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3,405,838

PRESSURE VESSEL VENTING MEANS

Filed Sept. 12, 1967

FIG. 1

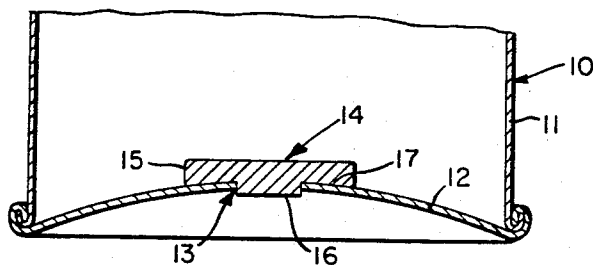


FIG. 2

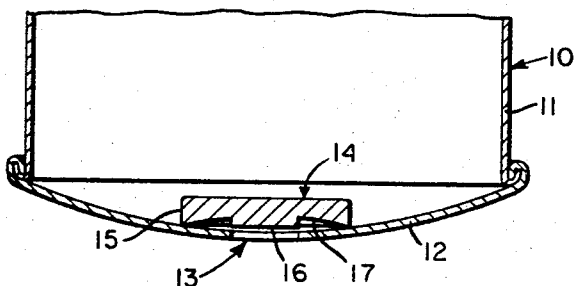


FIG. 3

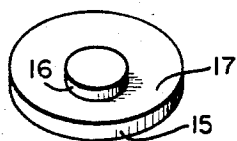
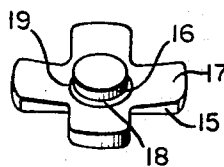


FIG. 4



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PRESSURE VESSEL VENTING MEANS

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7 Claims. (Cl. 220-44)

ABSTRACT OF THE DISCLOSURE

The invention provides a pressure vessel (e.g., an aerosol dispenser) equipped with a safety-valve which opens when the pressure in the vessel reaches a certain excessive level below that which would burst the vessel; when a bendable wall of the vessel bends outward at said excessive pressure, the bending causes a plug portion of a valve body to be pulled from an orifice in said wall to form a vent; the invention also provides a safety-valve which is useful not only in pressure vessels but also in vacuum vessels.

Background of the invention

This invention relates to a pressure vessel equipped with a safety-valve device which opens when the pressure in the vessel reaches a certain excessive level. An aerosol dispenser is a preferred embodiment of the vessel. The invention also concerns a safety-valve device capable of providing a vent in any kind of fluid-tight vessel (e.g., a pressure vessel or a vacuum vessel) at a predetermined pressure difference with reference to the pressure inside and outside the vessel.

The hazards associated with the storage and disposal of conventional aerosol dispensers which are not provided with a suitable safety-valve are well known. For example, when such a dispenser (whether full or "empty") is exposed to an open flame or other source of excessive heat, it usually explodes with great force, sending sharp metal fragments in all directions somewhat in the manner of a bomb or hand grenade. Such an explosion can also occur as the result of a pressure-generating chemical reaction within the container, for example, when separately stored reactive materials within the container inadvertently become mixed prior to being discharged through the dispensing valve as a result of failure of a storage compartment. It is known in the art that there is increasing interest in the use of aerosol dispensers containing separately-stored reactive materials; for example, such dispensers, useful for the preparation of warm shaving lather and the like, are described in the U.S. Patent Lewis 3,325,056, and Hayes 3,326,416. Although such dispensers are very useful, they are not entirely satisfactory from the standpoint of safety in the absence of an effective safety-valve. A harmful explosion can also occur during the manufacture of the dispensers; for example, when an operator introduces too much of the propellant component.

The aerosol dispenser industry is therefore in need of a safety-valve device which is effective in providing a dispenser vent at a predetermined excessive level of pressure below that which would burst the dispenser, and preferably a device which is not unduly difficult or costly to manufacture and install. In other words, the industry needs a dispenser which is practical to manufacture and substantially free of explosion hazards.

Summary of the invention

The present invention provides a pressure vessel in the form of a can, tank, pipe or the like, adapted to hold a fluid under super-atmospheric pressure, comprising a bendable wall adapted to bend outward when the pres-

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sure in the vessel reaches a predetermined excessive level below that which would burst the vessel, and a safety-valve in said wall which comprises (A) an orifice in said wall, and (B) a valve body having (1) an outer plug portion sealingly fitted in said orifice, and (2) an inner washer-like portion integrally united to said plug portion which (a) forms a fluid-tight seal with the inner surface of said wall surrounding said orifice when the pressure in the vessel is normal, (b) is rigid enough to resist any undue deformation under pressures which cause outward bending of said wall, and (c) is adapted to pull said plug portion from said orifice so that a vent is formed in said wall sufficient to prevent bursting of the vessel when said wall bends outward at said predetermined excessive level of pressure.

The invention also provides a safety-valve device, adapted to provide a vent in a fluid-tight vessel when the difference between the exterior pressure and the interior pressure of the vessel reaches a predetermined level, comprising a bendable wall adapted to bend when the difference between the pressure on one side of the wall and the pressure of the other side of the wall reaches said predetermined level, and a safety-valve in said wall which comprises (A) an orifice in said wall, and (B) a valve body having (1) a plug portion sealingly fitted in said orifice, and (2) a washer-like portion integrally united to said plug portion which (a) forms a fluid-tight seal with said one side of said wall in an area surrounding said orifice prior to the bending of said wall, (b) is rigid enough to resist any undue distortion under pressure conditions which cause said wall to bend, and (c) is adapted to pull said plug portion from said orifice so that a vent is formed when said wall is bent by said predetermined pressure difference.

Brief description of the drawing

The invention will be more readily understood by referring to the attached drawing wherein:

FIGURE 1 shows an embodiment of the novel pressure vessel as it appears when the pressure therein is normal; this is a view in central vertical section of the lower portion of an aerosol dispenser wherein the bendable wall referred to above is the metal bottom wall of the dispenser container, and the safety-valve feature of the invention can be seen in the central portion of this wall.

FIGURE 2 shows the dispenser of FIGURE 1 after the bottom wall has been bent outward by excessive pressure in the container, and the safety-valve has been opened by the resultant lifting of the lower portion of the valve body from the orifice in the bottom wall.

FIGURE 3 is a perspective view of the lower surface of the valve body of the safety-valve present in the dispenser of FIGURE 1.

FIGURE 4 is a perspective view of the lower surface of a valve body having a structure which differs from that of FIGURE 3 mainly in that it has the general shape of a cross instead of a circle, and there is a resilient rubber washer in the area which forms a seal around the orifice at the inner surface of the bottom wall of the container.

Description of preferred embodiments

In a particularly preferred embodiment of the invention, the novel pressure vessel is an aerosol dispenser wherein said bendable wall is a wall of the dispenser container, for example, the bottom wall of the can portion of any one of numerous known types of aerosol dispensers. Such a wall is normally made of relatively thin metal; however, other suitable construction materials can be used without departing from the spirit of the invention. One very useful aerosol dispenser embodi-

ment is illustrated in the drawing, which will now be discussed in further detail.

In FIGURE 1, container 10, which is adapted to hold a fluid under super-atmospheric pressure, is a can of the type commonly used in aerosol dispensers. The rolled bottom edge of can side wall 11 tightly engages the rolled edge of can bottom wall 12, and is crimped therewith to form a pressure-proof seal. Bottom wall 12, which is convex when viewed from its top surface, is of such a shape and thickness that it is capable of bending outward (downward) when the pressure in container 10 reaches a predetermined excessive level (e.g., 270 p.s.i.) below that which would burst the container (e.g., 390 p.s.i.).

The upper portion of the container (not shown in the drawing) and the dispensing valve therein can have any suitable structure known in the aerosol dispenser art. Among the useful kinds of dispenser upper portions are those shown in U.S. Patents Giangualano, 3,045,925; Miles, 3,117,404; Soffer, 3,132,774; Lewis, 3,325,056 and Hayes, 3,326,416; the disclosures of these patents are incorporated herein by reference.

The central portion of dome-shaped wall 12 has a safety-valve which consists of circular orifice 13 in the center of wall 12, and valve body 14. The valve body is made up of an outer (lower) circular plug portion 16, which is sealingly fitted in orifice 13, and an inner (upper) circular washer-like portion 15. Further details of valve body 14 can be seen in the upside-down perspective view shown in FIGURE 3.

Under normal conditions of use and storage of the dispenser, lower face 17 of portion 15, which is concave when viewed from its bottom surface, forms a fluid-tight seal with the convex inner surface of wall 12 in an area surrounding orifice 13. Washer-like portion 15 can be made of any suitable material, for example, a rigid plastic or metal; it must be rigid enough in the thickness used so that it will not undergo any undue deformation (e.g., bending) under pressures which cause outward bending of wall 12. As illustrated in FIGURE 2, washer-like portion 15 is capable of pulling plug portion 16 from orifice 13 so that a vent is formed in wall 12 through orifice 13 sufficient to prevent bursting of the container when wall 12 bends outward at some predetermined excessive level of pressure. Undue distortion of portion 15 would enable the plug portion to remain in the orifice so that no vent would be formed during the bending of wall 12.

As shown in FIGURE 4, valve body 14 can also have the general shape of a cross; and it can have a resilient washer 18 (e.g., a rubber O-ring) in an area of face 17 around plug portion 16 which enhances the seal formed with the upper surface of can bottom wall 12 around orifice 13. If desired, washer 18 can be positioned in a groove 19 having a depth slightly less than the thickness of the washer.

It will be apparent that one skilled in the art, after reading the present disclosure, will be able to make various obvious changes in the design of the safety-valves described above without departing from the spirit of the present invention. For example, wall 12 can be flat or any other suitable shape which still permits it to bend enough to cause the safety-valve to open. The amount of outward bending of wall 12 as shown in FIGURE 2 is considerably more than is usually necessary to cause the safety-valve to open.

One or more vertical holes can be provided in washer-like portion 15 to enhance the flow of fluid towards the vent upon opening of the valve. Valve body 14 can be made of a single piece of material, for example by injection molding of a suitable plastic; or it can be made by combining portions 15 and 16 by any suitable known fastening means. Plug portion 16 can be provided with a lower end which is slightly larger in diameter than orifice 13 so that the overlapping bottom portion outside the orifice locks valve body 14 in position until the force created by the bending of wall 12 pulls the plug portion from the orifice while either bending the orifice to make it larger

or bending or breaking the bottom portion of 16 to make it smaller. A polymer composition such as a suitable known adhesive or sealer composition can be applied to one or more surfaces of valve body 14 and/or the portion of wall 12 in contact therewith if it is desired to provide additional means of holding the valve body in place with a fluid-tight seal during the manufacture, filling and normal use of the vessel.

It will also be apparent that said bendable wall which contains the safety-valve can be a side wall or a top wall of a pressure vessel. In some embodiments of the invention, the wall which contains the safety-valve makes up only a portion of a side wall, top wall or bottom wall of a pressure vessel. For example, wall 12 of FIGURE 1 and the safety-valve thereof (or at least one wall and valve designed to function in a similar manner) can be sealingly fastened in a circular opening of a flat or curved side wall or top wall of a pressure tank designed for the storage of a liquid or gas, wall 12 being the only portion of the entire wall of the tank which is adapted to bend outward when the pressure in the tank reaches a predetermined excessive level below that which would burst the tank.

It will be obvious that if the tank contains a substance which cannot safely be vented through the safety-valve into the area surrounding the tank, a duct can be provided at the orifice of the safety-valve which is capable of carrying the substance flowing out of the vent to a container or area to which it can safely be transferred.

With reference to FIGURES 1 and 2, one can easily visualize the side wall 11 as projecting downward instead of upward from wall 12. Thus, a safety-valve device having the general design of the lower portion of the vessel shown in FIGURE 1 consisting of wall 12 and valve 14 can be installed as the top wall of a vessel to be used under conditions (1) wherein the interior pressure is well below atmospheric pressure and the exterior pressure is at about atmospheric pressure, or (2) wherein the interior pressure is at or below atmospheric pressure and the exterior pressure is far above atmospheric pressure. The latter conditions are encountered in vessels lowered to great depths in the ocean, for example during various studies in oceanography. In such applications, the safety-valve device of this invention can be used to prevent costly collapse of the vessel when the pressure differential becomes too great. For example, in the vessel mentioned in the beginning of this paragraph, washer-like portions 15 (a) forms a fluid-tight seal with the top side of the dome-shaped bendable top wall 12 of the vessel in an area surrounding orifice 13, (b) is rigid enough to resist any undue distortion under pressure conditions which cause said wall to bend, and (c) is adapted to pull plug portion 16 from the orifice so that a vent is formed at the orifice when top wall 12 is bent downward (e.g., to the position shown in FIGURE 2) by a predetermined pressure difference below that which would cause the other portions of the vessel to collapse. After installation of a new safety-valve device, which can be done with little effort and expense, the vessel is again ready for use.

Safety-valve devices are obtainable in accordance with this invention which are not only effective in providing a vent at a predetermined excessive level of pressure, but also are easy and inexpensive to manufacture and install. By using these safety-valve devices, a manufacturer of pressure vessels can reduce his costs by eliminating the need to make the vessels capable of withstanding extremely high pressures as a safety measure.

Aerosol dispensers and other pressure vessels constructed according to the present invention have important advantages from the standpoint of safety since they are substantially free of explosion hazards. These dispensers can be made with great ease and economy. And their safety features are effective regardless of what kind of dispensing valve is employed, and regardless of whether the excessive pressure build-up in the containers is caused by (1) introducing too much of one or more fluid components into the

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containers, (2) a pressure-generating chemical reaction of the contents, (3) exposing the dispensers to an open flame or other source of excessive heat or (4) a combination of two or more such factors.

These novel dispensers are useful for dispensing many different kinds of fluid materials including, for example, warm shaving lather, heated de-icer compositions for automobile windshields, adhesive compositions, paint compositions, insecticides, cleaning and bleaching compositions, caulking compositions, heated liniment, whipped cream and other food products, polyurethane foam and multicolored cosmetic creams and toothpaste.

Any dangerous build-up of pressure within the pressure vessel of the present invention is avoided by the opening of the safety-valve with the resultant release of pressure through the vent that is formed before the pressure becomes great enough to cause the vessel to burst.

I claim:

1. A pressure vessel in the form of a can, tank, pipe or the like, adapted to hold a fluid under superatmospheric pressure, comprising
 - a bendable wall adapted to bend outward when the pressure in the vessel reaches a predetermined excessive level below that which would burst the vessel, and
 - a safety-valve in said wall which comprises
 - (A) an orifice in said wall, and
 - (B) a valve body having
 - (1) an outer plug portion sealingly fitted in
 - (2) an inner washer-like portion integrally united to said plug portion which (a) forms a fluid-tight seal with the inner surface of said wall surrounding said orifice when the pressure in the vessel is normal, (b) is rigid enough to resist any undue deformation under pressures which cause outward bending of said wall, and (c) is adapted to pull said plug portion from said orifice so that a vent is formed in said wall sufficient to prevent bursting of the vessel when said wall bends outward at said predetermined excessive level of pressure.

2. A pressure vessel according to claim 1 in the form of an aerosol dispenser wherein said wall is the bottom wall of the dispenser container.

3. A pressure vessel according to claim 2 wherein said

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wall is convex when viewed from its top surface, and said washer-like portion is concave when viewed from its bottom surface.

4. A pressure vessel according to claim 3 wherein said washer-like portion has the general shape of a circle when viewed from its top surface.

5. A pressure vessel according to claim 3 wherein said washer-like portion has the general shape of a cross when viewed from its top surface.

6. A pressure vessel according to claim 3 wherein the diameter of the lower portion of said plug portion is slightly greater than the diameter of said orifice.

7. A safety-valve device, adapted to provide a vent in a fluid-tight vessel when the difference between the exterior pressure and the interior pressure of the vessel reaches a predetermined level, comprising

a bendable wall adapted to bend when the difference between the pressure on one side of the wall and the pressure on the other side of the wall reaches said predetermined level, and

a safety-valve in said wall which comprises

(A) an orifice in said wall, and

(B) a valve body having

(1) a plug portion sealingly fitted in said orifice, and

(2) a washer-like portion integrally united to said plug portion which (a) forms a fluid-tight seal with said one side of said wall in an area surrounding said orifice prior to the bending of said wall, (b) is rigid enough to resist any undue distortion under pressure conditions which cause said wall to bend, and (c) is adapted to pull said plug portion from said orifice so that a vent is formed when said wall is bent by said predetermined pressure difference.

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U.S. DEPARTMENT OF COMMERCE

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**UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION**

Patent No. 3,405,838

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

Column 5, line 28, "an outer plug portion sealingly fitted in" should read -- an outer plug portion sealingly fitted in said orifice, and --.

Signed and sealed this 10th day of March 1970.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.

Commissioner of Patents