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[54] FRICTIONLESS INERTIA RESPONSIVE GAS DISPENSING APPARATUS

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[51] **Int. Cl.** **B67b 7/100**

[58] **Field of Search** 137/38, 45, 46; 222/3, 52, 222/463; 280/150

[56] **References Cited**

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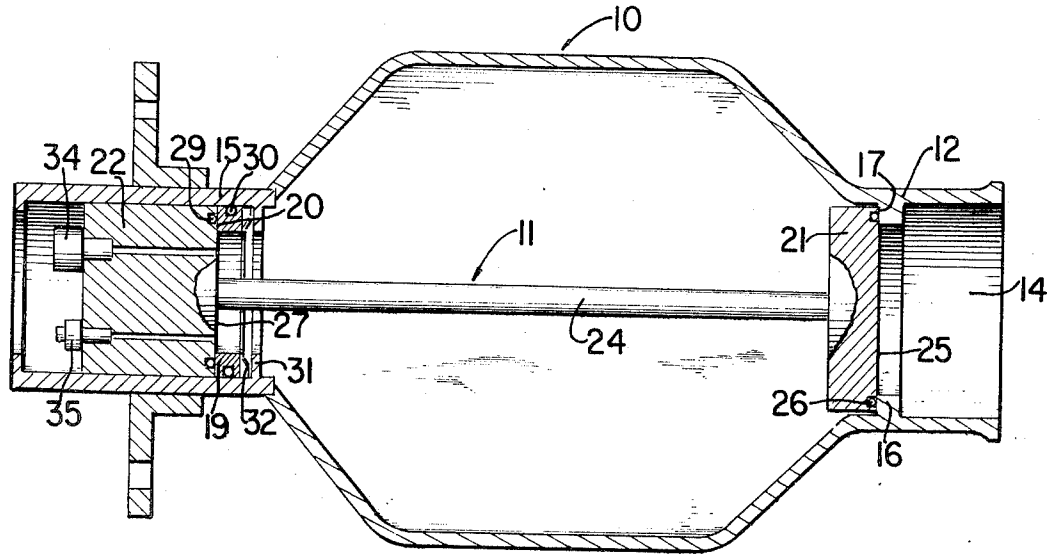
Primary Examiner—Stanley H. Tollberg

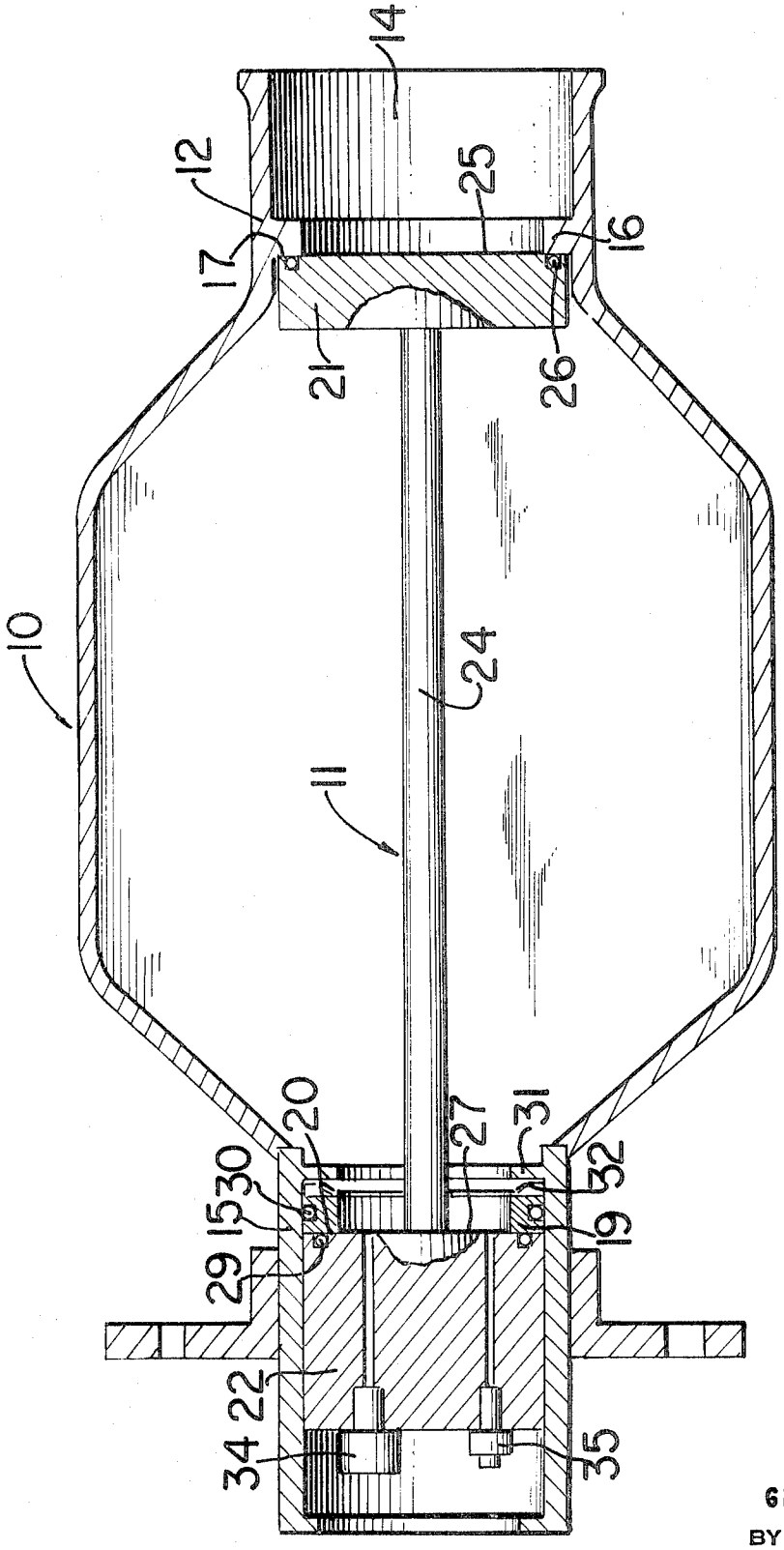
Attorney—Darby & Darby

[57] **ABSTRACT**

Apparatus for dispensing pressurized gas in response to a change in velocity including a container having an outlet opening and a second opening aligned therewith, and a valve member for sealing both of the openings. The valve member has a large diameter piston at one end which engages an annular flange at the outlet and a smaller diameter piston at the other end which engages an annular member at the second opening. The pistons are provided with face seals and the pressure within the container holds the seals in contact with the annular flange and the annular member to seal the openings. The valve member is of sufficient mass to overcome the pressure forces and open the container in response to a predetermined change in velocity of the container. A tubular member at the second opening closely fits the smaller piston so that substantially all of the gas in the container is emptied through the outlet opening.

6 Claims, 1 Drawing Figure





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FRICTIONLESS INERTIA RESPONSIVE GAS DISPENSING APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to apparatus for supplying fluid medium under pressure in response to a sudden change in velocity of the apparatus.

In recent years a great deal of attention has been devoted to safety systems and devices for protecting the occupants of passenger vehicles, particularly automobiles. One type of system which is currently being given serious consideration employs an inflatable bag or envelope which is stored in a deflated condition, usually in front of the occupant (for example under the dashboard of an automobile). When the vehicle experiences very rapid deceleration such that the occupant would be thrown forward (for example against the dash or windshield), gas stored under pressure is automatically released and the bag is inflated to restrain and cushion the occupant.

The majority of systems which have been previously proposed have employed electrically detonated explosive charges for rapidly releasing the stored gas. The explosive charge is connected to an electrical circuit which includes an inertia responsive electrical switch that closes in response to a predetermined rate of deceleration. In U.S. Pat. application Ser. No. 862,687 of John Cirillo, filed Oct. 1, 1969 and assigned to the assignee of the present application, there is disclosed apparatus for inflating such bags which does not require an explosive charge or an inertia actuated electrical switch. Instead, the container of pressurized gas is provided with an inertia actuated valve. The container is provided with an outlet opening connected to the inflatable bag and a second opening defined by a tubular formation aligned with the outlet. A valve member is positioned in the container to seal both openings. One end of the valve member is provided with a large piston which fits into the outlet opening and the other end is provided with a piston of lesser area which fits into the tubular formation. Each of the pistons is provided with an O-ring around its outer periphery to seal the openings.

To adequately protect the passenger of an automobile, it is necessary that the inertia actuated valve member respond, to inflate the bag, whenever the auto experiences a "G" loading of a magnitude and duration indicating a dangerously rapid deceleration. Since it is common for an auto to be driven for years without an accident, it is also necessary that the "G" loading required to operate the valve member not change as a result of aging of the components thereof. The valve member should always respond to a force of a given magnitude and duration whether the unit has recently been manufactured or has been sitting unused in an auto for a considerable number of years.

Sliding seals such as those disclosed in the aforementioned application exhibit a frictional force which tends to vary with the pressure within the container. Therefore, temperature changes and gas leakage would tend to effect the frictional forces in the unit. The frictional resistance of these seals also varies if the mechanical squeeze on the seal is effected by dimensioned changes such as those found within normal tolerance ranges. The effect of aging upon the resilience of the seal material is another factor which could alter the frictional resistance exhibited by the seals. It is apparent that any significant changes in the frictional resistance acting upon the inertia sensitive valve member results in a change in the magnitude and/or duration of the force required to operate the unit.

SUMMARY

Accordingly, it is an object of this invention to provide apparatus for supplying pressurized gas including an inertia actuated valve from which frictional forces affecting the operation thereof are substantially eliminated. This object is accomplished by providing such apparatus which includes a container having an outlet opening and a second opening aligned therewith, a valve member for sealing both openings, the valve member having a first end portion abutting and in sealing relationship with an inwardly facing annular surface at the outlet and having a second end portion abutting and in sealing relationship with an outwardly facing annular surface at the second opening.

DESCRIPTION OF THE DRAWING

A preferred embodiment of the invention has been chosen for purposes of illustration and description, and is shown in the accompanying drawing, forming a part of the specification, wherein:

The single FIGURE of the drawing is a longitudinal sectional view of apparatus according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing, there is shown apparatus for supplying fluid medium under pressure which includes a container **10** and an inertia actuated valve member **11** within the container.

The container **10** is generally cylindrical and is provided with a neck **12** at one end defining an outlet opening **14** and an open-ended tubular extension **15** at the other end. The tubular extension **15** is in alignment with the outlet opening **14** and provides a second opening in the container **10**. At the outlet opening **14**, a flange **16** extends radially inwardly from the neck **12** providing an annular surface **17** facing the interior of the container. At the second opening, a ring member **19** is positioned within the tubular extension and provides an annular surface **20** facing away from the interior of the container. The container **10** is mounted within a vehicle with the tubular extension pointing in the direction of travel of the vehicle.

The valve member **11** includes a first end portion comprising a piston member **21** dimensioned to engage the flange **16**, a second end portion comprising a piston member **22** slidably positioned within the tubular extension **15** and dimensioned to engage the ring member **19**, and a rod **24** connecting the piston members.

The piston member **21** is provided with a surface **25** for abutting the inwardly facing annular surface **17** of the flange **16**. An O-ring **26** recessed into the surface **25** provides a face-type seal for sealing the piston member **21** to the flange **16** to close the outlet opening.

The piston member **22** is provided with a surface **27** facing the interior of the container for abutting the annular surface **20** of the ring member **19**, an O-ring **29** is recessed into the surface **27** to provide a face-type seal for sealing the piston member **22** to the ring member **19** to close the second opening. The outer diameter of the piston member **22** is dimensioned to closely approximate the inner diameter of the tubular extension **15** to minimize fluid flow through the second opening when the valve member **11** is moved into the open position.

The ring member **19** is sealed to the tubular extension **15** by means of an O-ring **30** recessed in the outer periphery of the member **19**. A flange **31** is provided at the inner end of the extension **15** and a spring washer **32** is positioned between the flange **31** and the member **19** to ensure that the surface seal O-rings **26** and **29** are simultaneously in sealing relationship with their respective mating surfaces **17** and **20**.

The piston member **22** carries a pressure gauge or transducer **34** and a fill valve **35**, each connected to the interior of the container by suitable passageways.

The piston **21** has an effective area which is larger than the effective area of the piston **22** to produce a force normally holding the valve member **11** in the closed position shown in the drawing. The piston **22** is made to have a mass, which together with the mass of the piston **21** and the connecting rod **24**, is sufficient to move the valve member into an open position in response to a dangerously rapid deceleration of the vehicle.

For use in the protection of vehicle passengers, the container **10** would normally be mounted in front of a passenger

with the tubular extension pointing in the direction of travel of the vehicle. An inflatable bag would be attached to the neck **12** to be deployed toward the passenger upon inflation. The unit is pressurized through the fill valve **35** and the pressure acting on the piston **21** presses the seals **26** and **29** against the surfaces **17** and **20**. The ring member **19** moves against the spring washer **32** to compensate for any difference between the distance separating the surfaces **17** and **20** and distance separating the surfaces **21** and **27**.

When the velocity of the container **10** is decreased at a dangerous rate, the inertia of the valve member **11** overcomes the differential pressure acting on the piston **21** and the valve member moves to the left (as viewed in the drawing). The surface **25** moves away from the surface **17** to unseal the outlet, and, at the same time, the surface **27** moves away from the surface **20**. The seals **26** and **29** present no frictional forces to retard the movement of the valve member **11**.

After the initial movement of the valve member **11**, the pressure within the container acts on the pistons **21** and **22** to rapidly drive the valve member to a full open position. The contents of the container is rapidly discharged through the opening **14** with only a negligible amount escaping around the piston **22** through the second opening.

It will be seen from the foregoing that the present invention provides apparatus for supplying pressurized gas including an inertia actuated valve from which frictional forces affecting the operation thereof are substantially eliminated.

We claim:

1. Apparatus for supplying fluid medium under pressure comprising in combination a container of fluid medium under pressure having an outlet opening and a second opening aligned with said outlet opening, means providing a first annular surface at said outlet opening facing the interior of said container, a valve member mounted for movement along the axis of said openings including a first portion for closing said outlet opening having a second annular surface facing said first surface for engaging said first surface to seal said outlet opening, means providing a third annular surface at said second opening facing away from the interior of said container, said valve member including a second portion at said second opening having a fourth annular surface to seal said second opening.

2. Apparatus according to claim **1** wherein a tubular formation is provided at said second opening and said second portion is formed to closely fit within said formation to prevent excess fluid flow past said second portion when said first and second valve member portions are moved away from said first and third surfaces to open said outlet openings.

3. Apparatus according to claim **2** wherein both said first and second valve member portions are provided with piston surfaces in fluid flow communication with the interior of said container.

4. Apparatus according to claim **3** wherein said piston surfaces on said first portion has a larger effective area than said piston surface on said second portion whereby said valve member is pressure biased in the closed position.

5. Apparatus according to claim **2** wherein said means for providing said third annular surface includes an annular member slidably positioned in said tubular formation and means providing a fluid medium seal between said annular member and said formation, said third annular surface being provided on said annular member.

6. Apparatus according to claim **5** including a stop member for limiting movement of said annular member toward the interior of said container and spring means between said stop member and said annular member to bias said third annular surface against said fourth annular surface.

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