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Giocomo et al.

[11] **3,786,967**

[45] **Jan. 22, 1974**

[54] **PRESSURE RELIEF SYSTEM FOR AN AEROSOL CONTAINER**

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[73] Assignee: **American Can Company,** Greenwich, Conn.

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[21] Appl. No.: **261,126**

Related U.S. Application Data

[63] Continuation of Ser. No. 75,470, Sept. 25, 1970, abandoned.

[52] **U.S. Cl.** **222/397,** 222/541

[51] **Int. Cl.** **B65d 83/00**

[58] **Field of Search** 222/183, 394, 397, 54; 220/44, 220/67, 89 D; 122/504

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[57] **ABSTRACT**

A metal container that is adapted to hold a pressurized product for dispensing through a valve mounted on the container. The container has a safety venting system therein, whereby the product may be vented from a filled pressurized container through the system when an increase in internal pressure threatens to blow an end off the container. The venting system comprises a plurality of scores formed in the upper seam where the container body is jointed to the dome closure of the container. When the internal pressure of a filled container increases sufficiently the periphery of the dome buckles outwardly causing the residual of the scores to fracture and thus produce a plurality of vents to permit the highly pressurized contents of the sealed container to safely escape and prevent end blow off.

5 Claims, 9 Drawing Figures

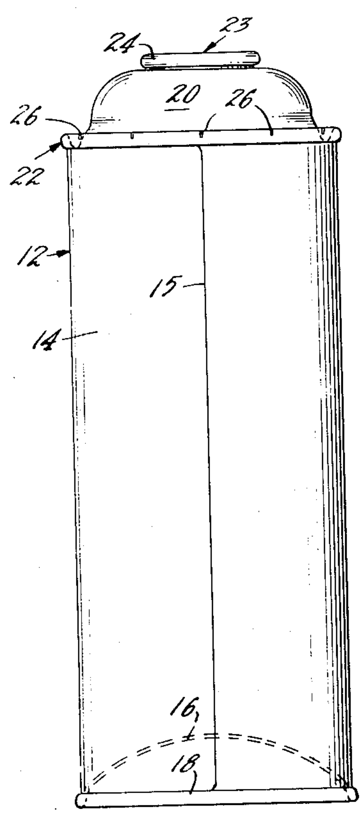

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FIG. 2

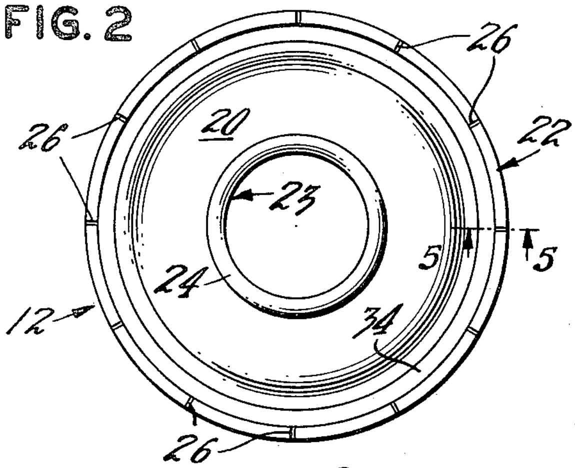


FIG. 3

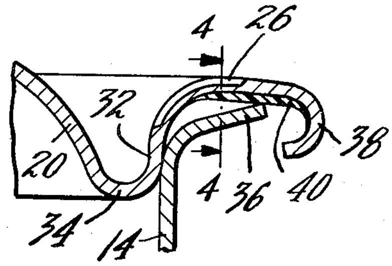


FIG. 4

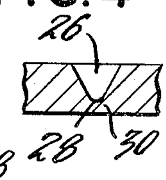


FIG. 1

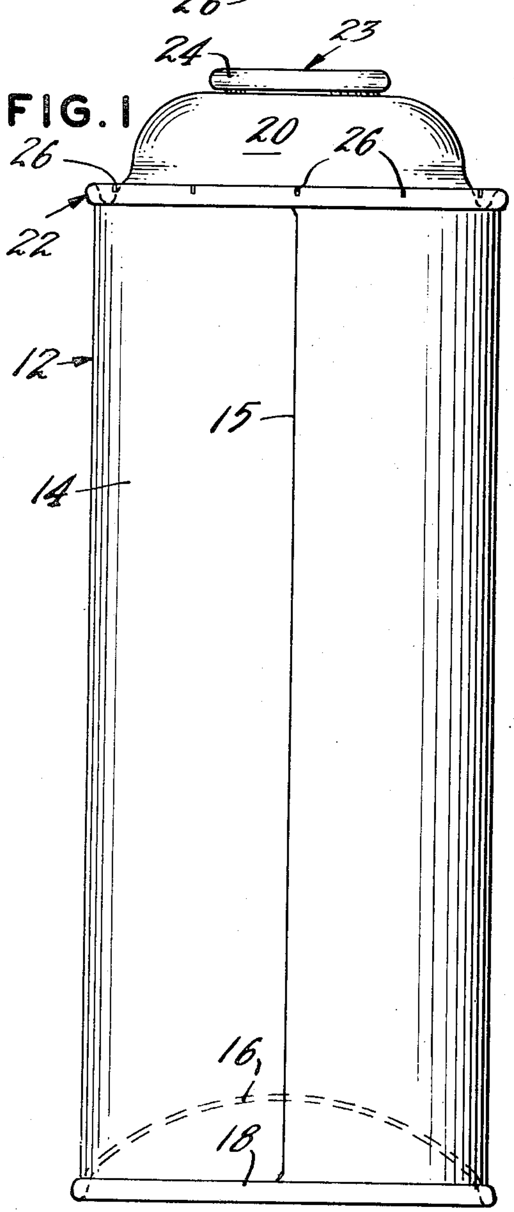


FIG. 5

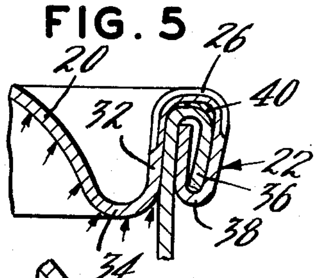
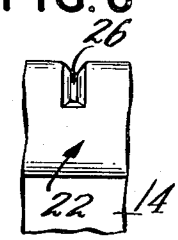


FIG. 6



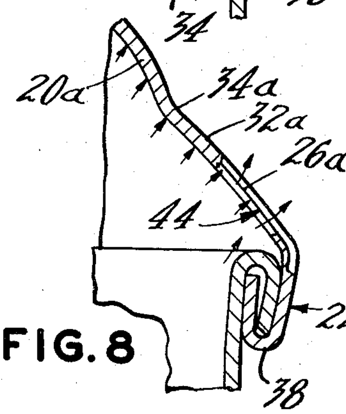


FIG. 8

FIG. 9

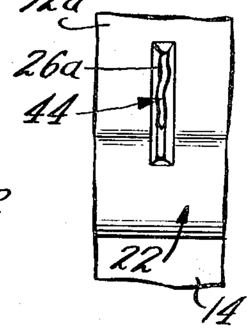
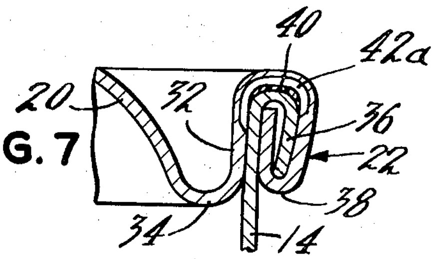


FIG. 7



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PRESSURE RELIEF SYSTEM FOR AN AEROSOL CONTAINER

This is a continuation of application Ser. No. 75,470, filed Sept. 25, 1970 now abandoned.

BACKGROUND OF THE INVENTION

The present invention relates generally to a metal aerosol container having a pressure relief system whereby the internal contents of the container may be vented therefrom when the internal pressure rises sufficiently to a level threatening blowing an end off the container. More particularly this invention relates to a two or three piece metal aerosol container having a simple venting system to eliminate explosion of a filled aerosol container when the internal pressure rises considerably, which may be encountered during excessive heating of the container.

For many years pressurized aerosol containers have been marketed to the general public. These containers usually comprise a three piece metal container having therein a product to be dispensed, together with a propellant that provides the internal pressure necessary to dispense the product through a valve mounted on the container. Products such as foods, cosmetics, insecticides, etc. have been packaged in these types of containers with considerable success.

However, due to the fact that the container is pressurized, problems have been encountered when the internal pressure of the container rises rapidly above that pressure to which the container construction has the capacity to hold. In some instances this rapid increase in internal pressure, resulting from rapid heating, has caused the container to explode. This has sometimes occurred in warehouse fires where large quantities of these aerosol containers are stored. In some cases, firemen have been injured during such explosions and in some instances firemen are unable to control the flames since they cannot approach them.

Over the years many attempts have been made to design containers having pressure relief systems in order to eliminate the possible explosive danger from pressurized aerosol containers. Many of these constructions include specialized valves which rupture upon heating or when exposed to extremely high internal container pressures. However, in general, such constructions have greatly increased the cost of these containers to such a degree that they are not economically practical.

Other safety features have included weak areas in the container body such that under excessive internal pressure the weakened portion would rupture and permit venting of the container contents. One such construction is shown in U.S. Pat. No. 3,074,602. In this patent a pressure sensitive area is formed in the valve cup such that when the dome of the container everts or buckles due to high internal pressure, venting will occur through a rupture produced in the pressure sensitive area. However positioned, this weakened portion would not necessarily rupture when the dome of the container buckles and venting through the single area of failure would not necessarily be rapid enough to prevent explosion of the container.

In U.S. Pat. No. 2,795,350 a nick is formed in the periphery of the body closure of the container where it forms a double seam with the container body. In this two piece aerosol container extremely high pressure supposedly causes concave bottom wall to buckle and

rupture the nick to form a vent through the bottom of the container. However, in the usual case the bottom would buckle and blow off before venting through the nick would relieve the high internal pressure of the container.

The new safety feature described in this invention will protect against can failures in the packing and marketing of aerosol cans. If excessive internal pressure develops in a filled can due to an unusual situation, the safety feature would activate rapidly and provide adequate venting to completely vent the container contents before bottom end blow off could occur.

Full cans will vent if excessive pressure develops in the can due to misuse. This might involve placing the can on a hot stove or radiator, near a hot iron, or in the glove box, trunk, or window of a car sitting out in the sun.

Generally, partially filled cans will also vent under the conditions mentioned above; however, near-empty cans may fail at the side seam in typical three piece metal cans before the pressure required to activate the safety feature is generated under prolonged exposure to intense heat.

Aerosol cans which are considered empty or nearly empty usually contain a small amount of residual product and propellant. These small amounts are sometimes not sufficient to generate the pressure needed to activate the safety feature when the can is incinerated. Under the intense heat of incineration, some of these cans will vent or rupture at the side seam. This is due to the fact that the side seam is adhered with a solder or relatively low temperature material. The side seam rupture will occur at pressures below the pressure required to buckle the dome and thus before activation of the safety venting feature. This failure, although dangerous, is less violent than blow-off of the bottom end.

Certain products in cans which are thrown away as empty or nearly empty will generate sufficient pressure to activate the safety feature when incinerated. This is entirely dependent upon the amount and type of product and propellant remaining in the can. Full or partially full cans will also vent safely if they are incinerated.

The instant aerosol pressure relief system effectively vents excess internal pressure in all filled cans before the bursting point is reached. Under conditions of intense heat, as in incinerators, empty or near empty cans may fail, but the intensity of the failure is dramatically reduced.

SUMMARY OF THE INVENTION

A pressure relief system for an aerosol container forming the present invention comprises a tubular metal container adapted to hold a pressurized product that is dispensed through a valve mounted on the container. The container has a safety venting system therein, whereby the product may be vented from a filled pressurized container through the system where an increase in internal pressure threatens to cause bottom end blow-off. The container comprises a tubular metal body having a closure seamed to one end and the opposite end has a metal dome seamed thereto, the dome being adapted to receive a valve to close the container. A plurality of scores are formed in the periphery of the dome. The scores penetrate only partially through the metal of the dome at the seam which forms a hermetic seal with the container body. Thus, when the internal pressure within the sealed container increases and threatens to cause the container bottom end to blow-off the periphery of the dome buckles outwardly, causing the residual of the scores to fracture and produce a plurality of vents to permit the highly pressurized contents of the sealed container to safely escape and thus prevent bottom end failure.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a three-piece metal container utilized to dispense pressurized products;

FIG. 2 is a top plan view of the container;

FIG. 3 is an enlarged partial sectional view showing the periphery of the dome and the container body prior to their being seamed together in forming of the container;

FIG. 4 is an enlarged sectional view taken substantially along the line 4—4 in FIG. 3;

FIG. 5 is an enlarged fragmentary sectional view of the double seam formed by the periphery of the dome and the top of the container body;

FIG. 6 is an enlarged fragmentary side elevational view of the seam shown in FIG. 5 more fully illustrating a vent score;

FIG. 7 is an enlarged partial sectional view similar to FIG. 5 but illustrating the vent score on the interior of the periphery of the dome;

FIG. 8 is an enlarged fragmentary sectional view illustrating the periphery of the dome after high internal pressure has buckled the dome and fractured the vent score to form a safety pressure relief vent; and

FIG. 9 is an enlarged fragmentary side elevational view illustrating the ruptured score safety vent after buckling of the dome.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As a preferred or exemplary embodiment of the instant invention FIGS. 1 and 2 show a container, generally designated **12**, comprising a tubular metal body **14** having a side seam **15**. The side seam is generally sealed with solder, as is well known in the art, although it may also be welded. Closing the bottom of the container is an end **16** hermetically seamed to the bottom of the body **14** by a seam **18**.

As the container **12** will ultimately be utilized as an aerosol container, a dome **20** is seamed to the top of the body **12** by a double seam **22**. The upper end of the dome has an orifice **23** defined by a top curl **24**. After filling with product and a suitable propellant, a valve cup, not shown, is placed into the orifice **23** and a suitable dispensing valve, also not shown, is positioned within the valve cup to seal the container **12** and to permit dispensing of the product and propellant from the container **12**.

A plurality of radial scores **26** are formed in the periphery of the dome in the top of the double seam **22**. As may be better seen in FIGS. 3–6 the scores **26** are narrow grooves formed in the periphery of the dome **20** and penetrate only partially through the metal of the dome **20**. For example, a score **26** has a depth of approximately 0.010 inch for a total metal thickness of 0.015 inch leaving a solid metal residual **30** of 0.005 inch. The developed length of the score is approximately 0.125 inch. As shown in FIG. 4 the angle of the score **26** is approximately 90° and it is desireable that this angle not be below 60°. As will be noted the bottom **28** of the score **26** has a radius and is rounded in cross sectional appearance. This provides greater integrity and prevents premature cracking through the residual **30** of the material which would result in leakage of product and propellant from the container **12**.

As can be seen in FIG. 3, the dome **20** has a countersink **32** comprising a portion of the double seam **22** and countersink radius **34** adjacent the seam area connecting the top of the body **14** with the dome **20**. In forming this double seam **22**, the top of the body **14** terminates in a flange **36** which fits within a curl **38** which forms the peripheral edge of the dome **20**. In forming the double seam the flange **36** is interfolded with the curl **38** to hermetically seal and close the container **12** as the double seam **22** is formed. In addition, a small amount of sealing compound **40** is positioned along the interior wall of the curl **38** to provide a hermetic seal in forming the double seam **22**. A similar type of double seam may be used to form the seam **18** at the bottom of the container **12**.

THe fully formed double seam **22**, shown in FIG. 5, thus hermetically seals the dome **20** to the body **14**. Spaced about the top of the double seam **22** are a plurality of the scores **26** which extend radially within the top of the double seam **22**.

In a modified construction, shown in FIG. 7, a plurality of radial scores **42** are formed on the interior of the periphery of the dome **20**. Thus, when the double seam **22** is formed by the flange **36** and curl **38** the score is hidden by being entirely within the double seam **22**. In certain instances this has aesthetic advantages in that the multiplicity of scores **42** are not seen by the user as are the exterior scores **26**. However, either will function in the manner described hereinafter to provide a pressure relief system for a filled container **12**.

As is well-known, there is some controversy in the usage of aerosol containers due to the fact that they are under high internal pressures and subject to abusive use. To date, the various concepts for pressure relieving an aerosol container have proved uneconomical. Any relief concept must function under both normal use conditions and under uncontrollable use conditions which violate general precautionary labeling. Some abusive conditions would include storage in direct sunlight, storage in enclosed automobiles during summer months and warehouse fires.

Also, the relief concept must allow function of the container under controllable use conditions in violation of precautionary labelling so long as the temperature does not exceed that temperature that could result in rupture of the container.

The greatest danger when aerosol containers are subject to temperature abuse is when the bottom of the container everts or buckles under extreme internal pressure and blows off. Due to the fact that the bottom is constructed to withstand extreme internal pressures, when these pressures are reached the bottom end may buckle and separate from the remainder of the container possibly resulting in propelling parts of the container about the immediate area.

A secondary type of failure encountered when internal pressure increases over the maximum allowable by the container construction is a side seam rupture which generally results from exposure to high temperatures. The side seam failure is dependent upon exposure temperature, the position of the container with respect to the heat source, the type of product and propellant packed in the container, the quantity of product and propellant remaining in the container, and the container size. For a container of average size such as those of 3 inches in diameter and approximately 7 9/16 height, it has been found that the relief concept must be capable of releasing 14 cubic feet per minute of internal gas at 200 psig. Less release capacity is required for smaller containers and vent capacity is strictly dependent upon volumetric capacity.

Following the teachings of U.S. Pat. No. 2,795,350, a nick was formed in the double seam securing the bottom closure to a container body. Upon heating the can in a fire failure was obtained as the bottom end buckled and the can exploded before venting could occur. When a single nick was placed in the top seam of a three-piece container and the container filled with Freon **12** propellant, another test was run wherein the can was placed in an open fire. The top end buckled, but the Freon **12** and the product therein could not escape rapidly enough. Thus, the top end of the container blew off in this instance. In another, the side seam failed explosively, whereas in a third test the bottom blew off. In all cases venting began through the fractured nick but explosive failure occurred in all instances.

Thus, a single venting means is not adequate due to the fact that the top dome does not vent rapidly enough. Instead the pressure within the container will continue to increase rapidly until it exceeds the strength of the container construction. When this point is reached the container can fail in an uncontrolled manner. In such instances, an explosion could occur and failure could occur in either the top, bottom or side seam.

As was mentioned hereinbefore, tests have indicated that a minimum venting capacity must be present in each container to insure safety and functional operation of the venting system. In tests where fifty cans without a relief system and containing propellant were subjected to an incinerator fire, fourteen exhibited bottom end blow off while twenty seven produced side seam failures after the top end had buckled with projectiles being thrown from the fire about the immediate area. In only nine instances of the fifty tests were no projectiles ejected from the fire.

When utilizing the venting pressure relief system described hereinafter it was possible to increase the degree of venting and decrease the end blow off failures to less than 10 percent for filled containers and to prevent ejection of container parts from the incinerator fire completely.

It can be seen in FIGS. **8** and **9** that when the internal container pressure increases sufficiently the dome **20***a* buckles and the countersink **32***a* and countersink radius **34***a* also deform as the double seam **22** partially unfolds raising the radial score **26***a* away from the seam and rupturing it to form a vent **44.** This vent **44** permits pressurized product and propellant from within the container **12** to escape and safely vent the container.

As may be seen from the drawings, a number of radial scores have been formed in the double seam **22.** This is to insure that no matter where the dome **20** begins buckling due to increased internal pressure, a vent **44** will be formed almost immediately and as the buckling continues about the periphery of the dome **20** additional vents **44** will form about the periphery of the dome **20** as additional radial scores **26** are deformed and fractured.

It has been found that at **200** psig inside a 300 × 709 can, **12** radial scores will vent from 14 to 21.5 cubic feet per minute of gas. Eight radial scores per end will vent from 11.5 to 14 cubic feet per minute of gas, and six radial scores per end will vent from 10 to 12.5 cubic feet per minute of gas. In these tests air temperature was about 78°F. Thus it can be seen for a container of such size a minimum of 8 score vents will permit reasonably safe evacuation of the internal gases within an overpressurized filled container, although at least 12 score vents are preferred for greater reliability.

It must be noted that these tests were all conducted with filled containers containing sufficient amounts of propellant to insure rapid buckling of the dome **20** when pressure was increased at a relatively rapid rate from external heating. However, with partially filled or near empty containers the external heat might be sufficient to melt the conventional solder side seam so that failure could occur at the side seam rather than by buckling the dome **20** to form the vents **44.** But, as has been indicated, failure of the side seam is far less serious than failure at the bottom where blow off could cause serious damage if container parts are propelled about the area.

It can thus be seen that a sufficient degree of venting must be present in the container to permit rapid exhaustion of the propellant and product through the vent system before end blow off occurs. The single vent shown in the prior art has been found to be insufficient to insure such rapid exhaustion as is necessary to prevent end blow off of aerosol containers when subjected to high internal pressures, frequently encountered under abuse of systems. In addition, the geometric shape of the score is most important in insuring rupture and proper formation of the vent **44** under buckling conditions while guaranteeing proper hermetic sealing of the container during normal use.

It is thought that the invention and many of its attendant advantages will be understood from the foregoing description and it will be apparent that various changes may be made in the form, construction and arrangement of the parts without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the form hereinbefore described being merely an exemplary embodiment thereof.

We claim:

1. A metal container adapted to hold a pressurized product that is dispensed through a valve mounted on said container, said container having a safety venting system therein whereby the contained product is vented from the container through said system when an increase in internal pressure threatens to cause rupture of said container, comprising:

a tubular metal body closed at one end;

a metal, domed end member attached to the opposite end by a double seam having a countersink segment, said countersink segment having a straight line portion, and said domed end member being adapted to receive said valve to close said container;

a plurality of score lines in a peripheral portion of said domed end member, said score lines being in at least a part of the straight line portion of the countersink segment and extending to at least the midpoint of the top portion of the double seam and penetrating only partially through the metal of said domed end member, whereby when the internal pressure within the sealed container increases and threatens to cause rupture of said container, said domed end member will buckle outwardly causing the residual of said scores to fracture to produce a plurality of vents to permit the highly pressurized contents of said sealed container to escape safely therefrom.

2. The container of claim **1** wherein the closed end

is formed by a separate end double seamed to the metal body.

3. The container of claim **2** wherein the separate end is concave.

4. The container of claim **2** wherein the score lines are located on the interior of the domed end member.

5. The container of claim **1** wherein the score lines are uniform.

* * * * *