

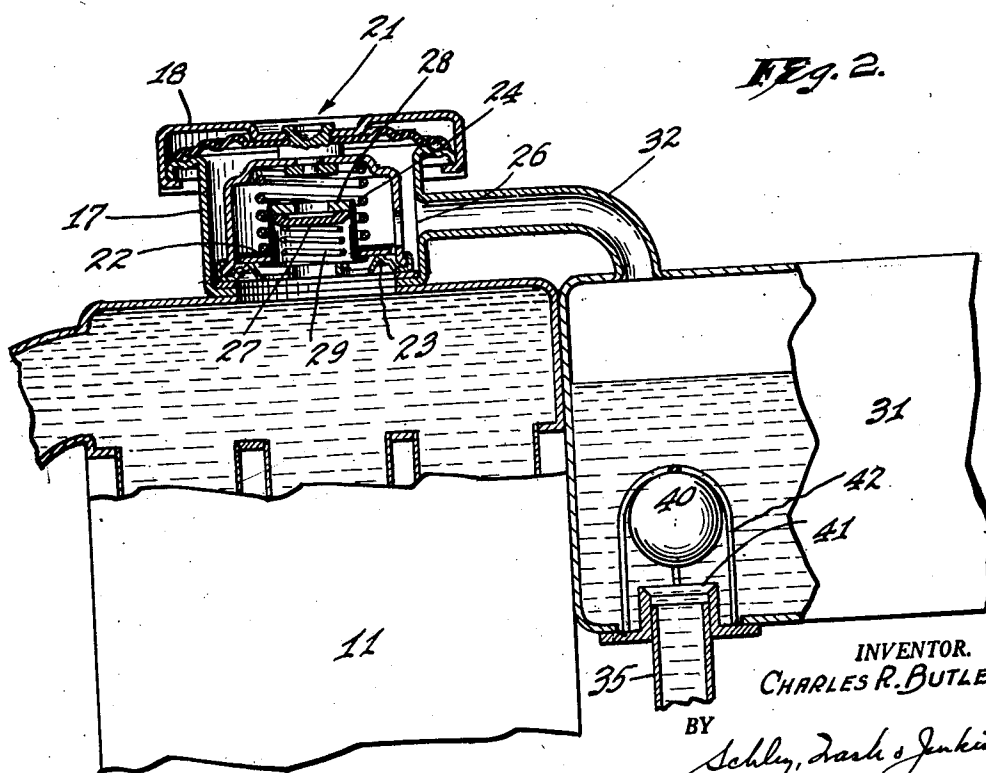
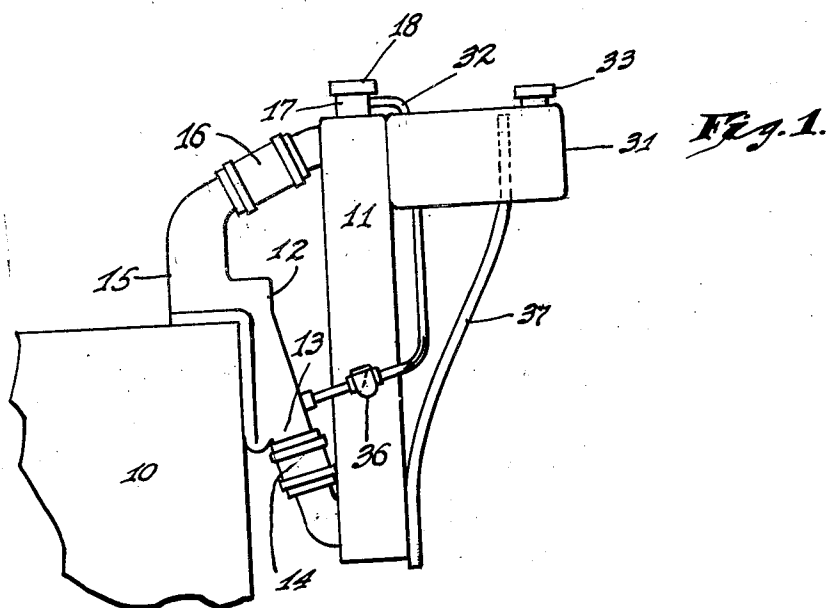
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COOLING SYSTEM FOR INTERNAL COMBUSTION ENGINES

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COOLING SYSTEM FOR INTERNAL COMBUSTION ENGINES

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This invention relates to a cooling system for internal combustion engines and more particularly to that type of cooling system in which means are provided for maintaining the system at a pressure above atmospheric. Such systems commonly embody a pressure-relief valve which prevents the escape of any air, vapor, or liquid from the system until the pressure therein attains a predetermined value. Commonly, the pressure-relief valve is associated with the radiator filler cap and located at the highest point in the system.

When the engine is not operating and the coolant cold, prior systems of the type described contain a pocket of air at the top of the radiator unless, of course, the system has just been filled. Accordingly, when the engine is placed in operation and the temperature of the coolant begins to rise, the air pocket can contract and accommodate a substantial thermal expansion of the liquid coolant before attaining a pressure sufficient to cause opening of the relief valve. If the quantity of gaseous material in the system is sufficient, it is possible that the desired operating pressure—i. e., a pressure just below that necessary to open the relief valve—will never be attained.

It is an object of this invention to produce an engine cooling system of the pressure type in which the desired operating pressure will be attained more quickly, will be maintained more effectively during engine operation, and will persist for a greater length of time after operation of the engine has ceased. Another object of the invention is to reduce the likelihood of pockets of gaseous material within the cooling system.

In carrying out my invention, I associate with the cooling system an auxiliary reservoir which is preferably open to the atmosphere and connected to the cooling system to receive coolant escaping past the pressure-relief valve. The lower portion of such auxiliary reservoir is connected to the inlet of the coolant-circulating pump through a check valve opening toward the pump to prevent return to the reservoir of any liquid once withdrawn therefrom by the pump.

In the accompanying drawing, which illustrates an embodiment of the invention:

Fig. 1 is an elevational view, somewhat diagrammatic in character, illustrating a portion of an engine and associated cooling system; and

Fig. 2 is a fragmental vertical section on an enlarged scale illustrating structural details of the cooling system.

In Fig. 1 I have shown, by way of illustration, a portion of a coolant-jacketed automobile engine 10, a radiator 11, and an engine-driven pump 12 for circulating coolant through the radiator and the jacket of the engine. The inlet 13 of the pump 12 is connected to the lower portion of the radiator 11 through a conduit 14, while the outlet 15 of the coolant jacket is connected to the upper portion of the radiator through a conduit 16. At its upper end, the radiator 11 is provided with a filler neck 17 and a removable closure 18 therefor.

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As shown in Fig. 2, the closure 18 has associated with it a valve mechanism designated in its entirety by the reference numeral 21 and including an outwardly opening valve 22 urged against a seat 23 by a compression spring 24. The cooling system is sealed by the valve 22, which remains seated until the pressure within the system builds up to a predetermined point dependent upon the strength of the spring 24. If that pressure is exceeded, the spring 24 yields and the valve 22 opens to permit escape of fluid through an outlet opening 26 provided in the side of the neck 17 outwardly beyond the valve-seat 23. To prevent a vacuum of too great a value from occurring within the cooling system as a result of a drop in temperature following termination of engine operation, the valve device 21 commonly includes an inwardly opening valve 27 urged outwardly against a valve-seat 28 by a compression spring 29. The opening through the valve seat 28 communicates with the atmosphere, as through the opening 26, so that the valve 27 can open to admit atmospheric air to the cooling system and limit the extent of the vacuum created therein when the temperature of the system drops.

As so far described, the cooling system is of a common type. In practice, the outlet opening 26 communicates with an overflow tube or pipe which extends downwardly to a point near the bottom of the radiator so that liquid expelled from the cooling system past the valve 22 will not escape into the engine compartment. Any material so expelled from the system as a result of a temperature rise therein is lost and is later replaced by air admitted past the valve 27 when the temperature of the system drops following termination of engine operation.

To incorporate my invention in a system of the type described, I provide an auxiliary tank or reservoir 31 which is conveniently located near the top of the radiator 11. The upper portion of such reservoir communicates with the outlet opening 26 in the filler neck 17 as through a conduit 32 and, if desired, may also be provided with a filler cap 33. The lower portion of the reservoir 31 is connected to the inlet 13 of the pump 12 through a conduit 35 in which there is incorporated a check valve 36 opening toward the pump. To accommodate a possible excess of liquid, the auxiliary tank 31 may be provided with an overflow tube or pipe 37 communicating with the reservoir near the top thereof. The tube 37 serves to vent the upper portion of the tank 31 to atmosphere, but additional venting may be provided if desired. For a purpose which will hereinafter become apparent, the connection between the reservoir 31 and the conduit 35 may be controlled by a float valve designed to close should the reservoir 31 become empty. As shown, such a float valve comprises a buoyant sphere adapted upon a drop of liquid level in the reservoir to engage a valve-seat 41 surrounding the outlet into the conduit 35. The valve 40 is held in operative association with the seat 41 as by an appropriate cage 42.

The system illustrated and above described, operates in the following manner: Let it be assumed that the engine 10 is not operating, that the sealed cooling system is substantially at atmospheric pressure and temperature, and that a pocket of air exists at the top of the radiator below the valve 22. When the engine is placed in operation, the pump 12 will reduce the pressure at the inlet 13 and will thereby cause liquid to be drawn from the auxiliary tank 31 past the check valve 36 and into the cooling system proper. By increasing the volume of liquid in the cooling system and thereby reducing the volume of the air pocket, the introduction of liquid from the tank 31 will increase pressure at all points in the system; and liquid will continue to be introduced until the pressure at the pump-inlet 13 becomes so high that no more liquid will be inducted from the tank 31. As the engine warms

up, the coolant will expand and the pressure within the system will rise further. If the pressure rises sufficiently to open the valve 22, some of the air will escape; but if it does not rise to that value, the liquid initially introduced from the tank 31 will still remain in the system, since its return is prevented by the check valve 36. When the engine is next placed in operation, following an interval during which the temperature of the coolant has dropped, more liquid will be introduced from the tank 31; so that even if all the air was not expelled during the first period of engine operation, the continued addition of liquid following each subsequent starting of the engine will eventually insure that the pressure within the cooling system during normal operation of the engine will rise to a value such as to open the valve 22 and eventually cause expulsion of all air from the system. Once the system is completely full of liquid, the amount of new liquid introduced upon starting a cold engine will be inconsequential because of the rapid pressure rise which results in the absence of an air pocket. Any liquid which escapes past the valve 22 once all air is expelled from the system will return to the auxiliary tank through the conduit 32.

It may be noted that in a cooling system incorporating my invention the importance of the vacuum relief valve 27 is considerably reduced; for should the pressure within the system tend to drop below atmospheric upon cooling, the incipient vacuum will be relieved by liquid drawn into the system from the auxiliary tank 31 past the check valve 36.

The function of the float valve 40 is to prevent the pump 12 from drawing air into the system should liquid in the auxiliary tank 31 become exhausted, as by reason of a leak in the cooling system. When that condition occurs, the float 40 settles into engagement with and seals the valve seat 41, thus preventing the pump from drawing air into the system.

In automobile cooling systems, the pressure relief valve 22 may be constructed to open at any desired pressure, usually at a pressure between six and fourteen pounds per square inch. Even if, with the engine operating, the cooling system is under the maximum pressure permitted by such relief valve, the pressure within the system will drop when operation of the engine ceases to a value such that upon the next succeeding operation of the engine the pressure at the pump inlet will be subatmospheric at least for a momentary interval.

By promoting the expulsion of all air from the cooling system, my invention provides several advantages. Upon starting the engine, pressure within the cooling system promptly rises to its normal value, since there is no air cushion to absorb thermal expansion of the liquid. When operation of the engine is terminated, the temperature of

the engine tends to rise while that of the radiator tends to fall. If there were an air pocket in the radiator, its drop in temperature might reduce the pressure of the cooling system to such an extent that the coolant would be vaporized adjacent those regions of the engine, such as around exhaust portions, where cooling is difficult. During operation of the engine, the maintenance of the maximum pressure permitted by the valve 22 greatly lessens the likelihood of vaporization at such difficultly cooled areas and promotes proper cooling of all parts of the engine.

I claim as my invention:

1. In combination with the cooling system of a jacketed internal combustion engine having a coolant-circulating pump for circulating liquid coolant through said system and a pressure-relief valve controlling communication of the cooling system with atmosphere, said pressure-relief valve being located at a point in said cooling system where gases tend to collect, an auxiliary coolant tank for containing a supply of liquid coolant in addition to that circulating in the cooling system, a connection between said auxiliary tank and the inlet of said pump, and a check valve in said connection permitting flow from the tank to the pump but preventing flow in the reverse direction.

2. The combination of claim 1 with the addition that said auxiliary tank is vented to atmosphere.

3. The combination of claim 2 with the addition of means for conducting to said auxiliary tank any liquid expelled from the cooling system past said pressure-relief valve.

4. In combination with an internal combustion engine having a cooling system through which liquid coolant circulates when the engine is operating, a valve operative when closed to seal said cooling system from communication with atmosphere, said valve being located at a point in said cooling system where gases tend to collect and being openable by superatmospheric pressure generated within the system upon an increase in coolant-temperature to permit the expulsion of matter from within the system, and means operative upon a subsequent cooling of the coolant to a temperature below that at which said valve opens for replacing the expelled matter with liquid coolant, whereby alternating increases and decreases in coolant temperature will result in eventual expulsion of all gaseous substance from the system.

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