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Speck

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[54] **PRESSURE RELIEF STRUCTURE FOR AEROSOL CONTAINERS**

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[52] **U.S. Cl.** ..... **137/543.19;** 137/540; 137/543.21; 220/44 R

[51] **Int. Cl.** **B65d 51/16**

[58] **Field of Search** ..... 220/44, 43 P; 137/540, 137/543.21, DIG. 4, 543.19; 251/75; 222/396, 397

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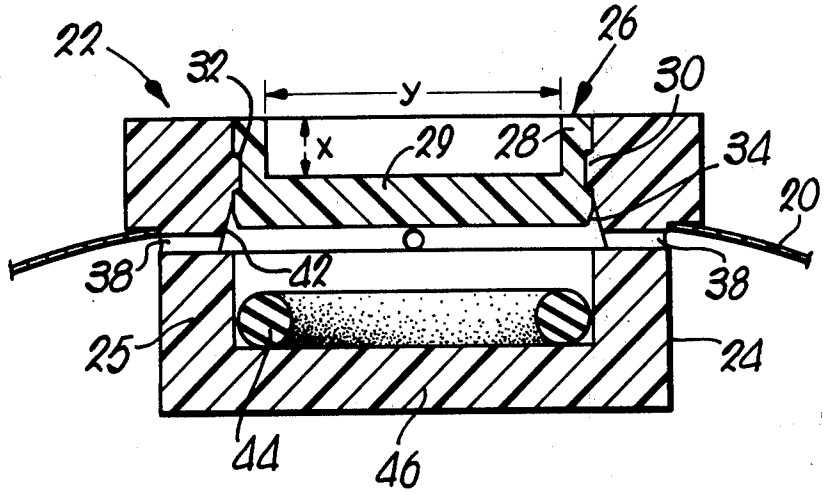
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Attorney, Agent, or Firm—Schmidt, Johnson, Hovey & Williams

[57] **ABSTRACT**

A safe, wholly self-contained, low cost pressure relief device fabricated from yieldable synthetic resin materials for use in pressurized aerosol cans or the like for relieving gas pressure inside the can before the can rupture point is reached that is operable to effectively preclude the possibility of dangerous explosive projectiles being created during actuation thereof. This objective is accomplished by provision of an outer cup-like vented housing adapted to extend through a wall of the aerosol can, with a shiftable, pressure responsive sealing disk contained within the housing serving to normally seal the can. In response to a rise in can pressure above what would otherwise be a potentially dangerous level, the disk shifts under pressure within the housing to a position communicating the interior of the can with vent openings provided in the housing, thereby achieving a safe, nonviolent venting of the can. In a preferred form, a compressible neoprene O-ring is positioned on the bottom wall of the housing in disposition to be engaged and thereby compressed by the disk when the latter is shifted to a pressure relief location thereof. As the pressure inside the can decreases, the compressed O-ring slowly forces the disk back toward its initial position until it finally reseals the interior of the can, but is operable to again open the can to the atmosphere when the pressure builds up to a level to shift the sealing disk back to a pressure relief position.

8 Claims, 6 Drawing Figures



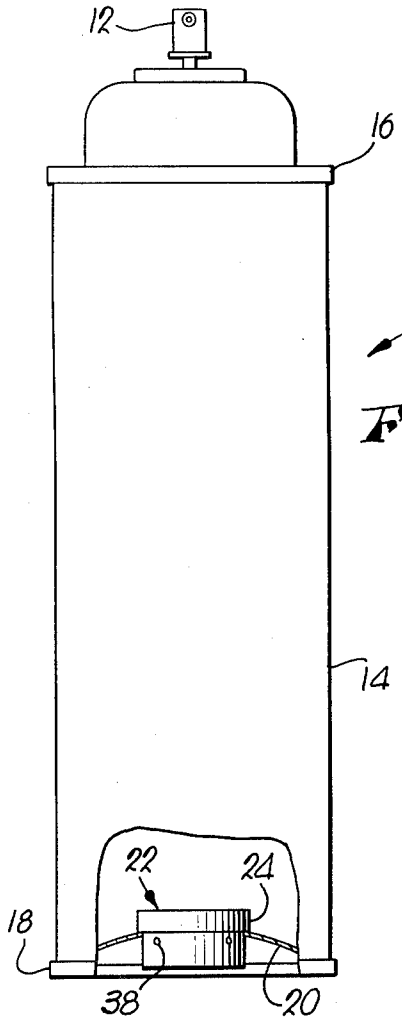


Fig.1.

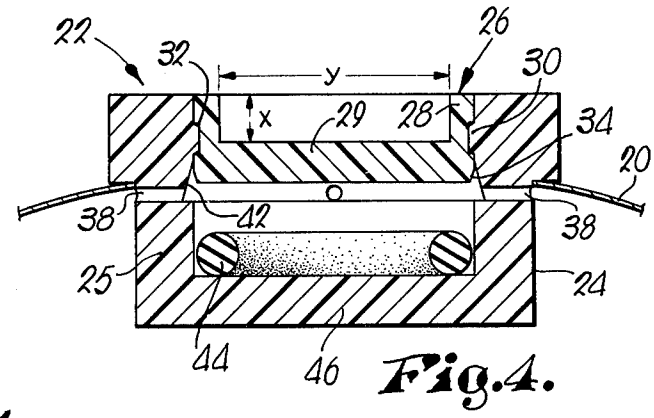


Fig.4.

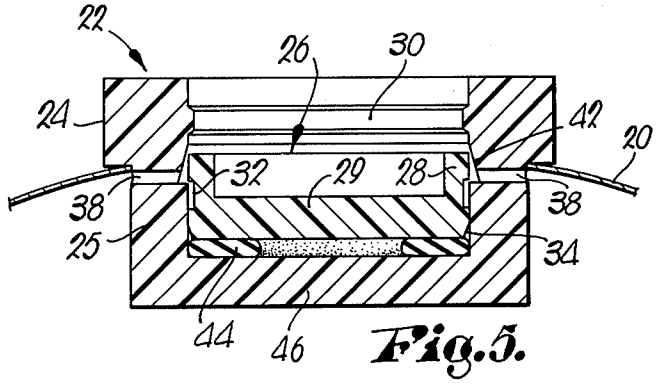


Fig.5.

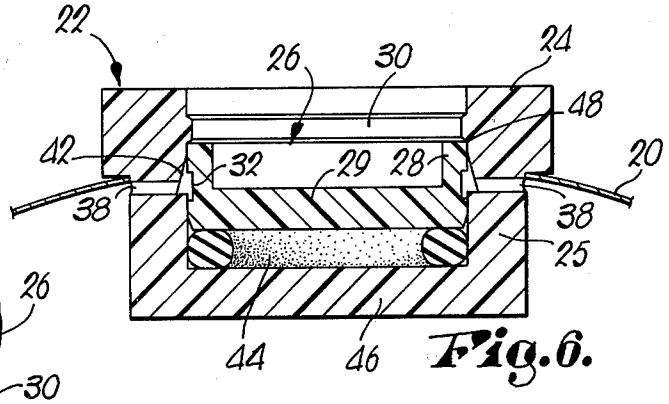
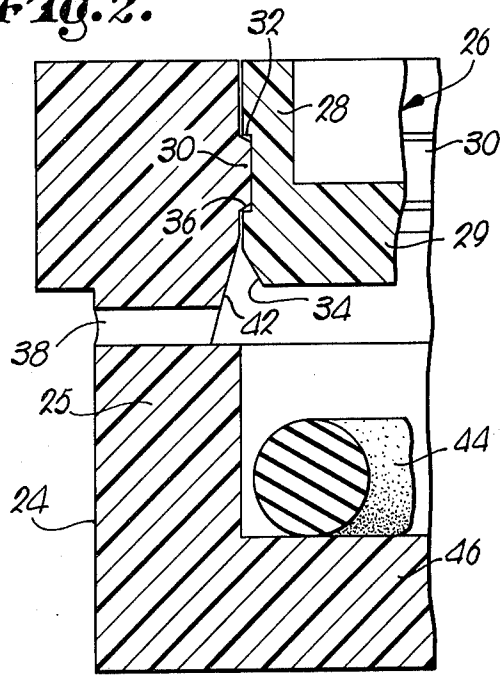


Fig.6.

Fig.2.



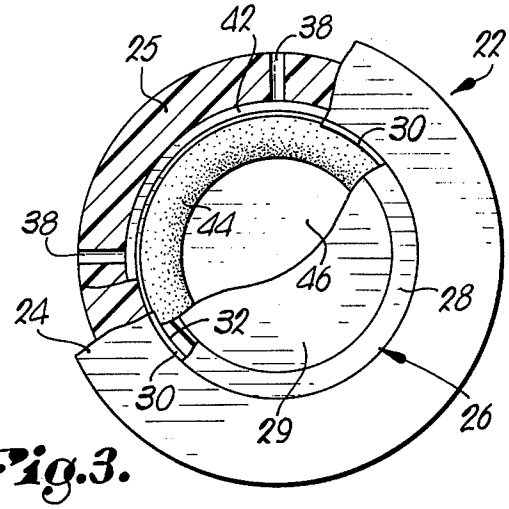


Fig.3.

PRESSURE RELIEF STRUCTURE FOR AEROSOL CONTAINERS

BACKGROUND

This invention relates to a safe, self-contained pressure relief device for use with aerosol cans or the like and embodying a disk which shifts to a pressure relief position when the pressure inside the container exceeds a preselected value. The relief structure is operable though without problems associated with explosive projectiles being emitted during actuation of the relief device and consequent depressurization of the can by virtue of the construction thereof of yieldable synthetic resin material and caging of the disk in a retainer housing. More particularly, it concerns a pressure relief device of the class described having a vented cup-like synthetic resinous housing member extending through a wall of an aerosol can, with a shiftable, pressure responsive sealing member within the housing serving to normally seal the can.

In the use of pressurized aerosol spray cans or the like, it has long been recognized that it would be desirable to provide some means for venting the same as a safety measure to protect the user, especially in situations where the can is subjected to high temperatures or other conditions inducing danerously elevated can pressures. Appropriate venting would minimize the hazards involved in violent explosion of these metallic cans and injury to the user or other persons in the vicinity thereof when the pressure inside the can reaches a dangerous level, usually by sudden increase in the temperature of the gas inside the container as for example, where the aerosol can is thrown into a fire or the like. Accordingly, workers in the art have attempted to produce simple, low cost pressure relief devices which were capable of safely and reliably venting aerosol cans when the internal pressure thereof rises to a relatively high level.

In general, pressure relief devices of the prior art have employed metallic burstable or fusable elements which were interposed in the wall of an aerosol can for the purposes outlined. When the internal can pressure became excessively high, these devices were designed to burst or melt, thus relieving the can pressure. However, in actual practice these prior constructions have proven deficient in a number of respects.

Most importantly, they oftentimes created hazards in use because metallic fragments from the ruptured diaphrams or the like became in effect extremely dangerous projectiles during high pressure actuation. Moreover, the explosive nature of these devices also often resulted in the contents of the can being sprayed or splattered from the can with great force. As can be appreciated, these undesirable characteristics severely limited the use of such prior devices, especially in conjunction with aerosol cans containing products sold to the public at large.

In an attempt to overcome the problems outlined above, other pressure relief devices have been suggested which employ complicated spring-actuated valving mechanisms and the like. While these have in some instances overcome the problems associated with explosive bursting, they were relatively expensive to produce and install on aerosol cans, which of course has militated against their use on a large scale.

Yet another problem associated with almost all of the pressure relief devices heretofore available has stemed from the fact that after their initial use, the aerosol can itself became essentially useless. Specifically, when such mechanisms operated, the internal can pressure was quickly relieved until reduced to that of the atmosphere, thus making it impossible to utilize the contents of the can. Moreover, in some instances, these contents actually leaked from the can through the aperture created by actuation of the device.

Therefore, there is a need in the art for a low cost pressure relief device for aerosol cans which is completely safe in all modes of operation, can be fabricated from relatively inexpensive materials, and is further operable to provide a resealing function after the initial actuation thereof.

SUMMARY

Accordingly, it has been found that a device exhibiting the characteristics outlined above can be produced from low cost yieldable synthetic resin materials such as polypropylene or nylon. The device broadly comprises a vented cuplike housing which is adapted to extend through a wall of a pressurized can or other enclosure in sealing relationship thereto, in conjunction with a sealing member operatively contained with the housing in disposition to normally seal the can by preventing flow of the contents thereof through the vent opening or openings of the housing. In response to a rise in can pressure above a predetermined dangerous level, the sealing member is operable to shift within the housing to a position permitting the excess pressure to be safely relieved through the vent openings. In this manner no potentially dangerous explosive fragments or projectiles are produced because the sealing member is safely contained within the outer housing under all conditions and modes of operation.

In a preferred form, the sealing member is a synthetic resinous disk having an upstanding annular sidewall which is adapted to be secured within the housing in disposition to block communication between the interior of the aerosol can and the vent openings of the housing. For this purpose cooperative flange and recess structure is provided on the interior of the housing and the disk respectively, which acts to firmly secure the disk in the sealing position thereof during normal temperature and pressure conditions within the can.

In order to provide a resealing function, the device also preferably includes a compressible neoprene O-ring which rests within the housing atop the closed end thereof. When the sealing disk is shifted to venting position thereof, the O-ring is at first compressed; when the pressure within the can has been reduced to a safer low level, the O-ring expands to push the sealing disk back into a blocking disposition with respect to the vent openings of the housing. In this manner a reseal of the aerosol can is effected after the dangerous high pressure condition has been alleviated, thus permitting continued use of the can and the contents thereof. Moreover, should can pressure again rise beyond tolerable limits, the sealing member resting atop the O-ring will again be pushed downwardly to compress the O-ring and vent the can, followed by another resealing thereof when the internal pressure is again safe.

DRAWINGS

FIG. 1 is a front elevational view of a standard aerosol can containing sprayable material with the base portion thereof being broken away to show the pressure

relief device of the present invention in operative disposition;

FIG. 2 is a fragmentary, greatly enlarged view in vertical section of a pressure relief device in accordance with the present invention shown in its normal sealing disposition;

FIG. 3 is top plan view of the two-piece pressure relief device of the invention irregularly broken away to illustrate the internal construction thereof;

FIG. 4 is an enlarged, vertical section view of the pressure relief device shown in FIG. 1 in its normal sealing disposition;

FIG. 5 is a vertical section view similar to that of FIG. 4 with the sealing disk thereof shifted to its operative venting position;

FIG. 6 is a vertical sectional view similar to that shown in FIGS. 4 and 5 showing the sealing disk moved upwardly by the action of the compressible O-ring into disposition blocking the vent openings of the housing.

DETAILED DESCRIPTION

Referring to FIG. 1, there is shown a standard aerosol can 10 of generally cylindrical configuration and having a spray head 12 which, in the known manner, is operable upon depression thereof to release a fine spray of the contents from the can. A top wall member and a bottom wall are attached to the hollow tubular body 14 of can 10 by means of upper and lower metallic sealing heads which prevent leakage of product as well as reinforce the can. Bottom wall 20 is of arcuate, generally concavo-convex configuration to offer greater pressure resistance.

The pressure relief device of the present invention is generally designated by the numeral 22 and is preferably centrally disposed within bottom wall 20. Device 22 broadly comprises an outer, cup-like housing 24 and a circular sealing disk 26. Housing 24 has a cylindrical side wall 25 and a closed end defined by bottom wall 46 and is adapted to extend through bottom wall 20 of can 10 in sealing engagement therewith. The circular sealing disk 26 is shiftably positioned within housing 24 for movement from the normal sealing location illustrated in FIG. 4 to the relief position of FIG. 5. Disk 26 includes a continuous, integral, annular upstanding sidewall 28 which is integral with the main circular body portion 29 thereof.

Referring particularly to FIG. 2 of the drawings it can be seen that sealing disk 26 is firmly held in its normal sealing disposition relative to housing 24 by the cooperative action between an inwardly directed, integral, circumscribing flange 30 projecting from the interior wall of housing 24 and outwardly facing complementary annular recess 32 provided in the outer face of sidewall 28 of sealing disk 26.

To facilitate installation of sealing disk 26 within cup-like housing 24, the circular bottom leading edge of disk 26 is chamfered as at 34. Moreover, installation is also facilitated by provision of opposed sloping annular sidewalls defining the upper and lower margins of flange 30 (see FIG. 2). In this manner, sealing disk 26 can be readily and easily installed within housing 24 without undue deflection of the latter while nevertheless maintaining the requisite frictional, snug fit between these two elements.

A plurality of vent openings 38 are provided in the cylindrical sidewall 25 of housing 24 about the circumference thereof at a position below that occupied by sealing disk 26 when in its normal sealing disposition. Additionally, the internal sidewall of housing 24 is tapered as at 42 between flange 30 and vent opening 38 for purposes to be made clear hereinafter.

In the preferred form of the present invention, a compressible neoprene O-ring 44 is positioned within housing 24 and rests on the interior surface of bottom wall 46 thereof. In other embodiments however, a compressible member of any desired shape could be used in place of O-ring 44 without detracting from the specific purpose thereof.

Referring now to FIGS. 4–6, the operation of the preferred form of the pressure relief device of the present invention is illustrated in detail. In FIG. 4, device 22 is shown in its normal sealing disposition under conditions where the internal pressure within can 10 is insufficient to cause dislodgement of the disk from its sealing position. In this configuration sealing disk 26 is firmly but shiftably held in place above vent openings 38 by means of the cooperative flange and recess structure described previously.

When the internal can pressure exceeds a predetermined dangerous level, the pressure exerted upon sealing disk 26 is sufficient to break the seal between the latter and housing 24 and shift disk 26 downwardly as shown in FIG. 5. During shifting of the disk away from the normal seal therefor, flange 30 is compressed slightly and deflected inwardly while sidewall 28 is also moved inwardly to a slight extent to cause the upper, outwardly facing, annular ledge portion of sidewall 28 above recess 32 to clear flange portion 30. Downward movement of disk 26 effects compression of O-ring 44 to an extent to bring the vent openings 38 into communication with the interior of can 10, thereby permitting the highly pressurized gas or liquid within can 10 to exit therefrom through the vent openings. As best shown in FIG. 5 the outwardly flaring conical surface 42 provides an unblocked passage between the vent openings 38 and the interior of can 10 to permit unrestricted flow of pressurized liquid gases from the latter and ultimately out through the vent openings.

When internal can pressure has been relieved sufficently to permit safe use of the can, the preferred device of the invention acts to reseal the can. This function is depicted in FIG. 6 and occurs when O-ring 44, which was compressed during venting operations, returns to substantially its original shape. This causes sealing disk to be moved upwardly until the latter contacts the interior wall of housing 24 proximal to flange 30. By virtue of the yieldable nature of the synthetic resinous housing and sealing disk, they are capable of mutually deflecting as illustrated at 48. Consequently, can 10 is resealed and it is thereafter possible to safely and effectively reuse the same.

It should also be understood that upon achieving a reseal as described, the pressure relief device of this invention is further capable of repeatedly venting the can as the need arises. Specifically, if can pressure were to again rise to an untoward level, sealing disk 26 would again be displaced downwardly to compress O-ring 44 as shown in FIG. 5, thereby further venting the contents of can 10. Similarly, upon again reaching a safe internal pressure, the expansion of O-ring 44 would effect another reseal of can 10 in a manner identical to that described.

In order to produce pressure relief devices in accordance with the present invention which are low in cost

and easily fabricated, it is preferred that the structurally distinct elements thereof be fabricated of yieldable synthetic resinous materials. In this regard, it has been found especially advantageous to produce the housing and disk structure from either polypropylene or nylon synthetic plastic, but it is to be understood that many other materials of this class would likewise be operable.

It has also been discovered that the relief characteristics of the pressure relief devices of this invention can be varied at will, depending primarily upon the particular dimensions thereof. Referring specifically to FIG. **4**, the internal diameter of the upstanding sidewall **28** is referred to by the dimension Y, while the height thereof above disk body **29** is referred to by the dimension X. It was determined during the development of the present invention that these dimensions are especially important in determining the amount of internal pressure required to unseat disk **26** from flange **30** of housing **24** (assuming of course that the outside diameter of the annular sidewall **28** remains constant).

The following Example will illustrate this design flexibility.

EXAMPLE

A number of pressure relief devices identical to that shown in FIG. **4** were produced from nylon synthetic plastic material and installed on aerosol cans adapted to contain sprayable materials and a propellant such as Freon. The cans were then filled and a pressure line was installed on each in order to measure internal can pressure. The cans were then placed in an oven at a temperature of 120° F for a period of 16 hours. At 120° F the initial pressure in the cans was approximately 90 psig. The temperature was thereafter increased to 150° F, and held for 2 hours, causing a corresponding pressure rise in the cans to about 105 psig. After 2 hours at 150° F, the temperature was again increased to 160° F causing a pressure rise inside the can to about 115 psig. This sequential procedure was followed until all of the pressure relief devices with the cans activated. The cumulative results of these tests are given in the following table.

TABLE*

X Dimension	Y Dimension	Actuation Pressure (psig.)
0.100 in.	0.550 in.	240 – 270
0.100	0.550	245 – 275
0.100	0.560	210 – 235
0.100	0.570	170 – 190
0.100	0.580	165 – 172
0.100	0.585	155 – 164
0.140	0.570	105 – 110

*In each case, the outside diameter of the sealing disk was 0.645 in.

As can be seen from a study of the foregoing table, as the Y dimension is increased (which in effect results in a thinner sidewall **28**), the pressure required to actuate the various special relief devices is lessened. It is believed that as sidewall **28** is made thinner, the latter is more pliable and tends to deform inwardly when pressure is applied to the circular base of disc **26**. When this occurs, the secure connection between the disk and housing **24** is of course weakened, thereby causing the disk to be shifted to its venting positions.

Additionally, as dimension X is increased (which in effect lessens the thickness of body **29** because the overall height of the cuplike member remains constant), the pressure required to actuate the device is again lowered. In a manner similar to that discussed above, it is believed that this result obtains because sealing disk **26** is more likely to deform inwardly when excessive pressures are applied thereto.

Accordingly, it can be seen that the pressure relief devices of the present invention can be modified at will in order to cause the latter to actuate at any desired pressure. This flexibility is enhanced because of the ease of fabrication of the structurally distinct components of the device, and their extremely low cost.

It is also to be understood that in situations where the emission of projectiles is not a consideration, an open bottom housing could be provided which sealingly engages a wall of the aerosol can and carries therewithin a disk which could be expelled upon actuation of the device. In this instance, the yieldable nature of the disk would serve to prevent any serious injury to those in the vicinity of the can.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. Pressure relief structure for use with enclosures having pressurized materials therein, comprising:

a tubular housing formed of yieldable material with one end thereof adapted to sealingly engage said enclosure about an aperture in a wall of the latter, with the interior of said housing communicating with the interior of said enclosure;

shiftable sealing means formed of yieldable material and disposed in a normal sealing position within said housing with the leading face of said sealing means facing the interior of said enclosure,

said housing having a vent opening therein located at a position remote from the leading face of said sealing means;

means releasably retaining said sealing means in said normal sealing position and operable upon a rise of pressure within said enclosure to a predetermined magnitude to permit shifting of the sealing means away from the enclosure to a venting position wherein the interior of the enclosure is depressurized by virtue of communication between the latter and the atmosphere through said vent opening; and

means carried within said housing for return movement of said sealing means back toward said enclosure when the latter has been sufficiently depressurized,

the internal wall surface of said housing, and the periphery of the leading face of said sealing means, being cooperatively configured to interengage during said return movement to effect a resealing of said enclosure by virtue of the mutual sealing deflection of the yieldable housing and sealing means.

2. Pressure relief structure as set forth in claim **1**, wherein the end of said housing remote from said enclosure is closed, said vent opening being provided through the sidewall of said housing.

3. Pressure relief structure set forth in claim **1**, wherein said sealing means is a cup-shaped member with the open end thereof facing the interior of said enclosure, and said retaining means comprises a circumscribing flange extending about the internal wall of said housing and integral therewith, the exterior surface of the sidewall of said cup-shaped member having a complementary circumscribing recessed area adapted to sealingly receive said flange.

4. Pressure relief structure set forth in claim 3, wherein said return movement means comprises an elastomeric member positioned within said housing proximal to the closed end of said cup-shaped member and at a position to be compressed when the latter is moved away from said enclosure during depressurization of the same, said elastomeric member also being operable to urge said cup-shaped member back toward said enclosure when the latter has been sufficiently depressurized.

5. Pressure relief structure as set forth in claim 4, wherein said elastomeric member comprises an O-ring.

6. Pressure relief structure as set forth in claim 1, wherein said housing and shiftable means are formed of yieldable polypropylene.

7. Pressure relief structure as set forth in claim 1, wherein said housing and sealing means are both formed of yieldable nylon.

8. Pressure relief structure as set forth in the claim 1, wherein said vent opening is provided in a sidewall of said housing, the internal surface of said sidewall between said vent opening and said sealing means when the latter is in normal sealing disposition thereof being configured to present a tapered, generally frustoconical surface.

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