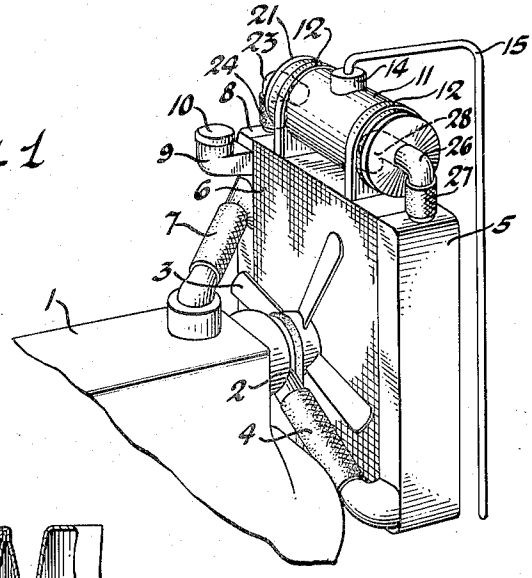
Feb. 21, 1939. F. M. HARDIMAN 2,147,699

ENGINE COOLING SYSTEM

Filed Jan. 20, 1938

Fig. 1



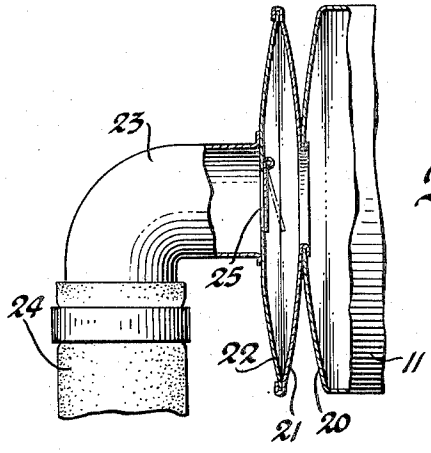


Fig. 2

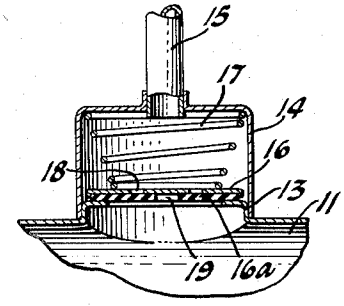


Fig. 3

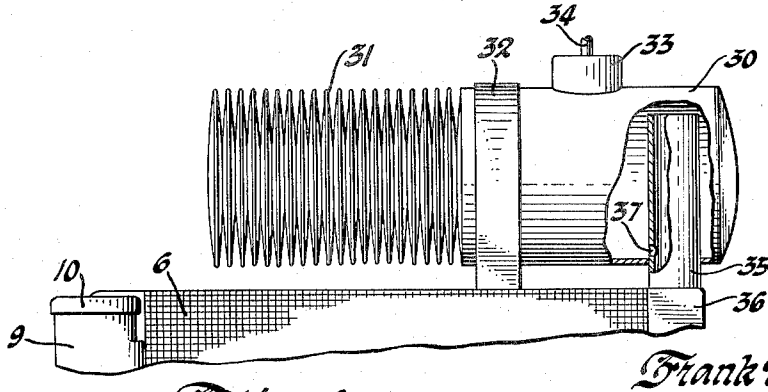


Fig. 4

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ENGINE COOLING SYSTEM

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4 Claims. (Cl. 257—25)

This invention relates to heat exchange systems and more particularly to an arrangement for the conservation of the heat exchanging medium.

Conventional automobile radiators afford proper cooling of the engine for all usual driving conditions but there are times when overheating causes surging of the liquid from the engine jacket and loss of the coolant through the overflow or system breather vent. The surging tendency is most likely to exist following a sudden stop from a hard run in weather adverse to cooling. The extremely hot engine cylinder block calls for additional heat transfer and with the engine driven fan and pump out of operation the body of liquid stands almost still in the engine jacket and continues to absorb heat finally going into steam.

The large expansion incident to the conversion of liquid into steam forcibly pushes the liquid ahead and raises the level in the radiator. Additional boiling follows and in a succession of pulsations or spurts, liquid and steam are coughed out of the engine jacket, a portion of the liquid supply spilling through the overflow pipe. Sometimes half or more of the system contents is discharged before after boiling ceases and the loss is expensive if the cooling solution includes a costly antifreeze, but in any event it is annoying to the car owner and if the loss occurs in a region remote from a convenient source of replenishment liquid, further operation of the vehicle may ruin the engine.

It has been proposed heretofore to provide the overflow pipe with a pressure valve to resist expulsion of the cooling liquid but this is only partly successful in stopping waste and furthermore the internal pressure developed may be so high as to strain the hose connections, water pump packings, gaskets and the radiator assembly, thereby increasing the likelihood of leakage and damage. It has also been proposed to provide an auxiliary or expansion tank outside the circulating system to receive and store expelled liquid for subsequent return to the system. The advantages of both of these previous expedients are combined according to the present invention in that there has been provided beyond the circulating system and as a part of the overflow a supplemental reservoir vented through a relatively low pressure relief valve and having a relatively large inlet for the flow from the engine jacket with minimum resistance to surging liquid and steam mixture. The arrangement is such that the mixture enters above the floor of the storage reservoir so that there can be a ready separation of the liquid and steam, the heavy liquid dropping to the floor so as not to block the inlet and the lighter vapors rising to the roof where the overflow valve is located so that the vapors are first to leave the system through the overflow while the liquid within the capacity of the tank remains for return to the circulating system as the temperature of the cylinder block drops off.

To reduce pressure strains and enlarge the capacity of the storage reservoir it is here proposed to provide the tank with expansible walls and according to one embodiment of the invention the reservoir located above the normal system liquid level, is rigidly mounted on and forms a unit with the radiator assembly and for convenience the flexible end walls have coupled thereto the inlet and outlet headers of the radiator assembly through flexible conduits which accommodate relative movement of the end walls. Inasmuch as the outlet connection in this arrangement passes through the middle of the flexible end wall it carries a downturned extension which opens into the tank near the floor thereof for the withdrawal of liquid by a siphoning action or more precisely by reason of an internal depression due to contraction of the system contents upon cooling. To prevent the action of suction above the liquid level in the auxiliary tank the inlet is provided with a check valve which opens freely into the tank but closes against back flow. This check valve can be omitted if the outlet connection is extended downwardly from the floor of the tank for gravity return of the liquid.

For a better understanding of the invention reference may be made to the detail structure shown in the accompanying drawing wherein Figure 1 shows in perspective an engine cooling system having the invention applied thereto; Figure 2 is an enlarged view partly in section showing the end wall construction and inlet connection to the storage tank; Figure 3 is a sectional view of the overflow controlling valve and Figure 4 shows a modification.

Referring to the drawing the reference numeral 1 indicates an engine block at the front of which is located the water pump 2 and radiator fan 3 both driven by the engine in the usual fashion for circulating water through the system and drawing air through the radiator. The suction side of the pump is connected by a hose 4 with the bottom portion of the outlet header or tank 5 extending along one side of the radiator core 6 which is of the cross flow type for purpose of illustration. The outlet from the engine jacket is cou-

pled by the hose 7 to the inlet header or tank 8 on the opposite end of the radiator core 6. On the inlet header 8 is a filler spout 9 which terminates near the top of the radiator assembly and determines the maximum level to which the system may be filled. A removable closure cap 10 is provided to seal the filler spout.

Above the normal system level is the expansion or storage tank 11 secured to the radiator assembly by means of the holddown straps shown at 12. This tank is shown as being of cylindrical shape and near the top thereof is provided with an apertured raised boss 13 to which is fitted a cupped stamping 14 enclosing a pressure valve for the overflow or vent pipe 15. This valve includes a metal disk 16 and a flexible or rubber disk 16a bearing one against the other and seating on the raised boss 13 under influence of a light spring 17. The two disks 16 and 16a are provided with offset ports or openings 18 and 19, respectively, which normally are closed from each other by reason of the face to face contact of the disks. Thus the system is closed to atmosphere unless internal pressure is sufficient to overcome the spring 17 to unseat the valve assembly or internal suction draws the flexible disk 16a inwardly to separate it from the rigid metal disk 16 and allow intercommunication between ports 18 and 19.

The opposite ends of the tanks are provided with flexible walls which may be in the nature of a bellows-like construction as shown in Figure 2 where 20 indicates a flexible wall having a central aperture to which is fitted a flexible disk 21 which is peripherally joined to a second flexible disk 22. Secured to the disk 22 in line with the central aperture therein is an elbow fitting 23 for connection by a flexible hose 24 with a pipe fitting on the top of the inlet tank 8. By reason of the flexible hose section 24 the relative movement of the end walls upon expansion or contraction may take place. Positioned over the central opening in the plate 22 is an inwardly opening flap valve 25 which allows free movement of fluid from the hot side of the radiator into the expansion tank but closes against back pressure. The opposite end wall construction is much the same as that just described except that in this instance the outlet pipe 26 connected by the flexible hose 27 to the cold side of the radiator core extends through the central portion of the end wall and has a downturned extension 28 opening near the bottom of the tank for the withdrawal of liquid therefrom.

In the normal operation of the system no liquid will be contained within the storage tank but the coolant will be drawn by the pump 2 from the bottom of the outlet header 5 and move through the engine jacket to absorb heat and pass out by the hose 7 and into the top of the inlet header 8 for return flow to the header 5 through the radiator core 6 giving up its heat to the air stream induced by fan operation and car movement. Should conditions be favorable to overheating, the formation of steam in the cylinder jacket displaces liquid therein, and the recurring action causes an intermittent gushing through the outlet to the hot side of the radiator core and with the increase in volume the liquid and steam mixture will rise in the inlet connection 23 and enter the expansion tank. The vomited liquid will drop to the floor out of the path of succeeding surges while the vapors will rise to the roof. The vapors will be held within the tank for condensation as they give up their heat unless the internal pressure exceeds the force of the spring 17 in which case some of the vapors separated out will leave the system. To relieve the parts from pressure strains the flexible end walls will move outwardly and enlarge the capacity of the tank and lessen the loss of the overflow. Under unusually severe conditions the expansion tank may become completely filled with liquid and some of the liquid may leave the system. However, for practical purposes the capacity of the expansion tank will be such that sufficient liquid is retained to enable subsequent operation of the engine without harm being done. As the engine finally cools down the liquid in the circulatory system will contract in volume as it gives up its heat and the suction produced will close the flap valve 25 and cause the liquid to be siphoned out of the tank through the outlet conduit 26 to restore the liquid level in the system.

As an alternative embodiment the expansion tank may be constructed as shown in Figure 4 as including a fixed capacity section 30 and an expansible bellows section 31. In this case the fixed section will be mounted to the radiator assembly by the strap 32 and will carry in its top portion the pressure valve casing 33 controlling the overflow pipe 34 and the connection to the system is through the standpipe 35 projecting upwardly from either of the headers, as for example the outlet header 36, through the bottom of the tank section 30. This standpipe 35 is shown as extending to a point near the top of the tank and as having a bleed port or opening 37 for the return flow of liquid from the bottom of the tank. The return of the liquid will be by gravity and is a small enough stream as not to interfere with the free upward movement of liquid being forced through the standpipe by internal pressure surges. In this case the expansible section 31 will increase the size of the tank in accordance with overflow demands and relieve the parts from pressure strains.

I claim:

1. In a heat exchange system, a radiator having inlet and outlet tanks, an expansible storage tank mounted on the radiator above the normal system liquid level and having flexible end walls, a flexible inlet connection between the inlet tank and the storage tank through one of said flexible end walls, an inwardly opening check valve controlling flow through said connection, a flexible outlet connection between the opposite end wall of the storage tank and said outlet tank, said last mentioned connection having a siphoning extension opening near the floor of the storage tank, and overflow vent means near the roof of the storage tank having an outwardly opening pressure relief valve and an inwardly opening vacuum relief valve.

2. In a heat exchange system, a radiator having inlet and outlet tanks, an expansible storage tank mounted on the radiator above the normal system liquid level and having flexible end walls, a flexible inlet connection between the inlet tank and the storage tank through one of said flexible end walls, an inwardly opening check valve controlling flow through said connection, a flexible outlet connection between the opposite end wall of the storage tank and said outlet tank, said last mentioned connection having a siphoning extension opening near the floor of the storage tank.

3. In a heat exchange system, a radiator having a pair of headers, an expansion tank mounted on the radiator, and having expansible end walls,

and flexible conduits carried by said end walls and communicating said tank with the pair of headers.

4. In an engine cooling system, a radiator assembly including a pair of headers and a core, an expansion tank fixedly mounted on the radiator assembly above the normal liquid level of the system, expansible bellows constituting opposite end walls of the tank, and flexible conduits secured to said end walls for communicating the opposite ends of said tank with said pair of radiator headers.

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