United States Patent

Prussin et al.

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[54] AUTOMATIC PRESSURE RELIEVING AEROSOL PRODUCT

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[52] **U.S. Cl.**.....**222/397**, 222/497;402.13

[51] **Int. Cl.**.....**B05b 3/00**

[58] **Field of Search**.....222/396, 397, 402.1, 399, 497, 222/402.13, 402.11, 518, 511

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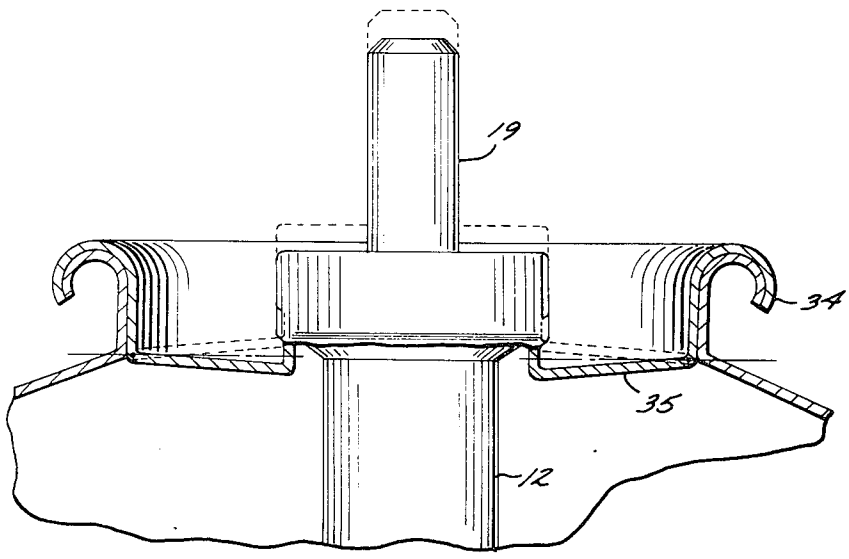
[57] **ABSTRACT**

An automatic pressure relieving aerosol product and container having an actuator member held fixedly against outward movement with respect to the can, and a valve carrying member that will move the valve stem against the actuator in response to excess pressure. When such pressure is present in the can, the valve carrying member moves upwardly whereupon the valve is opened thereby relieving the pressure. The actuator is of the type that will normally be moved with hand pressure to open the valve, thereby permitting the aerosol container to be operated in the usual manner under normal conditions.

5 Claims, 5 Drawing Figures



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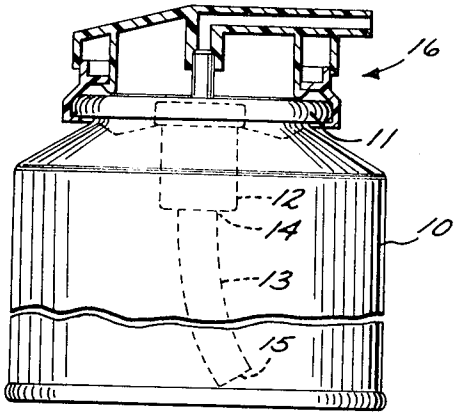

FIG. 1

FIG. 2

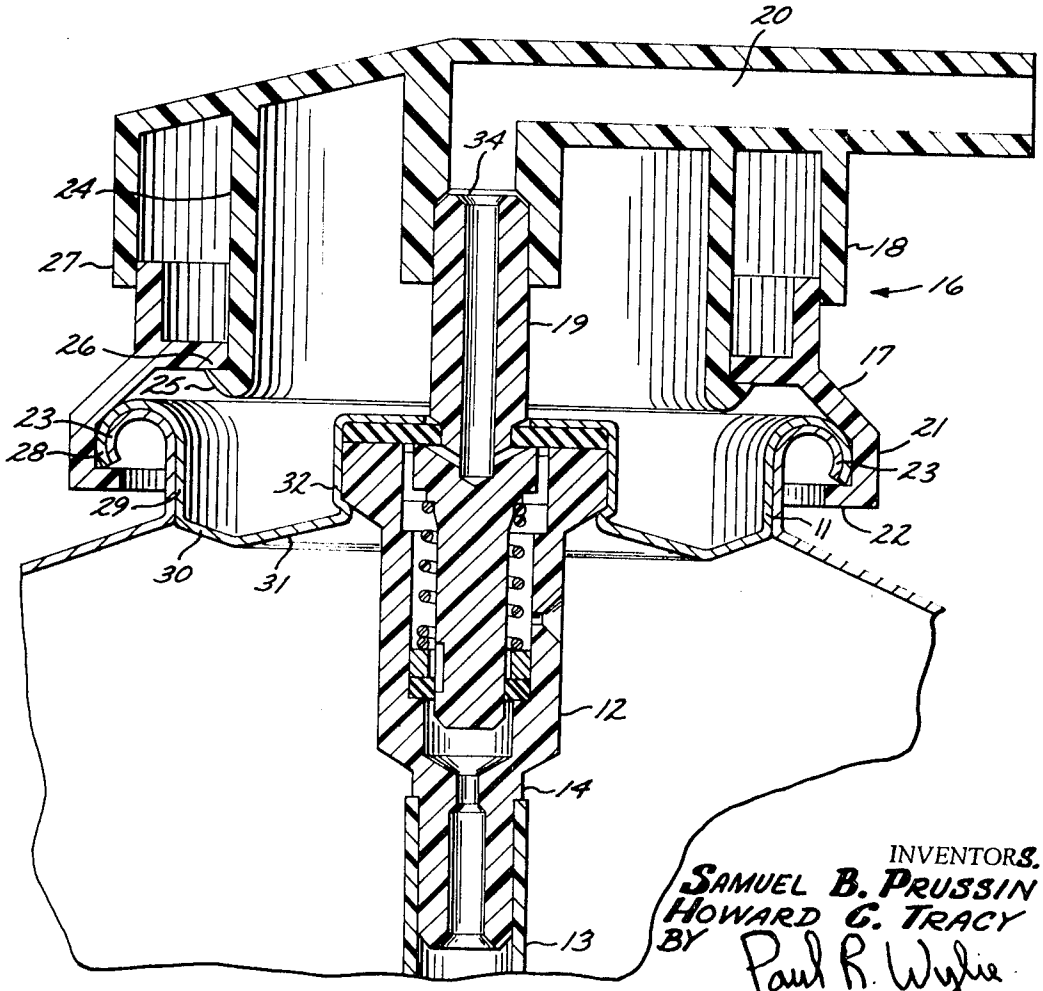

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FIG.3

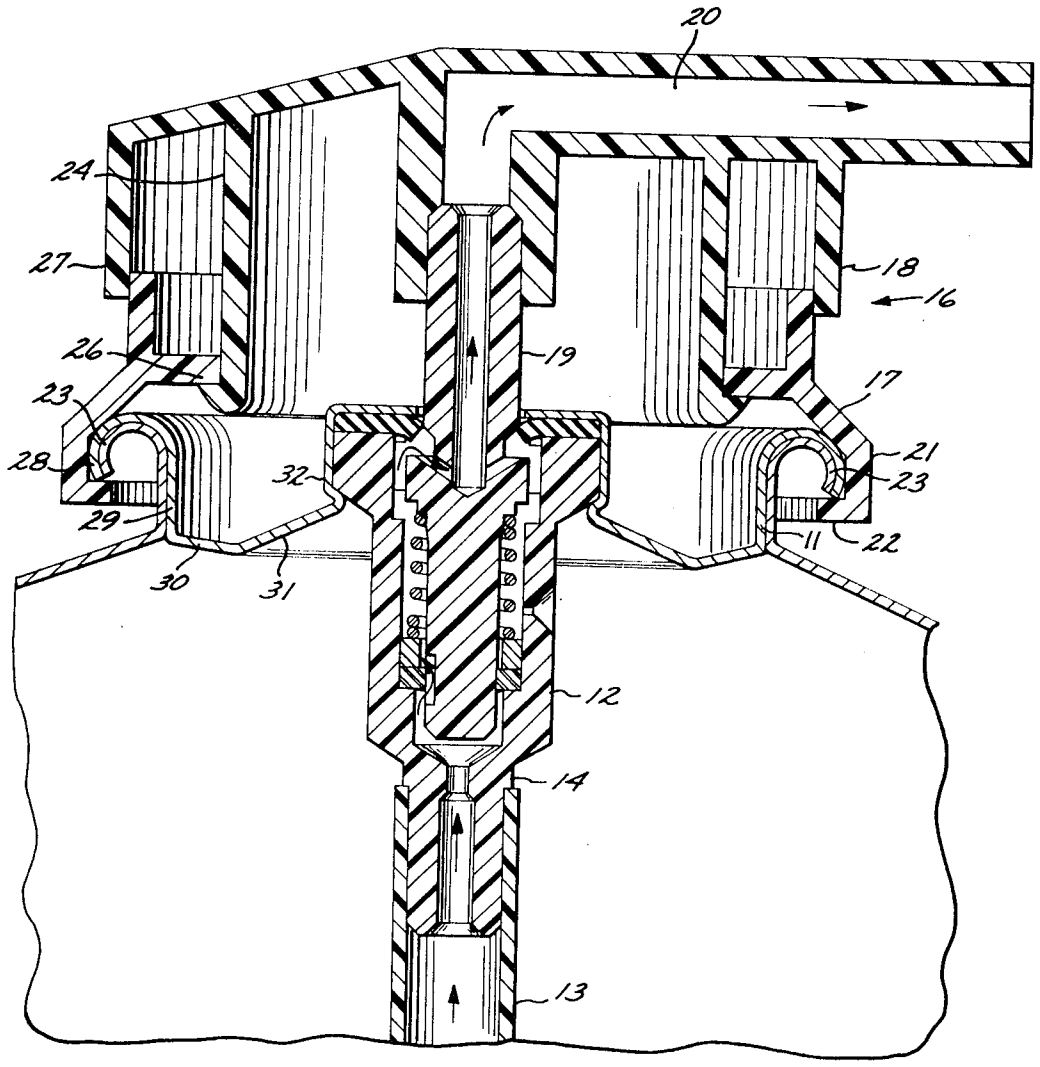

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FIG. 4

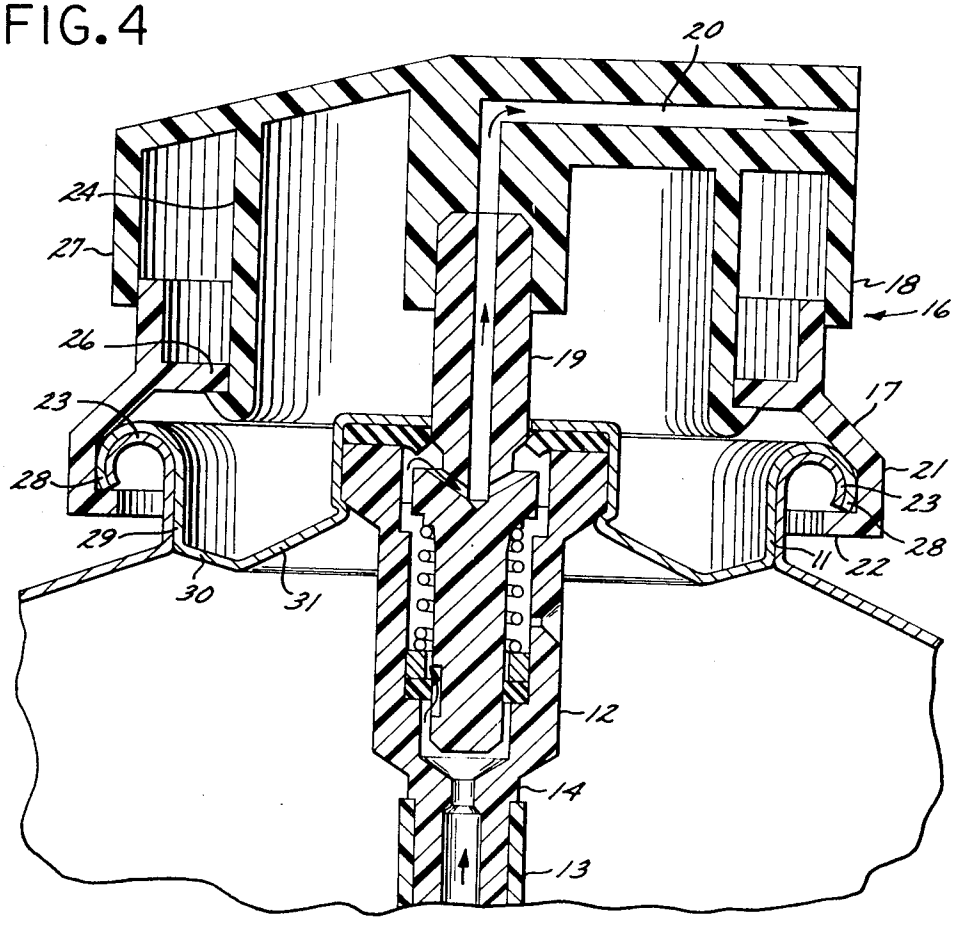
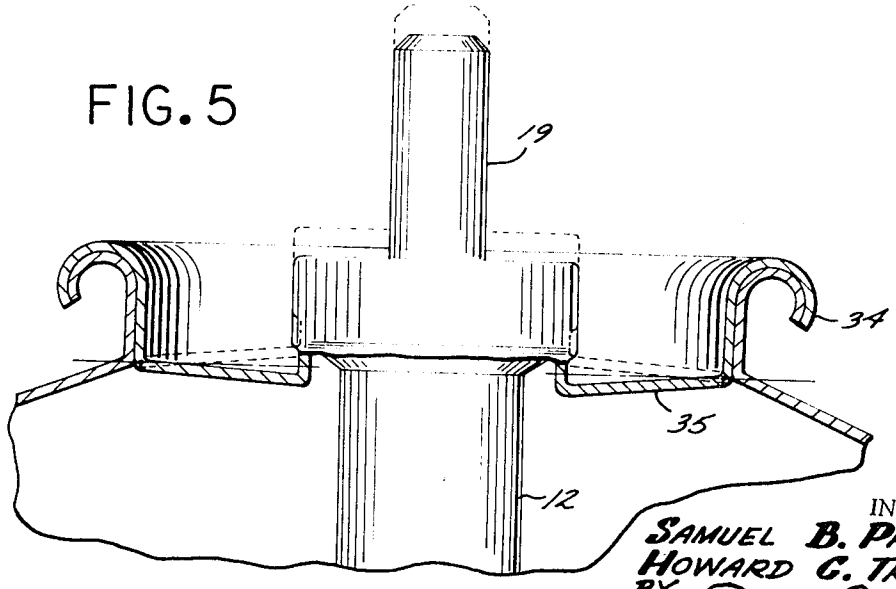


FIG. 5



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AUTOMATIC PRESSURE RELIEVING AEROSOL PRODUCT

This invention generally relates to pressurized products and containers. More specifically, it relates to an aerosol product that will automatically reduce excess pressure conditions in the container.

Aerosol products usually include various volatile materials such as propellants, solvents, or compositions that will chemically react, which render them dangerous when exposed to certain conditions. Because conditions such as, for example, heat or subatmospheric pressures may cause excess pressures to be created inside the aerosol container, there is a possibility that these products may either explode or become missiles if the container is ruptured. For this reason, a warning not to incinerate is commonly printed on commercial aerosol products.

In an effort to reduce the dangers that are inherent in the manufacture and use of aerosol products, many safety mechanisms have been proposed. For the most part, these mechanisms have involved the use of blowout plugs, frangible sectors, or score lines which are provided to create small openings to thereby reduce pressure. There are, of course, several disadvantages to these prior art pressure reducing means, not the least of which are lack of reliability and increased manufacturing difficulty and concomitant cost. Moreover, if a plug or other frangible sector is ejected from the container by excess pressure, it of course creates some hazards as a projectile.

It is an object of this invention to provide an automatic pressure relieving system for pressurized containers.

A further object of the invention is the provision of an automatic pressure relieving aerosol container that is safe, economical, and reliable.

According to a presently preferred embodiment of the invention, there is provided an automatic pressure relieving aerosol container which includes a container and pressure responsive member closuring said container. The pressure responsive member moves upwardly when pressure in excess of the normal and safe operating range is applied thereto. The aerosol valve, which is provided with an operating means, is attached to the pressure responsive means and communicates with the interior of the container. An actuator means is positioned to operate the valve by contact with the valve operating means. The actuator means is fixed to the container in such a manner that the operating means is forced into contact with the actuator when excess pressure forces the pressure responsive member upwardly, thereby automatically opening the valve. In the preferred form, the pressure responsive member is formed as a conventional valve cup of material and dimensions such that it will move upwardly upon application of excess pressure inside the container.

The cup can be formed so that it will return to its normal position when the excess pressure is relieved thereby shutting off the valve and rendering the aerosol product reusable even after the excess pressure is relieved. Alternatively the cup member can have a so-called bi-stable toggle action whereby the excess pressure will invert the cup outwardly from a normal concave position to a convex position. The cup can also be formed of material of a gauge and/or configuration such that excess pressure will deform the cup upwardly beyond the elastic limit of the material and thus maintain the valve permanently open, once it has been actuated by such pressure.

The invention will be more readily understood with reference to the accompanying drawings which show specific embodiments thereof, and wherein:

FIG. 1 is a side elevation view of an aerosol container according to the invention, utilizing a foam actuator, with parts thereof broken away for convenience of illustration;

FIG. 2 is a side elevation view in cross section taken on line 2—2 of FIG. 1 showing the aerosol cup and valve with the cup in a normal position;

FIG. 3 is a view similar to FIG. 2 showing the relationship of the components as they would be when there is excess pressure in the container.

FIG. 4 is a view similar to FIG. 3 showing the invention as utilized with a spray actuator.

FIG. 5 is a side elevation view partially in cross section showing an alternative embodiment of the invention.

Referring now to the drawings as shown in FIG. 1 thereof, an aerosol container 10 of substantially conventional construction is provided with a pressure responsive valve cup 11 according to the invention. The cup 11 supports a valve 12. Dip tube 13 is attached to a lower portion 14 of the valve. The dip tube 13 has an open end 15 in the normally lower end of container 10.

The container 10 holds materials with a pressurizing fluid therein such that the pressurizing fluid will drive the liquid materials up the dip tube 13 when valve 12 is opened.

As best seen in FIG. 2, the aerosol product according to the invention is provided with an actuator 16. The actuator is composed of an annular base portion 17 and a movable actuator portion 18. In normal operation, hand pressure is applied to actuator 18 to press down on a valve operating means formed as valve stem 19. The valve stem 19 opens the valve and material from the aerosol container is drawn up dip tube 13 through valve 14, actuator stem 19 and out discharge passage 20. As shown in the drawings, the base portion 17 of the actuator is secured to container 10 by means of flange 21 having undercut portions 22 which fit beneath the rolled rim 23 of container 10. Thus, the base portion is securely fixed against longitudinal displacement outwardly of container 10. Similarly, actuator portion 18 is fixed against outward movement from container 10 by means of internal flange 24 which is provided with an undercut 25, the latter being positioned under inwardly extending rib 26 of base portion 17.

When the actuator is pushed downwardly in the normal manner of opening the valve, internal flange 24 and external flange 27 are free to slide downwardly. However, their outward movement is fixed as noted above.

The pressure responsive member in its preferred form can be formed as a valve cup 11 as shown in FIGS. 1, 2 and 3 consists of a rolled shoulder portion 28 which securely fastens the cup to the rolled rim 23 of container 10. The cup in the embodiment shown in FIG. 2 has a downwardly directed side wall 29, a downwardly and inwardly directed connecting portion 30, and an upwardly directed portion 31 connecting with a valve holding portion 32. When excessive pressure is present in the container, the cup will deflect from the normal position as shown in FIG. 2 to a position such as that shown in FIG. 3. Because actuator base 17 and actuator portion 18 are fixed against upward movement relative to container 10, the cup deflection will force valve 14 and stem 19 up against actuator portion 18 whereby the valve will be in opened position. Material in container 10 will be drawn up dip tube 13 through valve 14, valve stem 19, and out dispensing conduit 20 as shown by the arrow in FIG. 3. The flow of material will reduce the pressure in the container and render such safe thereafter.

Spacing 34 between stem 19 and actuator 18 can be provided as shown in FIG. 2 to provide control in the automatic pressure relief sequence by causing a greater pressure to move stem 19 farther before it will contact actuator 18.

Cup 11 can be formed of materials and have dimensions such that the deflection as shown in FIGS. 2 and 3 will be within the elastic limit of material. Thus, once the pressure is relieved in the container the cup will return to its normal position and the container will be reusable for the dispensing of the contents therein.

In an alternative embodiment according to the invention, cup 11 can also be formed of a material such that permanent deformation will occur when the cup is in the position shown as FIG. 3. That is, the cup will be deformed by the excess pressure beyond its elastic limit.

A still further embodiment of the invention is that shown schematically in FIG. 5 where a cup member 34 is shown having a configuration such that it will have a bi-stable toggle action. When excess pressure is applied to the under side 35 of the cup 34, it will be inverted outwardly forcing the cup "over

centers" to a convex position where it will remain until repositioned to its normal attitude by the application of external pressure.

Cup **11** can be made from various materials. Stainless steel is highly advantageous in that it will not be corroded by the materials in aerosol container **10**, and at the same time it is sufficiently flexible to function as the pressure responsive member according to the invention. Spring steel, tin-plated steel, aluminum, and in some cases plastic, may also be advantageously used.

It is necessary for actuator base portion **17** and actuator portion **18** to be of materials and dimensions such that they will be fixed against outward movement. As previously noted, this is required in order that stem **19** be pushed down when valve **12** is pushed upwardly. Materials suitable for use in the fabrication of the actuator are the presently preferred relatively rigid thermoplastic materials such as linear polyethylene or polypropylene.

Of particular significance in this invention is the fact that release pressure for the product can be rather accurately controlled. Various valve cups of different materials and configurations can be used to provide aerosol products with different release pressures at which the valve will be opened. Because of the accurate pressure relief control that can be obtained, this invention permits the use of substantially thinner materials. This is possible because the same degree of safety does not have to be built into the aerosol container that was previously required for those containers with either less accurate or no pressure relieving systems. Substantial economic advantages can, of course, be realized by reducing the thickness and quantity of material in mass-produced items such as aerosol products.

Depending upon the type of valve used, pressure will be relieved when there is but a small movement of the valve upward. Aerosol valves of the type shown in the drawings commonly have a full-throw travel of from 0.035 in. to 0.050 in. With this invention, as little as 0.005 in. movement upward of the valve cup will create partial openings in the valve.

The advantages of the invention will be more fully illustrated with reference to the following specific examples:

EXAMPLE I

An aerosol container similar to that shown in FIG. 2 supplied with a cup having a 1¼ in. diameter and being fabricated from 0.011 in. tin-coated steel plate of substantially the configuration shown in FIG. 2 and 3 was tested at various pressures to determine the height increase of the center portion of the cup with respect to the rim thereof. In this test, a can was pressurized in increments according to column "A" below. The cup pedestal height according to column "B" below was measured as the distance above the rim at each of the pressure increments.

A Pressure (psi)	B Cup Pedestal Height (inches)
0	+.030
30	+.035
60	+.040
90	+.047
120	+.064
150	+.108
160	+.208

The cup did not blow off the can until the pressure reached 240 pounds. Thus, the cup pedestal height was shown to have increased 0.178 in. at 160 psi, a sufficient distance to actuate any of the commonly used aerosol valves.

EXAMPLE II

In order to test the effect of the difference in initial spacing (FIG. 2, element 34) between the valve stem and the actuator, valves and cups of the same type that were used in example I were provided with clearances as shown in the table below. The results of these tests were as follows:

Spacing (inches)	Partial Opening Pressure (psi)	Wide Open Pressure (psi)
.010	120	130
.015	135	145
.020	140	150
.025	175	180
.030	190	200

As can be seen, the pressure at which the valve will be actuated to provide either an initial pressure reducing leak or a wide open valve can be controlled by controlling the initial clearance.

The foregoing examples show the advantages of specific embodiments according to this invention.

While the invention in a preferred form is primarily useful for aerosol products where its advantages have been pointed out, it is conceivable that it could be utilized in a broad sense in other pressurized products where it might be desirable to eliminate excess pressures.

Other variations and modifications of this invention are possible within the scope of this invention and within the following claims:

We claim:

1. An automatic pressure relieving aerosol container comprising:
   - a container member;
   - a valve provided with an operating means for opening said valve;
   - a pressure responsive valve cup member holding said valve in a predetermined position, said pressure responsive member being adapted to move said valve upwardly upon application of excess internal pressure in said container; and,
   - actuator means fixed against outward movement and movable inwardly positioned on said container to operate said valve by contact with said operating means, said valve actuator normally permitting said valve to be in an unoperated position, said actuator means being positioned on said container in a position to open said valve when excess pressure causes the pressure responsive member to move the valve upwardly and bring said valve operating means into contact with said actuator means whereby excess pressure will be automatically relieved in said container.

2. An automatic pressure relieving aerosol container according to claim 1 wherein there is provided a predetermined clearance between said valve actuator and said valve operating means.

3. An automatic pressure relieving aerosol container according to claim 1 wherein said valve cup is of the type adapted to return to a normal position when excess internal pressure is relieved.

4. An automatic pressure relieving aerosol container according to claim 1 wherein said valve cup is of the type that will be permanently deformed when excessive pressure is applied thereto.

5. An automatic pressure relieving aerosol container according to claim 1 wherein said valve cup is of the type that has a bi-stable toggle action.

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