Aug. 9, 1966 L. J. HERBON 3,265,048

COOLING SYSTEM

Filed Oct. 14, 1964

2 Sheets-Sheet 1

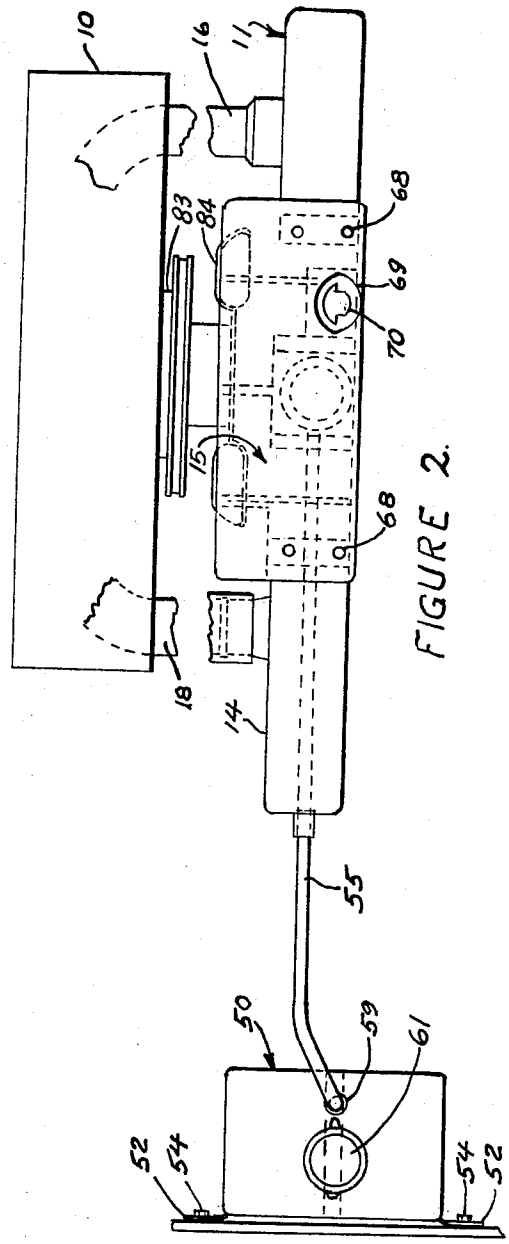

FIGURE 2.

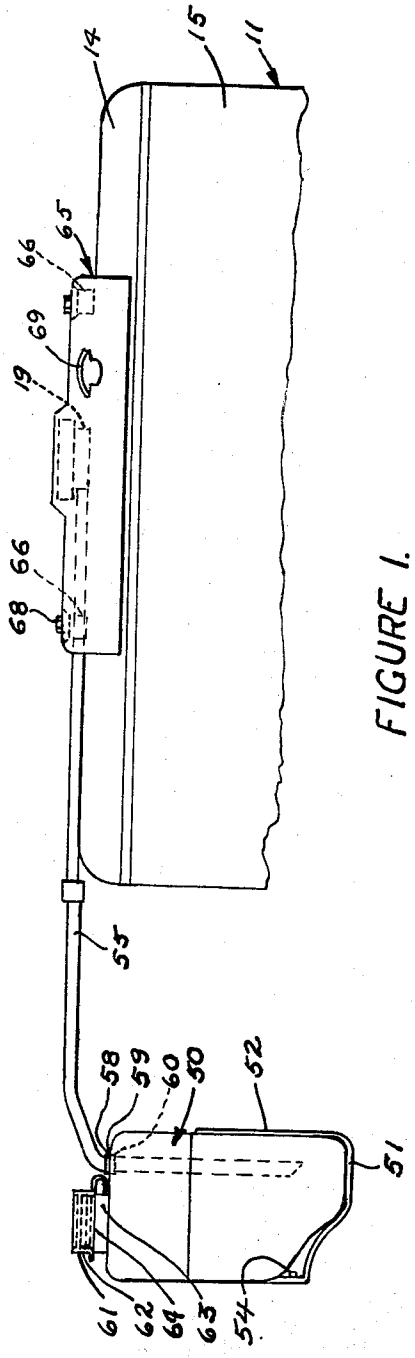

FIGURE 1.

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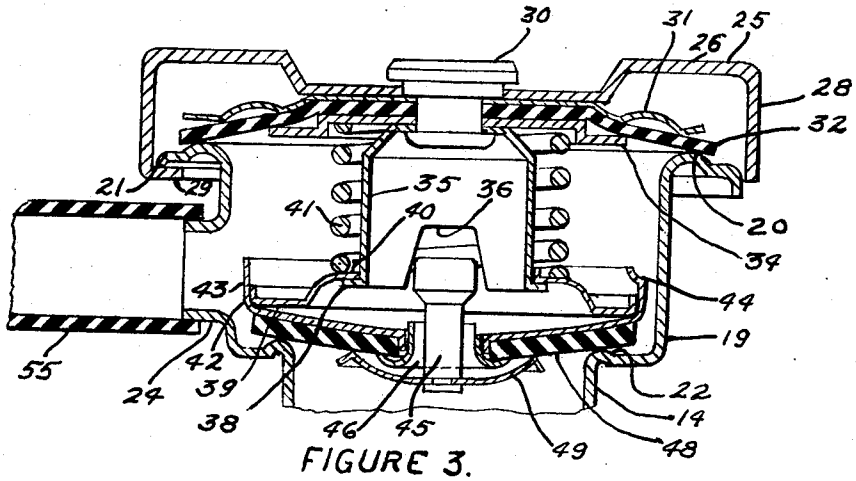

FIGURE 3.

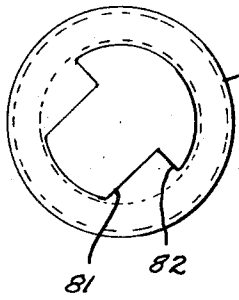

FIGURE 5.

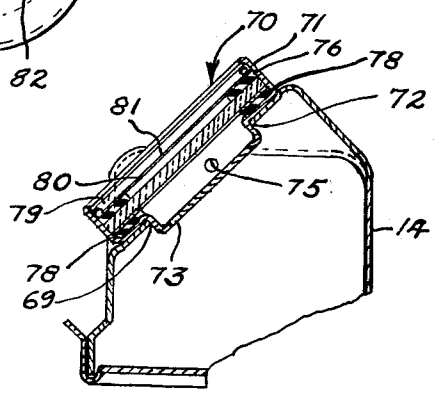

FIGURE 4.

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COOLING SYSTEM

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5 Claims. (Cl. 123—41.14)

The invention relates generally to a cooling system for internal combustion engines and more particularly to an improvement in a sealed type cooling system.

With the development of new engine coolants, the trend in the automotive industry has been to recommend that the coolants be used throughout the year and thereafter for a period of several years instead of being replaced by water each summer. Similarly, lubrication periods have been extended to several years of normal driving thereby further reducing servicing costs.

Obviously, if a portion of the coolant is lost during auto operation and has to be replaced, the advantage of reduced service is dissipated. Consequently, a sealer is often added to the system upon assembly of the auto to aid in sealing off minor leaks. Barring a badly cracked block or head or a leaking head gasket, the sole remaining possibility for exit of the coolant from the system is the standard overflow tube or extension located in the radiator filler neck.

To prevent permanent loss of coolant past the pressure relief valve in the radiator cap and out the overflow tube, inventors heretofore have provided auxiliary reservoirs. Returning the coolant to the system proper from the reservoir, however, has required such procedures as installing a line between the engine driven coolant pump and the reservoir and pumping the coolant back into the system. A suitable check valve is provided in this line to prevent exit of coolant when the system is pressurized. Further, a float valve is required to prevent the pump from drawing air into the system should the liquid in the reservoir become exhausted.

Applicant has devised a far simpler sealed cooling system which requires an auxiliary reservoir to receive the coolant overflow via an overflow line or conduit as in the past. For return to the system proper of the coolant, which contracts as it and the engine cools, applicant, however, utilizes the resulting vacuum which is normally relieved in a conventional system by air from the atmosphere moving through the overflow extension or the cap and past a vacuum relief valve located in the cap. Consequently, the radiator cap of this invention, in addition to containing a system pressure relief valve and vacuum valve, must also maintain a vacuum seal in conjunction with the associated filler neck. The coolant, therefore, in response to the vacuum, flows by way of the overflow conduit from the reservoir, aided by the atmospheric pressure therein, back into the system radiator through the overflow extension and through the open vacuum relief valve. Obviously for effective operation the system must initially be purged of air. Should a leak develop in the reservoir causing a loss of coolant therein, atmospheric air would eliminate the vacuum in the system by moving through the overflow conduit in place of the coolant.

Due to the essentially automatic operation of the system, a bracket is utilized to prevent removal of the radiator cap except when necessary to change the coolant in the system. A sight glass permits a visual check of the supply of coolant in the radiator.

In addition to preventing coolant loss, applicant's system has the further advantage of allowing virtual elimination, if desired, of the standard expansion top tank located above the tube section of the radiator as the reservoir could also handle this function. Thus, there would

be a lowered silhouette in addition to a reduction in cost as the reservoir could be made of a material such as polypropylene and mounted against the wheel well away from the heat of the engine.

It is, therefore, a primary object of this invention to provide a new and improved sealed cooling system for an internal combustion engine.

Another object of this invention is to provide a sealed cooling system for an internal combustion engine that not only prevents loss of overflow coolant but also automatically returns same for further use in the system.

Another object of this invention is to substantially eliminate the need for an expansion tank in the radiator of an internal combustion engine cooling system.

Another object of this invention is to provide a cooling system radiator for an internal combustion engine that can be produced at a substantially lower cost.

Other objects and advantages will become apparent from the following description in conjunction with the attached drawings in which:

FIGURE 1 is a front view of the cooling system;

FIGURE 2 is a top view of the system shown in FIGURE 1 and showing a portion of an internal combustion engine associated therewith;

FIGURE 3 is a vertical section along line 3—3 of a typical radiator cap that is located in position on the radiator filler neck;

FIGURE 4 is a vertical section along line 4—4 through the radiator sight glass of the cooling system;

FIGURE 5 is a view along line 5—5 of the radiator sight glass.

In FIGURES 1 and 2, I have shown by way of illustration a preferred embodiment of the cooling system of this invention. A coolant jacketed automobile engine is designated 10. A conventional radiator 11 is provided for use with the engine. Radiator 11 has a bottom tank (not shown) and an expansion top tank 14 with a core 15 inbetween. Hose 16 connects the bottom tank to the jacket of engine 10 as does hose 18 attached to top tank 14.

An engine driven pump 83 is utilized to move liquid coolant in the usual manner from the bottom tank and force same through the coolant jacket of the engine 10 and back to the top tank 14 of radiator 11. An engine driven fan 84 is also utilized to aid in the circulation of air through the radiator core 15 to cool the coolant passing therethrough.

Radiator 11 has a conventional filler neck 19, as best shown in FIGURE 3, which is located at the upper end of top tank 14. Filler neck 19 has an upper lip or seat 20 and a lower skirt portion 21. Pressure valve seat 22 is located in neck 19 below lip 20. An overflow extension 24 is provided in neck 19 between seat 22 and lip 20.

Removable radiator cap 25 which closes off neck 19 is typical of the closure devices required for operation of the sealed cooling system of this invention. Cap 25 has a body 26 with a downturned peripheral flange 28 which carries the usual fingers 29 that are engageable with the skirt portion 21 of neck 19 and by camming action tightly seats cap 25 on lip 20 of neck 19.

Affixed to body 26 of cap 25 by central rivet 30 is diaphragm 31, top gasket 32, annular plate 34 and bell 35. Bell 35 has one or more notches 36 opening through its lower edge which has an outturned flange 38. Collar 39 having upturned flange 40 is closely sleeved on bell 35. Spring 41 urges collar 39 downward from plate 34. Flange 38 serves as a stop to prevent collar 39 from moving off bell 35 in a downward direction. Member 41 is loosely mounted on collar 39. Member 42 has an upturned flange 43 which is crimped at points 44 thus also

serving as a stop to prevent movement of member 42 off collar 39 in a downward direction. Stem 45 having an enlarged head is loosely mounted in hollow rivet 46. Rivet 46 holds lower gasket 48 to member 42. Stem 45 has attached to its lower end vacuum valve 49.

As mentioned previously, cap 25 is tightened on lip 20 of neck 19 by the interaction of finger 29 and skirt portion 21. This action also has the effect of partially compresing spring 41 which in turn urges collar 39, member 42 and lower gasket 48 downward until gasket 48 is firmly seated on valve seat 22. Spring 41 also urges in the opposite direction annular plate 34 against top gasket 32 compressing same in conjunction with diaphragm 31 and body 26, so gasket 32 tightly seals rivet 30 where it projects therethrough. Diaphragm 31 holds flexible top gasket 32 tightly against lip 20 of neck 19.

Except for the top gasket 32 of cap 25 which effectively prevents air from the atmosphere from entering neck 19 either around lip 20 or around rivet 30 where it extends through gasket 32, in response to a vacuum therein, the cap and balance of the cooling system proper is conventional. Applicant, however (as best shown in FIGURES 1 and 2), has combined with these components, an auxiliary reservoir 50 made of polypropylene which is mounted in a wheel well away from the heat of the engine by means of bottom strap 51 and top strap 52 which are attached to the auto body by cap screws 54. A conduit 55 is connected to overflow extension 24. Conduit 55 extends from extension 24 to reservoir 50 and extends therein through an opening 58 in the reservoir top. Conduit 55 preferably extends to virtually the bottom of the reservoir and is at all times below the surface of the coolant located therein. Conduit 55 has shoulders 59 and 60 which maintain the conduit in position in the flexible reservoir top. Cover 61 comprises an integral sleeve 62 that fits over flanged entrance 63 located in the top of reservoir 50 and a closure 64 that covers the flanged entrance. The flanged entrance 63 holds the flexible cover 61 in position but does not form therewith an airtight connection.

Inasmuch as the reservoir prevents the loss of coolant out the overflow vent, frequent servicing of the system is not required. Consequently, applicant has provided a bracket 65 mounted on the radiator and covering cap 25 to prevent admittance thereto. Bracket 65 is fastened to radiator bosses 66 by cap screws 68. Aperture 69 is provided in bracket 65 for the projection therethrough of a sight glass assembly 70. Sight glass assembly 70 as shown best in FIGURES 4 and 5 is positioned in radiator 11 to give a visual check on the amount of coolant in the radiator.

The assembly 70 consists of a brass case 71, a portion of which extends into a passage 72 in the top of radiator 11. The case is attached around its edges as by soldering to make same integral with radiator 11. Case 71 has a lower hole 73 in its bottom which allows coolant from the radiator 11 to enter the case. For exit of the coolant to the radiator, there is an upper hole 75. Preventing the coolant from leaving the case 71 outward of the radiator 11 are upper gasket 76 and lower gasket 78 located on opposite sides of sight glass 79. Retainer ring 79 in contact with washer 80 compresses the gaskets thus sealing the glass around its external periphery in the top of case 71. Washer 80 has an internal arrow shaped central opening 81 which provides a recommended coolant level for indicating the proper amount of coolant in the radiator when the engine 10 is not in operation. The interior bottom of case 71 is painted a suitable light color to aid in distinguishing the coolant level in the case when looking through the glass past the interior contour 81 of the washer. Recommended coolant level is at what might be denominated the base 82 of the head of the arrow. At this level the radiator is virtually filled with coolant.

The cooling system as detailed thus far operates in the manner described below. Initially the system is filled with coolant in the conventional manner through the filler neck 19 while the system is cool and with the engine 10 idling to allow exit of entrapped air. With the level of coolant at the level 82 recommended on the sight glass, assembly 70, further addition of coolant is terminated, the engine 10 stopped and radiator cap 25 is tightened onto filler neck 19. In the process, spring 41 is partially compressed and indirectly urges gasket 48 firmly on valve seat 22. To unseat gasket 48 and further compress spring 41 requires approximately 15 pounds per square inch. Thus spring actuated gasket 48 acts as a pressure relief valve for the system which normally operates at a pressure of 13 p.s.i.

Coolant is then poured into auxiliary reservoir 50 until it covers the end of conduit 55 extending therein and an additional amount necessary to fill the length of the conduit 55 and the filler neck above valve seat 22 is also added. For the coolant to enter this area, the air must be removed therefrom. This is accomplished by starting up engine 10. During fast engine idle the coolant is heated and expands. It moves through vacuum valve 49, which is normally open around stem 45 located in rivet 46 and up into neck 19 above seat 22. Some coolant moves through notches 36 and out conduit 55 but since the coolant is expanding more rapidly than the flow out conduit 55, a portion of the coolant moves to the top of cap until restrained by the top gasket 32 and then drives the air therein toward and through conduit 55 into reservoir 50. The air escapes as bubbles from below the coolant level in reservoir 50 to the coolant surface which is open to the atmosphere. Upon stopping the engine, the coolant cools and contracts in radiator 11 creating a vacuum. Coolant in reservoir 50, aided by the atmospheric pressure therein, flows from the reservoir through conduit 55 back into radiator 11 through vacuum valve 49, which remained open during this period, thus relieving the vacuum and basically filling the radiator. Coolant also remains in the conduit 55 and the cap above the seat 22 rather than return to reservoir 50 because to do so would leave a vacuum, all air having been exhausted therefrom and prevented from entering same due to the special cap construction previously alluded to.

When engine 10 is started and again after the purging of the air from the system, the coolant is heated during engine operation as before and expands through open vacuum valve 49 and moves the coolant in neck 19 above seat 22 and the coolant in conduit 55 into reservoir 50. At approximately 212° boiling of the coolant momentarily occurs which creates a temporary surge of pressure of about 1 p.s.i., which causes vacuum valve 49 to close. Further heating of the coolant causes expansion, which in the confined area of the radiator 11, raises the pressure therein and increases the boiling point approximately 3° for every pound of pressure. During normal operation the system operates at 13 p.s.i., which is below the pressure exerted by the spring 50 and consequently no coolant moves out the overflow vent 24 past the seated gasket 48. On stopping the engine 10, the engine cools and the coolant contracts creating a vacuum in the radiator 11 and opening vacuum valve 49 allowing movement of the coolant back into the radiator from reservoir 50.

In the event enough pressure is developed in the system proper to exceed the strength of spring 41 which is set for about 15 p.s.i., the coolant will move past lower gasket 48 and out vent 24 through conduit 55 until the pressure in the system drops below the force exerted by the spring and gasket 48 is again seated. Due to absence of air in conduit 55, coolant will remain therein and in the top of neck 19 above the seat 22 ready to be drawn back into radiator 11 when the engine is stopped and the coolant cools and contracts creating a vacuum in the radiator 11 and opening again vacuum valve 49.

In which case the coolant will again be brought back into the radiator **11** for use therein. Should a leak develop in reservoir **50** and the end of conduit **55** be open to the atmosphere, air will relieve the vacuum resulting in the cooling system as in the past preventing the collapse of hoses and other difficulties.

From the above description, it can be seen that applicant has developed a cooling system which prevents the loss of coolant therefrom and by virtue of a radiator cap which maintains any vacuum developed in the system, to utilize same to return the overflow coolant from the auxiliary reservoir for further use in the system. It is also clearly apparent that if desired, the top tank could be drastically reduced and the reservoir enlarged to handle this function.

Having thus described the invention, it will be apparent to those skilled in the art that various modifications and changes can be made therein without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. A cooling system for an internal combustion engine comprising:

(a) an internal combustion engine having a coolant jacket;

(b) a hollow radiator having an inlet and an exit connected to said jacket for circulation of a liquid coolant between said radiator and jacket, said radiator also having a filler neck, said filler neck being located at an elevation above said inlet and exit, said filler neck having an internal valve seat therein, said filler neck having an overflow extension located above said valve seat;

(c) a radiator cap closing said filler neck above said overflow extension, said radiator cap having a pressure relief valve contacting said valve seat and controlling movement of coolant from said radiator between said valve and said seat, said pressure relief valve having a vacuum relief valve therein that is in open position at substantially atmospheric pressure and sub-atmospheric pressures;

(d) a pump for circulating a liquid coolant through said jacket and said radiator;

(e) an auxiliary reservoir vented to the atmosphere and also having an opening through which extends said overflow extension, said extension being located below and remaining below the coolant surface in said reservoir, whereby as said engine heats said coolant, the excess coolant of thermal expansion moves through said open vacuum valve into said neck forcing any coolant or air in said neck out through said extension into said reservoir until said vacuum relief valve closes and said system becomes pressurized and as said engine and said coolant cools and said coolant contracts, the resulting vacuum in said radiator opens said vacuum relief valve and draws therethrough said excess coolant and any coolant that has moved between said pressure relief valve and said seat from said reservoir and through said extension, neck and into said radiator for further use in said cooling system.

2. A cooling system for an internal combustion engine comprising:

(a) an internal combustion engine having a coolant jacket;

(b) a hollow radiator having an inlet and an exit connected to said jacket for circulation of a liquid coolant between said radiator and jacket, said radiator also having a filler neck, said filler neck being located at an elevation above said inlet and exit, said filler neck having an internal valve seat therein, said filler neck having an overflow extension located above said valve seat;

(c) a radiator cap closing said filler neck above said overflow extension and providing a vacuum seal

therewith, said radiator cap having a pressure relief valve contacting said seat and controlling movement of coolant from said radiator between said valve and said seat, said pressure relief valve having a vacuum relief valve therein that is in open position at substantially atmospheric and sub-atmospheric pressures;

(d) a pump for circulating a liquid coolant through said jacket and said radiator;

(e) a tubular member having one end connected to said overflow extension and the other end located remote from said engine;

(f) an auxiliary reservoir vented to the atmosphere and also having an opening through which extends said other end of said tubular member, said other end being located below and remaining below the coolant surface in said reservoir, whereby as said engine heats said coolant the excess coolant of thermal expansion moves through said open vacuum relief valve into said neck and through said overflow extension and tubular member into said reservoir until said vacuum relief valve closes and said system becomes pressurized, and as said engine and said coolant cools and said coolant contracts, the resulting vacuum in said radiator opens said vacuum relief valve and draws therethrough said excess coolant and any coolant that has moved between said pressure relief valve and seat from said reservoir through said tubular member, extension, neck and into said radiator for further use in said cooling system.

3. A cooling system for an internal combustion engine comprising:

(a) an internal combustion engine having a coolant jacket;

(b) a hollow radiator positioned remote from said engine, said radiator having an inlet and exit, said radiator also having a filler neck, said filler neck being located at an elevation above said inlet and exit, said filler neck having an internal valve seat therein, said filler neck having an overflow extension located above said valve seat;

(c) means for connecting said radiator inlet and exit to said engine jacket for circulation of a liquid coolant therebetween;

(d) a radiator cap closing said filler neck above said overflow extension and providing a vacuum seal therewith, said radiator cap having a pressure relief valve contacting said seat and controlling movement of coolant from said radiator between said valve and seat, said pressure valve having a vacuum relief valve therein that is in open position at substantially atmospheric and sub-atmospheric pressures;

(e) a pump for circulating a liquid coolant through said jacket and said radiator;

(f) a tubular member having one end connected to said overflow extension and the other end located remote from said engine;

(g) an auxiliary reservoir vented to the atmosphere and also having an opening through which extends said other end of said tubular member, said other end being located below and remaining below the coolant surface in said reservoir, whereby as said engine heats said coolant, the excess coolant of thermal expansion moves through said open vacuum relief valve into said neck and through said overflow extension and tubular member into said reservoir until said vacuum relief closes and said system becomes pressurized, and as said engine and said coolant cools and said coolant contracts, the resulting vacuum in said radiator opens said vacuum relief valve and draws therethrough said excess coolant and any coolant that has moved between

said pressure valve and seat from said reservior through said tubular member, extension, neck and into said radiator for further use in said cooling system.

4. The cooling system of claim 3 further comprising: a bracket covering said radiator and fixedly mounted on said radiator.

5. The cooling system of claim 4 further comprising: visual means for observing the level of coolant in said radiator.

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