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AUXILIARY COOLING SYSTEM FOR INTERNAL COMBUSTION ENGINES

FIG. 1.

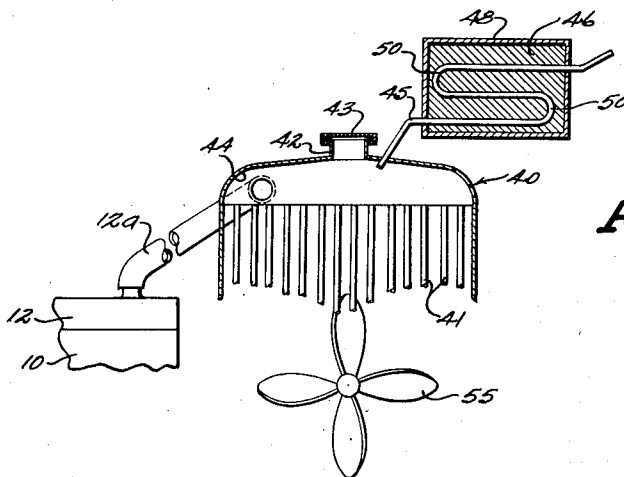
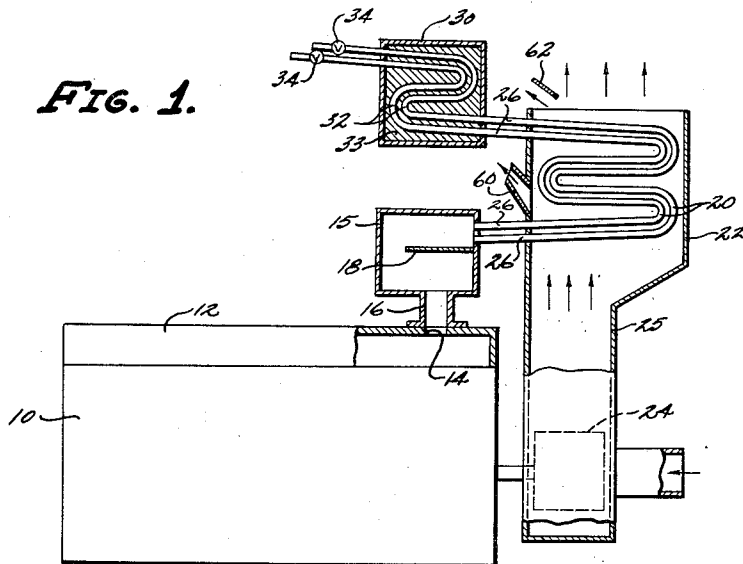


FIG. 2.

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This invention relates to cooling systems for internal combustion engines, whether of the stationary type or of the ordinary automobile type of engine, and it relates more especially to cooling systems of the vapor-liquid cooling type.

In vapor-liquid engine cooling systems, wherein vapor formed during engine operation is condensed and returned to the system, the cooling liquid medium may boil in the engine block to yield vapor, which vapor is then condensed and returned to the system. Under normal conditions adequate condensation is effected in a condensing unit by air flow over the condenser, such air flow being conveniently produced by a blower driven from the engine upon which the system is employed.

Ordinarily, so long as the engine operates under normal conditions, condensation is easily effected. However, when the engine is shut down, the residual heat contained in the engine very frequently results in excess or continued boiling occasioned by the residual heat in the engine block, there being no means operating to cause the condenser to function adequately.

It is therefore an object of this invention to provide auxiliary means in a vapor-liquid cooling system to care for boiling of the cooling liquid which is occasioned by excess heating, such as that resulting from contained residual heat or that resulting from overload under some conditions.

A further object of the invention is to employ in a vapor-liquid cooling system an auxiliary cooling agent of different type from that represented by the cooling liquid, and one which per volume unit is much more efficient than the cooling liquid. Such an auxiliary agent may be a solid, and according to a preferred form of the invention, is a solid of which naphthalene is a particular example.

Also, it is an object to use as a condensing agent a solid material fusible under the temperature of vapors separated from the cooling liquid and having a relatively high latent heat of fusion, especially where such solid agent is employed as an auxiliary condensing agent.

Other objects of the invention and various features thereof will become apparent from the following specification and the accompanying drawing wherein certain embodiments are illustrated.

In the drawing:

Fig. 1 illustrates more or less diagrammatically and largely in vertical section one embodiment of the invention; and

Fig. 2 illustrates in vertical section another embodiment of the invention.

The drawing shows in Fig. 1 a conventional block 10 of an internal combustion engine having the usual cooling liquid jacket and a cylinder head 12. In this particular form the usual hot water outlet passage 14 in the forward end of the cylinder head leads to a separator 15 by way of an intervening connecting neck 16. If desired, the separator 15 may be provided with a baffle 18 to

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facilitate the separation of steam or vapor from the mixture of cooling liquid and steam or vapor which passes up through the neck 16 into the separator during engine operation, as is common with many water-cooling systems and as is especially true in the case of vapor-liquid systems. Thus, liquid separated from steam or vapor in the separator 15 returns to the cylinder head 12 through the connection 16 and the communicating passage 14.

The steam or vapor separated in the separator 15 from the hot liquid is then passed to a series of cooling coils 20 which constitute a primary condenser and which are shown as preferably disposed in a cooling air duct 22 through which air is being forced by a blower 24, such as a squirrel cage blower, cold air being drawn into the lower end portion of an air conduit 25 which joins an enlarged upper end portion of the duct 22 as shown. Preferably, coils 20 are formed in each of a plurality of condenser tubes which are shown in Fig. 1 as being two in number and designated at 26. The number of coils 20 contained in the upper end of the air duct 22 is such as to adequately condense by air cooling the vapors commonly produced in the engine 10 and its cylinder head 12 under ordinary operating conditions.

A particular feature of this invention involves the employment of an auxiliary condensing device 30 into which extend end portions of the condenser tubes 26, such end portions being formed into a sufficient number of coils 32 to complete condensation of the conducted vapors as required. The coils 32 are imbedded in a solid substance 33 having an appropriately high latent heat of fusion and an appropriate melting point. The melting point, of course, needs to be below the temperature of the vapor to be condensed so that advantage may be taken of the high heat of fusion, that is, of the high heat absorption resultant upon the melting. Since, in practice, it is necessary to provide for venting of noncondensable so-called cylinder head gases, the extremities of the condenser tubes 26 extending beyond the auxiliary condensing device 30 are appropriately vented such as by direct venting to the atmosphere, or, where above atmospheric pressure in the system is desired, pressure relief valves 34 are used to vent the gases, or otherwise.

Another form of the invention wherein auxiliary condensing of the indicated type is employed is illustrated in Fig. 2. Here, a conventional automobile radiator 40 is illustrated, this radiator receiving hot liquid and vapors from the block 10 and head 12 via a hose 12a and having conventional liquid return tubes 41, and a conventional neck 42 closed by the usual cap 43 beneath which, at a convenient elevation, there is provided the usual steam pocket or chamber 44 into which there extends the lower end of a tube 45 which takes up the vapors and conducts them into a body of normally solid, fusible material 46 like that indicated at 33 in Fig. 1, such fusible material being carried in an appropriate receptacle 48. In this form the extremity of the pipe 45 is vented to the atmosphere directly or through a pressure relief valve, as in the other form, after providing a sufficient number of coils 50 to effect the required condensation. A common fan 55 may assist liquid cooling in the tubes 41.

In all instances the condenser tubes, namely the tubes 26 of the form of Fig. 1 and the tube 45 of the form of Fig. 2, have sufficient cross-sectional area to provide for the simultaneous passage upward of uncondensed vapors and passage downward of condensed liquids, under which conditions the descending liquids serve to an extent as reflux media facilitating condensation of the ascending vapors. By these means the condensed liquids are returned to the engine or to the radiator, as the case may be, the engine liquids being correspondingly cooled thereby upon reaching the engine cooling jackets in any conventional or preferred manner.

From the standpoint of the normally solid fusible material contained in the auxiliary condensing units 30 and 43, the particular material employed is not especially significant except that it should melt below the temperature of the vapors to be condensed and have an efficiently high latent heat of fusion. Thus, a fusible chemical compound such as naphthalene may be used, or an appropriate eutectic metal such as Wood's metal may be employed. The higher the latent heat of fusion, the lower the weight of the material that must be employed. For example the heat of fusion of naphthalene is about 64.1 B. t. u.'s per pound, whereas the heat of fusion of Wood's metal is only about 14 B. t. u.'s per pound, so that around 21.5 pounds of Wood's metal is required to perform the same cooling that about 4.8 pounds of naphthalene accomplishes. Since the boiling point of water at an elevation of ten thousand feet approximates 190° F., the melting points of naphthalene (176° F.) and of Wood's metal (149° F.) are sufficiently low to operate satisfactorily at high elevations.

When taking advantage of the heat of fusion of solids of the indicated character, after having exercised their functions of effecting engine cooling under unusually high load conditions, the solids will harden by subsequent cooling following termination of the condition occasioning unusual heat generation. Thus, when an engine is stopped, adequate cooling time normally elapses before the engine is started again. Also, following any other high load condition, such as a steep grade in the case of an automobile engine, air cooling of the solidifiable material in the auxiliary cooler 30 or 48 will occur normally even though the engine continues to run, the heat being dissipated into the atmosphere by reason of normal air circulation about the containers for the solidifiable material or by reason of especially directed air currents passed thereover, as from air currents produced by such means as the blower 24 after the air currents pass the coils 20, or through a supplementary jet such as indicated at 60, Fig. 1, or by a deflector means such as indicated at 62 in Fig. 1.

From the standpoint of the normally solid auxiliary cooling agent which is fusible at a temperature below the boiling point of water or other cooling liquid employed in the engine, it is probable that a solid that solidifies in the upper portion of the range is desirable because, especially in the vicinity of a hot engine still operating, it can solidify at higher temperatures (thereby again making its latent heat of fusion available) than would be the case with an auxiliary coolant which melts at a much lower temperature and might therefore remain liquid under some conditions of local heat under which the higher melting coolant would have solidified. Thus, the latent heat of fusion in the higher melting material could again become available if necessary, whereas with the lower melting agent its liquid condition would continue.

In addition to the particularly mentioned naphthalene (which might possibly be a preferred auxiliary coolant in the present instance), and also in addition to the mentioned Wood's metal, other appropriate coolants would include sodium, cyanamide, elaidic acid, methyl oxalate, and stearic acid.

Since variations of the invention herein disclosed may occur to those skilled in this art, it is intended to cover those modifications which fall within the scope of the patent claims.

We claim as our invention:

1. In a cooling system for an engine having a water jacket: a water and vapor separator having a connection to receive vapor and entrained liquid from said jacket and means to return separated water to said jacket; primary cooling means connected with said separator for receiving and effecting initial cooling of separated vapor; and aux-

iliary cooling means including a bed of normally solid material fusible at the temperature conditions of the vapor, and vapor conduit means disposed adjacent said bed and connected with said primary cooling means to receive and condense separated vapors therefrom.

2. A cooling system as in claim 1 wherein said cooling means are tubular heat exchange means.

3. A cooling system as in claim 1 wherein said cooling means are condensers for said vapor.

4. A cooling system as in claim 1 wherein said bed of normally solid material is a permanent, trapped bed which, after fusing by the action of said vapors, will solidify upon cessation of vapor flow thereto.

5. A cooling system as in claim 1 including forced draft means disposed to conduct cooling air over at least one of said cooling means.

6. In a cooling system for an internal combustion engine having a water jacket: primary cooling means arranged to receive heated coolant from said jacket; and auxiliary cooling means connected with said primary cooling means to receive and condense vapor not condensed in said primary cooling means and including a normally solid material having relatively high heat of fusion and melting under the temperature of the vapor whereby to condense the same.

7. A cooling system as in claim 6 wherein each cooling means includes vapor receiving coils and means are provided for air cooling the coils of said primary cooling means.

8. In a cooling system for an engine having a water jacket: a separator having means for connection to said water jacket to receive water and vapor therefrom and separate them; a primary cooling device having first cooling coils connected to said separator to receive hot vapors therefrom; means for passing cooling air over said coils; and a secondary cooling device having second cooling coils connected to receive hot vapors from said first cooling coils and including normally solid material fusible at the temperature of said hot vapors and containing said second cooling coils.

9. A system as in claim 8 wherein said normally solid material has a relatively high fusion heat and a melting point below 190° F.

10. A system as in claim 9 wherein the melting point of the fusible material is above 120° F.

11. A cooling system for an engine having a water jacket: a radiator having a vapor separating chamber connected with said jacket and cooling means leading from said chamber to said jacket; a cooling coil leading from said chamber to receive separated vapors therefrom; and normally solid material contacting said cooling coil and fusible at the temperature of hot vapors from said chamber.

12. In a cooling system for an engine having a water jacket: a device connected with said jacket for receiving hot water and vapors from the jacket and providing a chamber for separating hot vapors from the water and returning the water to the jacket; tubular cooling means leading from said separator chamber for receiving separated hot vapors therefrom; and a permanent body of normally solid material contacting said tubular cooling means and fusible at the temperature of separated hot vapors therein.

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