Nov. 10, 1953 I. H. FOOSHEE 2,658,714

DISPENSER VALVE ASSEMBLY

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FIG.1.

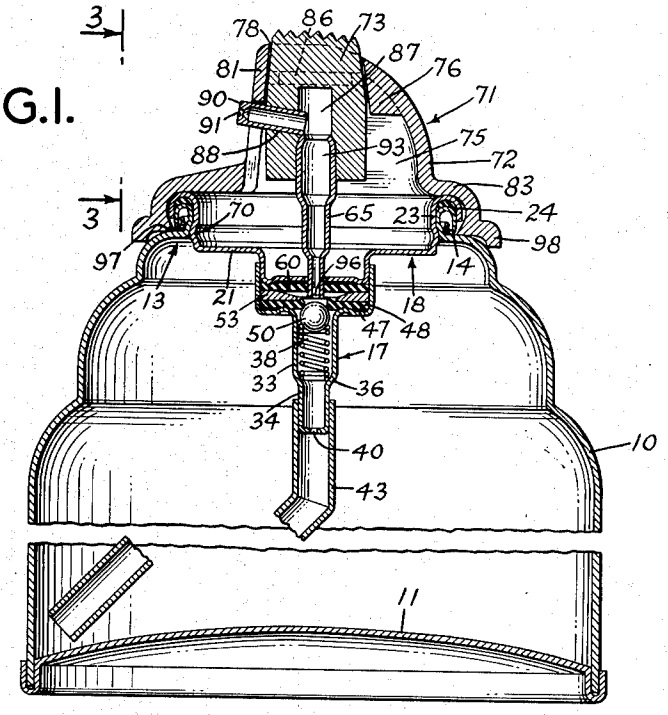
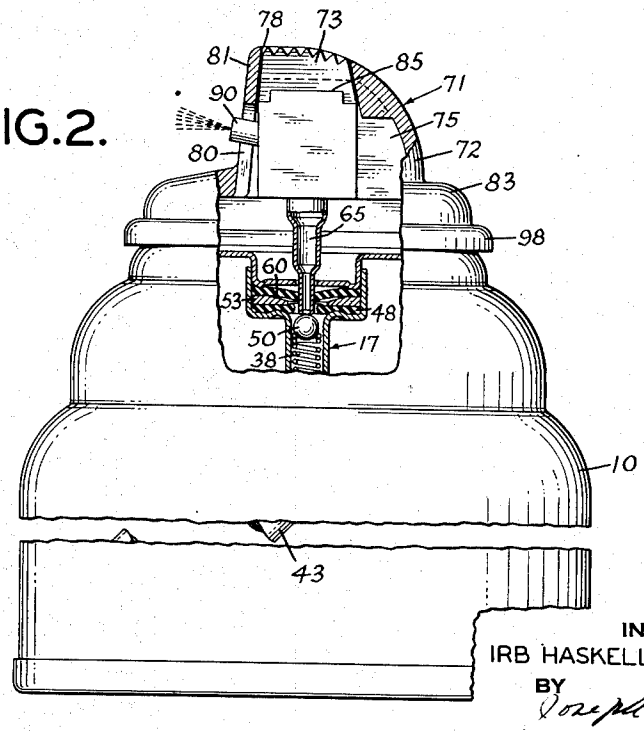


FIG.2.



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FIG.3.

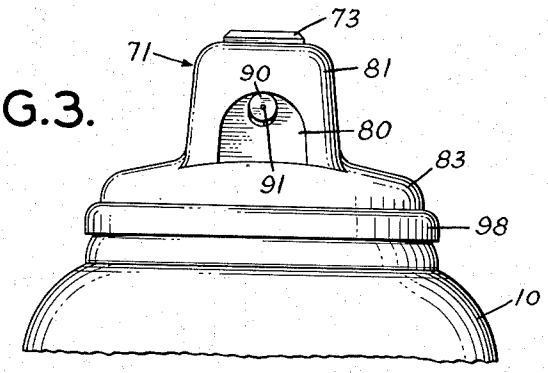


FIG.4.

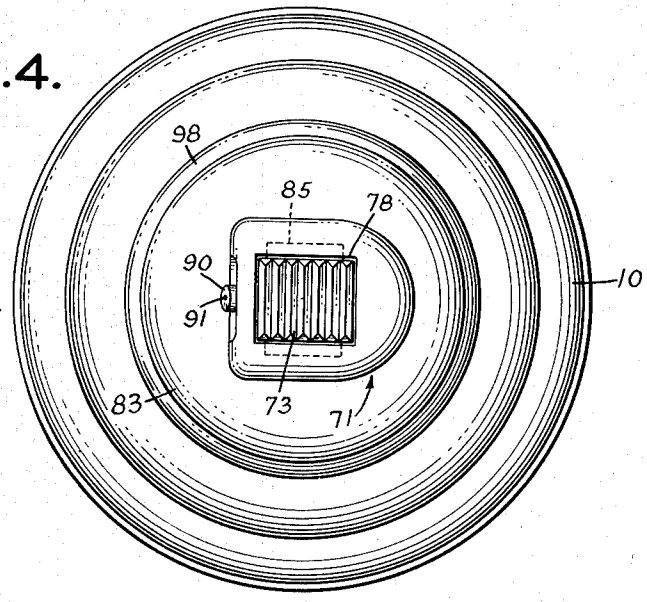
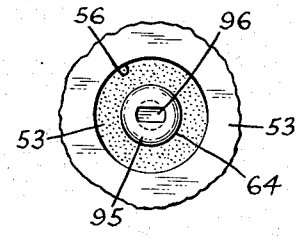


FIG.7.



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DISPENSER VALVE ASSEMBLY

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FIG.5.

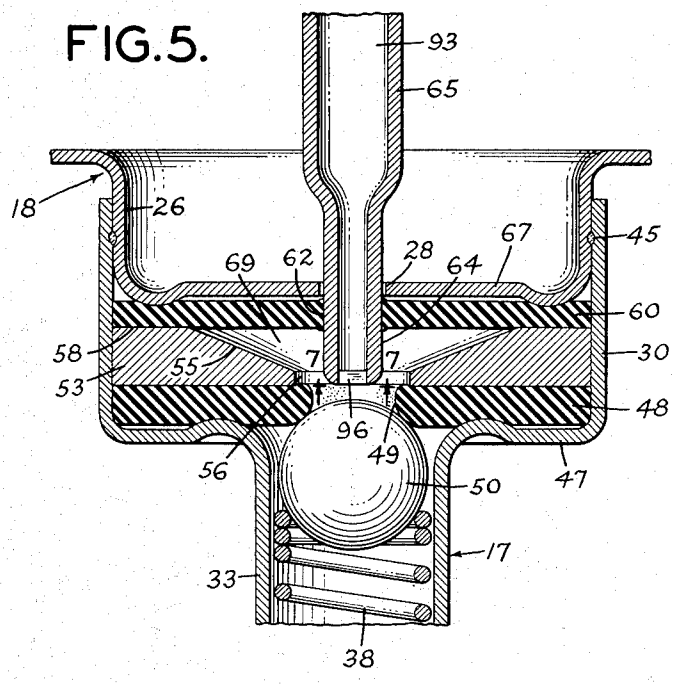
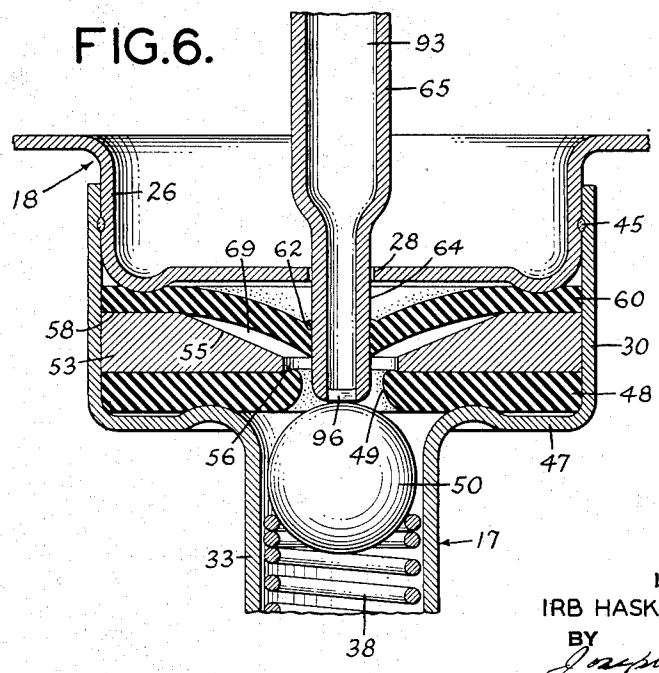


FIG.6.



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DISPENSER VALVE ASSEMBLY

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Application February 16, 1950, Serial No. 144,535

6 Claims. (Cl. 251—115)

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This invention relates to apparatus for dispensing material, and is more particularly directed to improvements in apparatus for dispensing material in spray or aerosol form.

The invention and the objects and advantages thereof may be understood from the following description taken in connection with the accompanying drawing, in which

Fig. 1 is a broken vertical section of the improved dispenser;

Fig. 2 is a broken vertical section, similar to Fig. 1, showing the parts in spray dispensing position;

Fig. 3 is an elevation of a cover cap taken on the line 3—3 of Fig. 1;

Fig. 4 is a top plan view;

Fig. 5 is an enlargement showing parts of a valve assembly in valve-closed position;

Fig. 6 is a similar enlargement showing parts of the valve assembly in spray dispensing position, and

Fig. 7 is a bottom plan view looking in the direction of the arrows on the line 7—7 of Fig. 5.

Referring to Fig. 1 of the drawing, the dispenser of the invention includes a spray or aerosol material container 10 provided with a crimped-on bottom 11 and having in the top wall thereof a circular opening, indicated at 13, which is formed with an upwardly, outwardly, downwardly, inwardly, and upwardly rolled bead 14 affording an upstanding flange. The container proper, the bottom, and the top bead thereof may be made of any suitable material, e. g. metal, suitable to withstand the internal pressure exerted by the particular liquid but normally gaseous dispersant utilized as the propellant for the spray or aerosol compositions used in the container.

The top of the container is closed off by a valve assembly comprising principally the valve cup 17 and valve body 18, both shown in Fig. 1 and in the enlargements of Figs. 5 and 6. The valve body comprises a disk-like plate 21 having an internally formed vertically disposed cylindrical section 23 terminating in an outwardly and downwardly turned flange 24. During manufacture, plate 21 is stamped downwardly, as shown at 26 (Fig. 5), and is centrally cut to form a circular opening 28. A second plate is stamped, drawn or otherwise worked to form the vertically extending cylindrical section 30 of cup 17, the diametrical dimension of section 30 being such that section 30 is adapted to tightly telescope the outside of depending portion 26 of body 18. Cup 17 is also integrally formed with depending cylindrical sections 33 and 34. As

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shown in Fig. 1, section 33 is of appreciably larger inside diameter than is section 34, the two sections being connected by a horizontally disposed annular shoulder 36 which constitutes a seat for a coil spring 38. The lower end of section 34 terminates in a circular wall provided with a flow restricting orifice. Section 34 is adapted to telescope into the upper end of a flexible dip tube 43 which, as indicated in Fig. 1, extends to approximately the bottom of the container.

A principal feature of the invention is the valve assembly shown in the enlargements of Figs. 5 and 6. As indicated, the stampings comprising the valve body 18 and the valve cup 17 are shaped and sized so that such parts may be telescopically tightly connected and spot-welded at suitable circumferential intervals such as denoted at 45. A horizontal annular portion 47 of cup 17 constitutes the bottom of the cup and a seat for a disk of packing 48 which may be made of any suitable material such as natural or synthetic rubber, or nylon, etc. Packing 48 has a centrally located circular opening 49 affording a valve port, and the lower periphery of such opening provides a seat for a ball valve 50 which, by pressure of spring 38, normally maintains the valve port closed.

Placed on top of packing 48 is an annular spacer 53 made of rigid material, preferably metal. As shown clearly in the section of Fig. 5, the spacer is formed with an inwardly and downwardly sloping, inverted cone-shaped surface 55 which terminates in a circular opening 56 which is in axial alignment with the valve port but has a cross-sectional area larger than that of the port. The upper planar surface 58 of spacer 53 constitutes an annular seat for a disk-like sealing gasket 60 which is made of material having substantial elastic properties and which may for example be natural or artificial rubber. Gasket 60 has a central circular cut-out 62 through which the lower end 64 of valve actuating pin 65 is adapted to pass.

The foregoing elements may be assembled as follows. Spring 38 and ball 50 are dropped into section 33 of cup 17. Washer 48, spacer 53, and gasket 60 are successively placed in the cup. The depending portion 26 of valve body 18 is telescoped into the upwardly extending cylindrical section of cup 17. The body is then forced downwardly into cup 17 by any suitable pressure means so that the outer peripheries of the washer 48, spacer 53 and gasket 60 are wedged in place tightly enough to effect a gas-tight fit in the cup. Subsequently, cup 17 and body 18 may be

spot-welded as at 45. Then, the lower end of pin 65 is inserted through opening 28 and forced through the opening 62 in gasket 60 to the approximate relative position shown in Fig. 5. The circular lower section 67 of body 18 and the portions 30 and 47 of cup 17 may be considered as a casing affording a housing for washer 48, spacer 53, gasket 60, the port in washer 48, and the chamber 69 which is formed mostly by the underside of gasket 60 and the sloping surface 55 of spacer 53.

After filling the container, the assembled valve unit is inserted in the opening in the top of the container, the vertical wall 23 of valve body 18 is outwardly crimped as at 70 (Fig. 1), and the outwardly directed flange 24 of body 18 is turned downwardly around container bead 14, this arrangement effecting peripheral attachment of the valve assembly to the top of the container in gas-tight relation.

The dispenser of the invention includes a closure cap indicated generally at 71 and shown in section in Fig. 1 and in elevation and plan in Figs. 3 and 4 respectively. The cap comprises a body 72 and a finger pressure push button 73 which, in association with the cap body and actuating pin 65, provides means for operating the valve and effecting discharge of spray or aerosol material to the atmosphere.

The cap body 72, which may be an integrally formed molding or stamping, is of the general configuration and structure shown in the several views of the drawing. The body comprises an internal chamber 75, a button guide block 76, a rectangular button opening 78 in the top surface, a spray or aerosol discharge nozzle window 80 in side wall 81, and an annular relatively horizontally disposed flange 83. Side 81 is substantially planar and is preferably sloped slightly rearwardly from the vertical as shown in Fig. 1. The inner smooth surface of side 81 furnishes a bearing surface for the up and down movement of button 73, and block 76 forms a rear thrust support guide for the button. The lower portion of the latter is substantially square in horizontal cross-section and is provided with oppositely disposed inwardly projecting shoulders 85 (Fig. 2) which are shaped to conform with corresponding reversely directed shoulders 86 which are formed integrally on the cap body and act as an up-stop for the button. The length of the push button above shoulders 85 is such that, when the button is in the uppermost position as shown in Fig. 1, the knurled top surface of the button projects above the surface of the cap body to an extent convenient for finger pressure.

The push button is provided internally with a vertical bore 87 and a connecting bore 88 of slightly smaller diameter, which lies in the same vertical plane as bore 87 and is axially disposed in a slightly upwardly direction. A cylindrical nozzle 90 having a discharge orifice 91 is set into bore 88 of the button in such a way that the outer end of the nozzle projects preferably just beyond the outer face of cap side 81. The valve actuating pin 65 having an interior longitudinal duct 93 is set into vertical bore 87. The actuating pin tapers towards its lower end and terminates in the circular wall 95 which is provided with a preferably rectangular cut-out or slot 96, both as shown in Fig. 7.

In accordance with another feature of the dispenser described, the cap body 71 is provided adjacent its lower periphery with an annular in-

wardly projecting rib 97 (Fig. 1) which is shaped to engage the downwardly turned exterior portion of the flange 14. The cap body may be made of any suitable material, but is preferably a molded plastic such as polyethylene. Whatever particular material is used, such material is so chosen as to provide a cap body which is rigid but yet sufficiently resilient about its lower peripheral section so that the cap body by moderate hand-pressure may be forced down onto and engage flanges 14 and 24 with a tight, snap-on fit. The lower rim of the cap body may be provided with a short depending flange 98 which just lightly contacts the surface of the container so as to afford a clean line appearance.

In valve assemblies of the nature to which this invention relates, i. e. assemblies including a washer or disk having an outlet port, a spring-pressed ball valve for closing the same, and an actuating pin for unseating the ball from the port and conducting the material to be dispersed to the atmosphere ususally through a duct in the actuating pin, two general types of structure have been suggested and utilized to some extent. In the first type, the washer has a dual function, that is to consitute a seating for the ball valve and also to form a seal around the lower extremity of the actuating pin which frictionally reciprocates in the washer to unseat the valve. This type of structure in some instances gives rise to objectionable leakage between the outer surface of the lower extremity of the actuating pin and the immediately adjacent portion of the washer through which the actuating pin slides to open and to permit spring closing of the ball valve. In some other circumstances, the lower extremity of the actuating pin gets stuck in the upper part of the port hole in the washer during the spring-pressed upthrust of the actuating pin and does not permit satisfactory seating of the ball valve.

A second type of previously proposed structure may be designated for convenience as a true diaphragm valve, i. e. one in which a sealing gasket similar to gasket 60 of Fig. 5 is permanently fixed, e. g. by vulcanizing or crimping, to the adjacent surface of the actuating pin. This so-called true diaphragm valve requires only a small force in the initial stage of the diaphragm flexure. However, as the diaphragm continues to be flexed and the material is strained, a directly proportional increase in force is necessary to give further flexure. Another and further important factor which adds to the force necessary to operate a true diaphragm valve is the fact that, as soon as the ball is depressed off its seat, the vapor pressure in the container starts to build up against the underside of the diaphragm which pressure soon requires additional force in order to open the valve fully, the amount of force being directly proportional to the area of the diaphragm and the pressure in the container. Thus, the combination of the inherent resistance to flexure of the diaphragm and gas pressure under the diaphragm make it notably difficult to force the actuating pin down far enough to completely open the valve with a convenient relatively light finger pressure applied to e. g. an operating push button mounted on the upper end of the actuating pin.

This invention provides an easily operable valve structure which prevents the frequent leaking and sticking described in connection with the first type of valve, and which does not offer the strong resistance to downthrust of the actuating

pin as is characterized by the so-called true diaphragm type valve.

Fig. 5 of the drawing shows the valve assembly of the invention in the inoperative non-spraying position. The plastic ball seat washer **48** is an elastic material, such as natural or synthetic rubber, of suitable composition to reduce changes in physical and chemical properties to a minimum when subjected to exposure to the formulation in the container to be dispensed. The elasticity of washer **48** should be such as to absorb any deformities at the circumference of port **49** in which the ball must make a tight seat. The spacer **53** is made of rigid preferably metallic material formed as shown and described to constitute the chamber **69** the major function of which will be subsequently apparent. The underside of spacer **53** acts as a structurally strong backing plate for the relatively thin plastic ball seat washer **48**. Spacer **53** is undeformed by any stress transmitted to it by spring **38**. It will be noted as shown in Fig. 5 that the diameter of circular opening **56** in spacer **53** is appreciably larger than the diameter of port **49** in the ball seat washer **48**. This construction affords adequate upward flexure and play of the material of washer **48** which constitutes the port, and permits sufficient movement of the port periphery to effect good seating of ball **50**. It will be further noted that the diameters of port **49** and of circular opening **56** in spacer **53** are appreciably larger than the outside diameter of the lower extremity of actuating pin **65**, the arrangement being such that there is no contact between the lower end of the actuating pin and either washer **48** or spacer **53**, and hence no possibility of sticking of pin **65** in washer **48** or spacer **53** during closing upthrust of the ball. In this connection, it is further noted that ample clearance is allowed between the circumference of the circular opening **28** in plate **67** and the adjacent outside surface of pin **65** to afford free movement of the pin through plate **67**.

The sealing gasket **60** is also a thin plastic material such as natural or artificial rubber of suitable elasticity and composition to hold changes in physical and chemical properties to a minimum when subjected to exposure to the formulation to be dispersed. In the operation of the valve structure under consideration, as will be hereinafter more apparent, gasket **60** and pin **65** function as a true diaphragm valve during an initial part of the valve opening movement of the pin, and during a final portion of the valve opening movement the pin slips through the gasket **60**, and the gasket and pin maintain a sliding seal relation as in the packing gland principle. To effect this operation, it is noted that the elastic properties and characteristics of gasket **60** are of substantially greater importance than the elastic nature of ball washer **48**. In accordance with the invention, in the case of gasket **60**, elasticity is necessary for flexure of the material when the sealing washer is stretched during its true diaphragm action. The joint between the sealing washer and the actuating pin is also dependent upon the elasticity of washer **60**, since this washer has an undersized hole diameter with respect to the adjacent outside diameter of the pin and is stretched onto the pin. Synthetic rubber is a particularly suitable material for gasket **60**.

Generally, in accordance with the invention, the periphery of the gasket opening **62** is normally undersized, with respect to the immediately adjacent outer periphery of the pin, to such an extent that the gasket frictionally engages the pin tightly enough to move unitarily therewith during an initial part of a valve opening movement of the pin, but loosely enough to slide with a sealing fit over the pin during a final portion of the valve opening movement of the pin. To accomplish the foregoing, in one satisfactory embodiment of the invention using synthetic rubber for gasket **60**, the manufactured diameter of the opening in gasket **60** may be about two-thirds (e. g. .04 inch) the outside diameter (e. g. .06 inch) of the immediately adjacent portion of the actuating pin. Thus, it may be said that the elasticity of gasket **60** and the size of the gasket opening are chosen, with respect to the immediately adjacent outer periphery of the pin so that during an initial part of a valve opening movement of the pin, the gasket and pin move unitarily in diaphragm seal relation and during a final portion of the valve opening movement, the gasket and pin maintain a sliding seal relation. To facilitate this operation the lower end of the actuating pin is made as small in diameter as feasible and is preferably nickel or similarly plated to minimize friction and permit slip-seal movement of the pin through gasket **60** during the last portion of the downward valve opening movement of pin **65**.

From the above, operation of the valve under consideration will be apparent for the most part. The mechanical action of the valve makes it extremely easy to operate with only very light finger pressure on push button **73**. Referring mostly to Figs. 5 and 6 of the drawing, on depression of the actuating pin to move the ball from its seat, sealing gasket **60** initially moves unitarily with the actuating pin. As washer **60** stretches in its diaphragm action, the hole in the washer at the point of grip with the actuating pin, also stretches and becomes larger. With this stretching and enlargement, the frictional resistance of the pin against travel through washer **60** decreases. Resistance of the sealing washer to flexing increases as it is stretched and opposes downward movement. The true diaphragm action of pin and washer **60** during initial downthrust of the pin requires only very light finger pressure to effect diaphragm flexure.

In the construction of the invention, a point is eventually reached in the unitary down movement of pin and gasket **60** where the force necessary to continue a true diaphragm action becomes greater than the frictional resistance of the pin to grip the sealing washer. This point may be assumed to be the condition shown in Fig. 6 in which it may be assumed also that the ball valve is only partly and not fully opened. From this point on with continued relatively light pressure of pushbutton **73**, pin **65** travels downwardly thru the sealing gasket with a sliding seal (packing gland like) action. Because the sealing gasket is thin and the pin is small in diameter and has a smooth surface, and because the hole in the sealing washer where it grips the pin has been stretched, the frictional resistance of the pin to travel thru the sealing gasket is small, and the sliding seal action begins and continues with only a slight increase in force until downthrust of the pin has been sufficient to completely unseat the ball and open the ball valve port to its maximum value. On release of finger pressure on button **73**, pin **65** and gasket **60** move upwardly unitarily until gasket **60** returns to its approximately horizontal position. Further spring

pressure transmitted to incompletely seated ball 50, moves pin 65 upwardly with slip seal action through gasket 60 until the ball is completely seated. From the foregoing it will be apparent that the formation of chamber 69 permits the described flexing of gasket 60.

Referring to Fig. 1, it is noted that in a device suitable for dispersing aerosols, orifice 40 may have a diameter of .015 inch, while the diameter of orifice 91 in nozzle 90 may be .022 inch. The area of slot 96 may be many times the area of either orifice 40 or 91. Thus, in effect there is provided an expansion chamber bounded at its lower end by orifice 40 and terminated at its upper end by the orifice 91, and including spring casing 33, the port 49, and the axial spaces in pin 65 and nozzle 90.

Washer 43, spacer 53 and gasket 60 are housed preferably in a two-piece drawn sheet metal enclosure suitably plated with corrosion resistant metal if necessary. The top of the valve body 18 is drawn over so that the valve assembly may be installed on any beaded top container. The valve cup 17 and body 18 are designed in such a manner that ball spring, ball, and the three disks 43, 53 and 60 may be assembled into the valve cup and the body assembled to the cup by means of a pneumatically operated fixture which will compress the disks under a constant pressure. By so doing, adverse combinations of tolerance in the three disks and housing will not affect the amount of compression under which the disks are assembled as would be the case in a constant volume housing. The valve cup 17 and valve body 18 may be spot welded together at points 45 around the contacting peripheries. Since the weld metal at these points is under a shearing stress rather than a tensile stress, a strong joint is effected.

I claim:

1. A valve assembly comprising a casing, a washer in the bottom thereof, a valve port in said washer having an inlet side and an outlet side opening into said casing, a valve and means for normally seating said valve in the inlet side of said port, an elastic sealing gasket on the outlet side of said port and having an opening in axial alignment with said port, a valve actuating pin projecting through said gasket opening and being movable through said port to unseat said valve and open said port, an annulus-like metallic spacer between said washer and said gasket, said spacer having an inwardly and downwardly inverted cone-shaped surface terminating in an opening in alignment with said port and having a cross-sectional area greater than that of said port, said spacer thereby forming a chamber-like recess between said gasket and said port and surrounding the projecting end of said pin, said washer, spacer and gasket being associated at the peripheries thereof with said casing in gas-tight relation; the periphery of said gasket opening being normally undersized, with respect to the immediately adjacent outer periphery of said pin, to such an extent that said gasket frictionally engages said pin tightly enough to move unitarily therewith during an initial part of a valve opening movement of said pin but loosely enough to slide with a sealing fit over said pin during a final portion of the valve opening movement of said pin, and a dispensing duct affording communication between the outlet side of said port and the atmosphere.

2. A valve assembly comprising a casing, a washer in the bottom thereof, a valve port in said washer having an inlet side and an outlet side opening into said casing, a valve and means for normally seating said valve in the inlet side of said port, an elastic sealing gasket on the outlet side of said port and having an opening in axial alignment with said port, an axially movable valve actuating pin projecting through said gasket opening, push button means for moving said pin through said port to unseat said valve and open said port, an annulus-like metallic spacer between said washer and said gasket, said spacer having an inwardly and downwardly inverted cone-shaped surface terminating in an opening in alignment with said port and having a cross-sectional area slightly greater than that of said port, said spacer thereby forming a chamber-like recess between said gasket and said port and surrounding the projecting end of said pin, said washer, spacer and gasket being associated at the peripheries thereof with said casing in gas-tight relation; the periphery of said gasket opening being normally undersized, with respect to the immediately adjacent outer periphery of said pin, to such an extent that said gasket frictionally engages said pin tightly enough to move unitarily therewith during an initial part of a valve opening movement of said pin but loosely enough to slide with a sealing fit over said pin during a final portion of the valve opening movement of said pin, and an axial dispensing duct in said pin affording communication between the outlet side of said port and the atmosphere.

3. A valve assembly comprising a casing, a washer therein, a valve port in said washer having an inlet side and an outlet side opening into said casing, a valve and means for normally seating said valve in said port, an elastic sealing gasket on the outlet side of said port and having an opening therein, a valve actuating pin projecting through said gasket opening and being movable through said port to unseat said valve and open said port, the portion of said pin adjacent said port having an outside cross-sectional area less than that of said port, an annulus-like spacer between said washer and said gasket shaped to form a chamber-like recess between said gasket and said port surrounding the adjacent portion of said pin, said spacer having an opening in alignment with said port and of cross-sectional area slightly greater than that of said port, said washer, spacer and gasket being associated at the peripheries thereof with said casing in gas-tight relation, the elasticity and the size of said gasket opening, with respect to the immediately adjacent outer periphery of said pin, being such that during an initial part of a valve opening movement of said pin said gasket and pin move unitarily in diaphragm seal relation for a substantial distance through an initial portion of said recess, and during a final portion of the valve opening movement said gasket and pin maintain a sliding seal relation, and a dispensing duct affording communication between the outlet side of said port and with the exterior of the assembly.

4. A valve assembly comprising a casing, a washer in the bottom thereof, a valve port in said washer having an inlet side and an outlet side opening into said casing, a valve and means for normally seating said valve in the inlet side of said port, an elastic sealing gasket on the outlet side of said port and having an opening in axial alignment with said port, means movable through said port and including a valve ac-

tuating pin projecting through said gasket opening for unseating said valve to open said port, the portion of said second mentioned means adjacent said port having an outside cross-sectional area less than that of said port, an annulus-like spacer between said washer and said gasket, said spacer having an inwardly and downwardly inverted cone-shaped surface terminating in an opening in alignment with said port and having a cross-sectional area greater than that of said port, said spacer thereby forming a chamber-like recess between said gasket and said port and surrounding the adjacent portion of said pin, said washer, spacer and gasket being associated at the peripheries thereof with said casing in gas-tight relation; the periphery of said gasket opening being normally undersized, with respect to the immediately adjacent outer periphery of said pin, to such an extent that said gasket frictionally engages said pin tightly enough to move unitarily therewith for a substantial distance through an initial portion of said recess during an initial part of a valve opening movement of said pin, but loosely enough to slide with a sealing fit over said pin during a final portion of the valve opening movement of said pin, and a dispensing duct affording communication between the outlet side of said port and the atmosphere.

5. A valve assembly comprising a casing, a washer therein, a valve port in said washer having an inlet side and an outlet side opening into said casing, a valve and means for normally seating said valve in said port, an elastic sealing gasket on the outlet side of said port and having an opening therein, means movable through said port and including a valve actuating pin projecting and movable through said gasket opening for unseating said valve to open said port, the portion of said second mentioned means adjacent said port having an outside cross-sectional area less than that of said port, and the portion of said pin movable through said gasket opening having a constant cross-

sectional area; spacing means between said washer and gasket and located adjacent the peripheries thereof for forming a chamber-like recess lying between said gasket and port and surrounding the adjacent portion of said pin and being of size sufficient to accommodate extended and substantial movement of the center of said gasket toward said port; said washer, spacing means and gasket being associated at the peripheries thereof in gas-tight relation and said gasket being immovably secured at its periphery in said casing; the manufactured size of said gasket opening being substantially less than that of the immediately adjacent outer periphery of said pin, and such size and the elasticity of said opening being such that during an initial part of a valve opening movement of said pin, said gasket and pin move unitarily in diaphragm seal relation for a substantial distance through an initial portion of said recess, and during a final portion of the valve opening movement said gasket and pin maintain a sliding seal relation, and a dispensing duct affording communication between the outlet side of said port and with the exterior of the assembly.

6. The assembly of claim 5 in which the spacing means provides, on the valve port outlet side of the washer, an annulus-like rigid backing having an opening in alignment with said port and of cross-sectional area slightly greater than that of said port.

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