Sept. 18, 1962 P. H. SAGARIN 3,054,536

VALVE AND CLOSURE CONSTRUCTION FOR AEROSOL DEVICES

Filed Jan. 20, 1960 3 Sheets-Sheet 1

Fig. 1

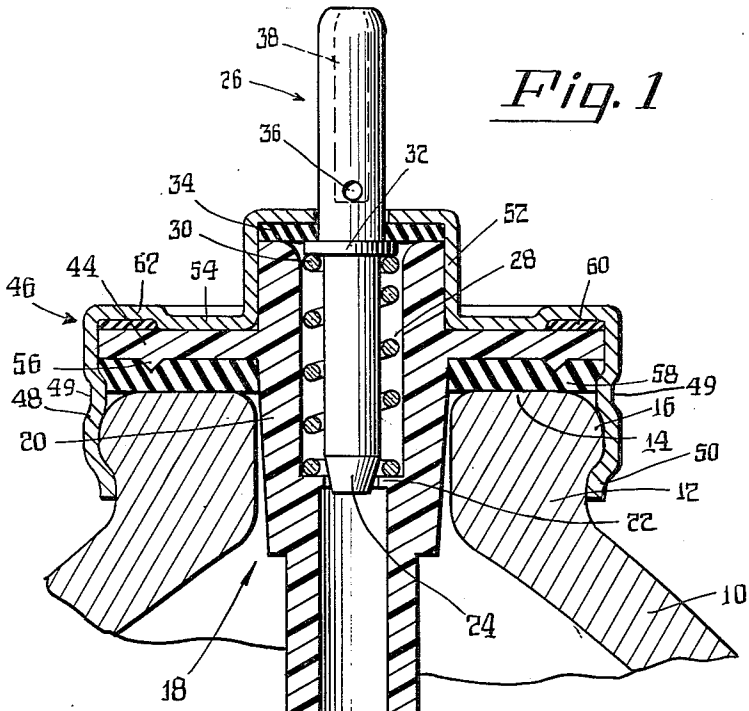


Fig. 3

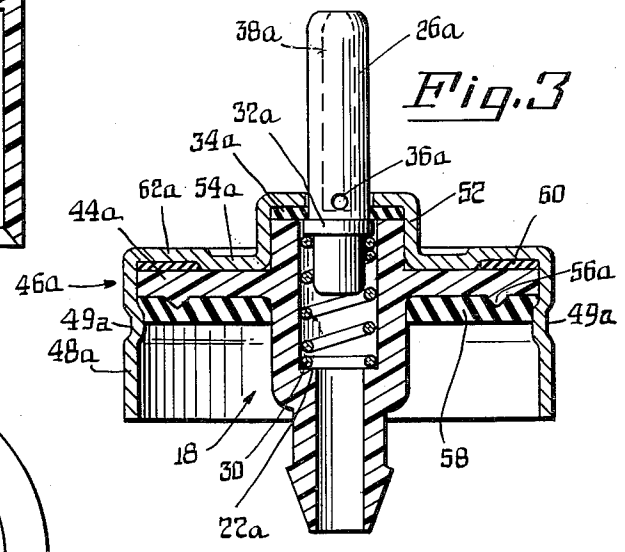
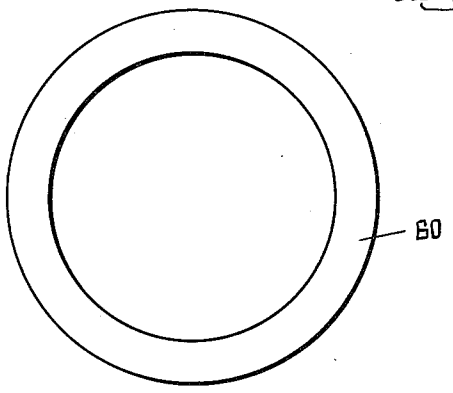


Fig. 2



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Fig. 4

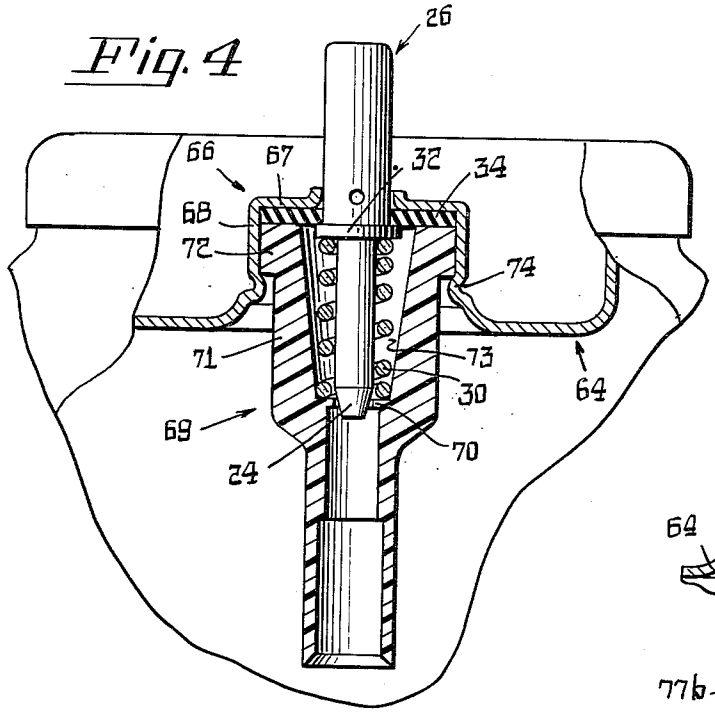


Fig. 8

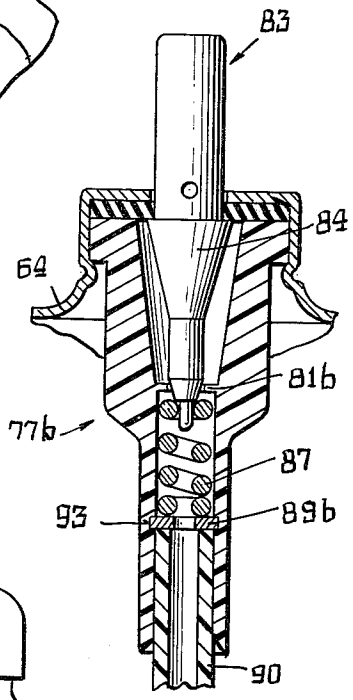


Fig. 5

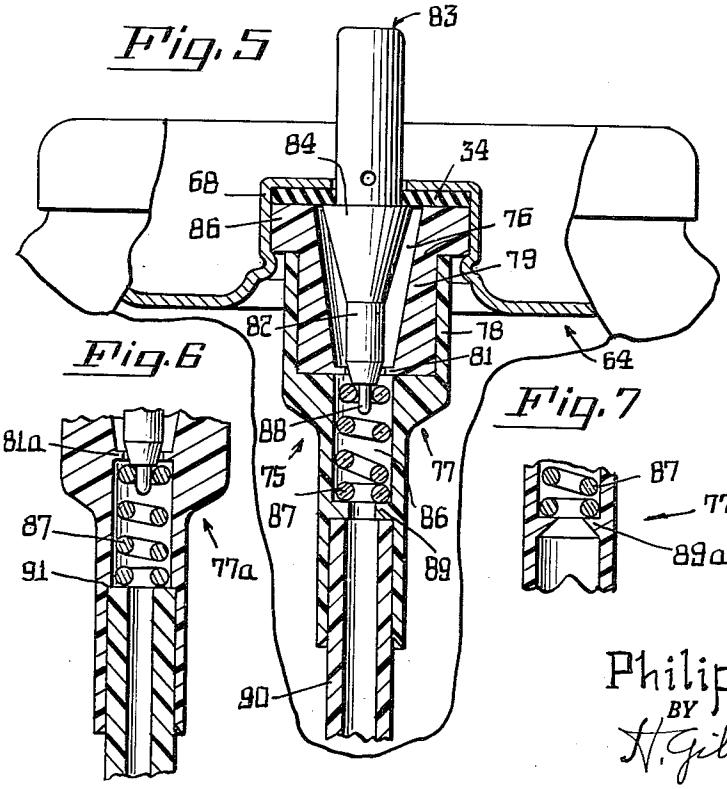


Fig. 6

Fig. 7

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VALVE AND CLOSURE CONSTRUCTION FOR AEROSOL DEVICES

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Fig. 9

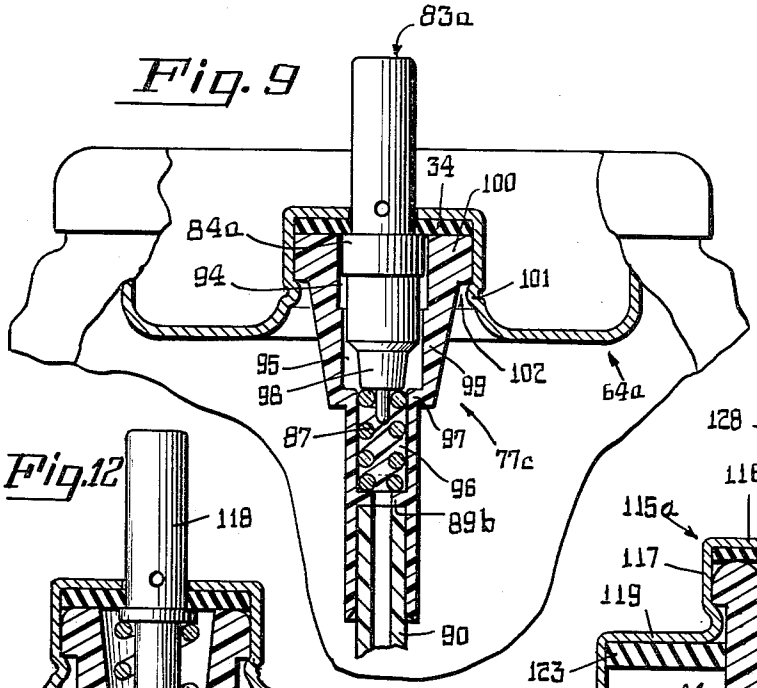


Fig. 12

Fig. 11

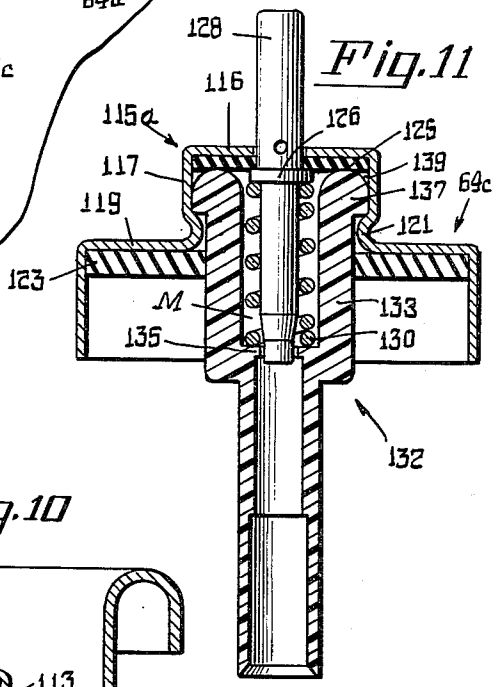
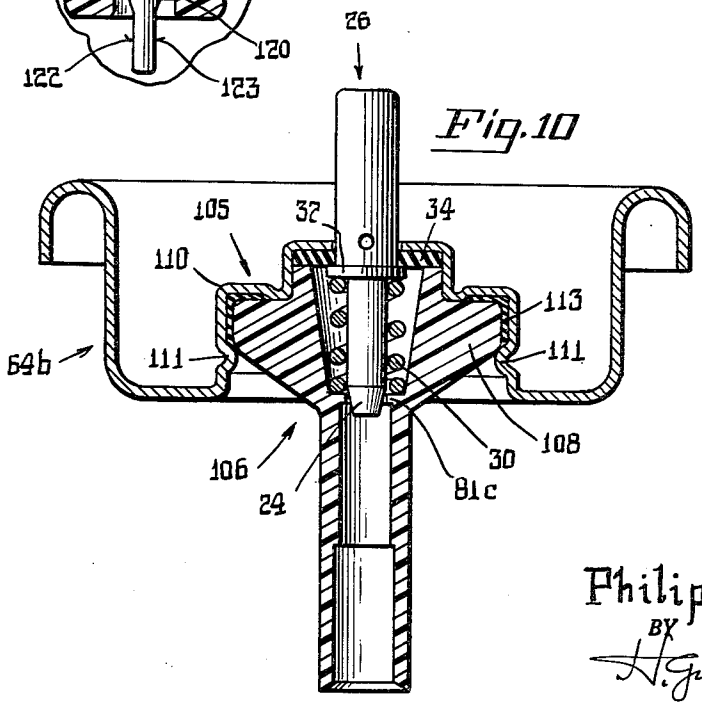


Fig. 10



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3,054,536

VALVE AND CLOSURE CONSTRUCTION FOR AEROSOL DEVICES

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Filed Jan. 20, 1960, Ser. No. 3,619
8 Claims. (Cl. 222—394)

This invention relates to small aerosol devices of the type having a pressurized container intended to be held in the hand for dispensing various substances, and more particularly to valve and closure structures as employed in such devices to close the pressurized container and effect and control the dispensing of the contents thereof.

In small hand-held aerosol devices employing pressurized containers, the dispensing of the aerosol substance is controlled by a manually operable valve which, in its most common form, is constituted as a small hollow valve stem having an annular enlargement constituting the valve proper, the said stem being longitudinally shiftable in a container closure structure between an extended, valve-closing position and a depressed, dispensing or valve-opening position.

Early in the development of these aerosol devices the container closure structure and also the valve stem were made up of a multiplicity of parts, mostly of metal, secured together in assembled relation by various means. Thus, the cooperable portions or components constituting the valve mechanism were fabricated as separate pieces, some of which were assembled to or united with the container closure structure, and to obtain certain functions such as a metering discharge, smooth action of the valve stem, etc. different kinds of separate metal parts or pieces were utilized, in conjunction with sealing and valve washers, packings, and the like. This prior type of construction accordingly was characterized by a relatively large number of components, generally of metal which is susceptible to corrosion, and by various assembly operations, all of which resulted in high fabricating cost and at times impaired operation.

More recently, there has been a trend toward simplification and economy, as by a reduction in the number of parts or components utilized in the valve and closure structures, while at the same time moving toward greater reliability. In attaining this, molded pieces were employed, and as the art developed further there were produced resilient closure and valve structures wherein a single molded or cast housing member constituted not only a main closure or sealing element for the container but also provided the valve housing and an expansible valve ring or sleeve portion for cooperation with the movable valve stem. Such construction eliminated a number of individual components and resulted in desirable economies in the fabrication and assembly of the devices, and provided in addition an improved operation in some respects. However, where such molded components as valve housings and the like have been relied on in a pressurized aerosol device there existed the problem of effectively mounting the plastic closure-housing member and also the problem of preventing leakage, not only when the container was made of metal as in the form of a can but also where the smaller-mouthed glass or similar bottles were utilized.

A number of such problems attendant the use of molded unitary resilient plastic closure and valve structures are solved by the present invention, and one object of the invention is to provide a novel and improved combination valve seat and closure construction for small aerosol devices of the type outlined above, wherein a simple yet extremely effective and reliable seal of the pressurized container by the closure is had while at the same time utilizing a resilient molded plastic main component constituted as a combined valve housing, expansible valve ring or sleeve, and main closure member.

Another object of the invention is to provide a simplified and effective combined sealing and mounting means in conjunction with a resilient plastic member constituted as both a closure and valve seat or part.

Yet another object of the invention is to provide in an aerosol device of the above type an improved clamping or crimping type seal and mounting means employing axial or radial forces or both, in conjunction with a molded, resilient valve housing, closure and expansible valve sleeve element wherein the said means does not adversely affect or impair the operation of the valve or flow-control structure.

A further object of the invention is to provide an improved expansible valve sleeve and closure structure for aerosol devices as above set forth, wherein relatively few, simple components are involved in effecting the improved seal and mounting, and wherein the assembly of such components may be economically effected, thereby to not appreciably increase the overall cost of the device.

The above objects are accomplished, in accordance with the invention, by the provision of a novel combination including a molded resilient valve sleeve, valve housing and closure element having an exterior, resilient but stiff, mounting and sealing ledge or flange in conjunction with annular, resilient, relatively soft and readily compressible sealing means disposed against the supporting flange or ledge of the molded member, and with clamping or abutment structures which are cooperable with the flange or ledge. This combination is characterized by three important factors, these being the use of a resilient yet relatively stiff plastic substance or composition; a relatively thin and readily yieldable wall section constituting the expansible valve ring or sleeve portion, and a relatively thick or heavy and unyielding wall section forming or adjoining the sealing and mounting flange or ledge of the member. The organization further may involve a second or an additional annual "soft" sealing means, and the latter may be arranged for engagement with another surface of the ledge or flange, and in some circumstances with the lip portion of the pressurized container whereas the first-mentioned "soft" sealing element is engaged especially with the inner surface of the metal mounting cup or shell of the closure assemblage. Further, effective and simple confining means may be provided for the said "soft" sealing elements, and the supporting flange or ledge of the molded member may be provided with a special configuration which is cooperable with one of the said sealing elements, all to the end that the molded member will be reliably held in place by the mounting cup or shell and will effect a perfectly tight and reliable seal of the container in conjunction with the container lip throughout the useful life of the aerosol device, without impairment of the valve function.

In the construction where a "soft" annular sealing element is arranged for engagement with the container lip such element has appreciable thickness, and the special configuration of the supporting flange or ledge of the molded member comprises an annular shoulder or bead arranged for imbedment into the said relatively thick sealing annulus, thereby to effectively cope with variations of the container lip and to provide an effective seal thereto at all times.

At the upper side of the resilient supporting flange or ledge of the molded member a somewhat thinner annular sealing element is provided in accordance with the invention, the lesser thickness being feasible due to the greater

uniformity which is possible in the configuration of the supporting flange and mounting cup or shell.

In one form of the invention, to accommodate the thinner sealing element and to provide a confining means therefor, the upper wall of the mounting shell is provided with an upwardly displaced or offset peripheral portion, providing in the undersurface of said wall a shallow annular groove in which the thinner sealing element is disposed and confined. In this sealing construction as provided by the invention the supporting flange of the molded member is subjected to oppositely-directed clamping pressures, such clamping pressures being exerted or transmitted at least in part by the said two annular sealing elements. In addition the undersurface of the mounting shell is made to engage the upper face of the supporting flange whereby the shell may constitute an unyielding, pressure-applying means acting directly on the upper surface of the supporting flange as well as indirectly thereon through the medium of the thinner sealing element. I have found that by such construction there is effected a uniformly tight, reliable seal of the pressurized container in conjunction with the expansible valve sleeve, valve housing and closure element, and the metal mounting cup or shell. This sealing construction is not only reliable at all times, but involves relatively few components which may be readily fabricated and assembled.

Yet another object of the invention is to provide a simplified valve and closure construction for an aerosol device, utilizing an easily molded resilient flanged or ledged closure, housing and expansible valve sleeve element, wherein the valve spring is disposed remote from the mounting ledge or flange and outside of the metering chamber, thereby to provide maximum freedom in the design and size of the said chamber, and insure against interference with the valve spring action.

Other features and advantages will hereinafter appear.

In the drawings accompanying this specification similar characters of reference are used to designate like components throughout the several views, in which:

FIGURE 1 is an axial sectional view, enlarged, of a novel and improved valve and closure construction for an aerosol device as provided by the invention, illustrating a metering-type valve.

FIG. 2 is a top plan view of the thinner one of the two sealing elements associated with the supporting flange of the molded one-piece valve housing and closure member as utilized in the construction of FIG. 1.

FIG. 3 is an axial sectional view of a valve and closure construction as provided by the invention, illustrating a non-metering type valve.

FIG. 4 is an axial sectional view of a metering-type valve and closure construction intended for use with wide-mouthed containers, as for example metal cans and the like.

FIG. 5 is an axial sectional view of another valve and closure structure of the metering type, as provided for use with wide-mouthed containers. This valve and closure structure utilizes a valve return spring which is disposed out of and below the metering chamber.

FIG. 6 is a fragmentary axial sectional view of a valve construction somewhat similar to that of FIG. 5, but showing another type of stop or abutment means for the valve return spring.

FIG. 7 is a fragmentary axial sectional view of a valve construction illustrating yet another type of stop or abutment means for the valve return spring.

FIG. 8 is an axial sectional view of a valve construction similar to that of FIGS. 4–7, but illustrating still another type of stop or abutment means for the valve return spring.

FIG. 9 is a fragmentary axial sectional view of an aerosol valve and closure construction illustrating another form of the invention wherein the mounting flange or ledge of the molded valve housing and closure member is connected to the lower part of the tubular body portion of the member and is made to have appreciable mass or thickness whereby it may withstand considerable radial clamping forces or radial components of clamping forces.

FIG. 10 is a fragmentary axial sectional view of an aerosol valve and closure construction of the type having the valve spring disposed below the metering chamber, this construction being characterized by simple molding of the resilient plastic closure and valve housing element.

FIG. 11 is an axial sectional view of an aerosol valve construction illustrating a modified form of snap-in assembly, somewhat similar to the snap-in assembly of FIG. 9 but adapted for small-mouthed containers such as glass bottles and the like.

FIG. 12 is a view partly in axial section and partly in side elevation of a molded plastic valve housing and valve stem assemblage, illustrating another embodiment of the invention.

Referring first to FIGS. 1 and 2 there is illustrated a pressurized container **10** which may be of the glass bottle type, said container having a reduced neck portion **12** and a top lip **14**, the latter including an annular peripheral exterior bead **16**. Disposed within the container neck portion **12** and extending into the container is a molded one-piece resilient valve housing and closure member designated generally by the numeral **18**, which has an expansible annular valve ring or sleeve portion adapted to be engaged and slightly spread by a valve stem. The molded member **18** may be advantageously constituted of a linear polyethylene or similar formulation which is quite stiff although yieldable without rupture, having a tough characteristic. This type of material also has somewhat a "memory" quality, since when deformed it will always tend to return to its original shape. The member or element **18** may have a tubular main or body portion **20** which is shown as being slightly tapered, said portion being provided with an annular thin-walled, expansible valve seat configuration **22** in the form of an internal annular shoulder, the valve seat **22** being cooperable with and slightly spreadable by the lower tapered and cylindrical end portion of a vertically movable valve stem **26** which latter is slidably mounted in the molded member **18**. The valve stem **26** may also be of plastic, as for example of nylon (synthetic fibre-forming polymeric amide).

The valve construction shown in FIGS. 1 and 2 is of the metering type, and the tapered and cylindrical lower end portion **24** of the valve stem in conjunction with the valve seat **22** comprises a first valve means which controls the flow of the aerosol substance from the container **10** into a metering chamber **28** constituted as the bore of the body portion **20** of the valve housing **18**. Within the metering chamber **28** there is disposed a helical compression spring **30** at its lower end bearing against the internal shoulder **22** and at its upper end engaging a valve enlargement **32** provided on the valve stem **26**, said enlargement being cooperable with a valve disc or seat member **34** and constituting therewith a second valve means, by which the flow of aerosol substance from the metering chamber **28** out through the discharge orifice of the aerosol device is controlled.

The valve stem **26** has an axial discharge channel **38** and a lateral opening **36** in its upper portion, the opening **36** being normally disposed above the valve seat member **34** as shown in FIG. 1. The valve stem **26** is in the non-discharging or closed position as seen in this figure, the closure being effected by engagement of the valve enlargement **32** with the valve seat member **34**. Such engagement, as will be understood, is maintained by the compression spring **30**.

Upon the valve stem **26** being depressed or shifted downward when considering FIG. 1, the spring **30** will be compressed and the valve enlargement **32** will be separated from the valve seat member **34**; also the side opening **36** of the valve stem will be disposed within the metering chamber **28**. In consequence, the contents of

the metering chamber, under pressure, will be discharged through the opening 36 and bore 38, and will issue as a spray from the aerosol device. The depressing of the valve stem 26 will dispose the lower tapered and cylindrical portion 24 thereof within and in engagement with the valve seat 22 of the valve housing 18, thereby shutting off any further flow of the aerosol substance from the container 10 into the metering chamber 28. Upon the valve stem 26 being released, the return spring 30 will return it to the upper position shown in FIG. 1, where the metering chamber is again charged and the valve means 32, 34 is closed, preventing further discharge of the aerosol substance. The above metering valve action is well understood in the art.

By the present invention in connection with different types of containers the resilient plastic element 18 with its expansible valve ring 22 is securely mounted by means utilizing clamping-type forces, which means also effects a secure seal of the container which is used. In FIGS. 1–3, considered first, a narrow-necked, bottle type container is utilized. For this purpose the molded valve housing and closure member 18 has an annular outwardly extended supporting flange or ledge 44 disposed intermediate its ends, said flange being engageable with a metallic mounting cup or shell designated generally by the numeral 46, by which the molded member is mounted or secured in place on the pressurized container 10. The mounting shell 46 has a depending skirt or flange portion 48 within which the annular mounting flange 44 of the member 18 is disposed and closely fits, said flange being forced upward past inwardly struck nibs 49 in a manner described later in connection with FIG. 4 and similar nibs. The skirt 48 surrounds the lip 14 of the container 10, and is clinched or spun under the bead 16 of the container lip, as indicated at 50. The mounting shell 46 also has a central, upwardly offset or cupped portion 52 surrounding the upper part of the molded member 18 and enclosing and positioning the valve seat member 34 as shown, said cupped portion imparting a desirable stability to the molded member.

In accordance with the invention, in conjunction with the large, radical supporting or mounting flange 44 of the molded member 18 there is provided a novel and improved confined sealing means by which an extremely effective and reliable seal is established between the flange 44 and the lip portion 14 of the container, and also between the said flange and the upper wall 54 of the mounting shell 46. Also, the supporting flange 44 is given a special configuration or shape at its undersurface, for engagement with a thick sealing means or element, and as illustrated in FIG. 1 this configuration comprises a sharp or pointed annular bead or rib 56, which is arranged for imbedment in the relatively thick sealing washer or annulus 58 disposed between the flange 44 and the lip portion 14 of the container 10. It will be noted that the sealing annulus 58 is confined on four sides, that is, its upper face is engaged with the flange 44, its lower face engaged with the lip portion 14, the outer peripheral surface engaged with the skirt 48 of the shell 46, and the inner peripheral surface is engaged with the body portion 20 of the molded member 18. Accordingly, when the sealing member 58 is subjected to compressive forces it will not be able to flow or be displaced to any appreciable extent even though it will distort somewhat and accommodate itself to the shouldered undersurface of the flange 44 and to any irregularities in the lip portion 14 of the container 10. The ledge or flange 58 when thus clamped by the wall 54 of the mounting shell 46 constitutes a stiffening means which tends to limit inward collapsing movement of the walls 20 of the valve housing 18 whereby interference with the action of the valve return spring 30 is prevented.

Further, in accordance with the present invention, a thin sealing element 60 is provided, engaged with the upper surface of the supporting flange 44, the said sealing element being appreciably thinner than the element 58 and being confined by a special configuration given to the upper wall 54 of the shell 46. As seen in FIG. 1, the said wall is provided with an upwardly displaced annular peripheral portion 62 by which there is formed a shallow annular groove at the inside of the shell 46. The said annular groove is arranged to accommodate the thinner annular sealing element 60 provided by the invention, and to confine the same as may now be understood from an inspection of FIG. 1. The thinner sealing element 60 is confined at four sides, that is, its undersurface engages the supporting flange 44 of the molded member 18, the upper surface engages the displaced wall portion 62 of the shell 46, and the outer and inner peripheral edges engage the corresponding side walls of the shallow groove provided by the upwardly displaced wall portion 62. Thus, while some slight distortion of the sealing element 60 may occur when the same is subjected to compression, since the element is confined at all times it cannot cold flow and thus is prevented from being displaced to any appreciable extent.

Also, in accordance with the invention, the yieldable-pressure action of the sealing element 60 against the supporting flange 44 is supplemented by a non-yielding pressure action on the supporting flange, exerted by the upper wall portion 54 of the mounting shell 46. When the mounting shell is applied to the container 10 after assembly of the various components therein, and the portion 50 of the shell clinched under the bead 16, the sealing element 60 will be compressed against the sealing flange 44, and the wall portion 54 of the shell will exert a positive and non-yielding force on the upper surface of the supporting flange. The lower sealing element 58 will also be compressed and the sealing bead 56 will be imbedded in the element 58 whereby a tight assemblage will be produced, characterized by an effective seal between the supporting flange 44 and the lip portion 14 of the container, and between the displaced wall portion 62 of the shell 46 and the said supporting flange.

I have found that by the above construction it is possible to utilize with advantage a one-piece molded valve housing and closure member such as the member 18 while at the same time providing an effective and reliable seal in conjunction with the metal mounting cup and the container lip, and such seal is not adversely affected by minor variations in the configuration or dimensions of the container lip. Thus, the valve and closure assemblage has the advantage of economy of manufacture by the use of the molded, resilient valve housing and closure member while at the same time obviating a possible drawback of such member, especially as utilized with containers such as glass bottles or the like, wherein dimensional variations are common. The improved valve and closure structure involves relatively few components, which may be economically fabricated and assembled. Moreover, great reliability is had in the seal which is effected, both during storage of the aerosol device and use of the same.

Another embodiment of the invention is illustrated in FIG. 3. This embodiment is in many respects similar to that described above in conjunction with FIGS. 1 and 2, but employs a non-metering type valve assemblage. As shown, the valve stem 26*a* in FIG. 3 is shorter than the corresponding stem 26 in FIG. 1, and controls but a single valve means, comprises the enlargement 32*a* and the valve seat member 34*a*.

A molded one-piece valve housing and sealing closure member 18*a* is provided, held in place by a metal mounting cup 46*a* in the manner already explained above. The shell 46*a* has a depending skirt 48*a*, and upper walls 54*a* and 62*a*, the latter constituting an upwardly offset portion of the cup. The molded member 18*a* has an internal, spring-abutting shoulder 22*a*, and a supporting flange 44*a* and annular sealing shoulder 56*a*, these latter two por-

tions being cooperable with upper and lower annular sealing elements **60**, **58**, all as shown.

The construction and functioning of the sealing elements **60**, **58** and the supporting flange **44***a* are similar to that already described above, and all of the advantages as explained above in connection with FIGS. 1 and 2, attributed to the provision and use of such components are had in the embodiment of the invention shown in FIG. 3.

It will be readily understood that when the valve stem **26***a*, which is shown in FIG. 3, in its closed position, is depressed or shifted downward, as seen in this figure, the valve enlargement **32***a* thereof will be separated from the valve seat member **34***a* and the side opening **36***a* of the valve stem **26***a* will be disposed below the valve seat member, whereupon the aerosol substance may be discharged from the container through the side opening **36***a* and bore **38***a* of the valve stem.

I have found it possible to utilize a resilient molded plastic closure and valve housing element having an expansible annular valve ring or sleeve portion of the type illustrated in FIG. 1, in conjunction with wide-mouthed containers such as metal cans or the like wherein direct contact between the said molded resilient element and the lip portion of the container is not feasible due to the enlarged diameter of the latter. In accomplishing this the annular wall of the tubular body portion of the resilient molded element is made appreciably thicker and the bore thereof is increased in diameter at the mouth or open end of the housing, to provide adequate clearance for the valve stem and valve spring even if the said upper end is slightly compressed or reduced in diameter by virtue of inwardly directed clamping forces. Such a construction is illustrated in FIG. 4. In this figure there is shown a metal mounting cup **64** having an outer peripheral portion **65** arranged for engagement with the lip or rim of a wide-mouthed container or can. The mounting cup **64** has a raised central portion **66** constituted of a generally flat, circular apertured top wall **67** and an annular, generally cylindrical side wall or skirt **68**, these two walls together having the form of an inverted cup.

Passing through the center aperture of the top wall **67** is a usual type of valve stem **26** having a valve enlargement **32**, the latter being engageable with a valve disc or seat member **34** engaged with the underside of the top wall **67**. The valve stem **26** carries the usual valve return spring **30** which at its upper end engages the valve enlargement **32**.

In accordance with the invention there is provided a resilient molded closure and valve housing member **69** which is so arranged as to be securely mounted within the portion **66** of the mounting cup **64** and to provide therewith a reliable seal, the said molded resilient member or element having an annular expansible valve sleeve portion arranged to receive and to be slightly expanded by the lower end portion of the valve stem **26**. In providing for a reliable mounting of the molded resilient member **69** and an effective seal, all without impairing the functioning of the valve stem **26**, the member **69** at its tubular body portion is provided with thickened or heavier walls **71** in conjunction with a retainer lip **72**, and the bore of the body portion of the member is preferably tapered so that its larger diameter is at the top of the member.

I have found that, contrary to what might be expected it is possible to securely clamp and grip, utilizing inwardly directed radial forces or force components, the upper or rim portion of a resilient plastic housing member in a manner to provide an effective and reliable seal and also to not interfere with the longitudinal movements and functioning of the valve stem. As seen in FIG. 4, the body portion of the housing member **69** has a tapered or conical inside wall surface **73**, and the small diameter of said surface at the lower end of the body portion is commensurate in size with the outside diameter of the valve spring **30** whereby the latter will be received without appreciable looseness in the lower part of the body portion.

When the plastic member **69** is constituted of a resilient but quite stiff composition such as linear polyethylene there is sufficient yield or resilience to permit the valve ring or sleeve portion **70** to expand slightly when the valve stem **26** is depressed and enters the valve sleeve, yet sufficient rigidity is had and resistance to deformation at the relatively thick walls **71** of the molded housing member to permit the ledge or flange portion **72** to be firmly gripped in the inverted cup **66** by the indented portions **74** so as to effect a secure mounting of the member and also to effect, in conjunction with the valve disc **34**, a secure sealing of the container. The amount of compression or distortion of the upper part of the tubular body portion of the resilient valve housing is not sufficient to appreciably reduce the diameter of the same or to interfere with the valve action. Thus, by the present invention as illustrated in FIG. 4 there is provided for the first time a novel resilient molded plastic closure and valve housing member having an integral expansible valve sleeve portion, wherein by the use of inwardly directed clamping forces the flexible housing member may be securely mounted on a metal mounting cup and a secure seal effected thereto. I attribute this in part to the tough, relatively stiff nature of the linear polyethylene composition, the relatively thin wall section provided at the expansible valve sleeve **70** and the relatively thick wall section **71** and retention ledge **72** provided for the support of the housing member on the metal cup **64**.

The valve construction shown in FIG. 4 as already stated is of the metering type wherein the valve sleeve or ring portion **70** is closed by the lower end of the valve stem **26** when the latter is depressed. The construction of FIG. 4 is seen to be extremely simple and to involve relatively few components which may be economically fabricated and assembled. Notwithstanding this, there is had a secure mounting of the molded housing **69**, and further effected thereby a positive and reliable seal in conjunction with the mounting cup **64**.

The center, apertured portion of the top wall **67**, surrounding the central aperture is preferably drifted or formed upward as shown, to provide a low annular flange which constitutes a smooth bearing of increased area for the valve stem **26** and prevents the latter from becoming abraided due to the operation of the valve.

Another embodiment of the invention is illustrated in FIG. 5. In this embodiment the mounting cup **64** carries a two-piece molded resilient closure and valve housing element **75**, said element having an upper mounting and valve part **76** and a lower dip tube support and spring holder part **77**, the said parts being telescopically fitted to each other by virtue of a cylindrical wall **78** of the lower part **77** being press-fitted over the body portion **79** of the upper part **76**.

As shown, the wall thickness of the part **79** is quite appreciable, and a ledge **80** is provided at the upper end or lip of the said part, further strengthening the same. The ledge **80** is gripped and held by the skirt portion **68** of the metal mounting cup **64** and effects a seal therewith by virtue of the valve disc **34**.

The lower end of the upper part **76** has a thin-walled expansible valve ring portion **81** adapted to receive the lower end **82** of a valve stem **83**, said stem having a valve enlargement **84** of conical configuration which is engageable with the valve disc **34**. The upper housing part **79** has a conical bore **85** closely spaced with respect to the valve enlargement **84**, as shown.

The lower housing part **77** has a cylindrical bore **86** in which there is disposed a valve return spring **87**, said spring engaging and being positioned by a nib **88** at the lower tip of the valve stem **83**. The lower housing part **77** has an integral internal shoulder or abutment **89** constituting a stop for engagement with the valve spring

87. The usual dip tube 90 is shown as press-fitted in the lower housing part 77 and positioned by the internal abutment 89.

With this construction as illustrated in FIG. 5 the valve spring 87 is not disposed in the metering chamber surrounding the lower half of the valve stem 83, but instead is disposed below the expansible valve ring 81. Thus, the valve spring is not in the portion of the molded resilient valve housing element which might become distorted due to clamping and mounting forces. Moreover, by disposing the valve spring 87 below the expansible valve ring 81, a greater freedom is had in designing the metering chamber and such chamber is no longer limited by the necessity of accommodating the valve return spring. Accordingly, the metering chamber may be made as small as might be desired or required for certain conditions of use. It is now seen that the construction of FIG. 5 is characterized by a resilient molded valve housing element having an expansible thin-walled valve ring or sleeve portion and having a thick-walled mounting portion arranged to be clamped and gripped by a metal mounting cup whereby the housing element is securely held in place and effects a positive and reliable seal of the contents of the container.

In FIG. 6 the construction is generally similar to that of FIG. 5 except that the member 77*a* is made in one piece and the integral internal shoulder or abutment 89 is omitted. Instead the dip tube 90 is press fitted against a shoulder 91 in the lower housing part 77*a*, the upper edge of the dip tube constituting the stop for the valve spring 87.

In FIG. 7 the lower housing part 77*b* shown therein has an internal annular shoulder 89*a* which is of triangular configuration in cross section, with a sloping lower surface to permit the valve spring 87 to be forced upward past the abutment without having the latter sheared out of place.

Another embodiment of the invention is illustrated in FIG. 8. This form is generally similar to that of FIGS. 5, 6 and 7 with the exception that to facilitate the molding of the resilient plastic valve housing the integral, internal shoulders 89 and 89*a* are omitted and there is provided a separate abutment ring 89*b*, disposed in an internal groove 93 provided in the lower portion of the valve housing member 77*b*.

Still another embodiment of the invention employing a valve spring disposed below and externally of the metering chamber, is illustrated in FIG. 9. In this figure there is shown a resilient molded valve housing 77*c* which differs from the housing 77 in that it is molded in one piece and has a modified from of expansible valve sleeve portion, together with a modified form of tubular body portion and a modified valve stem. The resilient valve housing 77*c* has a stepped bore comprising walls 94 and 95 constituting a metering chamber, and a third wall 96 within which a valve spring 87 is disposed. A thin-walled shoulder 97 is disposed between the walls 95 and 96, and a valve stem 83*a* is provided, having a valve enlargement 84*a* cooperable with the valve disc 34, and having a slightly tapered valve portion 98 adapted to be received in the expansible valve sleeve portion 97 and to slightly expand and shut off the latter when the valve stem 83*a* is depressed. The valve enlargement 84*a* of the valve stem is stepped to conform to the stepped configuration of the metering chamber of the valve housing 77*c* whereby an extremely small volume may be had in such chamber. The resilient valve housing and closure member 77*c* has a tapered tubular body portion 99 and a mounting flange or ledge 100 arranged for sealing engagement with the valve disc 34. The metal mounting cup 64*a* may have an inwardly displaced circular portion or bead 101 arranged to engage the undersurface of the mounting ledge 100, thereby to retain the valve housing 77*c* in place on the mounting cup 64*a*. The ledge 100 has an exposed annular surface 102 disposed inwardly of the bead 101 to accommodate an assembly tool whereby the resilient valve housing 77*c* may be press-fitted and snapped in place by being forced past the bead 101 through the use of such tool. It will be understood that the valve construction illustrated in FIG. 9 is of the metering type, in that when the valve stem 83*a* is depressed, the slightly tapered portion 98 thereof will be received in and will slightly expand the annular valve sleeve portion 97 of the valve housing 77*c*, thereby to shut off the metering chamber from the interior of the container. By the elimination of the valve ring 81 from the valve housing 77*c* it is possible to mold the latter readily as one piece.

Yet another metering type valve construction made in accordance with the invention is illustrated in FIG. 10. As shown in this figure, the metal mounting cup 64*b* has a raised, stepped center portion 105 carrying a valve disc 34*a*, valve stem 26 and a resilient plastic valve housing 106 having an expansible valve ring or sleeve portion 81*c*. The valve housing 106 has a massive mounting flange or ledge 108 disposed intermediate its ends and connected with the lower end of the tubular body portion in which the metering chamber is disposed. The ledge 108 is accommodated in an inverted cup portion 110 of the metal mounting cup 64*b*. The inverted cup portion 110 has inwardly struck dimples or nibs 111 arranged to engage and retain the flange or ledge 108 in place. For sealing purposes, a soft and resilient sealing annulus 113 is provided, preferably having an angular cross section as indicated, said annulus being disposed in the inverted cup portion 110 between the same and the supporting ledge 108 of the valve housing member 106. As with the other forms of the invention, an effective and reliable seal is had, utilizing a resilient molded plastic valve housing member having an expansible valve ring or sleeve portion, the said member being reliably and permanently mounted and retained in place, and the mounting and sealing forces on the resilient member causing such little distortion and deformation of the latter as to not interfere with the normal functioning of the valve stem and valve spring.

A modified form of valve construction employing a snap-in assembly somewhat similar to the form of the invention illustrated in FIG. 9, is shown in FIG. 11. In this figure there is depicted a metal mounting cup 64*c* having an upwardly dished or offset center portion 115*a* comprising a circular top wall 116 and a depending cylindrical side wall formation or skirt 117, the walls 16 and 17 being in the form of an inverted cup and being joined to a lower top wall 119 of the mounting cup 64*c*. At the juncture of the depending skirt 117 and the top wall 119 the mounting cup 64*c* is inwardly indented as shown at 121, and the said indentation may be advantageously constituted as an annular inwardly projecting bead.

Under the top wall 119 there is provided a relatively thick resilient sealing washer 123 for engagement with the lip of the container mouth, to effect a seal between the latter and the mounting cup 64*c*. Below the centrally disposed top wall 116 there is provided a combined valve and sealing disc 125 arranged for engagement by a valve shoulder 126 of a one-piece molded valve stem 128. The valve shoulder 126 is also engaged by a valve return spring 130 in the usual manner.

In accordance with the invention, in conjunction with the inwardly formed annular bead 121 there is provided a resilient molded plastic valve housing 132 having a tubular body portion 133 and an annular thin walled expansible valve sleeve portion 135, the lower portion of the valve stem 128 and the spring 130 being disposed within the metering chamber M of the tubular body 133 of the valve housing 132. At its upper end or lip, the relatively thick-walled valve housing 132 has an annular outwardly projecting peripheral bead or shoulder 137 which is arranged to closely fit within the dependent skirt portion 117 of the mounting cup 64*c*. The maximum diameter of the peripheral bead 137 of the valve housing 132 is appreciably greater than the minimum diameter of the inwardly projecitng bead 121 provided on the mounting cup 64*c*. Further, the upper or lip portion of the body 133 of the

valve housing **132** is provided with a rounded edge surface **139**, and such organization in conjunction of the resilience of the valve housing **132** enables the latter to be forced into the inverted cup portion **115** of the metal mounting cup **64***c*, past the retaining bead **121**. This assembly is in the nature of a snap-in action, and when the valve housing **132** is being brought into place the lip portion and bead **137** will be compressed and displaced radially inward until the retaining bead **121** is passed, whereupon the lip and bead **137** will regain substantially their original formation. The metering valve action of the embodiment illustrated in FIG. 11 is similar to that already described above and needs no further explanation.

It is seen that relatively few components are involved with the valve construction illustrated in FIG. 11, and that the assembly of such components is extremely simple and rapid, involving merely the applying of the sealing washer **123** and **125** to the mounting cup **64***c*, and the insertion of the spring **130** and valve stem **128** in the valve housing **132**, and finally the snap-in assembly of the valve housing **132** to the mounting cup **64***c*.

The embodiment of the invention illustrated in FIG. 11 is so arranged that the aerosol container may be pressure filled, as against the alternative procedure of cold filling the container with the aerosol substance in a liquid form. In effecting a pressure fill of the container, the aerosol substance under pressure is forced past the exterior of the valve stem, and the valve stem may or may not be slightly mechanically depressed to facilitate this operation. A filling nozzle is applied to the mounting cup, and as the aerosol substance is applied under pressure against the protruding portion of the valve stem and the upper surface of the inverted cup formation **115** the valve disc **125** will yield inwardly, accompanied by slight inward or downward movement of the valve stem **128** whereupon the pressurized aerosol substance will be forced downward past the exterior of the valve stem and into the metering chamber M, and from there it will be forced past the lower portion of the valve stem and past the expansible valve collar **135** into the container. It will be understood that a slight downward movement of the valve stem accompanies this pressure filling operation, the said movement merely being sufficient to enable a yielding action of the valve disc **125** to be had, without the extent of movement being sufficient to close the second valve means comprising the expansible valve collar **135**.

Still another embodiment of the invention is illustrated in FIG. 12, where there is shown a sub assembly comprising a molded resilient plastic valve housing **115** in which there is disposed a valve-return spring and a molded valve stem **118**. The valve housing **115** is similar to the housing **132** shown in FIG. 11 except that it is not adapted for use with a dip tube. Instead, the lower portion of the valve housing terminates at a point just below the annular expansible valve collar **120**. Also, the lower portion of the valve stem **118** is provided with a pair of opposite flats **122** and **123** to provide clearance between the stem and the expansible valve collar **120** when the stem is in the raised position illustrated.

The valve housing **115** is adapted to be press fitted within a metal mounting cup, as with the valve housing **132** shown in FIG. 11. The organization of FIG. 12 is intended for use with aerosol devices wherein the container is held upside down in order to dispense the contents. For such use, obviously a dip tube is not desired.

In all of the forms of the invention illustrated, relatively few parts are involved, and the said parts or components may be easily and economically fabricated and assembled, thereby resulting in a low manufacturing cost. The valve structure is reliable in operation at all times, not subject to corrosion, and eliminates to the maximum possible extent leakage of the contents of the container.

Variations and modifications may be made within the scope of the claims, and portions of the improvements may be used without others.

I claim:

1. In an aerosol device, in combination, a reciprocatable valve stem; a molded resilient plastic valve housing and closure element having a main tubular body portion in which the valve stem is reciprocatable and having an integral annular expansible valve portion disposed below said tubular body portion and adapted to receive and be expanded by the lower end of the valve stem to shut off the body portion from the container, said body portion also having an outwardly disposed annular supporting ledge arranged to supported the element at the mouth of a pressurized container and further having an upwardly extending hollow boss disposed above said supporting ledge; a metal mounting cup adapted to engage the container mouth and to secure the said supporting ledge and closure element in place thereon, said cup having an upper wall the outer peripheral portion of which overlies the outer peripheral part of the supporting ledge, and having an annular side wall in which the ledge snugly fits, and said wall further having a central raised cup-shaped portion snugly fitting and enclosing the said hollow boss of the valve housing to impart stability to the housing; inwardly projecting means on said annular side wall, engageable with said ledge to retain the same in the mounting cup; and resilient sealing means disposed between the outer peripheral part of said ledge and the outer peripheral portion of the upper wall of the mounting cup, for effecting a seal therebetween.

2. The invention as defined in claim 1, in which the housing and closure element has relatively thin walls constituting said valve portion, and has relatively heavy walls at the said supporting ledge.

3. The invention as defined in claim 1, in which there is a valve return spring disposed in the body portion and surrounding the valve stem, and in which the supporting ledge is disposed intermediate the ends of the body portions and extends radially therefrom to an appreciable extent, said ledge as secured by the mounting cup constituting a stiffening means tending to limit inward collapsing movement of the walls of said tubular body portion.

4. The invention as defined in claim 3, in which there is a valve return spring disposed in the body portion and surrounding the valve stem, and in which the walls of the body portion are relatively heavy to prevent collapse and interference with said valve spring.

5. The invention as defined in claim 1, in which the means on the annular side wall comprises an inwardly displaced wall portion disposed generally below the said ledge and constituting an abutment engaged with a lower portion of the ledge, and in which the ledge has an exposed undersurface located inwardly of the said wall portion to accommodate a tool for pressing the ledge into the cup.

6. In an aerosol device, in combination, a molded plastic valve housing and closure member having a main tubular body portion in which a valve stem is reciprocatable and having an outwardly disposed annular supporting flange on said body portion, arranged to support the member at the mouth of a pressurized container and further having an upwardly extending hollow boss disposed above said supporting flange; a metal mounting cup adapted to engage the container mouth and to secure the said supporting flange and closure member in place, said cup having an upper wall the outer peripheral portion of which is arranged to overlie the outer peripheral part of the supporting flange and in conjunction with the container mouth to apply clamping pressures to said peripheral part of the flange for securing and sealing the flange to the container mouth and said wall further having a central raised cup-shaped portion snugly fitting and enclosing the said hollow boss of the valve housing to impart stability to the housing; and an annular top seal element disposed between the upper surface of the said

peripheral part of the supporting flange and the outer peripheral portion of the upper wall of the mounting cup, effecting a seal therebetween, said seal element being located radially inward of the side walls of the mounting cup, being subjected to the said clamping pressures and being confined against appreciable displacement when under said pressures, said upper wall of the mounting cup having an unyielding portion directly engaged with the supporting flange and applying force thereto in a downward direction and the said unyielding portion being disposed radially inward of the sealing element and obstructing the same to prevent inward spreading movement of the element; outward spreading movement of the element being blocked by the side walls of the mounting cup.

7. The invention as defined in claim 6, in which the upper wall of the mounting cup has an upwardly offset annular portion providing a shallow annular groove in its undersurface, in which the annular seal element is disposed and by which it is confined.

8. The invention as defined in claim 7, in which the upwardly offset portion of the mounting cup wall extends along and is adjacent to the outer periphery of the cup, said unyielding portion of the wall being annular and being disposed within the offset wall portion.

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