Jan. 24, 1967 G. F. STERN 3,299,960

VALVE

Filed Oct. 30, 1964

FIG. 1

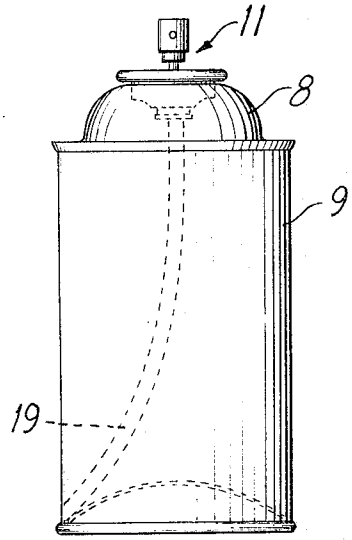


FIG. 2

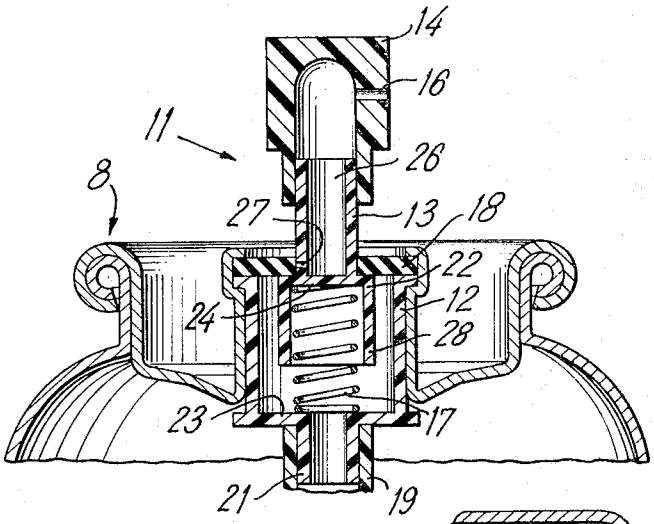
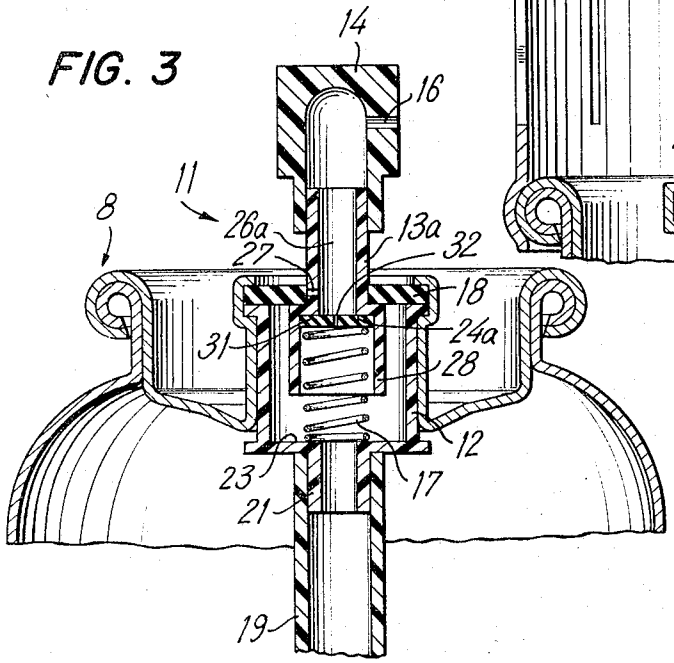


FIG. 3



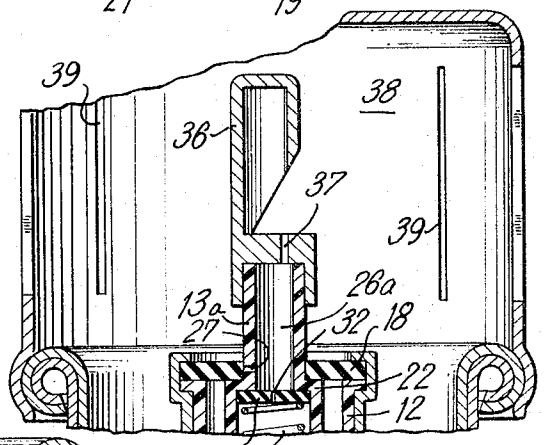


FIG. 4

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VALVE

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In the well known and widely used aerosol containers the materials to be dispensed (e.g. aqueous or non-aqueous liquids such as shaving cream, paints, insecticides, cleaning compositions, deodorants, etc.) are mixed with propellant. The propellants employed (for example fluorocarbons, e.g. fluorochlorohydrocarbons, or low boiling hydrocarbons, such as propane) are gaseous at atmospheric pressure at normal temperatures but are liquids at the pressures, say 15 to 100 p.s.i.g., prevailing in the closed container. When the push button of the container valve is depressed the material to be dispensed is forced out through that valve by the pressure generated by vaporization of the propellant.

Aerosol containers explode when they are exposed to excessive heat, which raises the pressure above the limit the sheet metal, glass, or plastic container is designed to withstand. This may occur even in the rear deck of an automobile left in strong sunlight on a hot summer day. Fatal explosions have taken place when used aerosol containers, still containing some propellant, have been incinerated with rubbish or garbage.

While pressure-relieving devices for aerosol containers have been proposed previously, these have involved relatively expensive modifications of the low-priced valves or have been inoperative until distortion of the container has occurred.

It is therefore an object of this invention to provide an economical and effective aerosol container valve capable of relieving excess pressure and thereby preventing explosions.

Another object of this invention is the provision of an aerosol container valve in which the pressure-relieving function is accomplished without drastic or expensive changes in the construction of the conventional valve elements.

Still another object is to provide an economical pressure-relieving valve which will relieve excess pressures by permitting a portion of the contents to escape without destruction of the valve, so that the valve will be operative repeatedly to relieve such excess pressure again if necessary.

A further object of this invention is the provision of a novel valve for a fire alarm device.

In the accompanying drawing which illustrates several aspects of this invention:

FIGURE 1 is an overall view of an aerosol container of conventional construction;

FIGURE 2 is a cross-sectional view of a conventional aerosol container, showing details of the valve construction;

FIGURE 3 is a similar view showing the valve of FIG. 2 modified in accordance with one aspect of this invention; and

FIGURE 4 is a view of a modification of the valve of FIG. 3 in which the push button is in the form of an alarm device.

In one conventional construction, shown in FIGS. 1 and 2, there is mounted at the top **8** of the aerosol can **9** a valve **11** having a body **12**, a reciprocable core **13**, a push button **14** having a discharge opening **16**, a spring **17** biasing the core **13** to closed position, an annular resilient sealing gasket **18**, and a dip tube **19** extending down below the level of the liquid in the container. The top **8** of the can is usually crimped or otherwise shaped about

the valve body **12** and sealing gasket **18** as to hold these elements in a fixed position relative to the can. The dip tube **19** is mounted on a depending axially bored extension **21** of the valve body. The spring **17** and the lower portion **22** of the core **13** are disposed within the hollow of the valve body **12**, with the bottom of the helical spring **17** abutting against a shoulder **23** of the valve body; in the conventional construction, the top of the spring presses against a face **24** of the core **13**.

The core **13** has an axial bore **26** extending part way down its length and communicating with a radial inlet passage **27** whose outer end is normally sealed by contact with the inner portion of the gasket **18**. The core **13** may also have a depending skirt **28** for housing the upper end of the spring **17**. Except for the orifices **16** and **27**, the parts are radially symmetrical.

In operation, a downward pressure on the push button moves the core **13** against the force of the spring **17** to a position where the outer end of the radial inlet passage **27** is no longer sealed by its contact with the gasket **18**. The contents of the can are then forced, by the pressure in the can, up through the dip tube **19** and valve body **12**, through the radial passage **27**, the axial bore **26** and the discharge opening **16**. The core may have circumferential tapered cam surfaces (not shown) to deflect the inner portion of the gasket away from the end of the passage **27** during the downward movement of the core **13**.

In the embodiment of this invention illustrated in FIG. 3, the parts are the same as those shown in FIG. 2 except that the axial bore **26***a* extends through the core **13***a* to the face **24***a* against which there is pressed a resilient disc **31** having a tiny perforation **32** terminating at the bore **26***a*. The perforation **32** is so small that it is normally effectively closed and no leakage of the contents, whether gaseous or liquid, occurs at the normal aerosol can pressures. If the pressure in the can should rise to dangerously high levels, the perforation will be forced open, venting the interior of the can to the atmosphere until the pressure decreases to below the danger level, at which time the can may be used again in the usual fashion. If, however, there is a sudden surge of pressure which cannot be vented gradually through the opened perforation, the pressure will start a rip in the resilient material at the perforation, thus enlarging the opening and permitting a quick release of the pressure. In this case, of course, the can will generally not be suitable for reuse after the pressure has declined, since the sealing effect at the perforation will be destroyed or diminished.

The disc **31** is preferably made of a rubbery material, advantageously one which is resistant to any deteriorating effects of the contents of the can. Silicone rubber, rubbery butadiene-acrylonitrile copolymers, and polychloroprene are some examples of suitable materials.

While the aperture **32** may be produced mechanically, as by penetrating the disc **31** with a fine steel needle, it is preferably produced by an electroperforating process. Electroperforation is a known technique in which a hole is burnt through a dielectric material by the passage of a current (usually forming a spark) between two electrodes disposed at opposite sides of the material. By using very small currents, for short times, microscopic holes can be produced. The conditions employed in the electroperforation operation will, of course, be determined by routine experimentation, varying the voltage, the current, and the time to produce a hole that will open or bleed when the disc is subjected to the selected pressure or range of pressures.

The disc **31** may be held in place, firmly against the face **24***a* of the core **13***a*, solely by the action of the spring **17** reinforced by the pressure of the contents of the can against the lower face of the disc. If de-

sired, the disc **31** may be force-fitted within the skirt **28** or may have its edges cemented to the face **24***a*. The face **24***a* may have an annular ridge to serve as a seat against which the disc **31** is pressed and the disc may have a rigid annular backing member, below it, to more uniformly distribute the pressure exerted by the helical spring. The open portion of such an annular backing is preferably small and aligned with the perforation of the disc. There may also be present a rigid annular washer between the disc and the face **24***a* to limit the deflection of the disc under the normal pressures in the container.

In the embodiment of the fire alarm device, shown in FIG. 4, the conventional push button is in the form of a signal producing device such as a whistle **36** secured, like the push button **14**, to the top of the core **13***a*. The whistle **36**, of conventional design, has a port **37**, leading from the bore **26***a*, for the passage of the gas escaping from the interior of the container when the pressure in the container exceeds the limit which the perforated disc **31** is designed to withstand. Suitable designs for whistles or other alarms for this purpose will readily suggest themselves to those skilled in the art (e.g. the whistles shown in U.S. Patents 2,697,999; 2,842,088; 2,865,320 and 2,798,452). A non-inflammable cap **38** placed over the valve serves to shield the valve from heat and flame; the valve usually is made in whole or in part of plastic and is not heat resistant. The cap **38**, which may be a cylindrical cup-like metal member of such size and shape as to be snapped over any appropriate portion of the upper part of the container, also serves to guard the valve against dirt, grease, etc. and thus helps to assure the reliable functioning of the device in the event of a fire. The cap preferably has side openings, such as the narrow vertical slits **39**, to help transmit the sound made by the whistle.

In the fire alarm device of FIG. 4, the container will generally be filled merely with a non-inflammable compressed gas such as carbon dioxide, or with a non-inflammable propellant liquid, such as a conventional fluorocarbon propellant (e.g. dichlorodifluoromethane). The device is intended to be placed in any position where a fire warning device is employed, for example, above the head of the stairs of a dwelling house. In the event of a fire, the heating of the contents of the container causes an increase in the pressure in the container until the perforation in the disc is forced open, and the resulting stream of gas actuates the whistle **36** to warn the occupants of the building. The gas in the container may also comprise an odoriferous substance, readily noticeable on discharge to give an additional alarm to the occupants.

The fire alarm device of this invention lends itself to easy demonstration and test. Thus, the sound of the whistle may be demonstrated to a prospective purchaser merely by manually depressing the whistle **36** and the attached core **13***a*, to permit gas under pressure to flow through the passage **27**, the bore **26***a* and the whistle **36**. The container may be heated (as by placing it in very hot water) to demonstrate and test the operativeness of the alarm device without the need for destroying the device.

The fire alarm device may also serve as an automatic fire extinguisher, particularly when it is used in a confined space, such as a furnace room. In this case the stream of gas, such as carbon dioxide, released from the container will form a dense blanket over the burning material. For the same purpose there may also be present in the container such fire extinguishing materials as carbon tetrachloride or chlorobromomethane to form a fog when discharged with the carbon dioxide or fluorocarbon propellant.

Returning now to the general operation of the perforated disc **31**, this need not be of resilient material, such as a soft rubber. For example, it may be made of a more or less rigid plastic such as linear polyethylene or isotactic polypropylene. When the perforation is in a rigid material, the advantageous rapid bleeding effect will generally not be obtained, since the material surrounding the perforation will not reversibly deform in response to the excess pressure. Instead the material will tend to break at the perforation when the unsafe pressure is reached and thereby tend to allow the entire contents of the can to be discharged through the valve. In either case, by proper choice of hole size, the excess pressure can be vented well before any deformation of the can takes place (e.g. at a pressure of less than 125 p.s.i.g., for example at about 80–110 p.s.i.g.) for a sheet metal aerosol container.

If desired, there may be a number of perforations in a single disc. Thus there may be used a microporous material such as the known microporous artificial leather having a multitude of meandering pores, which may if desired be coated with a suitable lacquer to reduce the effective size of the pores. Or there may be employed a disc having a series of perforations arranged in a circle with lines of lesser thickness than the remainder of the disc joining the perforations to facilitate rupture if there is a sudden buildup of very high pressure. Also, the disc need not be of uniform thickness; it may, for example, be concave on one or both of its faces, and the perforation may be situated in the thin portion of the disc.

It is to be understood that the foregoing detailed description is given merely by way of illustration, and that variations may be made therein without departing from the spirit of this invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A valve for a container having therein a normally gaseous liquid, said valve having means for permitting the discharge of at least part of the contents of said container through said valve to dispense said material from said container as desired, said valve having a portion having a microscopic perforation impermeable to discharge of the contents of the container through said perforation under the normal pressures in said container but permeable to discharge through said perforation when the pressure in the container exceeds said normal pressure and approaches a level at which rupture of said container occurs.

2. A valve as set forth in claim **1** in which said valve has a push button and a member movable with said push button to a dispensing position permitting discharge of at least part of the contents of the container through said valve to dispense said material from said container as desired, said member having a wall one side of which is positioned to be subjected to the superatmospheric pressure of the contents of the container and the opposite side of which is positioned to be at the substantially atmospheric pressure in said valve, said wall having said microscopic perforation.

3. A filled aerosol container having therein a normally gaseous liquid under a superatmospheric pressure, which container is sufficiently strong to retain said pressure, said container being subject to rupture when the pressure therein is raised, as by heating of said container, to a higher level which distorts the walls of said container, said container having a dispensing valve as set forth in claim **2**, said perforation being formed in a rubbery material.

4. A valve as set forth in claim **2** in which said member comprises a hollow core having a normally sealed passage and being movable with said push button to said dispensing position permitting the discharge of at least part of the contents of said container through said passage and thence through said core to the atmosphere, a spring biasing said core away from said dispensing position, said wall being part of said core and comprising a resilient material having said microscopic perforation therein.

5. A valve as set forth in claim 4, said core having an opening at the lower end thereof, sealing means at said lower end to block the flow of the contents of the can through said opening, a spring pressing against said sealing means to urge said core away from said dispensing position, said sealing means being part of said wall and having said microscopic perforation therein.

6. A valve as set forth in claim 5 in which said sealing means comprises a flat member of rubbery material pressed against said lower end of said core by said spring.

7. A filled aerosol container having therein a normally gaseous liquid under a superatmospheric pressure, which container is sufficiently strong to retain said pressure, said container being subject to rupture when the pressure therein is raised, as by heating of said container, to a higher level which distorts the walls of said container, said container having a dispensing valve as set forth in claim 4.

8. A filled aerosol container having therein a normally gaseous liquid under a superatmospheric pressure, which container is sufficiently strong to retain said pressure, said container being subject to rupture when the pressure therein is raised, as by heating of said container, to a higher level which distorts the walls of said container, said container having a dispensing valve as set forth in claim 6.

9. A filled container as set forth in claim 8, said container being of sheet metal and said perforation being permeable to the contents of said container when the pressure is in the range of about 80 to 125 p.s.i.g.

10. A filled aerosol container having therein a normally gaseous liquid under a first superatmospheric pressure, which container is sufficiently strong to retain said pressure, said container being subject to rupture when the pressure therein is raised, as by heating of said container, to a higher level which distorts the walls of said container, said container having a dispensing valve as set forth in claim 1.

11. A filled aerosol container as set forth in claim 10, said permeability and impermeability being reversible whereby, when the pressure is reduced to said first pressure after rising to a level at which said perforation is permeable, said perforation continues to be impermeable to said first pressure.

12. A push button operated valve adapted for use in an aerosol container, said valve having a push button, a hollow core having a normally sealed passage and being movable with said push button to a position permitting the discharge of at least part of the contents of said container through said passage and thence through said core to the atmosphere so as to dispense said material from said container as desired, said core having an opening at the lower end thereof, sealing means at said lower end to block the flow of the contents of the can through said opening, a spring pressing against said sealing means to urge said core away from said dispensing position, said sealing means having a microscopic perforation in a resilient material, said microscopic perforation being of such size as to prevent passage of said contents through said perforation under the normal pressures in said container but permitting discharge through said perforation when the pressure in the container exceeds said normal pressure and approaches a level at which rupture of said container occurs.

13. An alarm device comprising a container having therein under superatmospheric pressure a material which is a gas at atmospheric pressure and having a valve as set forth in claim 12, the push button of said valve having a whistle for producing a signal when there is a discharge of the contents through said core.

14. An alarm device as set forth in claim 13 and having a protective cap over said valve, said cap having openings in its walls for transmitting the sound of said whistle, and said container having therein a fire extinguishing composition.

15. A fire alarm device comprising gas actuatable alarm means, a container having therein under superatmospheric pressure a material which is a gas at atmospheric pressure, manually operable valve means normally in closed position for preventing said gas from actuating said alarm means and movable to an open position to permit said gas to actuate said alarm means, and means sensitive to the change in conditions produced by the heat of a fire for permitting said gas to actuate said alarm means when said valve means is in closed position.

16. A fire alarm device comprising gas actuable alarm means, a container having therein under superatmospheric pressure a material which is a gas at atmospheric pressure, pressure responsive means normally preventing said gas from actuating said alarm means, said pressure-responsive means having a microscopic perforation impermeable to said gas under the normal pressures in said container but permeable to said gas when the pressure in the container is increased owing to the heat of a fire.

17. A fire extinguisher comprising a container having therein under superatmospheric pressure a fire extinguishing composition whose pressure increases with temperature, and pressure-responsive means for preventing discharge of said composition from said container, said pressure-responsive means having a microscopic perforation impermeable to said composition under the normal pressures in said container but permeable to said composition when the pressure in the container is increased owing to the heat of a fire.

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