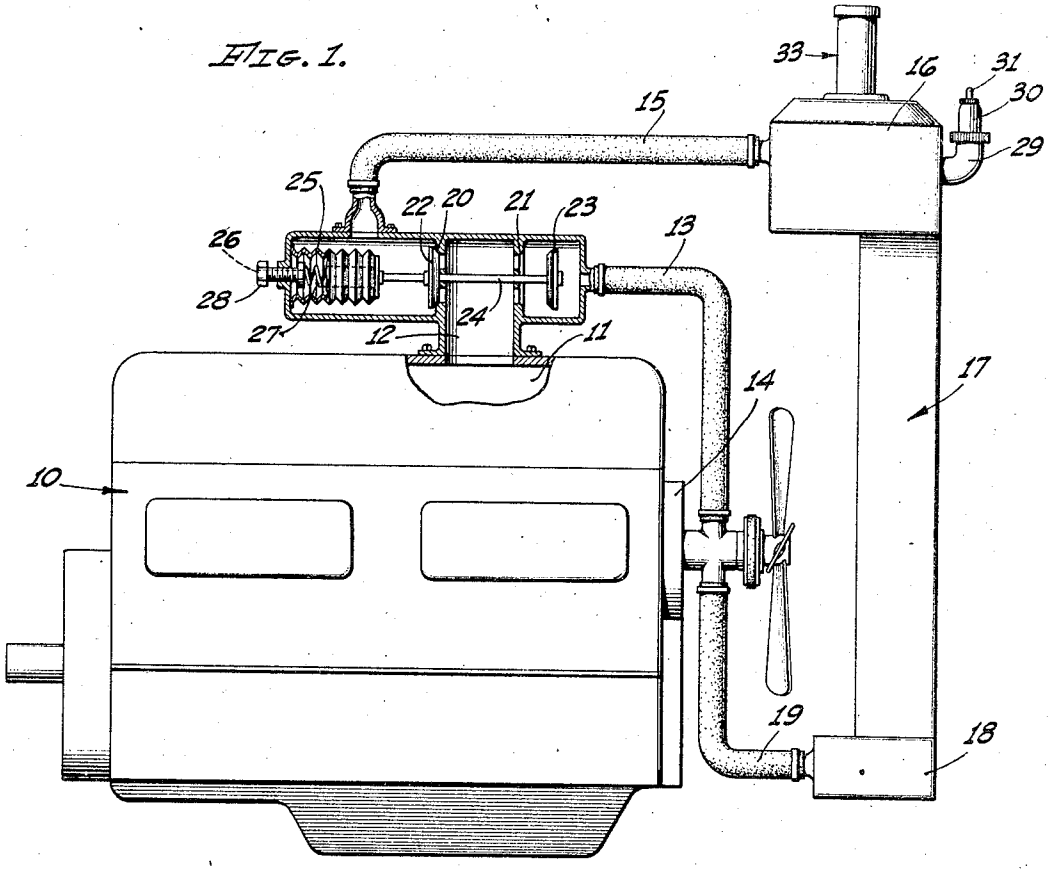
Oct. 26, 1943. J. H. WALLACE 2,332,680

COOLING SYSTEM FOR LIQUID JACKETED ENGINES

Filed June 8, 1942

FIG. 1.



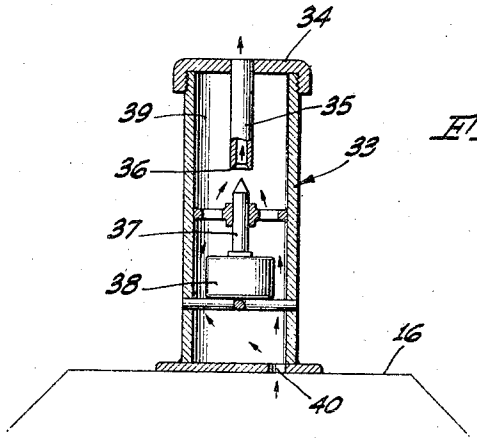


FIG. 2.

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COOLING SYSTEM FOR LIQUID JACKETED ENGINES

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7 Claims. (Cl. 123—174)

This invention relates to a method and apparatus for cooling liquid jacketed engines.

Heretofore, liquid jacketed engines have been cooled by a cooling liquid for which two passages have been provided externally of the liquid jacket, one of which includes a radiator. A thermostat has been employed to control the flow through these passages so that when the engine is relatively cold either all or a substantial part of the cooling fluid is circulated through that external passage which does not include the radiator. Then, as the engine warms up the thermostat serves to open the other passage and cause all or a substantial portion of the flow to take place through the passage that includes the radiator.

In the cooling of internal combustion engines many advantages are derived from having the temperature of the cooling liquid at or above the normal boiling point of the liquid. The use of thermostats in high temperature cooling systems is objectionable for numerous reasons, including the inability of the thermostat to be sufficiently sensitive at temperatures in the neighborhood of the boiling point of the liquid, the lag in the operation of the thermostat, and danger of the thermostat either breaking or getting out of order.

A primary object of the present invention is to provide a cooling system for liquid jacketed engines having two circulatory external passages one of which includes a radiator, and to provide a more sensitive and prompt control of the flow of the cooling liquid through these passages than is afforded by a thermostat. In accordance with the present invention the control mechanism that regulates the flow of cooling liquid through the two circulatory passages is responsive to pressures developed in the system whereby an increase of pressure developed in the system due to the boiling of the liquid brings about an immediate and highly sensitive regulation. In this way, a much more sensitive and prompt regulation is secured than that afforded by thermostat controls.

As a part of the combination, the invention contemplates closing the cooling system during normal operation so as to maintain the system under pressures that may be developed due to the boiling of the liquid and utilizing the developed pressures to regulate the flow through the circulatory passages.

Another object of the invention is to provide a cooling system for liquid jacketed engines having the above-described characteristics, wherein means is provided for allowing air in the cooling system to escape or to be expelled from the system, and after the air has been expelled, to then close the system to retain the pressure developed to operate the control mechanism and to also prevent unnecessary loss of cooling fluid or cooling fluid vapors.

The air that is allowed to escape is that air that is normally present in the top of the radiator or heat exchanger when the engine is cold or prior to its having been started. The term "air" as herein used not only includes this initial air that may be in the system but also non-condensable vapors that may be introduced into the system. These non-condensable vapors are for example carbon monoxide and carbon dioxide that leak into the water jackets from the cylinder such as passed the cylinder head gasket.

The ability of the present system to expel the air and non-condensable vapors and to thereafter seal itself is highly advantageous, particularly in respect to eliminating air pockets in the radiator or condenser as well as in the pump that may be in the system and from the water jackets themselves.

With the foregoing and other objects in view, which will be made manifest in the following detailed description and specifically pointed out in the appended claims, reference is had to the accompanying drawing for an illustrative embodiment of the invention, wherein:

Figure 1 is a view in side elevation of a liquid jacketed internal combustion engine, parts being broken away and shown in vertical section illustrating the system embodying the present invention as having been applied thereto; and

Fig. 2 is a sectional view through a float valve which preferably forms a part of the present system.

Referring to the accompanying drawing wherein similar reference characters designate similar parts throughout, 10 indicates an internal combustion engine having a water jacket 11. The outlet from the liquid or water jacket is generally indicated at 12 which leads to two circulatory passages externally of the engine. One such passage is provided by a pipe 13 of relatively large capacity which leads back to a point near the bottom of the water jacket where there is disposed the conventional circulating pump 14 that is usually a centrifugal pump driven by the engine 10. The other passage comprises a pipe 15 leading from the water jacket outlet 12 to the top tank 16 of a heat exchanger or radiator, generally indicated at 17. The heat exchanger

may also be termed a condenser. The bottom tank of the radiator or condenser is indicated at 18 and a pipe or conduit 19 leads from the bottom tank back to the inlet to the pump. Thus, the lower ends of the two passages meet together at the inlet to the pump. If desired, a suitable mixing chamber may be located at the junction, but this is not essential. The entrances to the two passages meet at the water jacket outlet 12. In this outlet there are provided opposed valve seats 20 and 21 on which there are adapted to seat opposed valves 22 and 23. These valves may be on a common valve stem 24 that is operable by a bellows 25. The bellows 25 is disposed within the entrance to the conduit or pipe 15 so that the outside of the bellows is subjected to the pressure within this circulatory passage. The inside of the bellows is subjected merely to atmospheric pressure through an aperture 26 and within the bellows there is a spring 27 the compression of which may be adjusted by a nut or the equivalent 28. When the engine is cold the spring 27 is effective to shift the valve stem 24 so that valve 22 is closed and valve 23 is fully opened. As pressure is developed within the system this becomes effective on the exterior of the bellows which shifts the stem 24 to open valve 22 and to close valve 23 a corresponding amount.

29 indicates a filling nipple through which cooling liquid can be supplied to the system. The nipple is equipped with a pressure cap 30 which preferably carries a safety valve 31 designed to open whenever pressures in the system become excessive but to retain therein normal pressures.

A float valve chamber 33 is mounted on the top of the radiator and has its top closed as at 34 around a downwardly extending tube 35. This tube provides at its bottom a seat 36 for a needle valve 37 operable by a float 38. 39 indicates an air entrapping space around the tube 35. The bottom of the float valve chamber communicates with the top of the radiator through a small aperture 40. The float valve is preferably located slightly above the level of the top of the radiator with its inlet 40 disposed at the extreme top of the radiator tank, thus permitting any air or non-condensable gas to pass into the valve chamber and permitting the escape of the air or non-condensable gas. This arrangement, while desirable, is not essential and the float valve may be considerably below or above the top tank of the radiator. However, if it is below the tank the escape of any air or non-condensable gases which may enter the system after the engine is in operation cannot be expelled or allowed to escape.

The operation and advantages of the system, as above-described, are as follows: Assuming that the engine is cold and is started in its operation there will normally be a small air space in the upper tank 16 above the level of liquid therein. The valves 22 and 23 are in the position shown. During the initial operation of the engine cooling liquid in the water jacket is circulated through the passage afforded by the conduit 13 entirely, valve 22 being closed. This liquid is returned to the pump 14, forced back into the water jacket, out through the outlet 12, and past the open valve 23. Continued operation quickly brings this small amount of circulated liquid up to the boiling temperature of the liquid.

As steam is generated in the water jacket this increases the volume of fluid in the system with the result that the level of liquid in the upper tank 16 rises, expelling the air in the upper tank past the open needle valve. Finally, some of the liquid is forced through inlet 40 after substantially all of the air has been expelled. This liquid that is forced over into the float valve chamber is effective upon the float 38 to elevate it and cause the needle valve to seat, thus closing the system against any further egress.

Continued operation of the engine then becomes effective to build up a pressure in the system which is effective upon the bellows 25. As the pressure increases the bellows 25 becomes effective to shift the stem 24 and to open valve 22 and close valve 23 a corresponding amount. Thus the second or auxiliary circulatory passage is automatically brought into operation and the primary pasage 13 is either partially or completely closed off. Under normal running conditions a substantial portion, if not all, of the cooling liquid is then circulating through the radiator 17 before being returned through the pump 14 to the water jacket. With this arrangement it will be appreciated that there is no thermal lag after the float operated needle valve has been closed. Small changes in temperature immediately manifest themselves as changes in pressure in the closed system which are instantly transmitted to the bellows and result in immediate regulation. As the air is expelled from the system and the system is then closed, loss of circulation fluid by escaping vapors is effectively prevented. High temperature or vapor phase cooling is readily accomplished without danger of the resultant loss of vapors of the cooling liquid and a breakdown of the system. As the system is operating under pressure, liquid is supplied to the pump at positive pressure so that danger of "flashing" within the pump is eliminated. The pump is primed at all times.

When the engine is shut down there is considerable residual heat in the cylinders of the engine. This residual heat, which must be carried off, is effective to maintain or develop even higher pressures in the system with the result that the valve 22 is held open and cooling continues even after the engine and pump 14 have been shut down on the principle of a thermosiphon. the water circulating from the radiator through the pump, the water jacket, and the auxiliary circulatory passage formed by the conduit 15 which leads to the radiator. Finally, when the engine has been cooled below the boiling point of the liquid by this thermosiphoning action the cooling liquid contracts in the system developing a partial vacuum therein. This vacuum is effective to suck or draw back liquid in the needle valve chamber 33 through the inlet hole 40 with the result that the float chamber is emptied of liquid and the needle valve is opened preparatory to a subsequent starting of the engine.

The inlet 40 is relatively small, being in the neighborhood of ⅛ or possibly $\frac{3}{16}$" with the result that liquid once in the valve chamber tends to remain there. Non-condensable gases that may be introduced into the system, such as those that leak into the water jacket past the cylinder head gasket, may rise, collect in the upper tank of the top of the radiator and pass therefrom into the valve chamber. The valve once closed would normally tend to remain closed by the liquid forced therein and retained therein by the small inlet 40. However, when the non-condensable vapors or gases collect these tend to collect in the valve chamber above the level of liquid therein and as they build up they force some of the liquid in the valve chamber to be ex-

pelled back into the radiator through the inlet 40. When such liquid is expelled the level of liquid in the valve chamber drops allowing the needle valve to open and these non-condensable gases which may be fed into the system slowly but continuously are given an opportunity to escape.

From the above-described construction it will be appreciated that the improved system is highly advantageous in that it uses but a single pump which is primed at all times and which has liquid supplied thereto under positive pressure. The system adequately takes care of residual heat of the engine after the engine has been shut down and eliminates air from the radiator. By the use of a pressure responsive control over the two circulatory passages a prompt regulation is secured which is a decided improvement over thermostat controls wherein there is invariably a lag in the regulation. Although the air is first allowed to be expelled from the system the generation of vapors subsequently does not bring about an escape of these vapors or a consequent loss of cooling liquid.

Various changes may be made in the details of construction without departing from the spirit or scope of the invention as defined by the appended claims.

I claim:

1. In combination with a liquid jacketed engine, means providing a circulatory passage for cooling fluid externally of the jacket, and means for allowing air in said passage to be expelled from said passage and thereafter closing said passage to maintain pressures developed therein.

2. In combination with a liquid jacketed engine, means providing two circulatory passages for cooling fluid externally of the jacket, one of said passages including a radiator, means for mutually varying the rate of flow through said passages, and means for allowing air in the radiator passage to be expelled therefrom and thereafter close the radiator passage to retain the pressures developed therein.

3. In combination with a liquid jacketed engine, means providing two circulatory passages for cooling fluid externally of the jacket, one of said passages including a radiator, means responsive to pressures developed in the radiator passage for opening the radiator passage and correspondingly closing the other passage, and means for opening the radiator passage for the release of air therefrom and thereafter closing the radiator passage to retain pressures developed therein.

4. In combination with a liquid jacketed engine, means providing two passages for circulating cooling fluid externally of the jacket, one of said passages including a radiator, a pump to which both passages lead for returning cooled fluid to the jacket, and means for allowing air to be expelled from the radiator and thereafter closing the radiator passage against the escape of pressure therefrom.

5. In combination with a liquid jacketed engine, means providing two passages for circulating cooling fluid externally of the jacket, one of said passages including a radiator, a pump to which both passages lead for returning cooled fluid to the jacket, means responsive to pressure developed in the jacket for opening the passage that includes the radiator and correspondingly closing the other passage, and means for allowing air to be expelled from the radiator and thereafter closing the radiator passage against the escape of pressure therefrom.

6. In combination with a radiator of a liquid jacketed engine cooling system, means providing an air outlet therefrom, and a float actuated valve in said air outlet arranged to permit air to be expelled therefrom and thereafter closed to retain pressures developed therein.

7. In combination with a radiator of a liquid jacketed engine cooling system, means providing an air outlet therefrom, a float actuated valve in said air outlet arranged to permit air to be expelled therefrom and thereafter to retain pressures developed therein, and means defining an air chamber in the air outlet above said valve within which air may be entrapped.

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