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3,138,173

AUTOMATIC PRESSURE AND VACUUM CAP

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2 Sheets-Sheet 1

Fig. 1.

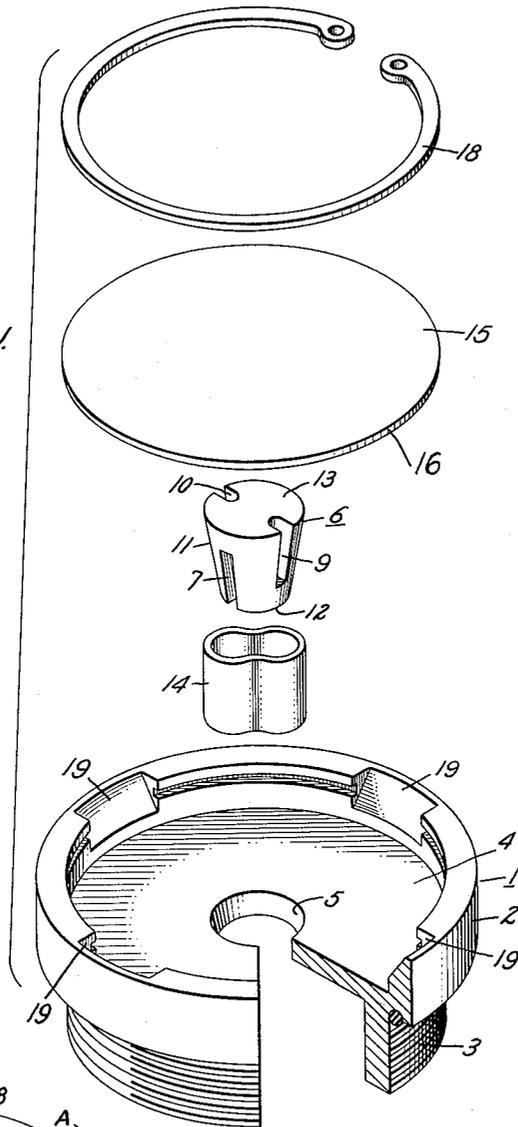
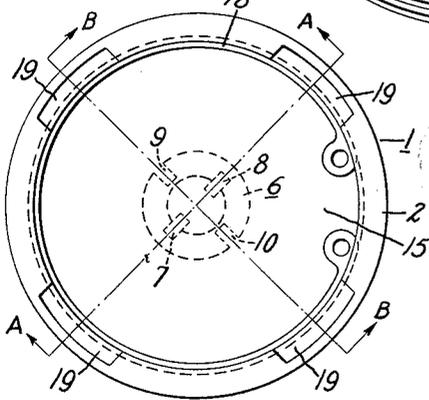


Fig. 2.



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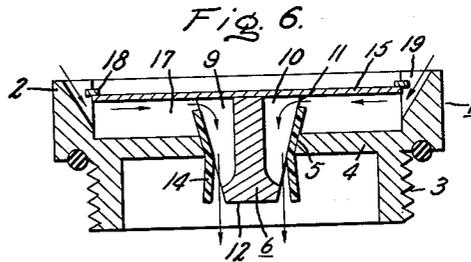
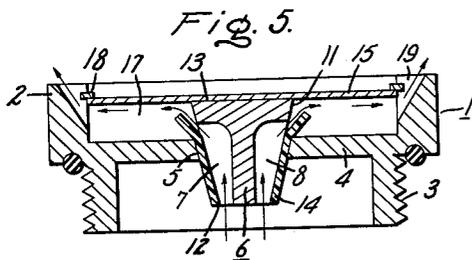
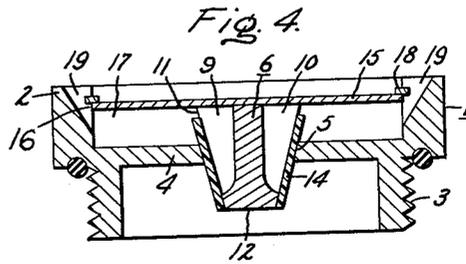
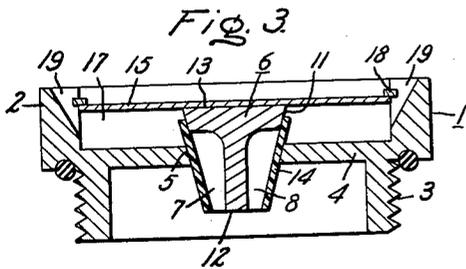
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**AUTOMATIC PRESSURE AND VACUUM CAP**  
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13 Claims. (Cl. 137-493.8)

This invention relates to a cap or closure for a container which permits venting of the container when a predetermined excessive pressure or vacuum exists in the container.

More specifically, the invention relates to a gasoline tank cap adapted to relieve an excessive pressure or vacuum in the tank and which is especially useful on gasoline driven chain saws and other like machines where the gas tank is not always oriented in one position.

Many gasoline tank caps and other various methods for venting gasoline tanks have been devised in the past. In general, it appears that venting for both vacuum and pressure in the cap itself is the least expensive method for venting.

Venting of gasoline containers under pressure is necessary to prevent evaporation of the gasoline or flooding of the engine and at the same time to insure against a build-up of dangerous pressures through volatilization of the gasoline resulting from high atmospheric temperatures or to turbulence caused by handling of the gasoline container. The present invention also safeguards against the spilling of gasoline when the gas tank is overturned, as it often is in its use with a chain saw. Relief must also be afforded against excessive pressure within the gas tank in case of fire where heat would destroy the effectiveness of the proposed valving.

An object of the invention is to provide a container cap having a two-way vent valve which will admit air to the container to relieve the vacuum as the contents are withdrawn, and means for venting the contained gases when the container, filled with a volatile liquid, is subjected to heat or under any other condition of excessive internal pressure, both of said means being closed normally to seal the container against unwanted leakage or evaporation of the volatile liquid.

A further object of the invention is to provide a gasoline tank cap assembly which is economical to manufacture and effective in its function to vent excessive pressure and vacuum within the gas tank.

A further object of the invention is to provide a two-way valve having only a few parts, which is easy to assemble and to repair, and which will undergo sturdy usage without clogging or malfunctioning.

A further object of the invention is to provide a tapered plug valve adapted to permit a differential in the force necessary to vent predetermined pressures and vacuums in a container.

A further object of the invention is to provide an effective venting means which will not leak when the tank and cap are inverted or in any position.

Other objects of the invention will become apparent from the following description when considered in connection with the accompanying drawings, in which:

FIGURE 1 shows an exploded isometric view of the gasoline tank cap;

FIGURE 2 is a plan view of the cap;

FIGURE 3 is a cross-sectional view taken through line A—A of FIGURE 2 under static and vacuum conditions;

FIGURE 4 is a cross-sectional view taken through line B—B of FIGURE 2 under static and pressure conditions;

FIGURE 5 is a cross-sectional view taken through line A—A of FIGURE 2 under an excessive pressure condition; and

FIGURE 6 is a cross-sectional view taken through line

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B—B of FIGURE 2 under an excessive vacuum condition.

Although a single embodiment is shown in the drawings, it must be appreciated that various changes and modifications can be made without affecting the inventive concepts explained below. Also, although the drawings and specifications will refer to a gasoline tank cap, the invention can be utilized in various other circumstances where a container must be vented to both excessive internal pressure and vacuum.

The specific embodiment in the drawing illustrated shows a cap 1 which preferably is die cast although it can be made by any other method. The cap 1 includes a circular head portion 2 whose lower portion is threaded at 3 to form fastening means by which the cap is attached to the gas tank.

A transverse web portion 4, integral with the circular head portion has a central opening 5 therein which is the only means of access or communication through the web portion.

A tapered valve plug 6 which is placed in opening 5 has pressure release ports 7 and 8 and vacuum release ports 9 and 10 provided in the tapered peripheral face 11 thereof. Release ports 7 and 8 open onto the peripheral face 11 of plug 6 and the inner, lower plug end face 12 while vacuum release ports 9 and 10 open onto the peripheral face 11 of plug 6 and the outer, upper plug end face 13. Thus, when the gas tank cap is in position, the pressure release ports, because of their opening in the inner end face 12, are in continuous contact with the atmosphere within the gas tank while the vacuum release ports 9 and 10, because of their openings in the outer end face 13, are in continuous contact with the atmosphere outside of the gas tank.

Stretched to fit around the tapered peripheral face 11 of plug 6 is an elastomeric tube 14 of a gasoline and oil resistant material. The tube closes off the axially elongated pressure ports 7 and 8 in the tapered peripheral face 11 but does not close off the port openings in the inner plug end face 12. The tube also closes off all but a segment of the axially elongated vacuum ports 9 and 10 in the tapered peripheral face 11 which is located on the outer side of the transverse web portion 4. The vacuum port opening in the outer plug end face 13 also is not closed off by the elastomeric tube.

In order to maintain the tapered plug 6 and the elastomer 14 in sealed relationship with transverse web portion 4 in opening 5, a stamped solid disc 15 is provided to abut the outer plug end face 13 and hold the tapered plug and elastomer in wedged position in the opening. When disc 15 abuts the top of plug 6, the periphery 16 of the disc is in sealing engagement with the head portion 2, thus providing a cavity 17 in the cap. Snap ring 18 holds the disc in place as can be seen in FIGS. 3-6. It will be appreciated that various modifications are possible whereby the disc can be held in place, e.g., the snap ring and stamped disc might easily be replaced by a simple Welsh plug, thereby reducing the total number of components in the cap to four.

FIGURE 2 shows that there are four grooves 19 which constitute paths around the snap ring through which communication is maintained between outside atmosphere and the inside cavity 17 of the cap.

### Operation

The operation of the two-way valve under various conditions can be understood best from FIGURES 3-6. FIGURE 3 shows the relationship of the elastomeric tube 14 and the pressure ports 7 and 8 under static (or normal) and under vacuum conditions. It can be seen that under normal and vacuum conditions, the pressure ports 7 and 8 maintain continuous contact with internal tank atmosphere

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while the elastomer 14 acts as a valve to external atmosphere. Under these conditions, the pressure ports remain closed. When the pressure exceeds a predetermined limit, as may be produced by overheating volatile contents of the tank, the elastomer band is expanded within the cap cavity 17 and venting occurs as indicated in FIGURE 5. The selected pressure level should be one which will vent before excess pressure reaches a level which will produce flooding of a carburetor. These limits are controlled by varying the taper of the plug and also by varying the stiffness of the elastomer.

The vacuum ports 9 and 10 function oppositely to the pressure ports in that they are continuously exposed to external atmosphere and the elastomer 14 provides valving to the tank atmosphere (FIGURES 4 and 6). Under normal and pressure conditions, the elastomer closes off the vacuum ports in the tank as shown in FIGURE 4. Under vacuum conditions or when the internal tank atmosphere pressure exceeds a predetermined negative pressure differential with the external atmosphere, the elastomer is stretched and venting occurs. (See FIGURE 6.) Since fuel is normally withdrawn from such a tank by a diaphragm type fuel pump, the vacuum release capabilities of the cap must be balanced against the pumping ability of the fuel pump or fuel may not be withdrawn from the tank.

The taper on the tapered valve plug serves a dual purpose; first, the taper permits a seal between the valve plug and the gas cap due to its wedging nature, thereby eliminating any critical fits. Also, the taper in extending the elastomer at the larger end, permits a differential in the force necessary to port the pressure and vacuum ends of the plug—the greater the taper, the greater the differential between the forces required to operate the vacuum and the pressure ends of the valve plug.

The effective labyrinth or cavity between the gas tank and external atmosphere with the reservoir within the cap should eliminate completely the occasional spitting that occurs with some present caps as pressure is released.

It is to be understood that the novel valve of this invention does not necessarily equalize the internal atmosphere of the tank with the external atmosphere. The term "normalize" is believed to be more descriptive since the specifications on the actual cap may permit a tolerance zone for both pressure and vacuum. For example, the cap may be required to vent to vacuum over two inches of water and pressures over four inches of water. By adjusting the taper on the cap plug, and by adjusting the diameters of the two plug ends, these limits may be varied. Thus, the "normal" or "static" condition referred to above is a pressure range rather than a specific pressure point.

It should be clear that the invention is not limited to a gasoline tank but can be used to vent any liquid or gaseous container. Moreover, the invention can be used in other circumstances where the so-called external atmosphere is not necessarily the normal atmospheric pressure. The valve can be used to vent or regulate any differential pressure.

Finally, an advantage not mentioned heretofore is that the gasoline tank cap valve means of the present invention is designed to permit movement of the gas tank in all directions and positions without permitting leakage of the gas through any vent holes in the gas tank cap. This, of course, is important and necessary for the intended use of having the gas tank mounted on a gasoline chain saw which is often put down or operated in various positions.

What is claimed is:

1. A pressure and vacuum relief valve comprising cap means having an opening therein, plug means positioned in said opening, means to retain said plug means in said opening, said plug means including a plurality of port means, elastomeric means surrounding said port means whereupon certain of said port means are in continuous

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contact with an internal atmosphere and certain other port means are in continuous contact with an external atmosphere, said elastomeric means and said port means being adapted to act as two-way valve means whereby upon excessive vacuum or excessive pressure in said internal atmosphere, said elastomeric means is actuated to vent said internal atmosphere to the external atmosphere and thus normalize the pressure in the internal atmosphere.

2. A relief valve as recited in claim 1 wherein said plug means comprises a tapered plug and said elastomeric means comprises an elastomeric tube which fits around the tapered side of said plug.

3. A relief valve as recited in claim 1 wherein said plug means comprises a tapered plug, and said port means comprise axially extending grooves in the periphery of said plug, some of which grooves extend through a plug face exposed to the internal atmosphere and other of said grooves extend through a plug face exposed to the external atmosphere.

4. A relief valve as recited in claim 1 wherein said plug retaining means comprises a disc which abuts the outer plug face which is exposed to the external atmosphere and means detachably securing said disc on said cap means.

5. A relief valve as recited in claim 2 wherein said cap means includes a transverse web element rigidly attached thereto in which said opening is provided, said plug retaining means comprising a disc element detachably mounted on said cap means and longitudinally spaced from said transverse element thus forming a cavity in said cap means, said disc element adapted to abut said outer plug face.

6. A relief valve as recited in claim 5 in which openings are provided at the peripheral intersection of said disc element and cap means to permit communication between said cavity and the external atmosphere.

7. A gasoline tank cap assembly comprising a cap means including a transverse element with a single opening therein, a tapered valve plug having a plurality of peripheral port means, an elastomeric means mounted around the peripheral tapered face of said plug, said plug and elastomeric means positioned in said opening and retained therein by a detachable retaining means, said port means being so arranged in said plug at permit certain portions of said elastomeric means to expand away from associated port means to permit communication between internal atmosphere of the tank and an external atmosphere upon a predetermined either excessive pressure of vacuum in said tank.

8. A gasoline tank cap assembly as recited in claim 7 wherein said tapered valve plug is of frusto-conical shape, said plug having an outer plug face, an inner plug face substantially parallel to and spaced from said outer plug face, and a tapered face connecting said inner and outer plug faces.

9. A gasoline tank cap assembly as recited in claim 7 wherein said port means comprise axially extending grooves in said plug, some of which grooves are in continuous contact with an internal atmosphere on the inner side of said transverse element and other grooves of which are in continuous contact with an external atmosphere on the outer side of said transverse element.

10. A gasoline tank cap assembly as recited in claim 7 in which said detachable plug retaining means comprises a transverse retaining member detachably connected to said cap means so as to be in abutment with said plug and longitudinally spaced from said cap transverse element thus forming a cavity between said transverse element and said transverse retaining member, said cavity being in constant communication with the external atmosphere.

11. In a storage receptacle having a closure member, a combined excessive pressure and vacuum relief valve comprising an opening in said closure member, plug means securely mounted in said opening, said plug means

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having pressure release ports and vacuum release ports therein, said pressure ports being in continuous contact with internal receptacle atmosphere, and said vacuum ports being in continuous contact with external atmosphere, and means responsive to predetermined pressure differentials between interior and exterior atmospheres to vent either said pressure ports or said vacuum ports to the atmosphere in which they are not in continuous contact depending on whether an excessive pressure or vacuum exists in said receptacle, said pressure differential responsive means comprising an elastomeric means surrounding said pressure and vacuum ports whereby communication between internal and external atmospheres is prevented under normal conditions but under excessive pressure or vacuum in said receptacle, portions of said elastomeric means are expanded to permit communication between the internal and external atmospheres through certain of said ports.

12. A pressure and relief valve as recited in claim 11 in which said plug means comprises a tapered plug and said elastomeric means comprises an elastomeric tube which fits around the tapered face of said plug.

13. In a storage receptacle having a closure member, a combined excessive pressure and vacuum relief valve

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comprising an opening in said closure member, plug means securely mounted in said opening, said plug means having pressure release ports and vacuum release ports therein, said pressure ports being in continuous contact with internal receptacle atmosphere, and said vacuum ports being in continuous contact with external atmosphere, and means responsive to predetermined pressure differentials between interior and exterior atmospheres to vent either said pressure ports or said vacuum ports to the atmosphere in which they are not in continuous contact depending on whether an excessive pressure or vacuum exists in said receptacle, said pressure release ports comprising axially-extending, peripheral grooves which start at a point spaced from the outer plug face and extend through the inner plug face, and wherein said vacuum release ports comprise axially-extending, peripheral grooves which start at a point spaced from the inner plug face and extend through the outer plug face.

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