows from valve body cavity 26
through discharge orifice 44 into discharge passage 45
of valve stem 22 and out terminal orifice 54.

Each alternate embodiment operates identically to
the embodiment shown in FIG. 1. That is in FIGS. 6
and 7, product flows through the restricted feed means
into stepped recess 66 through recess 64, valve body
cavity 62 and from thence to discharge orifice 44, dis-
charge passage 45 and out terminal orifice 54. In the
alternate embodiment of FIGS. 8 and 9, product flows
through restricted feed channels 82 and expansion
chambers 78 into valve body cavity 62 and from there
through discharge orifice 44 into discharge passage 45
and out terminal orifice 54.
The circuitous route of product through the restricted feed channels and expansion chambers creates a low delivery rate. In addition, the positioning of the expansion chambers relative to each other and to the restricted orifice channels causes a continuous rebending of product as it is dispensed.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained, and, since certain changes may be made in the above construction without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

Now that the invention has been described, what is claimed is:

1. A low delivery rate aerosol valve for use in combination with an aerosol dispenser comprising a valve body including an enlarged upper portion and a lower portion connected to said upper portion, said enlarged upper portion including a valve body cavity formed on the interior of said valve body, restricted feed passage means formed in said lower portion in fluid communication with said valve body cavity, a valve stem movably mounted within said valve body cavity to open and close the valve, said restricted feed passage means comprising a plurality of expansion chambers and a plurality of restricted channels, said plurality of expansion chambers disposed in substantially successive relation to one another, each two successively disposed expansion chambers interconnected by at least one of said plurality of restricted channels, said successively arranged plurality of expansion chambers and plurality of restricted channels disposed in predetermined flow reversing relation to one another so as to substantially reverse the main fluid flow through said restricted feed passage means, said restricted feed passage means disposed in fluid communicating relation between said valve body cavity and the interior of the dispenser, whereby upon actuation of the valve the contents of the dispenser pass through said restricted feed passage means to the atmosphere.

2. A low delivery rate aerosol valve as in claim 1 wherein said plurality of expansion chambers and said plurality of restricted channels include a first predetermined number of expansion chambers and restricted channels arranged in interconnected, fluid communicating relation to one another and disposed in a substantially planar configuration.

3. A low delivery rate aerosol valve as in claim 2 wherein said restricted feed passage means comprises a second plurality of expansion chambers and restricted channels arranged in interconnected relation to one another and disposed into a substantially planar configuration in spaced, substantially parallel relation to the planar configuration defined by said first predetermined number of expansion chambers and interconnected restricted channels.

4. A low delivery rate aerosol valve as in claim 1 wherein said plurality of expansion chambers and said plurality of restricted feed channels comprise a substantially circuitous configuration such that fluid flow through said plurality of expansion chambers and restricted feed channels encounters a directional change of at least 90° as the fluid passes through the restricted feed passage means.

5. The low delivery rate aerosol valve of claim 1 wherein said restricted feed passage means includes a second plurality of expansion chambers disposed between said first plurality of expansion chambers and the interior of the aerosol dispenser, each said expansion chamber of said second plurality being disposed in substantially the same plane.

6. The low delivery rate aerosol valve of claim 5 wherein said common plane of said first plurality is substantially parallel to said common plane of said second plurality.

7. The low delivery rate aerosol valve of claim 1 wherein said valve body further includes a dip tube attached to said elongated lower portion of said valve body, each said expansion chamber cooperatively formed by a recess formed on the side wall of said elongated lower portion and the inner surface of said dip tube.

8. The low delivery rate aerosol valve of claim 7 wherein each said expansion chamber comprises an elongated recess formed longitudinally on said side wall of said elongated lower portion.

9. The low delivery rate aerosol valve of claim 7 wherein each said expansion chamber comprises a diagonally disposed recess, each said expansion chamber interconnected to the next adjacent said expansion chamber by one of said restricted feed channels formed transversely through said elongated lower member.

10. The low delivery rate aerosol valve of claim 9 wherein each said expansion chamber comprises an oval shaped cross-sectional area.

11. The low delivery rate aerosol valve of claim 9 wherein each said expansion chamber comprises a V-shaped cross-sectional area.

12. The low delivery rate aerosol valve of claim 7 wherein each said expansion chamber and said corresponding restricted feed channel are angularly inclined relative to each other.

13. The low delivery rate aerosol valve of claim 1 wherein the diameter of each of said plurality of channels is different.

14. The low delivery rate aerosol valve of claim 1 wherein each of said adjacent channels comprises a different diameter.
UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,893,597  Dated July 8, 1975

Inventor(s) Ronald F. Ewald

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 30, "90b" should read -- 70b --.

Column 5, line 39, delete "predetermined".

Signed and Sealed this thirtieth Day of December 1975

[SEAL]

Attest:

RUTH C. MASON  C. MARSHALL DANN
Attesting Officer  Commissioner of Patents and Trademarks

Attest: