

[54] **SAFETY VENT FOR A PRESSURE CONTAINER**

3,826,412 7/1974 Kneusel 222/397

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[22] Filed: **Oct. 23, 1974**

[57] **ABSTRACT**

[21] Appl. No.: **517,325**

A safety vent is provided for an aerosol container which includes a metal closure member adapted to be sealed on a container body and having an integral hollow groove therein, an integral hollow rib interrupting and spanning the groove, and a score line in the groove across the rib to weaken the rib so that excessive pressure in the container will fracture the residual metal in the score line across the rib to vent the pressure from the container.

[52] U.S. Cl. **222/397; 220/207**

[51] Int. Cl.² **B65D 83/14**

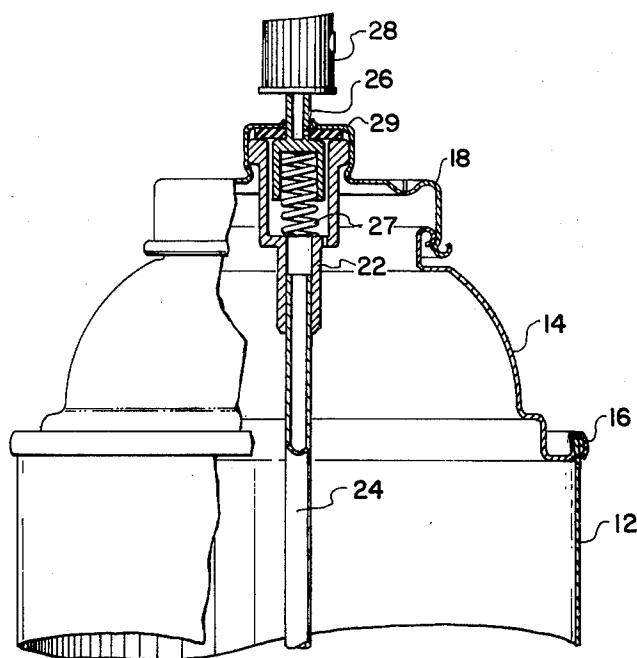
[58] Field of Search 222/396, 397; 220/89 A,
220/207, 202, 203, 367

[56] **References Cited**

UNITED STATES PATENTS

3,622,051 11/1971 Beason 222/397

12 Claims, 12 Drawing Figures



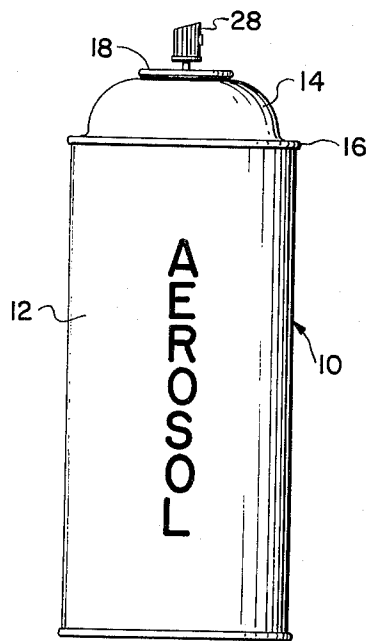


Fig. 1

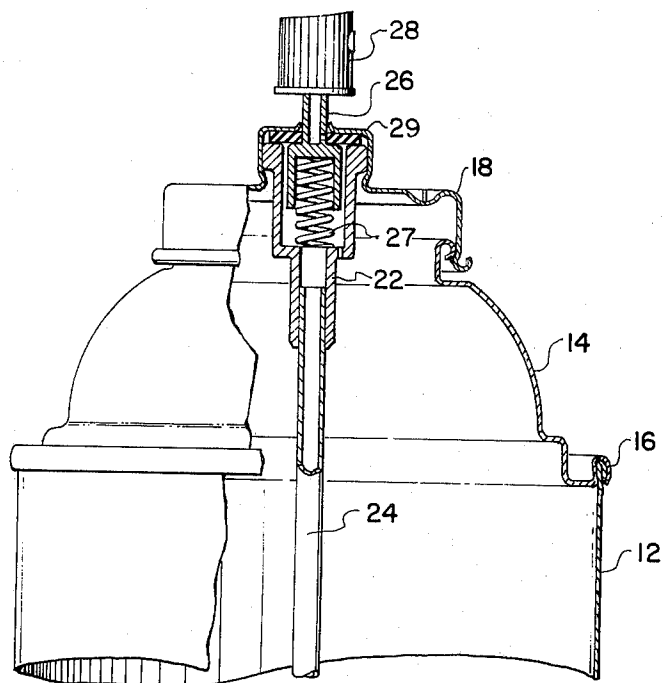


Fig. 2

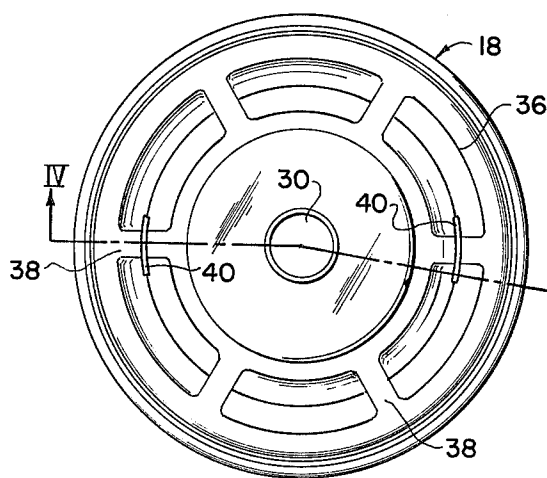


Fig. 3

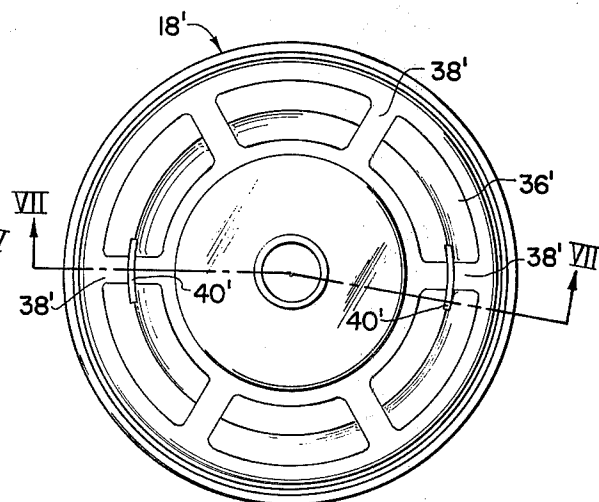


Fig. 6

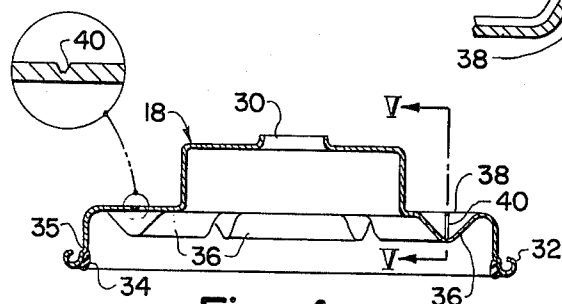


Fig. 4

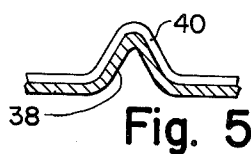


Fig. 5

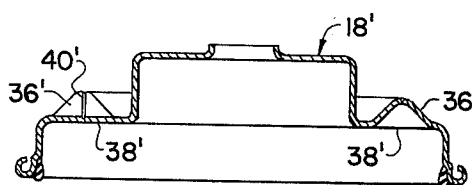


Fig. 7

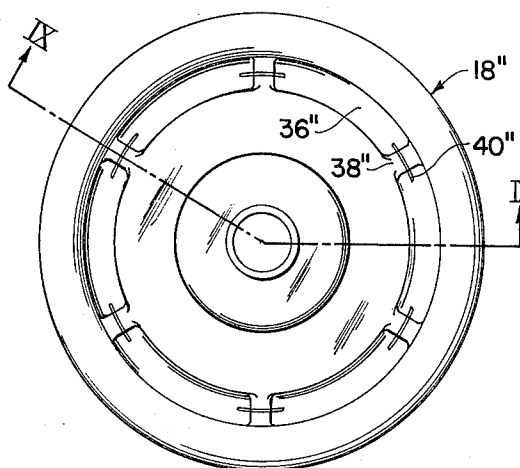


Fig. 8

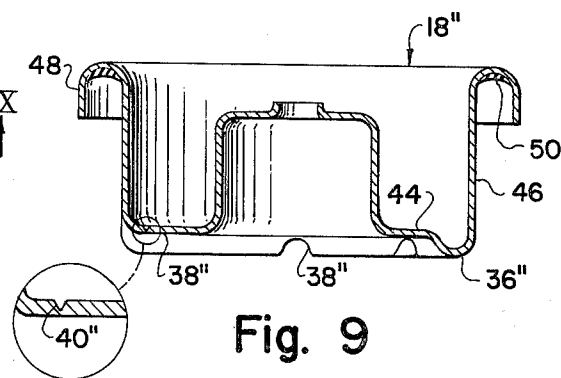


Fig. 9

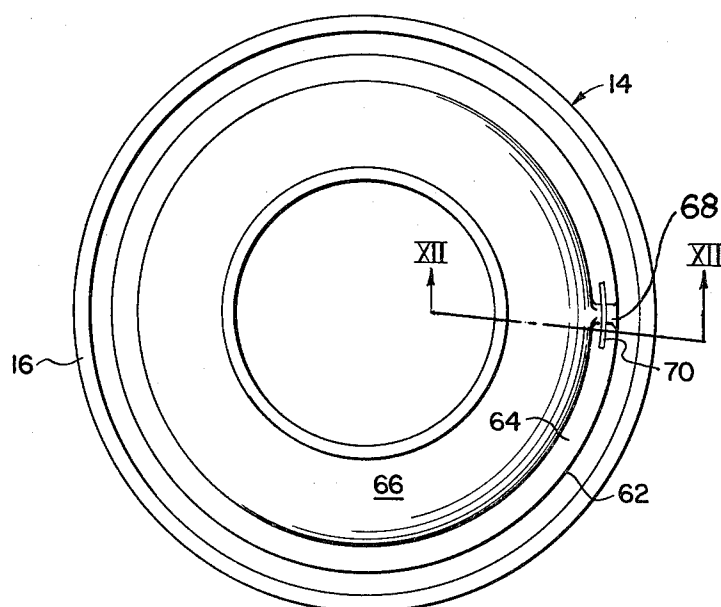


Fig. 10

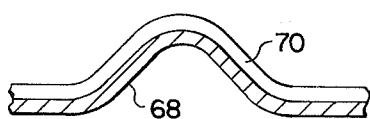


Fig. 11

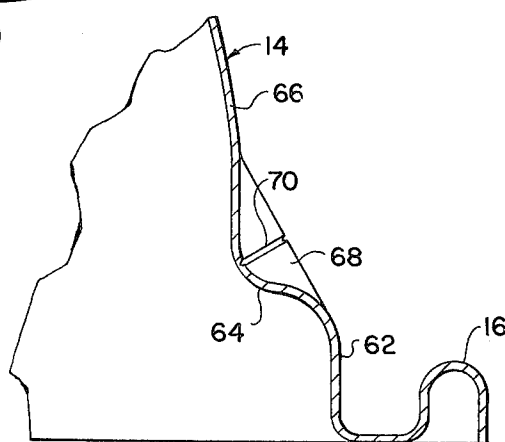


Fig. 12

SAFETY VENT FOR A PRESSURE CONTAINER

BACKGROUND OF THE INVENTION

1. Field of Art

This invention relates to pressurized containers and in particular to a safety vent for an aerosol container.

2. Brief Description of the Prior Art

Aerosol containers are potential bombs which can and have caused numerous serious injuries. The pressure in an aerosol container rises excessively when the container is heated and can cause the container to explode, or the end of the container to fly off, producing flying fragments of metal which can cause serious injury. Scarring facial burns are also a common result of the shower of flaming liquid spewed forth by an exploding aerosol bomb. When an aerosol bomb bursts, the contents spray out and often form a flammable or explosive mixture with the surrounding air. The rupture is often so sudden and occurs with such force that the fire ball which is created may be large and have a high intensity.

Numerous methods have been proposed for disarming aerosol cans so they can be disposed of in a normal manner as by incineration, without causing undue risk. For example, an aerosol container can be rendered safe by releasing all the pressure by pressing the nozzle and/or by puncturing the can. This can be messy and is more trouble than the average consumer is willing to take to avoid the risk of an exploding bomb. It has been estimated by Ralf Hotchkiss and Mark Gulak of the Center for Concerned Engineering in Washington, D.C. that a six person household uses an average of 78 aerosol containers per year. They further state that the efforts of the industry to educate the consumer to properly dispose of such containers has been generally fruitless.

Numerous devices have been suggested for rendering aerosol containers safe as by providing pressure release means in the containers to vent excessive pressure therefrom and thereby prevent explosion. For example, U.S. Abplanalp U.S. Pat. No. 3,292,826 discloses the provision of a line of weakness in an aerosol container wall which is adapted to be ruptured at a pressure lower than the rupture pressure of the remainder of the container. U.S. Giocomo et al. U.S. Pat. No. 3,786,967 discloses a pressure release system for an aerosol container comprising a plurality of score lines in a peripheral portion of the domed end member in a portion of the double seam whereby excessive pressure in the container will buckle the domed end member outwardly causing residual metal in the scores to fracture to produce a plurality of vents. U.S. Lapin U.S. Pat. No. 2,795,350 discloses the use of a nick in a double seam around the bottom of the container to vent the pressure from within the container when such pressure becomes excessive. Preisendanz U.S. Pat. No. 3,405,838 provides a plug in the bottom wall of an aerosol container for a similar purpose. Other safety vent means are disclosed in U.S. Patents numbered U.S. Pat. Nos. 3,074,602; 3,081,919; 3,385,481; and 3,450,305.

Although a considerable number of ideas have been proposed for releasing excessive pressure from aerosol containers, none of the suggested devices appears to be completely satisfactory. This may be because the proposed devices do not meet all of the criteria for a successful safety vent means for an aerosol container.

As reported by Hotchkiss and Gulak, supra, spokesmen for 11 of the largest companies in the aerosol business summarized their criteria for a successful vent means in a conference held by Cornell University in 1969. The criteria set forth are as follows:

1. The emergency relief should be sensitive to pressure rather than temperature;
2. The emergency relief should be on top of the can;
3. The design must take the current tooling for aerosol manufacture well into count;
4. The integrity and coatings of the can must be maintained;
5. The emergency release valve must be completely reliable;
6. The addition of the pressure relief valve should not cost more than five cents per container to manufacture;
7. The emergency release valve should (a) not be a blowout plug type, (b) not operate through an unaltered aerosol valve of the present type because they clog, (c) not be a resealing type of high cost, (d) not require any scoring techniques which may be affected by loose metal thickness tolerances and not require any scoring to be done after the container is plated, and (e) be a single operation rupture type valve.

A safety vent for a pressure container is desired which will meet all of the above criteria.

SUMMARY OF THE INVENTION

This invention provides a safety vent for an aerosol container which includes a container wall having an integral concavity therein, a substantially V-shaped hollow rib within the concavity and bridging the same between opposed walls thereof, and a score line in the container wall transversely across the rib so that excessive pressure in an aerosol container will stress the rib in tension to fracture the residual metal in the score line across the rib and permit release of the pressure from the container.

This invention facilitates accurately controlling the internal pressure at which a container will vent. As is well known, a pressurized sphere has only tensional stresses therein and no bending stresses. The addition of a concavity such as an annular groove in the wall of a pressure vessel produces a bending moment in the container wall which in effect tries to make the wall spherical. When a rib is provided in the container wall bridging the groove, the rib forms a link between the sides of the groove which absorbs the stresses across the groove so that the maximum stresses in the container wall are produced in the rib. For example, the stresses in a rib across a groove in a pressurized container wall may be approximately 20 or more times the stresses in the container wall adjacent the rib. The combination of a groove and rib therefore produces a stress riser or area of stress magnification in the container wall. The result is that when the stresses in a container wall increase in response to pressure increases in the container, the stresses in the rib will increase 20 or more times faster than the stresses in the remainder of the container wall. A safety vent in the form of a score line across the rib will therefore be 20 times more responsive or sensitive to increases in internal pressure in the container than would a vent score line at some other location. Consequently, it is much easier to predict and control the rupture pressure of a vent score line across the rib than it is to predict the rupture pres-

sure of a score line at some other location in the container wall. Additionally, since the stresses are much greater in the rib than in the remainder of the container, a vent score line across the rib can be formed shallower than a score at some other location. A vent score line across such rib is therefore less likely to affect the integrity of the container wall or a coating thereon.

Accordingly, an object of this invention is to provide an improved safety vent for a pressurized container.

Another object of this invention is to provide an emergency relief for an aerosol container which is sensitive to pressure.

A further object of this invention is to provide a pressure release vent for an aerosol container which does not destroy the integrity of the container.

Another object of this invention is to provide a safety release vent for an aerosol container at minimum expense.

Another object of this invention is to provide a vent means that can be formed to vent at a predetermined pressure.

The above and other objects and advantages of this invention will be more fully understood and appreciated with reference to the following description and the drawings appended hereto.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of an aerosol container of the type adapted to have a safety vent of this invention incorporated therein.

FIG. 2 is a fragmentary side view of the top portion of the aerosol container of FIG. 1 partially cut away to show the aerosol valve and closure member.

FIG. 3 is a top plan view of a cup member which is adapted to be used in an aerosol container of the type illustrated in FIGS. 1 and 2 and having a safety vent therein.

FIG. 4 is a cross sectional view through the cup member of FIG. 3 taken along line 4—4.

FIG. 5 is a cross sectional view through the score line across the rib in the cup member of FIG. 3.

FIG. 6 is a top plan view of an alternative embodiment of a cup member for an aerosol container.

FIG. 7 is a cross sectional view through the cup member of FIG. 6 taken along line 7—7.

FIG. 8 is a top plan view of another alternative embodiment of a cup member for an aerosol container.

FIG. 9 is a cross sectional view through the cup member of FIG. 8 taken along line 9—9.

FIG. 10 is a top plan view of a dome member for an aerosol container with an alternative embodiment of a safety vent in the member.

FIG. 11 is a cross sectional view through the score line in the rib in the safety vent illustrated in FIG. 10.

FIG. 12 is an enlarged fragmentary cross sectional view of a portion of the dome member illustrated in FIG. 10 taken along line 12—12.

DESCRIPTION OF PREFERRED EMBODIMENTS

FIGS. 1 and 2 illustrate an aerosol container 10 which is essentially of conventional form except for the provision of a safety vent in accordance with this invention. The container includes a body portion 12, a dome member 14 sealed on the body portion as by double seaming at 16, a mounting cup 18 secured in an aperture in the top of the dome member, a valve body 22 seated in the mounting cup 18, a dip tube 24 extending

from the valve body to the bottom of the container, a stem 26 projecting from the top of the valve body and an actuator or spray head button 28 seated on the top of the stem. As is conventional, the stem 26 is seated in the valve body 22 with a spring 27 supporting the stem so that an orifice 29 in the stem is normally closed until the actuator 28 is depressed to depress the stem and open the orifice so that the contents of the container can be forced upwardly through the dip tube and through the orifice in the stem to be sprayed from the actuator through a small hole therein. Aerosol valve mechanisms of this sort are well known in the art, and further illustration and description thereof is not required for an understanding of this invention.

A safety vent means of this invention may be provided in the aerosol container 10 at a number of locations, but is preferably located in the top portion of the container so the propellant gas can be released with little or no loss of the contents of the container. As is herein described, the vent means is located in either the dome member 14 or the mounting cup 18. FIGS. 3—9 illustrate safety vents in the mounting cup, and FIGS. 10—12 illustrate a safety vent in the dome member.

The mounting cup 18 is a hat-shaped sheet metal piece which may be formed from either steel or aluminum and which has an aperture in the top of the hat through which the stem from a valve assembly may project. The mounting cup 18 has an annular curled bead 32 around its bottom peripheral edge for facilitating securement of the cup on a dome member 14 on an aerosol container. Gasket material 34 is disposed on the inner surface of the annular shoulder 35 of the cup for sealing the cup on a dome member.

In accordance with this invention, mounting cup 18 has an annular groove 36 formed therein at a convenient location in the wall of the cup, at least one hollow bridge or rib 38 interrupting and spanning the groove, and a score line 40 in the sheet metal across one or more of the ribs. The mounting cup 18 which has been selected for purposes of illustration has six ribs 38 formed across the annular groove 36 in the cup, with two of the ribs having score lines 40 thereacross. A plurality of ribs 38 is preferred because this will give the cup 18 substantially uniform strength throughout, whereas a cup with only one rib or with only a couple of ribs might have unequal strength in some areas and result in unpredictable venting pressures. Only two of the ribs are scored because it is believed that this will prevent complete separation of a portion of the mounting cup as might occur if all of the ribs were scored and all of the scores were to rupture in response to excessive pressure in an aerosol container in which the cup is mounted.

The annular groove in the mounting cup may be formed to project toward the interior of the container as is illustrated in FIGS. 3—5 or may be formed to project outwardly from the container as does the groove 36 in the cup member 18 illustrated in FIGS. 6 and 7. The ribs or bridges 38 in the cup member 18 span the sides of groove 36 and score lines 40 are cut across at least one of the bridges in the same manner as the ribs and score lines in the cup illustrated in FIGS. 3—5.

A mounting cup of this invention can be provided to vent an aerosol container within plus or minus 10 pounds per square inch and perhaps as close as plus or minus 5 pounds per square inch pressure depending on manufacturing tolerances. There are four basic areas of

control for determining the venting pressure of the mechanism: (1) the score residual, (2) the rib height, (3) the rib width and (4) the groove depth. A reasonable target pressure for venting of an aerosol can is considered to be approximately 150 psi. At a 150 psi pressure, the dome on many aerosol containers begins to bulge upwardly. The bottom of most aerosol containers will usually begin to bulge outwardly at around 200 psi, and the containers will explode on the average of approximately 250 psi. Tests run at Cornell University in 1969 for the National Commission on Product Safety measured burst pressure ranging from 210 to 400 psi, with the higher burst pressures sending shrapnel flying at much higher speeds and with significantly more energy.

One embodiment of a mounting cup having a venting means formed therein in accordance with this invention was formed from sheet steel approximately 0.009 inch thick and had an annular groove formed therein which projected toward the interior of the container approximately 0.060 inch from the inner surface of the metal. The groove had an included angle of approximately 90 between its sides, and a radius of approximately 0.030 inch in the apex of the groove. The score was formed in the sheet metal approximately one-half of the way through the metal leaving a residual of approximately 0.007 inch. Ribs were formed in the mounting cup spanning the groove with the top or the apex of each rib approximately coplanar with the metal on opposite sides of the groove. The ribs had an included angle of approximately 90 between the sides thereof.

A mounting cup of this invention may be formed by drawing it from a metal blank. The groove in the cup may be formed during the initial drawing operation or may be formed as a separate operation following such initial drawing operation. The score line or lines are formed in the groove at one or more locations around the groove after the groove has been formed, and one or more ribs are formed across the groove and across the score or score lines in the groove as a last step in the fabrication of the cup member.

The aerosol valve mechanism is mounted or secured in the mounting cup prior to securing of the cup on the dome of an aerosol container. The assembly of the mounting cup and valve assembly is then secured on the aerosol container by crimping the peripheral bead on the cup inwardly under an annular bead around the mouth of a dome member on the aerosol container.

Pressure in the aerosol container on which a mounting cup of this invention is secured acts against the interior surface of the mounting cup and against the annular groove therein, and acts to open the groove or increase the included angle between the sides of the groove. This produces tensional stresses in the ribs or bridges which span the annular groove and connect the sides of the groove. When the pressure becomes excessive, the greatest stresses will be produced in the cup at the apex of the ribs across the groove. Since the ribs are weakened at such locations by means of the score lines across the ribs, the pressure will cause the residual metal in the score lines to rupture and permit the escape of the gases from within the container and thereby avoid explosion of the container. This escape of gases will be relatively gradual since the scores are relatively short, and the opening which is formed as a result of rupture has a cross sectional area of only a few thousandths of a square inch. Accordingly, there is little or

no danger of the escaping gases producing a torch effect if they are accidentally ignited as they escape from the container.

FIGS. 8 and 9 illustrate another alternative embodiment of this invention comprising a mounting cup 18 adapted to receive a valve assembly therein and be secured on an aerosol container. The cup 18 has an annular groove 36 in a wall thereof, at least one bridge or rib 38 spanning the sides of the groove, and a score line or lines across at least one of the ribs. In cross section the rib 38 would look like the rib 38 shown in FIG. 5.

The cup member 18 with a valve assembly therein is adapted to be seated in the aperture in the top of a dome member 14 on an aerosol container body with the curled flange 48 on the cup member resting on the bead around the aperture in the dome member, and the cup member and valve assembly disposed generally within the dome member. Top pressure is applied against the cup member to compress the gasket material 50 on the undersurface of flange 48 to seal it against the bead on the dome member. The vertical wall 46 of the cup member 18 is next expanded radially outwardly at a plurality of locations to form outwardly projecting lugs which lock the cup member on the aerosol container.

As with the other cup member herein disclosed, excessive internal pressure in the aerosol container will force the groove 36 outwardly and stress the connecting bridges 36 across the groove to rupture at least one of the score lines 40 to vent the container and thereby avoid potential explosion of the container.

FIGS. 10-12 illustrate an alternative embodiment of a venting means for an aerosol container in which the vent means is provided in the dome member 14 for the container. Typical dome members for aerosol containers have substantially irregular shapes such as an annular groove around the base of the dome, an outwardly projecting shoulder 62 immediately above the groove and a U-shaped depression or channel 64 above the shoulder and below a hemispherical portion 66. This non-spherical shape of the dome produces a bending moment in that portion of the wall which is of irregular configuration and produces a differential stress level in the inside and outside surface of the metal wall in response to pressure in the container. The degree of difference in stresses is dependent upon the size and shape of the irregular surfaces. The corner radius of the channel 64 deflects substantially under pressure of 150 psi from inside the container due to the differential in stresses in the dome.

This invention takes advantage of the differential in stresses by providing at least one rib 68 in the dome spanning the channel 64 and providing a score line 70 across the rib which is adapted to rupture when the rib is stressed in tension as a result of excessive internal pressure in the container on which the dome is sealed. The effect of the rib 68 is to lock the corner radius in the channel 64 so that the rib supports the load across the channel and stresses the rib in tension. The result is that the highest stresses in the dome 14 are produced at the apex of the rib 68 approximately in the middle of the rib spanning the channel 64 in the dome. By properly dimensioning the channel, rib and score lines, the venting pressure of the device can be accurately predicted within a range of plus or minus 5 to 10 pounds per square inch pressure within the container. Although a single rib 68 will provide the necessary vent means in an aerosol dome, it may be desirable to pro-

vide additional ribs and score lines in order to provide assurance that at least one of the score lines will rupture at the desired pressure and also to provide an appearance of symmetry in the dome.

Although several preferred embodiments of this invention have been illustrated and described with respect to provision of a vent means in an aerosol container, it will be apparent to those skilled in the art that the same sort of vent means could also be provided in any other pressure vessel such as gas tanks or the like. It will also be appreciated that various modifications can be made in the embodiments which have been illustrated and described without departing from the invention or the scope of the claims appended hereto.

What is claimed is:

1. A safety vent for a pressurized container comprising a container wall having an integral concavity therein, an integral hollow bridge interrupting said concavity, and spanning opposed sidewalls thereof, and a weakening line in the container wall transversely across said bridge, whereby excessive pressure in a container will stress said bridge to fracture the residual metal in said weakening line across the bridge and permit venting of the container.

2. A safety vent as set forth in claim 1 in which said bridge has a substantially V-shaped cross section.

3. A safety vent as set forth in claim 1 in which said concavity comprises an annular groove.

4. A safety vent as set forth in claim 1 in which said container wall comprises a hemispherical shaped dome member which is adapted to close the top of an aerosol container and have a valve assembly secured therein.

5. A safety vent as set forth in claim 1 in which said container wall comprises a mounting cup for a valve assembly for an aerosol container.

6. A safety vent as set forth in claim 5 in which said concavity comprises an annular groove in the mounting cup and at least four bridges across said groove.

7. A safety vent as set forth in claim 6 in which weakening lines cross at least two of said bridges.

8. A safety vent as set forth in claim 1 in which said concavity projects toward the interior of the container a distance equal to approximately six times the metal thickness of the container wall.

9. A safety vent as set forth in claim 1 in which the residual metal in said weakening line is at least one-half of the original metal thickness.

10. A safety vent as set forth in claim 1 in which said weakening line is formed in the exterior surface of said container wall.

11. A safety vent for an aerosol container comprising a metal closure member for the top of the container with an integral annular hollow groove in the closure member projecting toward the interior of the container a distance approximately six times the metal thickness, at least one substantially V-shaped hollow rib bridging the sidewalls of the groove with the apex of the rib substantially in line with the metal adjacent said groove, and a score line in the exterior surface of the closure across said rib near its center, whereby excessive pressure in the container will stress the rib in tension to fracture the residual metal in said score line and vent the container.

12. A safety vent as set forth in claim 11 in which the residual metal in said score line is at least one-half the metal thickness in said closure member.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 3,918,610
DATED : November 11, 1975
INVENTOR(S) : Wilburn C. Willis

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 4, line 58	After "36" insert --'--.
Col. 4, line 58	After "18" insert --'--.
Col. 4, line 59	After "38" insert --'--.
Col. 4, line 59	After "18" insert --'--.
Col. 4, line 60	After "36" insert --'--.
Col. 4, line 60	After "40" insert --'--.
Col. 5, line 23	After "90" insert --°--.
Col. 5, line 31	After "90" insert --°--.
Col. 6, line 5	After "18" insert --'--.
Col. 6, line 7	After "18" insert --'--.
Col. 6, line 8	After "36" insert --'--.
Col. 6, line 9	After "38" insert --'--.
Col. 6, line 11	After "38" (first occurrence) insert --'--.
Col. 6, line 12	Change "therin" to --therein--.
Col. 6, line 22	After "18" insert --'--.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 3,918,610
DATED : November 11, 1975
INVENTOR(S) : Wilburn C. Willis

Page 2 of 2

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 6, line 28 After "36" insert --'---.

Col. 6, line 29 After "36" insert --'---.

Col. 6, line 30 After "40" insert --'---.

Signed and Sealed this

seventeenth Day of February 1976

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks