COOLING SYSTEM

Filed Feb. 16, 1955 3 Sheets-Sheet 1

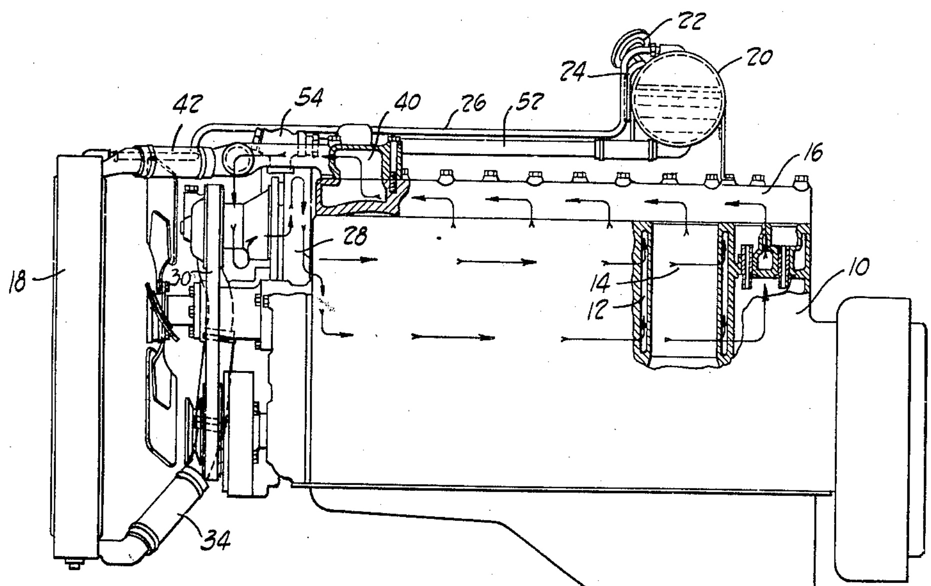

FIG. 1

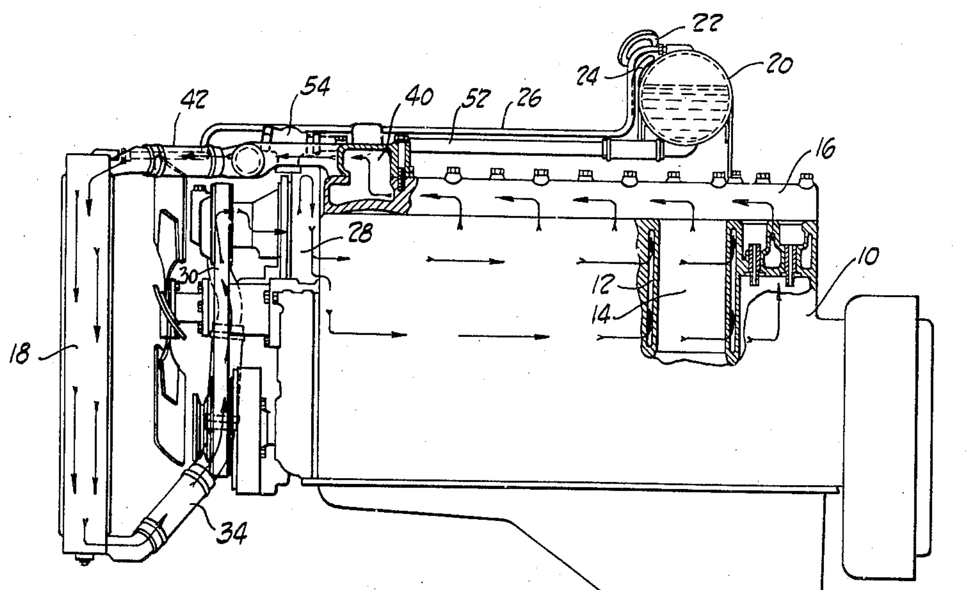

FIG. 2

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COOLING SYSTEM

Filed Feb. 16, 1955 3 Sheets-Sheet 2

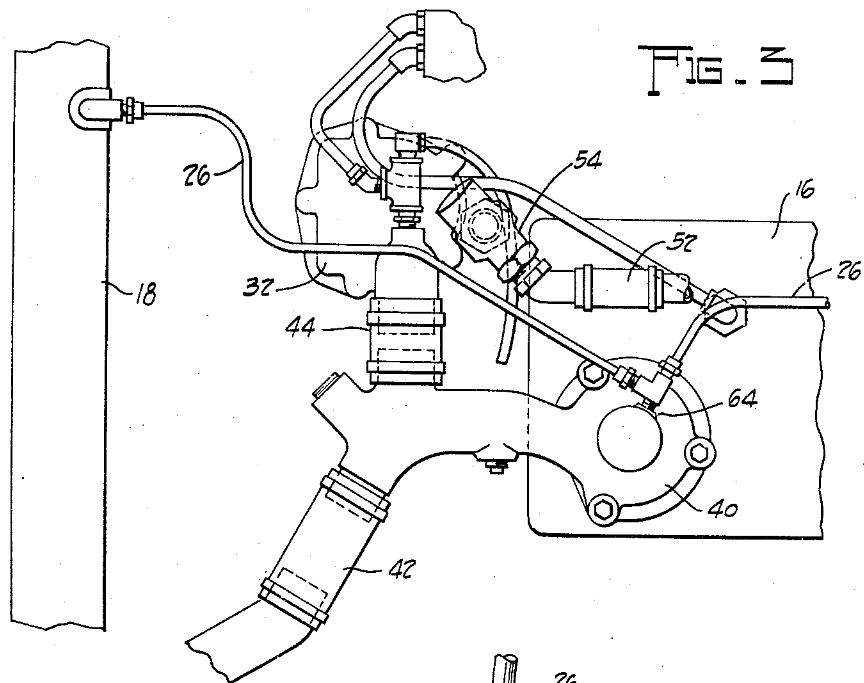

FIG. 3

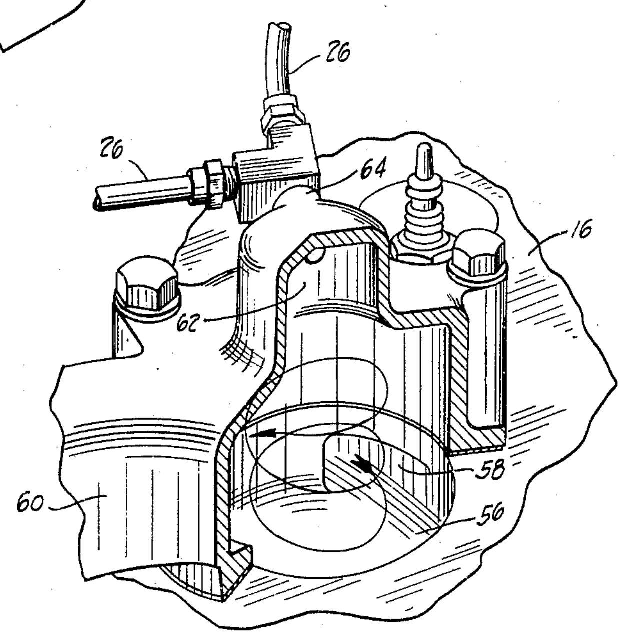

FIG. 4

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3 Sheets-Sheet 3

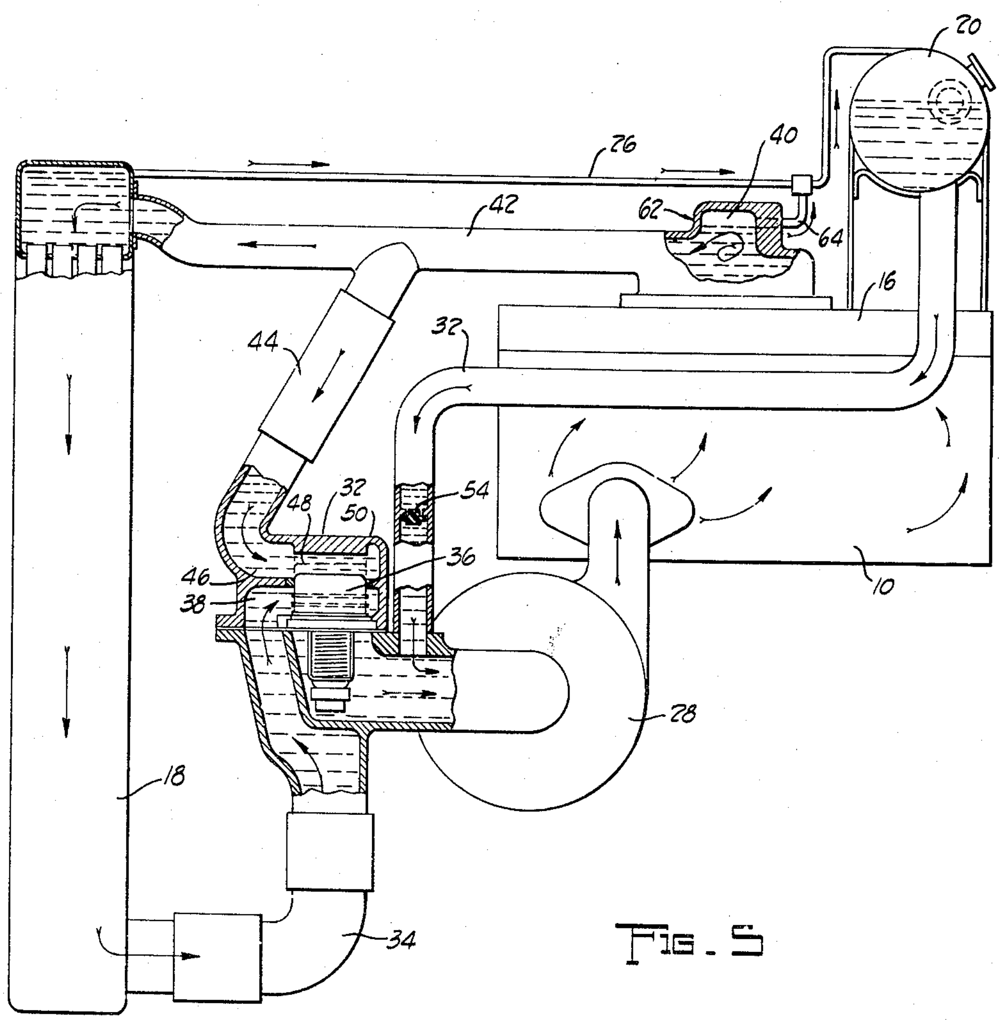

FIG. 5

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1

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COOLING SYSTEM

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This invention relates to engine cooling systems and more particularly to a "closed" or pressure type cooling system.

One of the primary objects of this invention is to provide a cooling system which is simple in design and operation and which reduces the most frequent causes of trouble in truck circulating systems.

A long-standing problem in the operation of a truck over the road is trouble in the engine cooling system resulting from the presence of dirt, scale and lime deposits. These accumulations are introduced into the cooling system by frequent refilling with water which is sometimes chemically harmful and oftentimes dirty. These effects may be minimized by reducing the need for frequent refilling which reduces accordingly the amount of fluids entering the cooling system. By providing a pressure system having certain components, the need for frequent refilling is eliminated, thus reducing the over-all maintenance needed for the cooling system. The features which are included in my novel cooling system, the preferred embodiment which is disclosed herein, are effective to accomplish this result and yet simple in structure and maintenance.

A check valve is provided in the connection from the surge tank to the water pump inlet which serves to prevent reverse flow from the engine to the surge tank when large volume vapor pockets would otherwise form. However, the check valve does not restrict additional coolant from entering the circulation stream as needed. An air separator mounted at the engine outlet serves as a collecting point for the elimination of air and vapor bubbles which would otherwise tend to travel through the cooling system. These two units functioning together enable the system to operate continuously on solid water, thereby eliminating cavitation and flashing at the pump and maintaining a more uniform temperature in the engine under the most adverse conditions.

One condition of operation which leads to a problem in maintaining the coolant in the system occurs when the vehicle is operated continually under heavy load conditions and then stopped immediately. A large amount of heat is built up in the engine and the stopping thereof does not give the cooling system an adequate time to dissipate such heat. In previously used cooling systems, the coolant would be vaporized in the engine and a sudden increase in volume would force the coolant to overflow and it would be lost. The provision of the check valve preventing reverse flow to the surge tank results in a positive head pressure being maintained on the engine and prevents the flow of large quantities of coolant into the surge tank and out of the overflow.

Accordingly, it is an important object of this invention to provide a cooling system for an internal combustion engine in which the components function to maintain a constant supply of solid coolant in all parts of the system.

Another important object of this invention is to provide a cooling system for an internal combustion engine having means for removing the air bubbles and vapor from the coolant as it is discharged from the engine.

A still further important object of this invention is to provide a non-return valve between the discharge of the engine cooling jacket and the top tank of the system.

2

Another object of the invention is to provide a cooling system for an internal combustion engine which is vented to the top tank of the cooling system in such a manner that all parts of the system will be filled with coolant at all times.

Other objects and advantages more or less ancillary to the foregoing, and the manner in which all the various objects are realized, will appear in the following description, which considered in connection with the accompanying drawings, sets forth the preferred embodiment of the invention.

In the drawings:

Fig. 1 is a side view of an engine and cooling system embodying my invention in which the circulation of the coolant is shown with the thermostat closed.

Fig. 2 is a view similar to Fig. 1 in which the circulation is shown with the thermostat open.

Fig. 3 is a fragmentary top view showing in detail the components of the cooling system.

Fig. 4 is a fragmentary perspective view of the air separator with parts cut away for purposes of clarity; and

Fig. 5 is a schematic view showing the cooling system circuits.

Referring first to Fig. 1, the preferred embodiment of my invention is shown in connection with an internal combustion engine designated by the numeral **10**. The engine **10** includes the usual cooling water passages **12** surrounding the cylinders **14** and connected with similar passages around the combustion chamber in the cylinder head **16**. The radiator **18** of the fin and tube type is provided for cooling the water which is discharged from the engine in the heated condition.

A surge tank **20** is mounted on the engine head **16** above the level of the radiator **18** and provides an expansion chamber for accommodating the variation in volume of the cooling water as it is heated and cooled. A fill pipe and cap **22** is provided on the tank **20** for adding water to the system. The cap **22** is of the type which seals the system until a pressure of about 3½ to 4½ pounds per square inch gage pressure is reached at which time the valve in the cap opens to relieve the pressure to the overflow **24**. A vent line **26** connects the top of the radiator **18** with the top of tank **20** to provide a passage for the air in the radiator to escape to the tank **20** when the system is being filled.

A water pump **28** is mounted on the engine and driven by a belt **30** in the usual manner for inducing flow in the coolant circulation system. The inlet of the pump **28** is connected to a thermostat housing **32** as shown diagrammatically in Fig. 5. The outlet of the pump **28** discharges directly into the engine cooling jackets, water being forced to all parts of the engine by the operation of the pump **28**.

The cooled water from radiator **18** is conducted to the thermostat housing **32** through a flexible hose and pipe connection **34**. A thermostatic valve **36** shown in full line in Fig. 5 closes a passage **38** to the flow of water when the temperature thereof is below a predetermined point. This condition occurs during the warm-up period of engine operation. An air separator **40** is mounted on the head **16** and receives the heated water being discharged from the engine. A line **42** connects the separator **40** with the top of the radiator **18** for conducting the heated water into the radiator when the thermostatic valve **36** has opened to the passage **38**. A by-pass **44** conducts the cooling water to passage **46** in the thermostatic housing **32**. When the thermostatic valve **36** is in the full line position, the cooling water may flow through to the pump inlet and into the engine without restriction. As the water in the system becomes heated, the thermostatic valve first moves to the dotted line position **48** at which condition a portion of the water flows through the radiator 18 and the remainder of the cooling water flows through the by-pass 44 to the pump 28. In the dotted line position 50 of the valve 36 the passage 46 would be completely closed and all of the flow of the cooling water would be through the radiator 18, the connection 34, the passage 38, to the pump 28.

A line 52 interconnects the bottom of the surge tank 20 to the inlet of the pump 28 for supplying additional water as required to maintain a constant supply to the pump 28. The hydraulic head pressure on the pump inlet is constant, it being the difference of the elevation of the pump inlet and the water level in the surge tank 20.

A check valve 54 is located in the line 52 and disposed to prevent flow away from the pump inlet which effectively prevents large quantities of coolant from being discharged into the surge tank 20 as a result of flashing in the cooling system.

The air separator is shown in detail in Fig. 4. An annular chamber 56 is formed in the head 16 and a tangential opening 58 is formed in the wall of chamber 56 to induce high velocity rotational flow in the chamber 56 as the coolant enters into the chamber 56 from the cooling passages in the engine. A tangential discharge 60 conducts the water from the separator 40 to the line 42. A dome 62 forms a pocket for receiving air which tends to be forced out at the end of the vortex of the rotational flow pattern. A vent connection 64 is made to the vent line 26 from the upper part of the dome 62 to allow the air or vapor bubbles collected therein to flow into the top of the surge tank 20. Since the cooling water is at the highest temperature at this time the air bubbles in the water are the largest and most easily separated. Further, the vapor bubbles are removed from the main stream of the cooling water, thus assuring solid water in the circulation system external of the engine.

When the engine is started in a cool condition, the pump 28 immediately begins circulating the coolant through the engine. Since the thermostatic valve 36 is closed, all of the cooling water will be recirculated without benefit of cooling by the radiator 18. When the temperature of the water has reached the predetermined temperature of approximately 175° F. the thermostatic valve 36 begins to open and divides the flow between the by-pass 44 and the radiator 18. A continued rise in temperature operates the thermostatic valve 36 to increase the flow of cooling water through the radiator 18. When the temperature of approximately 195° F. has been reached the thermostatic valve closes the by-pass 44 and all of the coolant passes through the radiator 18. It is noted that due to the continuous circulation, the air separator 40 is functioning to remove the air and vapor bubbles from the coolant as it is discharged from the engine.

When the vehicle is operated under adverse conditions for a considerable length of time and parked immediately, the overheated portions of the engine continue to heat the cooling water with the result that the temperature rises since there is no circulation through the radiator 18 being provided. As a result the water in the cooling jacket of the engine may be vaporized which tends to displace large volumes of coolant out of the engine 10. At this condition, the check vavle 54 prevents reverse flow of the cooling water through the line 52 to the surge tank 20 which would occur in the absence of the check valve 54. The check valve 54 further assures the presence of water at the inlet of the pump 28 thus preventing vapor locking and failure of the pump to discharge adequate quantities of cooling water as required for cooling the engine.

Although the foregoing description is necessarily of a detailed character, in order that the invention may be completely set forth, it is to be understood that the specific terminology is not intended to be restrictive or confining, and that various rearrangements of parts and modifications of detail may be resorted to without departing from the scope or spirit of the invention as herein claimed.

I claim:

1. A cooling system for an internal combustion engine comprising a radiator, pump means for circulating coolant through the engine and the radiator, a conduit connected to the top of said radiator, air separator means on said engine connected with said conduit, a tank above said air separator and connected thereto, conduit means connecting said tank to the inlet of the pump means, and a one way valve for preventing flow from said pump inlet to the tank.

2. A cooling system for an internal combustion engine comprising a pump, a radiator, surge tank and conduit means interconnecting said engine, pump, surge tank and said radiator to form a circuit, an air separator disposed in the conduit means between the discharge of the engine and the top of the radiator, said air separator being vented to the top of the surge tank, and one way valve means in the conduit means interconnecting the surge tank with the pump for limiting flow toward the pump.

3. A cooling system for an internal combustion engine comprising a pump, a radiator, surge tank and conduit means interconnecting said engine, pump, surge tank and said radiator to form a circuit, an air separator disposed in the conduit means between the discharge of the engine and the top of the radiator, a vent connection between the air separator, the top of the radiator and the top of the surge tank, and one way valve means in the conduit interconnecting the surge tank with the pump for limiting flow toward the pump.

4. A cooling system for an internal combustion engine comprising a pump, a radiator, surge tank and conduit means interconnecting said engine, pump, surge tank, and said radiator to form a circuit, an air separator disposed in the conduit means between the discharge of the engine and the top of the radiator, a vent connection between the air separator, the top of the radiator and the top of the surge tank, one way valve means in the conduit interconnecting the surge tank with the pump for limiting flow toward the pump, and thermostatic control means for providing circulation for the coolant without passing through the radiator.

5. In a cooling system for an internal combustion engine, a radiator, a pump, and a surge tank above said radiator and said pump, conduit means interconnecting the engine, radiator, surge tank and pump, a conduit between the inlet of the pump and the lower portion of the surge tank, and non-return valve means in the second named conduit for restricting the flow therein in a direction toward said pump inlet.

6. In a cooling system for an internal combustion engine, a radiator, a pump, and a surge tank above said radiator and said pump, conduit means interconnecting the engine, radiator, surge tank and pump, a conduit between the inlet of the pump and the lower portion of the surge tank, and a check valve in the second named conduit for restricting the flow therein in a direction toward said pump inlet.

7. In a cooling system for an internal combustion engine, a radiator, a pump, and a surge tank above said radiator and said pump, conduit means interconnecting the engine, radiator, surge tank and pump, a conduit between the inlet of the pump and the lower portion of the surge tank, non-return valve means in the second named conduit for restricting the flow therein in a direction toward said pump inlet and a vent connection between the top of said radiator and the top of said surge tank.

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