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J. R. HOLMES ET AL

2,732,971

RADIATOR CAPS

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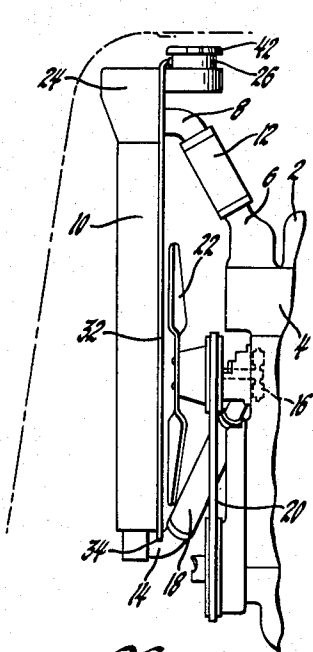


Fig. 1

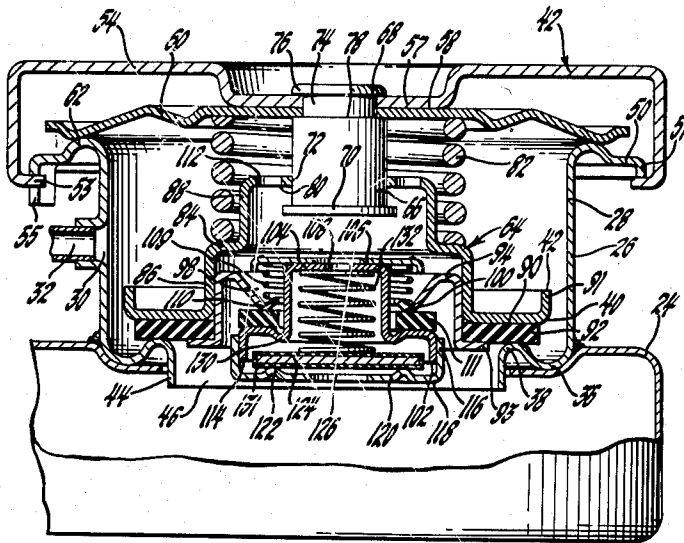


Fig. 2

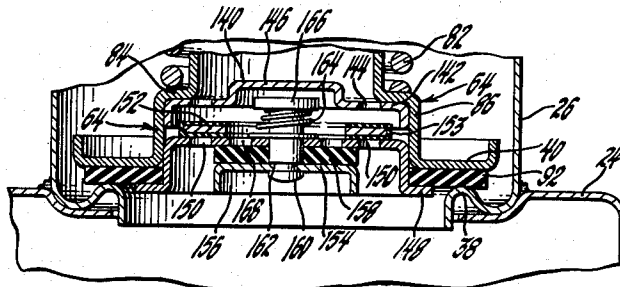


Fig. 4

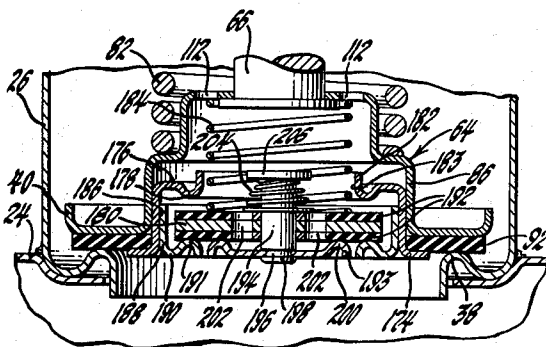
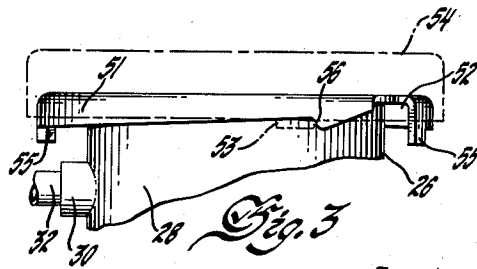


Fig. 5



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2,732,971

RADIATOR CAPS

John Ralph Holmes and Adolf Schwarz, Lockport, N. Y.,
assignors to General Motors Corporation, Detroit,
Mich., a corporation of Delaware

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12 Claims. (Cl. 220—44)

This invention relates to pressure type caps for liquid cooling systems and more particularly to the pressure type radiator caps employed in the cooling systems for the engines of automotive vehicles.

Pressure caps are employed in the cooling systems of engines, particularly those of the automotive type, for the purpose of raising the boiling temperature of the coolant, it being well known that the temperature at which a liquid boils, increases with each increase in pressure. During operation of motor vehicles, it is desirable to maintain the coolant at certain temperatures and yet prevent undue vaporization thereof and also the continuous escape of such vapors from the system. In order to prevent the occurrence of undue pressures in cooling systems, the radiator caps are provided with pressure relief valves which open when the system pressure reaches a predetermined value. Most of the pressure caps employed heretofore either permit the free escape of vapors from the cooling system during a large portion of the time that the associated engine is in operation, or prevent the escape of such vapors until the pressure therein has reached a relatively high value. In the first instance, a continuous loss of coolant occurs as the result of vaporization. During the winter months when anti-freeze solutions are employed in the cooling systems, by permitting vapors to continue to escape, objectionable odors also, are likely to occur. On the other hand, when no escape is provided for vapors during normal driving, the pressure in the cooling system increases with a consequent increase in the temperature of the coolant which is undesirable especially when driving during mild weather.

One object of the present invention is to provide an improved pressure radiator cap having a plurality of valves for controlling the pressure in an engine cooling system in such a manner as to overcome the above referred to objections.

Another object is to provide a radiator cap having two or more valves provided therein, one of which relieves the pressure in the cooling system when it increases slightly above atmospheric pressure, and the other releases the system pressure when it reaches a higher value.

A further and more specific object is to provide in systems of the stated character, a radiator cap having a plurality of normally closed relief valves one of which opens when the pressure increases to approximately one pound per square inch above atmospheric pressure, another opens when the pressure reaches a higher pressure above atmospheric pressure, and a third opens when the pressure in the cooling system falls below atmospheric pressure.

A still further object is to provide a radiator cap which is simple in construction, economic in manufacture, and efficient and durable in operation.

Other and further objects will become apparent as the description of the invention progresses.

Of the drawings:

Fig. 1 is a fragmentary elevational view showing a

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portion of an engine of a motor vehicle, a radiator for cooling the coolant circulating therein having a pressure cap associated therewith and the connections through which the coolant circulates.

Fig. 2 is an enlarged sectional elevational view taken through a radiator cap showing the arrangement of the various valves provided therein.

Fig. 3 is a fragmentary elevational view of the upper end of the filler spout of the radiator.

Fig. 4 is a fragmentary sectional elevational view of a slightly modified radiator cap construction.

Fig. 5 is a view similar to Fig. 4 showing a still further modification.

Referring to the drawings, the numeral 2 indicates an engine of an automotive vehicle having a jacket thereon for receiving a liquid coolant indicated generally at 4. The outlet connection 6 of jacket 4 is connected to the inlet spout 8 of a cooling radiator 10 by a flexible connection 12. The outlet spout 14 provided at the lower end of radiator 10 is connected to a coolant circulating pump 16 by a flexible connection 18. The pump 16 is driven from the engine crank shaft by a belt and pulley mechanism indicated generally at 20. Belt and pulley mechanism 20 also drives a fan 22 which draws air through the core of radiator 10 in a well known manner. The upper end of radiator 10 has provided thereon the usual inlet header 24 having a filler spout 26 attached thereto. Filler spout 26 comprises an annular member 28 having an atmospheric vent opening 30 provided intermediate its ends to which one end of a vent pipe 32 is operatively connected. The vent pipe 32 is bent downwardly and the discharge end 34 thereof lies near the lower end of radiator 10.

The lower end of spout 28 has provided thereon an inwardly extending flange 36 which is provided with a circular rib 38 forming a valve seat for the main or high pressure valve 40 provided in a pressure cap structure indicated generally at 42. Flange 36 terminates at its inner end in a downwardly extending skirt 44 which defines a circular opening 46 communicating with the interior of header tank 24. Spout 26 may be secured to header tank 24 by welding, soldering or by any other suitable means which will effect a liquid tight seal between the abutting edges thereof.

Spout 26 has provided at its upper edge an outwardly extending flange 50 terminating in a downwardly directed skirt 51. Both flange 50 and skirt 51 are provided with entering slots 52 at oppositely disposed points thereon for a pair of intumed locking fingers 53 provided on the cap portion 54 of pressure cap 42. The slots 52 divide skirt 51 into two portions. The lower edge of each portion of skirt 51 is adapted to be engaged by the associated finger 53 and is in the nature of a stepped cam whereby upon rotation of the cap the camming portions effect an axial movement of the cap assembly 42 on the spout 26. Depending tongues 55 on skirt 51 constitute stops which define the final seated position of fingers 53. The step portion 56 of each skirt portion 51 disposed between the camming sections thereof is located adjacent an entering slot 52, as shown more clearly in Fig. 3. Attaching means for radiator caps of this general type are shown in the patent to J. E. Eshbaugh et al., No. 2,164,450.

The center of cap portion 54 is provided with a depression as shown at 57 having a central aperture therein. Disposed immediately beneath depression 57 and abutting the under-surface 58 thereof is a spring disk or diaphragm 60 which is adapted to engage the upper annular rounded seat 62 provided at the upper end of spout 26. An annular valve unit indicated generally at 64 is disposed beneath and in spaced relation with spring disk 60. The enlarged portion 66 of a stud 68 having a head 70

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provided thereon extends through an opening 72 provided centrally of valve structure 64. The reduced portion 74 of stud 68 extends through apertures provided in disk 60 and cap portion 54 and the upper end thereof is peened over as shown at 76. The peened over portion and the shoulder 78 between the enlarged and reduced portions of stud 68 effectively secure cap portion 54 and disk 60 to the said stud. The head 70 abutting the inner surface 80 of valve structure 64 prevents separation of the latter from the spring disk 60 and cap portion 54. A coil spring 82 extends between spring disk 60 and an annular shoulder 84 provided between the offset enlarged and reduced concentric portions 86 and 88 of valve structure 64. The lower portion 86 of valve structure 64 terminates in an outwardly extending flange 90 having a flexible washer or gasket 92 secured thereto. The outer edge 91 of flange 90 is turned upwardly to add rigidity to the latter. Washer 92 may be held firmly against the undersurface of flange 90 by the annular flange 93 of an annular bracket 94. Bracket 94 is press-fitted or otherwise secured to the internal surface of the enlarged portion 86 of valve structure 64 and the upper portion thereof is provided with a substantially frusto-conical depression centrally thereof as shown at 98. The lower inner end portion of depressed portion 98 is provided with a rounded annular rib 100 which forms a seat for a second valve member 102. Valve member 102 is of substantially cup-shaped construction and the upper relatively flat portion 104 thereof has secured thereto by welding or otherwise a disk-like spring seat 106. Flat portion 104 and disc 106 are provided with aligned openings shown at 108 through which the pressure in the system may be relieved, as hereinafter more fully described. A coil spring 109 extends between the lower surface of disk 106 and the annular substantially V-shaped notch 110 provided at the lower end of member 94. Spring 109 retains valve 102 seated until the pressure of the coolant falls below atmospheric pressure. To effect a tight seal between valve 102 and its seat, a resilient gasket 111 is secured in any suitable manner to said valve. When valve 102 is opened air may flow into the system through vent pipe 32, spout 28, thence through openings 112 provided in the upper end of valve structure 64 and thence between valve seat 100 and valve 102 and into header tank 24. Damage to the flexible fluid connections and other parts due to a temporary partial vacuum in the system is thus prevented.

Valve element 102 has provided at the lower end thereof an annular downwardly extending flange or skirt 114 to the exterior of which is press-fitted or otherwise secured the upwardly extending annular flange 116 of a cup-shaped member 118. The lower flat portion 120 of member 118 is formed with an annular raised rib 122 to provide a lower seat for a third valve element 124 and also has provided centrally thereof a pressure relief opening 126. An annular rib 130 is also formed interiorly of valve element 102 which provides an upper seat for valve element 124. To effect a tight seal between valve element 124 and seats 122 and 130 a covering of resilient material indicated at 131 is provided on said valve element. A coil spring 132 extends between the upper surface of valve element 124 and the under surface of the relatively flat portion 104 of valve 102. Spring 132 is so tensioned as to retain valve 124 upon its lower seat 122 until the pressure of the coolant in the system increases to a value slightly above atmospheric pressure, as for example one pound per square inch above atmospheric pressure, at which time valve 124 will raise slightly thereby permitting the pressure in the system to be relieved and any vapors therein to escape around said valve and to discharge from the system through openings 108 and 112, vent 30, and vent pipe 32. When the pressure in the system increases above the predetermined value determined by spring 109, valve 124 is urged upwardly into engagement with its upper

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seat 130 thereby again sealing the system against pressure leakage. As long as the pressure remains at this or a higher value, valve 124 remains seated. When the pressure in the system reaches a higher predetermined value, as for example, 5 pounds per square inch above atmospheric pressure for which spring 82 may be designed, valve structure 40 will move upwardly against the pressure of said spring away from its seat 38. The system is now connected to vent 30 and the pressure therein is consequently relieved.

Fig. 4 discloses a somewhat modified construction which also comprises a main high pressure valve 40 which seats against an annular rib 38 provided at the lower end of the spout 26 attached to the header tank 24. Valve 40 is held in seated position by a coil spring 82. In this construction the enlarged vertical annular portion 86 of valve structure 64 has tightly fitted or otherwise secured therein and against the annular shoulder 84, an inverted cup-shaped member 140. The upper surface 142 of member 140 is provided with a series of pressure relief openings 144. The lower end of annular concentric portion 86 of valve structure 64 has tightly fitted or otherwise secured therein a second inverted cup-shaped member 148 also having a series of pressure relief openings 150 provided therein. A valve element 152 normally rests upon the upper surface of member 148 and covers the openings 150, the weight thereof in this instance being sufficient to retain it in this position until the pressure in the system exceeds approximately one pound per square inch above atmospheric pressure at which time valve element 152 will be raised to uncover openings 150 thereby connecting the system to the atmospheric vent. In order to prevent leakage around valve element 152 when the latter is in seated position a cover of resilient material indicated at 153 is provided on said valve element. When the pressure in the system exceeds approximately one pound per square inch above atmospheric pressure, valve element 152 will move upwardly to cover the valve openings 144 provided in member 140 thereby sealing the system against pressure leakage. The valve, accordingly, will now remain in this position until the higher predetermined pressure for which the system is designed to operate occurs, at which time valve structure 64 will be moved upwardly against spring 82 causing valve 40 to move away from its seat 38, thereby relieving pressure in the system as previously described.

A third valve 154 is provided for connecting the system to atmosphere when the pressure therein reaches a subnormal value. Valve 154 comprises a cup-shaped member 156 having a flat resilient washer or gasket 158 secured to the upper surface thereof. A stud 160 extends through an aperture provided in member 148 and through apertures provided in valve element 154 and gasket 158 and the lower end thereof is peened over as shown at 162 to secure the parts in position. A coil spring 164 extending between the head 166 of stud 160 and the upper surface of member 148 retains valve element 154 in seated position. Normally valve 154 covers a series of openings 168 provided in valve member 148.

However, in the event that the pressure in the cooling system should fall below atmospheric pressure, a partial vacuum occurs therein causing valve 154 to be actuated downwardly against spring 164, thereby uncovering openings 168 and connecting the system to atmosphere.

Fig. 5 shows a further and somewhat simplified embodiment of the present invention which also includes a main valve structure 64 having a valve 40 at the lower end thereof which seats upon a valve seat 38 provided in the filler spout 26 in the manner previously described in connection with the structures shown in Figs. 2 and 4. In this structure a substantially cylindrical member 174 is tightly fitted or otherwise secured in the enlarged concentric portion 86 of valve structure 64. An in-

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wardly extending flange 176 is provided at the upper end of member 174 having an annular depression 178 formed therein which constitutes the upper valve seat for a second valve element 180. The depressed portion 178 terminates in a vertical skirt 182 defining an enlarged central opening 183 through which a coil spring 184 extends. Coil spring 184 extends between the upper end of valve structure 64 and the upper surface of valve element 180. Press fitted into the annular wall 186 of member 174 or otherwise secured thereto is a cylindrical member 188 having an inwardly extending annular flange 190 at the lower end thereof. An annular rib 191 is provided in flange 190 forming a second valve seat for valve element 180. To insure a tight seal between valve element 180 and its seats 178 and 191 resilient gaskets 192 are secured to the upper and lower surfaces thereof. During normal operations, spring 184 urges valve 180 against its lowest seat 191, the said valve remaining in this position until the pressure in the system exceeds approximately one pound per square inch above atmospheric pressure. When this pressure is exceeded valve 180 moves upwardly to relieve the pressure in the system. Should the system pressure exceed the pressure of spring 184, valve element 180 moves upwardly against its upper seat 178 thereby sealing the system against pressure leakage. Valve element 180 will remain in this position until the pressure falls below that of spring 184 when the latter returns it to its lower seat 191. When the system pressure reaches the highest pressure for which the system is designed, valve 40 moves away from its seat 38 against spring 82 to relieve the pressure therein, as in the constructions shown in Figs. 2 and 4. Mounted on valve element 180 is a third valve element 193. A stud 194 extends through an opening provided centrally of valve element 180 and the reduced portion 196 thereof extends through a central opening provided in valve element 193 and the lower end thereof is then peened over as shown at 198. The valve element 193 has provided near the periphery thereof an annular rib 200 which engages the under surface of valve element 180. A series of openings 202 are provided in valve element 180 which lie within the confines of annular rib 200 and are thereby normally sealed by the latter against system pressure. A relatively weak coil spring 204 extends between the head 206 of stud 194 and the upper surface of valve element 180 and normally urges valve element 193 upwardly against the said valve element 180 thereby preventing pressure leakage through openings 202. In the event that the pressure in the system should fall below atmospheric pressure, the partial vacuum created will cause valve element 193 to move downwardly against the action of spring element 204, thereby connecting the system to atmosphere through openings 202 and 112 and vent 30. The pressure in the system now substantially equals atmospheric pressure and accordingly collapsing of any of the connections of the system is prevented.

From the foregoing description it is seen that novel and highly efficient pressure caps have been provided which effectively control the pressure conditions in the cooling system under all conditions of operation. During normal conditions the vapors are prevented from escaping from the system thereby not only preventing the loss of fluid but also preventing the occurrence of objectionable odors in the event that certain volatile anti-freeze solutions are employed. The improved valve caps also enable relief of pressure in the system when it reaches a predetermined maximum value for which the system is designed. A third valve in the system prevents collapsing of any of the connections or parts in the event that the pressure therein should fall below atmospheric pressure, due for example to the rapid condensing of the vapors therein.

While but three embodiments of the invention have been shown and described herein, it is apparent the in-

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vention is subject to further modification and change without departing from the spirit thereof. It therefore is to be understood that it is not intended to limit the invention to the embodiments disclosed herein, but only by the scope of the claims which follow.

What is claimed is:

1. A radiator pressure cap, comprising, a cap retaining member, a valve structure, means connecting said valve structure to said retaining member for limited relative movement with respect thereto, said valve structure comprising a supporting housing having normally ineffective pressure escape openings therein, valve means provided at one end of said housing, a coil spring disposed between said retaining member and said housing for resiliently urging said housing and said valve means away from said retaining member, an inverted cup-shaped member having one or more openings therein secured within said supporting housing, a second inverted cup-shaped member having one or more openings therein secured within said supporting housing, and a valve element adapted for movement between said first and second inverted cup-shaped members to close and open the said openings in the latter.

2. A radiator pressure cap, comprising, a cap retaining member, a valve structure, means connecting said valve structure to said retaining member for limited relative movement with respect thereto, said valve structure comprising a supporting housing having normally ineffective pressure escape openings therein, valve means provided at one end of said housing, a coil spring disposed between said retaining member and said housing for resiliently urging said housing and said valve means away from said retaining member, an inverted cup-shaped member having one or more openings therein secured within said supporting housing, a second inverted cup-shaped member having one or more openings therein secured within said supporting housing, a valve element adapted for movement between said first and second inverted cup-shaped members to close and open the said openings in the latter, said second inverted cup-shaped member having one or more additional openings therein, a valve element mounted on said second inverted cup-shaped member and adapted to close the said last mentioned openings therein, and spring means for normally resiliently holding said last mentioned valve element in closed position.

3. A radiator pressure cap, comprising, a cap retaining member, a valve structure, means connecting said valve structure to said retaining member for limited relative movement with respect thereto, said valve structure comprising a supporting housing having normally ineffective pressure escape openings therein, valve means provided at one end of said housing, a coil spring disposed between said retaining member and said housing for resiliently urging said housing and said valve means away from said retaining member, a cylindrical member secured in said supporting housing, an inwardly extending flange at one end of said cylindrical member forming a valve seat, a valve element adapted to engage said seat, a second cylindrical member secured within said supporting housing, an inwardly extending flange at one end of said second cylindrical member forming a second seat for said valve element disposed in spaced relation with said first seat, and resilient means for retaining said valve element on said last mentioned seat.

4. A radiator pressure cap, comprising, a cap retaining member, a valve structure, means connecting said valve structure to said retaining member for limited relative movement with respect thereto, said valve structure comprising a supporting housing having normally ineffective pressure escape openings therein, valve means provided at one end of said housing, a coil spring disposed between said retaining member and said housing for resiliently urging said housing and said valve means away from said retaining member, a cylindrical member secured in said supporting housing, an inwardly ex-

tending flange at one end of said cylindrical member forming a valve seat, a valve element adapted to engage said seat, a second cylindrical member secured within said supporting housing, an inwardly extending flange at one end of said second cylindrical member forming a second seat for said valve element disposed in spaced relation with said first seat, resilient means for retaining said valve element on said last mentioned seat, a safety valve carried by said valve element, and spring means for normally holding said safety valve in closed position.

5. A radiator pressure cap, comprising, a cap retaining member, a valve structure, means connecting said valve structure to said retaining member for limited relative movement with respect thereto, said valve structure comprising a supporting housing having normally ineffective pressure escape openings therein, valve means provided at one end of said housing, a coil spring disposed between said retaining member and said housing for resiliently urging said housing and said valve means away from said retaining member, an inverted cup-shaped member having one or more openings therein secured within said supporting housing, an annular valve element adapted to close said openings, a second inverted cup-shaped member having one or more openings therein secured within said housing, said valve element normally closing said last mentioned openings, one or more additional openings provided in said last mentioned cup-shaped member, a valve element adapted to close said last mentioned openings, a stud slidably supporting said last mentioned valve element on said second cup-shaped member, and spring means for resiliently retaining said last mentioned valve element against said second cup-shaped member to close the said last mentioned openings therein.

6. A radiator pressure cap, comprising, a cap retaining member, a valve structure, means connecting said valve structure to said retaining member for limited relative movement with respect thereto, said valve structure comprising a supporting housing having normally ineffective pressure escape openings therein, valve means provided at one end of said housing, a coil spring disposed between said retaining member and said housing for resiliently urging said housing and said valve means away from said retaining member, a cylindrical member secured in said supporting housing, an inwardly extending annular flange at one end of said cylindrical member, an annular valve seat formed in said flange, a valve element adapted to engage said seat having one or more pressure relief openings therein, a second cylindrical member secured within said first mentioned cylindrical member, an annular flange extending inwardly of one end of said last mentioned cylindrical member, an annular rib on said flange forming a seat for said last mentioned valve element and disposed in spaced relation with said first mentioned seat, resilient means for resiliently retaining said last mentioned valve on said last mentioned seat, a stud slidably mounted on said last mentioned valve element, a valve element secured to said stud, and resilient means for resiliently retaining said last mentioned valve element against said first mentioned valve element to prevent pressure leakage through the openings in the latter.

7. A pressure cap structure comprising a retaining member, a valve unit extending from said retaining member comprising a dome-shaped valve member having pressure escape openings provided therein, means providing a slidable connection between said valve unit and said retaining member to permit relative movement thereof, a valve element mounted within said dome-shaped valve member, means normally retaining said valve element in seated position, a second valve element mounted in said dome-shaped member, and a pair of spaced seats for said last-mentioned valve element disposed at opposite sides of the latter, said last-mentioned valve element normally engaging one of said seats and being adapted

to engage the other seat when subjected to a predetermined pressure.

8. A pressure cap structure comprising a retaining member adapted for attachment to a spout, a valve unit extending from said retaining member having a dome-shaped valve member adapted to engage a seat in said spout, means providing a slidable connection between said valve unit and said retaining member to permit relative movement thereof, a coil spring extending between said retaining member and said valve member to resiliently urge the latter in seated position when said retaining member is secured on said spout, a valve element mounted within said dome-shaped valve member, means normally retaining said valve element in seated position, a second valve element mounted in said dome-shaped member and a pair of spaced seats for said last-mentioned element disposed at opposite sides of the latter, said last-mentioned valve element normally engaging one of said seats and being adapted to engage the other seat when subjected to a predetermined pressure.

9. A pressure cap structure comprising a retaining member, a valve unit extending from said retaining member comprising a dome-shaped valve member having pressure escape openings provided therein, means providing a slidable connection between said valve unit and said retaining member to permit relative movement thereof, a cylindrical member secured within said dome-shaped valve member having an inwardly extending flange defining an opening and forming a valve seat, a valve structure adapted to engage said seat, said valve structure comprising a housing member having a reduced portion having a pressure escape opening therein adapted to extend through said last-mentioned opening and an enlarged portion, a valve element mounted in said enlarged portion, valve seats disposed in said enlarged portion at opposite sides of said valve, and resilient means for urging said valve element into engagement with one of said seats.

10. A pressure cap structure comprising a retaining member, a valve unit extending from said retaining member comprising a dome-shaped valve member having pressure escape openings provided therein, means providing a slidable connection between said valve unit and said retaining member to permit relative movement thereof, a coil spring disposed between said retaining member and said dome-shaped valve member for resiliently urging the latter in seated position, an annular member secured within said dome-shaped valve member adjacent the end of the latter disposed remote from said slidable connection and having a central opening therein, an annular rib formed on said annular member forming a valve seat, a valve structure adapted to engage said seat comprising a hollow casing member having an upper reduced portion extending through said last-mentioned opening and a lower enlarged portion, said reduced portion having an escape opening provided at the upper end thereof, a spring seat secured to the top of said reduced portion, a coil spring extending between said spring seat and said annular member to resiliently retain said valve structure in seated position, a valve element mounted in said lower enlarged portion, openings provided at the lower end of said enlarged portion, a pair of valve seats disposed in said lower portion at opposite sides of said last-mentioned valve element, and spring means disposed between said last-mentioned valve element and the top of said reduced portion to resiliently urge said last-mentioned valve element in engagement with one of said pair of valve seats.

11. In a liquid cooling system for internal combustion engines, a filler spout for said system having an atmospheric vent provided therein, a valve seat mounted in said spout and a pressure cap structure mounted on said spout, said pressure cap structure comprising a retaining member adapted for attachment to said spout, a valve unit extending into the spout from said retaining member including a dome-shaped valve member adapted to engage said valve seat, means providing a slidable connection

between said valve member and said retaining member to permit relative movement thereof, spring means extending between said retaining member and said valve member to resiliently urge the latter upon said seat when said retaining member is attached to said spout, a low-pressure valve mounted in said dome-shaped valve member near the end thereof remote from said slidable connection for controlling the flow of low-pressure vapors and liquid through said dome-shaped member, a valve seat disposed on either side of said low-pressure valve, said low-pressure valve normally engaging one of said valve seats and being movable into engagement with the other of said valve seats when the system pressure exceeds a predetermined value.

12. In a liquid cooling system for internal combustion engines, a filler spout for said system having an atmospheric vent provided therein, a valve seat mounted in said spout and a pressure cap structure mounted on said spout, said pressure cap structure comprising a retaining member adapted for attachment to said spout, a valve unit extending into the spout from said retaining member including a dome-shaped valve member adapted to engage said valve seat, means providing a slidable connection between said valve member and said retaining member to permit relative movement thereof, spring means extending between said retaining member and said valve

member to resiliently urge the latter upon said seat when said retaining member is attached to said spout, a pressure relief valve mounted in said dome-shaped valve member near the end thereof remote from said slidable connection adapted to open when the system pressure falls below atmospheric pressure to connect said system to atmospheric pressure, a seat for said relief valve, a spring for retaining said last-mentioned valve in seated position, a low-pressure valve carried by said relief valve adapted to prevent pressure leakage from said system through said dome-shaped valve member, a valve seat disposed at either side of said low pressure valve, said low pressure valve normally engaging one of said last-mentioned valve seats and being movable into engagement with the other of said last-mentioned valve seats when the system pressure exceeds a predetermined value.

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