United States Patent

[11] 3,620,421

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[21] Appl. No. **866,988**
[22] Filed **Oct. 16, 1969**
[45] Patented **Nov. 16, 1971**

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[32] Priority **Oct. 21, 1968**
[33] **Great Britain**
[31] **49,844/68**

[54] **VALVES FOR PRESSURIZED LIQUID CONTAINERS**
21 Claims, 8 Drawing Figs.

[52] U.S. Cl. **222/402.21**, 222/402.24, 251/349
[51] **Int. Cl.** **B65d 83/14**
[50] **Field of Search** 251/353, 349; 239/579; 222/402.21, 402.22, 402.23, 402.24, 402.1, 402.13, 400.7

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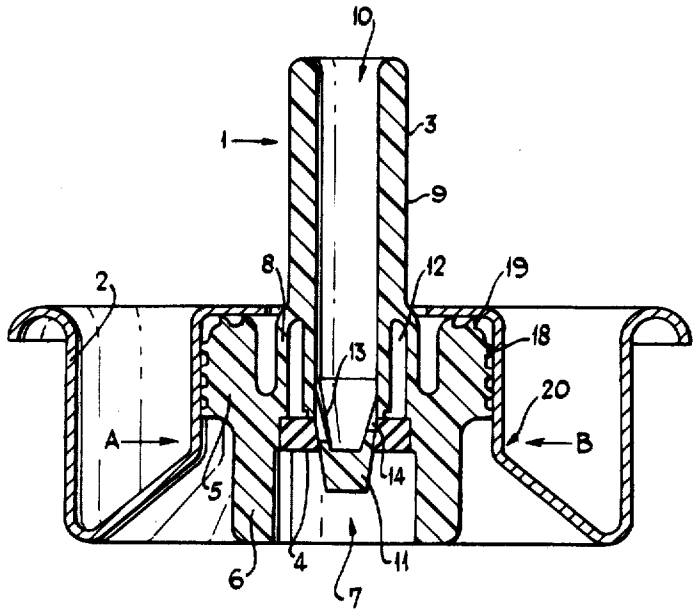
ABSTRACT: A valve member which is a single moulding able to form a valve device with an annular member to be held in an annular cavity defined by and within the moulding, the moulding having an integral spring which allows relative movement between the annular member and a further portion, which is integral with the moulding and encircled by the spring, to open a fluid path which is normally closed by the abutment of said annular member and said further integral portion.



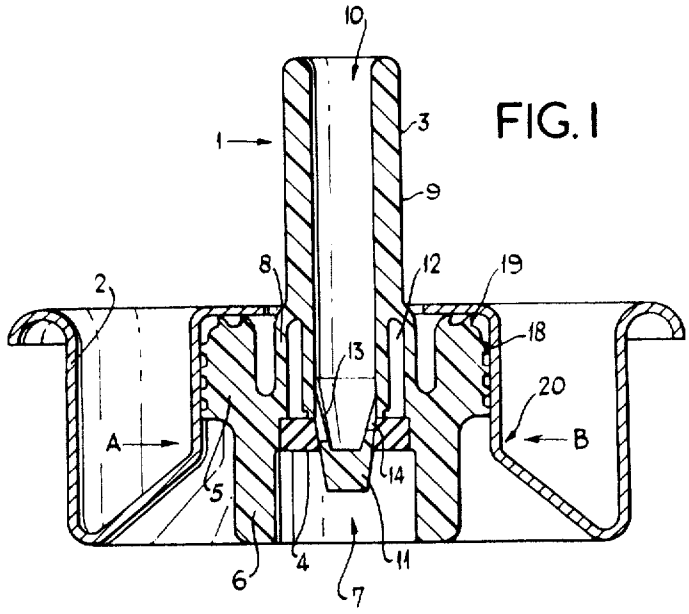


FIG. 1

FIG. 2

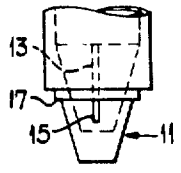


FIG. 3

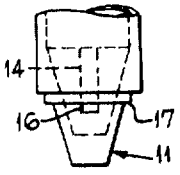


FIG. 4

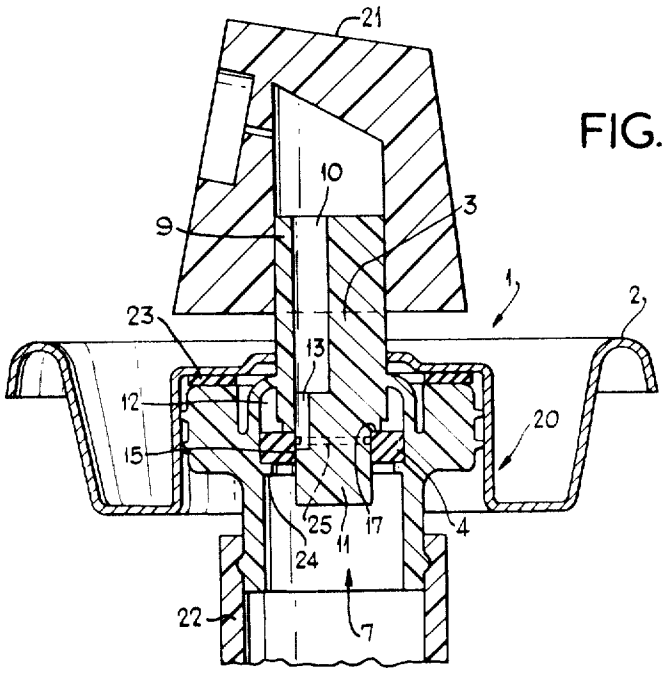

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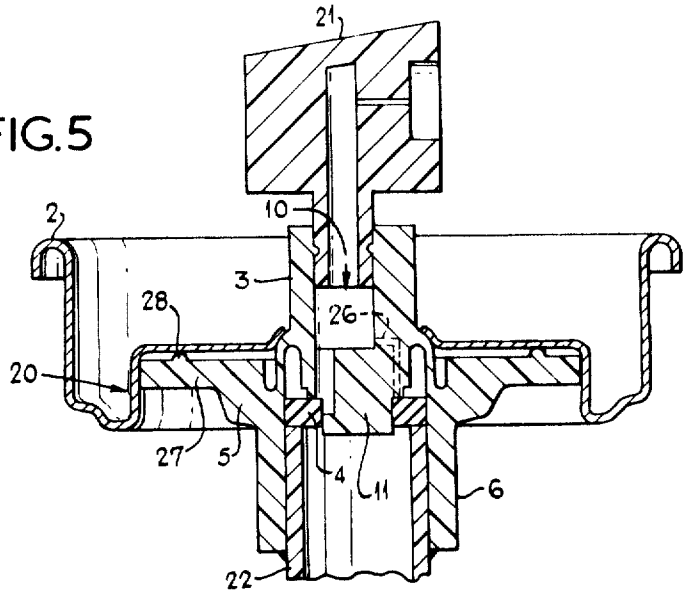
FIG. 5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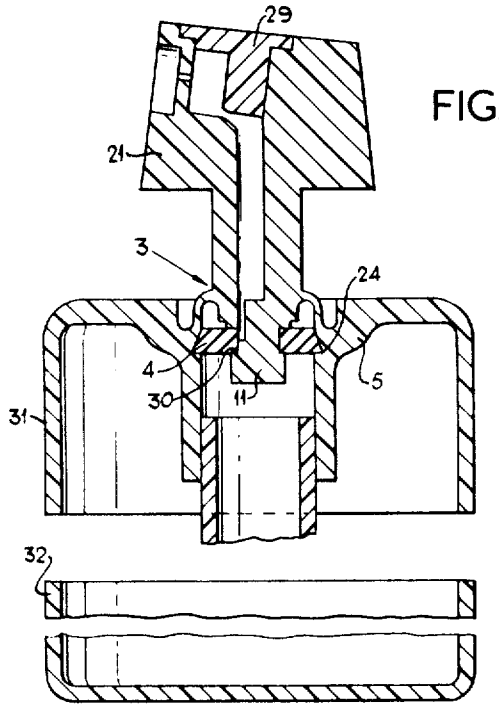

FIG.6

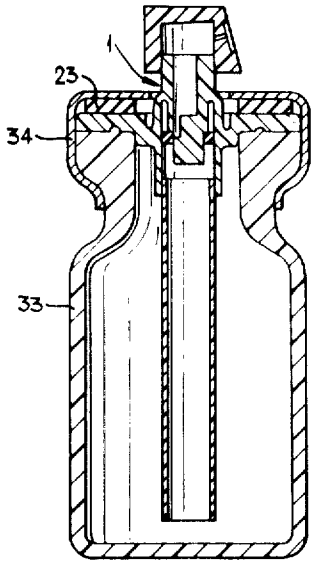

FIG.7

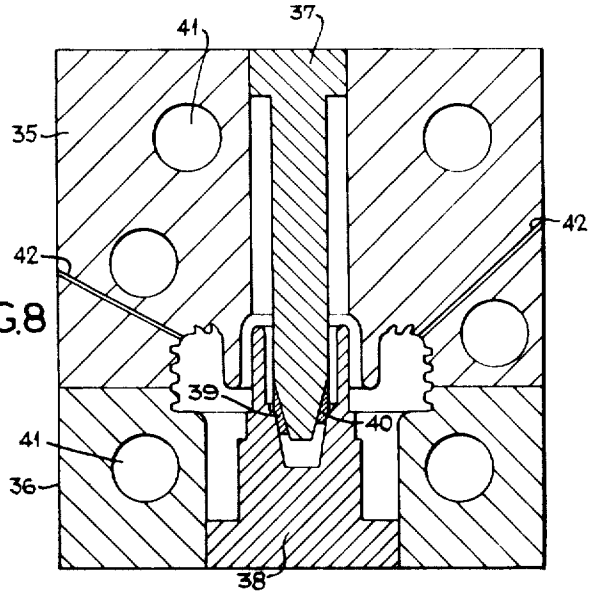

FIG.8

VALVES FOR PRESSURIZED LIQUID CONTAINERS

This invention relates to valves, such as valves suitable for controlling the discharge of a pressure-packed product, as in the aerosol art.

In the aerosol art, the product is placed as a fluid formulation under pressure in a container, the necessary pressure being derived, for example, from the vaporization of of a low boiling point substance or from a compressed gas or from a combination of such means.

The pressurized containers are provided with a valve in order to control the discharge of the product. Such a valve must be constructed to seal the container securely and to avoid leakage through the valve between dispensing operations. In order to meet the necessary sealing standard, aerosol valves in current use conventionally have a plurality of parts, including a separate spring arranged to hold the controllable fluid path in the valve in a normally closed condition. These parts are manufactured separately and must be assembled together in order to produce a complete valve. The time taken to manufacture and assemble the separate parts plays a crucial part in deciding the cost of the valves and thus the cost of the pressure-packed product to the public.

It is accordingly an object of the present invention to reduce the number of parts that need to be manufactured assembled together, and to provide a means for manufacturing such a valve.

According to one aspect of the present invention, there is provided a valve member which is a single moulding defining a fluid flow path and within which is a cavity encircling one integral portion of the moulding and in which an annular sealing member can be held normally to seal said path by abutment with said portion, and there being a spring which is another integral portion of the moulding, which normally maintains the abutment condition and which allows relative movement between the annular member and said one integral portion to open the path.

According to a second aspect of the invention, there is provided a thermoplastic injection moulding tool, for producing the aforesaid valve member, formed of a number of metallic components which define an internal cavity within the tool and which include members which project into the cavity, the cavity defining the outer form of valve member, including the outer surface of the spring, and the said members defining an outlet passage of the valve member, an annular cavity within the valve to accommodate the annular sealing member, the inner surface of the spring being a wall portion of said cavity, and a passageway which extends from the outlet passage through a portion of the valve member encircled by the annular cavity to an aperture opening into said annular cavity at a surface of said portion.

Preferably, the single moulding is such as to have integral portions which are:

a first annular portion which provides means by which the valve member may be sealed to a container;

a second portion which provides an outlet passage;

a third, spring, portion of annular form which joins the first and second portions; and

a fourth portion which extends from the second portion in the space within the first and spring portions, the fourth portion containing a passageway joining the outlet passage to an aperture at a surface of said fourth portion and the second portion being displaceable with the fourth portion relative to the first portion against the resilience of the spring portion. The annular sealing member is to be held between the first and fourth portions normally to seal said aperture, the arrangement being such that said relative movement will produce relative movement between the annular sealing member and said fourth portion to open said aperture. Preferably, the radially inner surface of said annular sealing member seals said aperture.

Preferably, the first portion includes a projection to which a dip tube may be attached, either by being engaged about or within the projection. Such a projection will provide an inlet passage for the valve.

It is to be noted especially that the controllable path through the valve member has no communication with the outer surface of the single moulding apart from at the inlet and at the outlet. This is to be contrasted with the prior valves constituted of a number of parts the joins between which provide possible leakage paths from the controllable path of the valve to the outer surface of the valve at regions intermediate the valve inlet and outlet. This feature arises specifically because of the use of a single moulding and the necessity for only one further part, i.e., the annular sealing member, which is accommodated within the moulding an is thus not secured thereto so as to define an outer surface portion of the valve. The seal between the valve and the container is therefore to resist leakage merely of the contents in the main body of the container and is not also required to resist leakage of products via the dip tube or valve inlet.

The relative movement produced between the annular member and the portion of the moulding which it encircles may be sliding movement and/or flaring movement. Indeed, for sliding movement, the annular member may be substantially rigid, when the moulding is desirably of rubber. On the other hand, this member is preferably resilient or elastomeric.

With regard to flaring, it is to be noted that the portion of the moulding encircled by the annular sealing member may have a shoulder or other means to abut the annular member, whereby the relative movement will produce distortion of the annular sealing member, when resilient, such as to flare or roll its radially inner surface away from the facing surface of the moulding portion encircled by it.

The annular sealing member may be a simple circular gasket formed preferably, but not essentially, from some resilient or elastomeric substance, such as rubber or EVA. It may even be provided by an end portion of the dip tube. It may with advantage have its outer surface so formed in a tapering configuration as to ensure an interference fit within the cavity of the moulding. In addition, the sealing member may be located on a seating provided by a shoulder within the moulding. In any case, it is preferred that the sealing member be formed with larger outside dimensions than the outside dimensions of the cavity to contain it so that it is held by compression at its desired location within the cavity firmly to seal off the passageway in the valve. If a seating is provided by the moulding, this seating may be a projection on the outer or inner surface of the cavity which is to contain the sealing member. A further method of holding the sealing member in position would be to assemble a dip tube in an inlet passage of the valve so that the edge of the dip tube bears against the sealing member. The dip tube may be firmly secured to the moulding, as by welding.

In addition, a groove may be formed in the sealing area of the valve, that is in the sealing surface of the sealing member and/or in the sealing surface of the moulding, to admit the pressure in the container to the inner surface of the spring, which will therefore be utilized as a diaphragm assisting the spring action.

Furthermore, the fourth portion may have more than one aperture at its surface. Preferably, these apertures open at different levels along the fourth portion, so that a single opening may be used for discharge and all the openings for achieving a high filling rate.

The valve action has been described above in relation to relative axial movements of the sealing member and the moulding portion which it encircles. In addition, however, valve operation can be achieved by a relative tilting action. Assuming a single opening normally sealed by a resilient annular sealing member, only tilting in a limited range of directions will open the valve. To overcome this problem, there may be a groove which extends entirely or at least for a major part around the sealing area and which communicates with the passageway in the moulding portion encircled by the sealing member. This groove may be in the sealing member and/or in the portion surrounded thereby. Tilting in substantially any direction will open this groove and thus provide an open discharge path through the valve.

The outer surface of the moulding may have any convenient shape which enables it to be held, for example by crimping, in sealing engagement with a metallic cap serving as an intermediate container-sealing member or with the walls of any suitable container such as the upper cone of an aerosol can. For example, the moulding may have an annular outer projection which may be so utilized. The outer surface of the moulding in contact with the container or an intermediate connecting member may have any number of small projections extending continuously about the moulding which, when forced into contact with the intermediate member or can, will distort and act as a seal between the moulding and the intermediate member or can. There may also be a projection or projections serving to retain a dip tube in sealing engagement with the valve. Similarly, there may be a projection or projections to enable a nozzle or actuator button to be held to the valve. In the alternative, the nozzle or actuator button and/or the dip tube might be formed as an integral portion of the single moulding.

For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings in which:

FIG. 1 is a cross-sectional view of a two-piece valve;

FIGS. 2 and 3 are views of a portion of the valve of FIG. 1;

FIGS. 4 and 7 show further embodiments in cross section and including dip tubes and nozzles; and

FIG. 8 is a diagrammatic cross-sectional view of a thermoplastic moulding tool for forming a valve.

FIG. 1 is a cross-sectional view of a valve generally denoted 1 in combination with a metallic intermediate mounting member 2 which is to be crimped at its periphery to an aerosol can.

The valve itself consists of two pieces, a single moulding 3 of plastics material, such as polypropylene or other suitable thermoplastic material, and an annular member 4 which acts as a sealing gasket and is of resilient or elastomeric material, such as natural or synthetic rubber or EVA.

The moulding 3 comprises a first body portion 5 having a projecting tubular portion 6 defining the inlet passage 7 of the valve.

A second portion 9 defines an outlet passage 10.

A third annular thin-walled portion constitutes a spring portion 8 which joins the first portion 5 directly to the second portion 9.

Extending from the second portion 9 is a fourth portion 11 which defines with the first portion 5 an annular cavity 12. The passage 10 within the second portion 9 extends into the fourth portion 11 and communicates with the outer surface of the portion 11 by two channels 13 and 14. These two channels provide openings one of which extends further towards the inlet passage 7 than does the other. FIG. 2 shows the portion 11 as viewed in a direction of the arrow A OF FIG. 1 to show the channel 13 and its aperture 15 at the surface of the portion 11. FIG. 3 shows the portion 11 in the direction of the arrow B of FIG. 1 to show the channel 14 and its opening 16 at the surface of the portion 11.

FIGS. 1, 2 and 3 also show that the portion 11 is provided with a shoulder 17 which completely encircles the portion 11 and abuts upon the upper surface of the annular member 4. It is also to be noted that the portion 11 and the annular member 4 have cooperating surfaces of tapered form.

The first portion 1 is formed with circumferential ribs 18 and circularly extending ribs 19 on its upper annular surface. The ribs 18 are so dimensioned as to provide a force fit with a cylindrical portion 19 of the mounting member 2. The distortion of the projections 18 will thus provide a plastics-to-metal seal at this region. In addition, the mounting member 2 will be deformed at 20 so that it is crimped to the portion 5 whereby the projections 19 will also be forced into sealing engagement with the member 2. In this case it is not proposed to provide any sealing gasket between the metallic mounting member and the valve. However in this case, as in the embodiments to be described, a gasket could be provided by injecting liquid latex between the member 2 and the moulding 3.

In use, a dip tube will be engaged within the portion 6 and will abut against the lower surface of the member 4. Preferably the dip tube is spotwelded to the portion 6. In addition, a nozzle member is engaged about or within the portion 9.

In operation, a pressure will exist in the inlet passage 7 to urge the member 4 upwardly and thus increase the sealing pressure by virtue of the tapered form of the sealing surfaces. When a force is now applied downwardly to the portion 3 by way of the nozzle (formed conventionally as an actuator "button") the portion 11 moves downwardly relative to the body portion 5 while the spring 8 deforms. The force therefore applied by way of the shoulder 17 to the annular member 4 causes its sealing surface to flare or roll away from the fourth portion 11, thus opening the aperture 15 to the inlet passage 7 and producing discharge of the pressure-packed product. By increasing the operating force the aperture 16 is also opened to provide an increased discharge rate.

The provision of the two channels 13 and 14 and their apertures 15 and 16 at different levels enables rapid filling of a container to be achieved via both channels, while providing, if desired, a relatively low discharge rate by way of channel 13 for low levels of actuating force.

FIG. 4 illustrates such a valve 1, with modifications, assembled with a plastics nozzle member 21, a plastics dip tube 22 and a mounting member 2 with a sealing gasket 23. The moulding 3 differs in several respects from that of FIG. 1. Firstly, the cavity 12 provides a shoulder 24 on which to locate the member 4. In addition, the outlet passage 10 is formed eccentrically in the second portion 9 to provide increased rigidity for this portion and communicates with at least one eccentric channel 13 in the fourth portion 11. Furthermore, a groove 25 is formed in and encircles the fourth portion 11 at the level of the aperture 14. Accordingly, if a lateral force is applied to the nozzle member 21, this groove will be opened to the inlet passage 7 and provide a communication between the inlet passage 7 and the aperture 14 for all directions of such a lateral force. If an additional channel, such as the channel 14 of FIG. 1, is included for filling purposes, this preferably does not open into the groove 25.

It is also to be seen that both the nozzle member and the dip tube engage the external surface of the moulding, but other arrangements are possible in which either one or both of these parts engage an internal surface of the moulding. Finally, it is pointed out that, if the shoulder 17 is omitted, valve operation can be accomplished purely by a relative sliding motion of the fourth portion 11 and the annular member 4.

FIG. 5 illustrates the case in which the nozzle member 21 and the dip tube 22 are held within the moulding 3. This embodiment also shows the dip tube 22 holding the annular member 4 in its desired position within the cavity 12. This dip tube may be welded to the portion 6 of the moulding.

The dotted lines in FIG. 5 show a passageway 26 joining the outlet passage 10 to a surface of the fourth portion 11 abutting a sealing surface of the member 4 other than its radially inner surface. This passageway 26 may be employed to provide an increased filling rate, the pressure of the product supplied to the outlet passage during filling forcing the member 4 away from the fourth portion 11 to produce an additional entry path for the product.

Finally, this embodiment comprises a flange 27 formed integrally with the first or body portion 5 and by which the moulding may be sealed with respect to a container. A rib 28 on the flange and encircling the moulding assists in producing an effective seal. The flange may be crimped to a mounting member 2 with or without the interposition of a gasket.

FIG. 6 illustrates an embodiment in which the main portion of the nozzle member 21 is formed integrally with the moulding 3, the top of this nozzle member 21 being closed by a plastics plug 29.

This embodiment employs an annular member 4 with a tapered outer configuration seated on a shoulder 24 of the moulding. A further seating 30 is provided on the fourth portion 11 and may be present in addition or alternatively to the shoulder 24.

In this embodiment, the body portion 5 is formed integrally with the upper portion 31 of a plastic bottle, the lower portion 32 of which will be moulded separately and welded to the upper portion 31.

FIG. 7 shows a valve 1 sealed to an aerosol container 33 by means of a metallic cup 34 spun so as to be sealed to the neck of the container, sealing being assisted by a gasket 23.

FIG. 8 diagrammatically represents in cross section a thermoplastic moulding tool for forming the moulding 3 of a valve such as that illustrated in FIG. 1. The moulding tool has a plurality of separable metal parts, two of which, 35 and 36, define a cavity having the form of the outer surface of the moulding. The internal form of the moulding is defined by two metallic pins 37 and 38 removably mounted with respect to the parts 35 and 36. The pin 37 defines the outlet passage and the inner form of the fourth portion 11 of the moulding. It also carries, possible releasably, two projections 39 and 40 to define the channels 13 and 14. The parts 35 and 36 contain cooling water channels 41 and thermoplastic material injection passages 42.

The tool is provided with means (not shown) for automatically ejecting the moulding, such as pins slidable in channels in the parts 35 and 36.

Finally, the annular member 4 may be produced by slicing a portion from a tube of elastomeric material.

It has been mentioned that the dip tube may be used to retain the annular sealing member 4. Alternatively, a relatively rigid, short, tube, as of metal or high-density polyethylene, may be used to retain the annular sealing member and a flexible dip tube could be attached to the rigid tube. It may prove that the rigid tube can retain the annular sealing member 4 better than a flexible tube, thereby avoiding a relatively rigid dip tube.

In addition it is to be noted that a projection of the moulding 3 may be formed as a closure cap for a bottle or can, the form of the moulding then being as shown in the upper part of FIG. 6. The cap 31 may be sealed to a bottle or can be welding, a screw thread formed within the cap or by a metal or other band encircling the cap.

I claim:

1. A valve member comprising an annular sealing member and a single moulding defining: a flow path defined wholly within said moulding; an annular cavity within said moulding encircling on integral portion of said moulding and in which said annular sealing member is held normally to seal said path by abutment with said one integral portion; and a spring which is another integral portion of said moulding normally to maintain the abutment condition between said annular member and said one integral portion and to allow relative movement between said annular member and said one integral portion to open said path.

2. A valve member which is a single moulding defining a flow path wholly within said moulding and has integral portions which are:

a first annular portion by which said member may be sealed to a container and within which is a first part of said path;

a second portion within which a second part of said path is defined;

a third, spring, portion of annular form which joins said first and second portions; and

a fourth portion which extends from said second portion and is the space within said first and spring portions, said fourth portion containing a passageway which joins said first and second parts of said path by way of an aperture at a surface of said fourth portion, which aperture is normally to be sealed by an annular member which can be held within the annular cavity defined between said first and fourth portions of said moulding.

3. A member as claimed in claim 2, wherein said aperture is at a circumferential surface portion of said fourth portion thereby to be sealed by the radially inner surface of said annular member.

4. A member as claimed in claim 3, wherein said fourth portion has a form which tapers in the direction away from said second portion.

5. A member as claimed in claim 3, wherein said fourth portion has a groove communicating with said aperture and extending over at least a major portion of said circumference of said fourth portion.

6. A member as claimed in claim 3, wherein said fourth portion has a groove to provide a communication between opposite sides of said annular member when in its sealing condition, said groove not communicating with said aperture in the sealing condition.

7. A member as claimed in claim 2, wherein said fourth portion has more than one aperture at its surface, each such aperture communicating with said outlet passage, and two of said apertures having their edge portions which are more remote from said second portion at different distances along said fourth portion.

8. A member as claimed in claim 2 for a resilient annular sealing member, wherein said moulding has a shoulder or projection to abut said annular member to deform said annular member when said relative movement occurs.

9. A member as claimed in claim 8, wherein said shoulder or projection is provided on said fourth portion.

10. A member according to claim 2, wherein the moulding has a seating to retain said annular member.

11. A member as claimed in claim 2, wherein the moulding is of polypropylene.

12. A member a claimed in claim 2, wherein said moulding has a circumferential rib or ribs on its exterior surface to provide sealing engagement with a container or connecting member.

13. A member as claimed in claim 2, wherein said moulding has a flange for securing said moulding to a container or connecting member.

14. A member as claimed in claim 2, wherein an integral portion of said moulding defines an inlet passage.

15. A member as claimed in claim 2 in combination with a spray nozzle member a major portion of which is an integral portion of said moulding.

16. A member as claimed in claim 2 in combination with said annular member held within said moulding normally to seal said path.

17. A member as claimed in claim 16, wherein the outer surface of said annular member is tapered.

18. A member as claimed in claim 16, wherein said annular member is retained within said moulding by a tube engaged within said moulding.

19. A member as claimed in claim 16, wherein said annular member defines a groove to provide an open fluid path between opposite sides of said annular member and separate from said aperture in the sealed condition.

20. A member as claimed in claim 16, wherein said annular member defines a groove extending for at least a major portion of its inner circumference and communicating with said aperture.

21. A member as claimed in claim 16, wherein said annular member is of elastomeric material.

* * * * *