# United States Patent

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[54] **IMPROVED AEROSOL VALVE WITH GASKET DEFORMATION TO ENHANCE SEALING**
**3 Claims, 1 Drawing Fig.**


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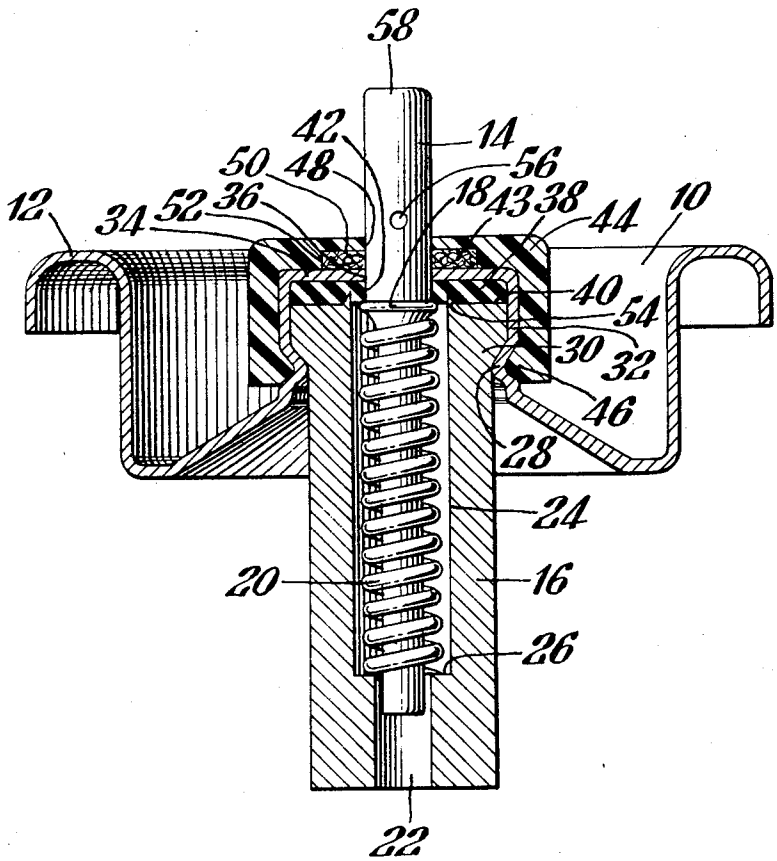
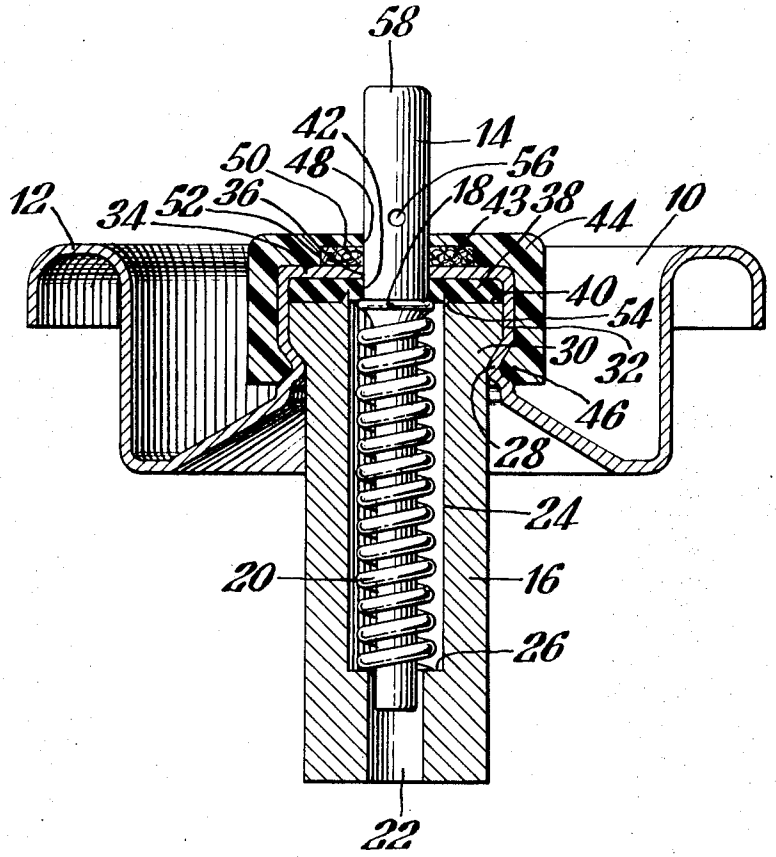
**ABSTRACT:** An improved valve assembly for an aerosol dispensing system is provided comprising a valve stem movable between a dispensing and a nondispensing position and a sealing gasket tightly surrounding said stem. An annular protuberance in said valve assembly projects against the gasket and deforms the gasket from its normal shape compressing it against the valve stem to enhance the sealing action. By a further aspect of the invention, a lubricator washer and a retaining lubricator cap are positioned externally of the container of the dispensing system to provide lubrication of the valve stem overcoming undue resistance to axial movement thereof.

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# IMPROVED AEROSOL VALVE WITH GASKET DEFORMATION TO ENHANCE SEALING

The present invention relates to aerosol dispensers, and more particularly to the structure and arrangement of the valve assembly provided in the container of an aerosol dispensing system.

Aerosol dispensing systems normally comprise a container or can within which is stored under pressure the aerosol formulation to be dispensed. A valve assembly is mounted in the container, usually at the top thereof, for the purpose of controllably effecting dispensing of the aerosol formulation from within the can to the exterior thereof. The valve assembly usually comprises a stem which is cylindrical in shape and which extends from interiorly of the container to the exterior thereof. Actuation of the stem, normally by axial movement thereof, operates to effect passage of aerosol formulation through the stem for dispensing. An actuator assembly which normally comprises an actuator button engaging the valve stem is mounted over the top of the container and when the actuator button is manipulated by a user, it effects movement of the valve stem thereby causing aerosol formulation to flow from within the container through the stem and through the actuator assembly to the point of ultimate use or application.

The valve assembly is usually fixedly mounted upon the container. However, due to the fact that the valve stem must be moved relative to the container, there is usually involved a sliding engagement between the outer surface of the valve stem and other structural elements of the valve assembly. Normally, the valve stem is surrounded by a gasket or similar means which tightly engages the stem to effect a seal but which enables sliding movement of the stem relative thereto. Because of this necessity for relative motion between the stem and other fixed components of the valve and container structure, a potential exists for the occurrence of unwanted leakage of aerosol formulation from the container. Additionally, clogging of the valve mechanism or jamming of the valve stem preventing necessary unrestricted movement thereof can occur due to unwanted deposits of aerosol formulation or for other reasons thereby rendering the aerosol dispenser inoperative. Problems of leakage, clogging and jamming are among the most important and significant obstacles which must be overcome in producing an operationally successful aerosol dispenser.

An important factor to be considered in resolving these obstacles is the nature of the aerosol formulation to be stored and dispensed. Certain valve structural arrangement will be appropriate for some types of aerosol formulations, e.g., liquid systems, while being inappropriate for other systems such as dry powder systems. Furthermore, any structural expedient which is utilized to overcome these problems must be adaptive to existing manufacturing techniques and apparatus and capable of being produced at an economically competitive cost.

It is an object of the present invention to provide an improved aerosol valve structure which is especially adaptable for use with dry powder aerosol systems which will enable effective valve stem operation while exhibiting improved performance with regard to leakage, clogging and jamming.

Another object of the present invention is to provide such an improved valve structure which may be simply produced and manufactured at an economically competitive cost.

Briefly, the present invention may be described as pertaining to a valve assembly for an aerosol dispensing system comprising a valve stem which is mounted in said valve assembly in a manner enabling axial movement thereof between a dispensing and a nondispensing position. A sealing gasket tightly surrounds the valve stem to prevent leakage of aerosol formulation. In accordance with the principles of the present invention, annular protuberant means are provided in the valve assembly proximate the valve stem, said protuberant means projecting against the gasket deforming the gasket from its normal shape and compressing it against the valve stem to enhance the sealing effect.



In a second aspect of the invention, a lubricator washer surrounding the valve stem in sliding engagement therewith is provided externally of the container means of the aerosol dispensing system, with a lubricator cap engaging said container means being provided to retain the lubricator washer in position.

A better understanding of the present invention may be had by reference to the following detailed description of a preferred embodiment thereof taken in connection with the accompanying drawing which comprises a single FIGURE showing in cross section an elevational view depicting the embodiment of the present invention.

In referring now to the drawing, there is shown a valve assembly mounted within a mounting cup **10** of an aerosol container. The mounting cup **10** includes a mounting curl **12** which extends circumferentially around the outer portion of the mounting cup **10** adapting the structure for mounting to the body of an aerosol container (not shown) which stores the aerosol formulation to be dispensed. The mounting curl **12** is suitably shaped and structured to permit leakproof attachment to a container in any appropriate manner which should be apparent to those skilled in the art. The portion of the mounting cup **10** located radially inwardly from the mounting curl **12** engages and supports the aerosol valve assembly in a manner to be described hereinafter.

The valve assembly comprises a vertically movable valve stem **14** mounted within a valve housing **16**. The valve stem includes an annular enlargement **18** which is engaged on the under side thereof by a spring **20** which biases the valve stem **14** in an upward direction. The lower end of the housing **16** comprises an opening defined by a cylindrical wall **22** through which aerosol formulation may flow from the aerosol container (not shown) to the inner portion of valve housing **16** defined by cylindrical wall **24**. It should be noted that the lower portion of the stem **14** is smaller than the diameter of cylindrical wall **22** thereby providing a spacing between the lower end of valve stem **14** and cylindrical wall **22** to permit aerosol formulation to flow to within the chamber defined by wall **24**. A step formed by horizontal wall **26** between walls **22** and **24** engages the lower portion of spring **20** and thereby maintains the spring **20** in compression between the step **26** and the enlargement **18**.

The valve housing **16** is firmly mounted in the container by mounting cup **10** and held securely in place by means of the particular configuration of mounting cup **10** which includes an indentation **28** engaging the underside of shoulder **30** formed in the upper portion of valve housing **16**. The mounting cup **10** extends from the indention **28** to a vertical cylindrical wall **32** tightly surrounding valve housing **16** and to an upper horizontal wall **34** which includes an opening defined by cylindrical edge **36** extending therethrough, the opening **36** surrounding the upper portion of valve stem **14** but being dimensioned to permit free vertical movement of the valve stem therethrough. A gasket **38**, preferably made of Buna N rubber, is positioned between the upper horizontal surface **40** of valve housing **16** and the upper horizontal wall **34** of the mounting cup **10**. The gasket **38** has therein an opening defined by wall **42** which is dimensioned to firmly engage the valve stem **14** to seal the interior of the valve housing **16** from the outer atmosphere.

Mounted about the valve stem **14** externally of the container and of the mounting cup **10** is a lubricator felt washer **43** enclosed and held firmly in place by a lubricator cap **44**. The lubricator cap **44** comprises an inverted cup shaped arrangement which overlies the central portion of the mounting cup **10** with the inner wall of the lubricator cap **44** lying against the outer surface of walls **32** and **34** of the mounting cup **10**. The lubricator cap **44** includes an annular nose **46** which engages the indentation **28** of mounting cup **10** thereby permitting the lubricator cap **44** to be firmly mounted upon the mounting cup **10**. A circular opening defined by wall **48** permits passage through the lubricator cap of the valve stem **14** and a recess defined by walls **50** and **52** firmly holds the lubricator felt washer **43** therein.

One of the most significant structural aspects of the present invention is an annular protuberance **54** formed in the valve housing **16** at the intersection of the walls **24** and **40** of the valve housing **16**. The functional and operational advantages brought about by this particular structural aspect of the present invention may be better appreciated by referring the leakage and clogging problems which may arise in the operation of a valve assembly in an aerosol dispensing system.

In the operation of the valve assembly described herein, dispensing of aerosol formulation is effected by downward depression of the valve stem **14** whereby the valve stem is caused to move against the bias of the spring **20** thereby compressing this spring. As previously noted, the spring **20** is held in compression between the step **26** and the enlargement **18** and thereby tends always to drive the valve stem **14** to its uppermost position depicted in the drawing. With the valve stem **14** depressed against the compression of spring **20**, an opening **56** in the valve stem **14** is moved from exteriorly of the aerosol container past the lubricator washer **43** and the gasket **38** to a position interiorly of the valve housing **16**. The portion of valve stem **14** above opening **56** is hollow and provides a vertical conduit interiorly of the stem **14** for aerosol formulation to flow through opening **56** and the hollow interior of stem **14** through an exit in the top section **58** of stem **14** which defines the termination of the internal vertical conduit within the stem **14**. Accordingly, with the opening **56** positioned below the gasket **38** and interiorly of the valve housing **16**, aerosol formulation will be caused to continuously flow through the valve stem **14** to be dispensed therefrom.

It should be noted that although the embodiment of the present invention disclosed herein is described in connection with a continuous flow valve, it need not be limited thereto and may be utilized with other type valves, such as metered flow valves and the like.

As previously pointed out, a basic consideration in determining the structural arrangement of a valve best suited to avoid leakage and clogging is the nature and composition of the aerosol formulation to be dispensed. Different types of aerosol formulations will present different problems with regard to adequate sealing of the dispensing mechanism. The present invention is intended for particular utilization with a dry powder aerosol system such as is described and claimed in U.S. Pat. No. 3,081,223 to P. E. Gunning and D. R. Rink issued Mar. 12, 1963.

In the operation of an aerosol valve system as described herein, the reciprocating movement of the valve stem as it is actuated between a dispensing and a nondispensing position results in frictional engagement between the external surface of the valve stem and the sealing gasket of the aerosol assembly thereby inducing deformation of the gasket. For example, in the specific structure depicted in the drawing, when the valve stem **14** is moved downwardly to effect dispensing, the frictional engagement between the exterior surface of the valve stem **14** and the surface **42** of gasket **38** causes some deflection of downward bending of the gasket **38**. Many factors will be pertinent to a determination of whether the amount of gasket deflection will cause operational problems in the valve assembly. Such factors as the types of materials used for the valve stem and the gasket, as well as the particular structural configuration of that portion of the valve housing **16** which supports the gasket **38**, will be factors to be considered.

It has been found that in dry powder aerosol systems when the gasket **38** is deflected downwardly, there occurs a separation between the external surface of the valve stem **14** and the surface **42** of the gasket **38**. This separation permits particles of aerosol formulation to become entrapped between the valve stem **14** and the gasket **38** thereby causing problems. It has been found that these problems can be very successfully and expediently overcome by a particular structural arrangement of the valve housing **16** in accordance with the principles of the present invention whereby the gasket is afforded sufficient structural support to avoid excessive gasket deformation by movement of the valve stem **14**.

The specific structural concept which has been found to effectively overcome in dry powder aerosol systems the problems discussed involves structuring of the portion of the valve stem **14** at which surfaces **40** and **24** intersect in the specific configuration comprising the annular protuberance **54**. As depicted in the drawing, the protuberance **54** extends completely around the edge of valve housing **16** at the intersection of surfaces **24** and **40**. Furthermore, the protuberance **54** should project into the gasket **38** a sufficient amount to effect some deformation thereof from its normal shape and compression of the gasket material about the valve stem **14**. As shown in the drawing, the protuberance **54** involves a narrow jutting edge which bites into the gasket **38** to force the material in a more compact arrangement about the valve stem **14**. However, depending upon the specific gasket material utilized, as well as other factors, certain variations from the specific shape and configuration of the protuberance **54** depicted and described in the drawing may be tolerated. For example, it may not be necessary to form the protuberance **54** with a narrow jutting edge but rather with a more rounded configuration.

It will be clear that the protuberance **54** provides structural support resisting the downward deflection of the surface **42** of gasket **38** when the valve stem **14** is moved downwardly. In providing such support, there are very important limitations which exist regarding the proximity of surface **24** of valve housing **16** to the valve stem **14** and the enlargement **18**. If, in attempting to provide maximum support for the gasket **38** the surface **24** is brought too close to the stem **14** and the enlargement **18**, there may exist interference between the enlargement **18** and a portion of the valve housing **16** which could impede the free movement of the stem **14** sufficiently to render the valve mechanism inoperative or to at least seriously detract from its effective utilization. Accordingly, in attempting to provide needed support for the gasket **38**, an important limitation exists with regard to the clearance which must be present between the enlargement **18** and the surface **24**. Because of those limitations, there will always be a portion of the gasket **38** which will overhang or extend beyond the surface **24** of valve housing **16**, the amount of this overhanging being dependent upon the clearance which must be provided. In the embodiment depicted in the drawing, the overhang will be the horizontal distance between surface **24** of valve housing **16** and surface **42** of gasket **38**. Accordingly, under normal circumstances, the limitations presented by this clearance requirement could create an obstacle to providing sufficient support for the gasket **38** to prevent undue deformation thereof.

By means of the present invention there is provided structural support for the gasket **38** which is greater than the support which could normally be provided within the limitations of the necessity for clearance between the valve stem **14** and the valve housing **16**. The protuberance **54** extends into the material of the gasket **38** and thereby effects a compression or firming of the material of the gasket **38**. Because of this, the gasket material surrounding the valve stem **14** is caused to be more resistant to downward deflection and less inclined to become deformed in such a manner that particles of aerosol formulation may become entrapped between the surface **42** and the valve stem **14**. It has been found that by utilization of the principles of the present invention, structural support for the gasket **38** may be provided in a dry powder aerosol system which is in excess of that which could be provided due to clearance limitations and which is sufficient to overcome and prevent problems of leakage, clogging and jamming thereby enabling production of a dependable, operative dry powder aerosol dispensing valve assembly.

As previously noted, many aspects of the operation of the valve mechanism of an aerosol system will be affected by the specific materials utilized. The valve stem **14** could be formed of several types of material, among those commonly in use being molded thermoplastic material or stainless steel. As previously mentioned herein, the gasket **38** is preferably

formed of Buna N rubber. The specific material utilized will affect the amount of friction which is developed between the outer surface of the valve stem **14** and the surface **42** of the gasket **38**. Under certain conditions, and with a combination of materials which create increased friction, it may be that compaction of the gasket **38** against the valve stem **14** by means of the protuberance **54** could sufficiently increase the frictional engagement between the outer surface of valve stem **14** and the surface **42** of gasket **38** to detract from the smooth movement of the valve stem **14** between the dispensing and the nondispensing positions. In order to avoid the effects of such increased frictional resistance, the lubricator washer **43** is provided about the valve stem **14** exteriorly of the aerosol container and of the mounting cup **10**. The purpose of the lubricator washer **43** is to provide a lubricant coating about the exterior surface of valve stem **14** as the valve stem is moved between the dispensing and nondispensing positions thereby to overcome the effect of any additional frictional resistance which might arise between the surface **42** of gasket **38** and the exterior surface of valve stem **14**. The washer **43** may be comprised of felt material which is impregnated with a lubricant, such as Ucon 1145. As the valve stem **14**, during normal use of the aerosol dispenser, is actuated in the axial direction, movement of the valve stem **14** against the washer **43** will cause application of lubricant to the external surface of the valve stem **14**, which surface as it moves across the surface **42** of gasket **38** will effect lessened frictional engagement due to the lubricating action created. Thus, there is created a mechanism overcoming frictional resistance to movement of valve stem **14** without consequently detracting from the deformation-preventing support which is provided to the gasket **38** by protuberance **54**.

In accordance with the principles of the present invention, and as a result of the simplified arrangement provided thereby, the washer **43** may be easily mounted upon the aerosol dispenser merely by positioning the washer over the valve stem **14** after assembly of the dispenser. The lubricator cap **44** may be thereafter positioned over the washer **43** and the central hub portion of the mounting cup **10** to hold the washer **43** securely in place about the valve stem **14** in a simple and expedient manner. The lubricator cap **44** may be comprised of molded thermoplastic material and may be easily snapped over the central hub portion of the mounting cup **10** into the position shown. Due to the nature of the material of the lubricator cap **44**, some deflection thereof is possible. Therefore, when the nose **46** encounters the wall **32** of mounting cup **10**, it will cause some outward deflection of the nose **46** thereby enabling it to slide over the wall **32** into the position shown engaging the indentation **28** thereby holding securely in place both the washer **43** and the lubricator cap **44**. It will be clear that the specific structural arrangement of washer **43** and lubricator cap **44** described herein enables optional utilization of these elements of the invention. If it is desired to construct the aerosol dispenser without a lubricator washer **43** and lubricator cap **44**, this may be easily accomplished with no affect upon other components of the structure. However, utilization of lubricator washer **43** and lubricator cap **44** may be easily and simply provided, if desired, subsequent to assembly of the aerosol container and valve structure.

We claim:

**1.** In a valve assembly for an aerosol dispensing system comprising container means storing aerosol formulation to be dispensed, means firmly mounting said valve assembly to said container means, means including said valve assembly defining an opening, a valve stem extending through said opening and mounted in said valve assembly in a manner enabling axial movement thereof, conduit means defined by said valve stem and extending therethrough, said valve stem being axially movable movable between a dispensing position wherein said conduit means is placed in flow communication with the interior of said container means, and a nondispensing position stopping said flow communication, and gasket means mounted in said valve assembly encircling said valve stem in tight sliding engagement therewith enabling said axial movement of said valve stem between said dispensing and nondispensing positions while providing a seal for said opening preventing undue leakage of aerosol formulation therethrough, the improvement comprising annular protuberant means in said valve assembly closely adjacent said valve stem projecting beyond and through the limits of the outer surface of said gasket means and deforming said gasket means from its normal shape thereby compressing said gasket means about said valve stem to enhance said sealing action and a lubricating washer being mounted externally of said container means closely surrounding said valve stem in sliding engagement therewith.

**2.** A valve assembly according to claim **1** wherein said protuberant means comprise a narrow edge defined by a portion of said valve assembly projecting against said gasket means causing said deformation.

**3.** A valve assembly according to claim **1** comprising a lubricator cap overlying said lubricating washer and firmly engaging said container means to hold said washer in place about said valve stem.