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THERMOSIPHON LIQUID CIRCULATING HEATING SYSTEM

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2 Sheets-Sheet 1
This invention relates to heating systems of the circulating liquid class that are especially suited to the heating of internal combustion engines and their appurtenances for the purpose of facilitating the starting of the engine during cold weather, and for protecting the engine and associated equipment from damage by exposure to extremely low temperatures between engine operations.

The present invention is quite similar to that which forms the subject matter of my copending application Serial No. 572,918, filed January 15, 1945, but is distinguished therefrom by its thermosiphon principle of operation. The circulation of liquid in the system of the other invention depends on the liquid being elevated by vapor action to a high point in the system from which it gravitates.

In order to convey a better understanding of my present improvements, I shall first describe briefly the ordinary thermosiphon liquid circulating heating system as employed on military and other vehicles for engine heating purposes and point out certain undesirable features thereof, the elimination of which is the primary object of my invention.

In order to properly heat an engine by means of the ordinary thermosiphon circulating system, it is necessary to supply the heated liquid to the bottom of the water jacket or coolant space of the cylinder block, as otherwise the hot liquid at the top of said jacket or space would cause the thermostatic valve, now commonly used in engine cooling systems, to open and pass the hot liquid into the radiator instead of circulating it through said jacket or coolant space, thus rendering the heating of the engine very slow and ineffective.

To accomplish the introduction of the hot liquid to the bottom of the coolant space, the top of the heat exchanger or circulating element of the heater has to be situated below the point of entrance of the liquid, such point usually being provided by the drain opening or pump connection. This arrangement places the heater so low with respect to the engine that it is inaccessible except from underneath the vehicle and, because of its location, the heater is exposed to the action of road dirt, mud, snow, slush and water.

Also, in the use of the ordinary thermosiphon circulating system, when it is desired to heat the oil pan of the engine, and/or the electric battery that supplies current for ignition and other purposes, the hot liquid is first circulated through the water jacket or coolant space, which has a very large radiating surface, before it is conveyed to the heat dissipating or delivery unit or units associated with the oil pan and/or battery, and because of this sequence, it requires such a long time for the hot liquid to reach said units that quick heating is impossible of achievement. This undesirable condition is sometimes remedied to a measurable extent by providing a small bypass tube through which a part of the hot liquid is conveyed directly to the unit or units aforesaid.

Obviously, it is highly desirable to locate the heater at a higher elevation with respect to the engine than is possible in the system above described, and it is the principal object of my invention to provide an improved thermosiphon circulating system that will permit of such location of the heater.

While this same end is attained in the vapor-lift system disclosed and claimed in my companion application above referred to, the present invention has the advantage over the other that the heat exchanger or circulating element of the heater is always kept full of liquid which results in faster circulation at lower temperatures.

The foregoing objects and advantages, with others that will appear as this description proceeds, are attained in the embodiment of the invention illustrated in the accompanying drawing wherein Fig. 1 represents a side elevation of an internal combustion engine equipped with my improved thermosiphon circulating heating system, the view being in the nature of a diagram, and showing the system as including heat dissipating or delivery units in heating relation to the oil pan of the engine and to the electric battery; Fig. 2 is an enlarged central vertical section through the vent chamber of the system shown in Fig. 1; Fig. 3 is a view, similar to Fig. 2, illustrating a modified form of the vent chamber, and Fig. 4 is a view, similar to Fig. 1, showing a somewhat different arrangement of conduits.

In the drawings, the engine is designated generally by the reference letter E, and the coolant space—that is, the water jacket of the cylinder block—is designated e. Said space is a part of the liquid circulating cooling system of the engine, which system includes also the radiator R, and said coolant space is in circuit with the radiator through the usual connections e and e'. The connection e' leads from the top of the coolant space to the corresponding part of the radiator, while the connection e leads from the bottom of the radiator to the lower portion of said space and includes the usual circulating pump, the portion of the connection e', between the pump and said coolant space, in the present instance, being
formed by a pipe e. The oil pan of the engine is designated e.

The heating system includes a heater that comprises a heating means or combustion device 1, and a heat exchanger 2 that consists of a circulating element or coil. The system also embraces, as an essential part thereof, a vent chamber 2 and an outlet.

In the embodiment of the system shown in the drawing, heat dissipating or delivery units 3 and 4 are included, the former being disposed in heat relation to the oil pan e, and the latter in heat relation to the electric battery B. The battery B provides the source of current for the starting and ignition circuits of the engine, and the lighting and other circuits of the vehicle. As will be readily understood, each of the units 3 and 4 includes a liquid passage having an inlet and an outlet.

The vent chamber 2, shown in central vertical section in Fig. 2, comprises a vessel designated 2 and a stand pipe 2. Said vessel may be of cylindrical form, and in the embodiment illustrated, it is substantially semi-spherical at top and rim bottom. The stand pipe 2 extends upwardly through the bottom of said vessel, substantially central thereof, and terminates adjacent the top of the vessel. The stand pipe is provided with an aperture 2 adjacent the bottom wall of the vessel 2 so as to establish free communication between the interior of the stand pipe and the surrounding part of the chamber. A relatively small pipe 24 leads from the upper portion of the chamber 2 and is vented to the cooling system of the engine, according to the present arrangement, into the top of the radiator B. The vent chamber is located well above the plane of the heater 1 and is so related to the cooling system of the engine that the plane of the maximum liquid level of the cooling system is intermediate the top and bottom of said chamber, desirably nearer the bottom than the top. Thus, a liquid space is provided in the bottom portion of the vent chamber, with a vapor space thereabove, as clearly shown in Fig. 2.

A conduit 3 has communicative connection with the liquid of the heat exchanger 1 and leads therefore upwardly to and communicates with the bottom of the stand pipe 2, said conduit continuing, according to the present arrangement, to the inlet of the liquid passage of the heat dissipating or delivery unit 3 that is arranged in heat relation to the oil pan e. A conduit 6 leads from the outlet of said unit to the inlet of the unit 4, and communicative connections are made between the outlet of the latter unit and the bottom portion of the coolant space e of the engine through a conduit 7. A conduit 8 leads from the top portion of said coolant space to the inlet of the heat exchanger 1, the same including a trap 9 that prevents liquid from being forced by vapor pressure from the heat exchanger 1 through the conduit 8 back into the coolant space of the engine.

Assuming that liquid stands in the cooling system of the engine at about the elevation indicated by the dot-and-dash line a, a liquid level corresponding thereto prevails in the cooling system, more specifically, in the vent chamber 2, the liquid level therein being indicated at b in Fig. 2. Accordingly, liquid is present in all conduits of the heating system, as well as in the liquid passages of the units 3 and 4, in the coolant space e, and in the heat exchanger 1. With the heating means or combustion device 1 in operation, the liquid in the exchanger is heated and, as a consequence thereof, rises through the conduit 5, any surging of the liquid caused by boiling being manifested by a rise and fall of the liquid in the stand pipe 2. Air or vapor bubbles created in the heated liquid will escape through the top of the stand pipe into the vapor space of the vent chamber 2 and will pass out through the pipe 2 to the cooling system of the engine. The stand pipe, which extends well above the liquid space of the vent chamber, prevents any of the liquid from being blown out of the chamber through the pipe 2, notwithstanding a pronounced surging action in the stand pipe or a boiling effect caused by the air or vapor bubbles. Displacement of liquid out of the top of the stand pipe under the conditions just mentioned is precluded by the presence of the aperture 2 in said pipe through which free communication prevails between the liquid space of the chamber and the interior of the pipe.

By thermosiphon action, flow of the hot liquid will continue on through the descending branch of the conduit 5 and, passing through the liquid space of the conduit 6, the liquid space of the unit 4, and conduit 7 to the bottom portion of the coolant space e. The heated liquid rising within said space will displace liquid from the top portion thereof through the conduit 8 which conveys the liquid to the outlet of the stand pipe and the surrounding part of the chamber.

Thus it will be seen that a constant flow of liquid will continue within the system in the direction described as long as heat is supplied to the exchanger by the heating means or combustion device 1, and circulation will start as soon as the liquid in the exchanger becomes warm enough to rise through the conduit 5. By variously arranging the liquid conducting means or conduits, hot liquid may be carried to any point desired below the vent chamber, although the conduit arrangement must be such that there are no upturned loops in which air or steam may collect.

Instead of connecting the units 3 and 4, and the coolant space of the engine—which is, in effect, another heat dissipating or delivery unit—in a single circuit as shown in the drawing, parallel circuits may be used so that the hot liquid from the heat exchanger, after passing the stand pipe of the vent chamber, may flow directly to each of the units and return from each to the inlet of the heat exchanger. Such an arrangement is illustrated in Fig. 4, where the conduit 5, that extends from the outlet of the heat exchanger 1 to the bottom of the stand pipe 2 and thence to the inlet of the heat dissipating or delivery unit 4, has branches 4a and 4b that lead, respectively, to the inlet of the coolant space e of the engine and to the inlet of the heat dissipating or delivery unit 4. The respective outlet conduits 5a and 5b of said units 3 and 4, and the outlet conduit 5c of the coolant space e discharge directly into a manifold 10 that constitutes the inlet of the heat exchanger 1. Examples of other arrangements are disclosed in my companion application above identified.

In Fig. 3 I have shown a modification of the vent chamber, designated generally by the reference numeral 25. In this form, the stand pipe 20 terminates at its junction with the bottom wall of the vessel 20a, and bubbles rising through said pipe are immediately liberated to the body of liquid in the vessel and ascend to the vapor space thereabove from where the air as gases,
and a possible small quantity of vapor sustained thereby, escape through the vent pipe 20d. Having thus described my invention, what I claim is:

1. In a heating system of the class set forth, a heat exchanger having a liquid passage provided with an inlet and an outlet, a source of heat in heating relation to said heat exchanger, a vent chamber located at a higher elevation than said heat exchanger the bottom portion of which constitutes a liquid space and the portion thereof above a vapor space, a stand pipe opening into said vapor space a substantial distance above the liquid space and having an aperture adjacent the bottom of the chamber through which the interior of the pipe communicates with said liquid space, means venting the vapor space, a heat dissipating unit below the plane of the vent chamber, said unit having a liquid passage, and liquid conducting means leading from the outlet of the heat exchanger upwardly to and communicating with the stand pipe and continuing there beyond to provide a circuit including the liquid passage of said unit and leading to the inlet of the heat exchanger.

2. In a heating system of the class set forth for use with an internal combustion engine incorporating a coolant space and a liquid circulating cooling system including said space, a heat exchanger having a liquid passage provided with an inlet and an outlet, a source of heat in operative relation to said heat exchanger, a vent chamber located at a higher elevation than said heat exchanger and so related to the cooling system that the plane of the maximum liquid level in the latter is intermediate the top and bottom of said chamber so as to provide a liquid space within the bottom portion of the chamber and a vapor space thereabove, means venting the vapor space to the cooling system, and liquid conducting means leading from the outlet of the heat exchanger to the bottom portion of the coolant space of the engine, other liquid conducting means leading from the top portion of said space to the inlet of said heat exchanger, the first mentioned liquid conducting means including a part rising from the outlet of the exchanger, and a stand pipe communicating with the top of said part and opening into the vapor space of the vent chamber, said stand pipe having an aperture through which its interior communicates with the liquid space of the chamber adjacent the bottom of the latter.

3. In a heating system of the class set forth for use with an internal combustion engine incorporating a coolant space and a liquid circulating cooling system including said space, a heat exchanger having a liquid passage provided with an inlet and an outlet, a source of heat in operative relation to said heat exchanger, a vent chamber located at a higher elevation than said heat exchanger and in such relation to the cooling system that the plane of the maximum liquid level in the latter is intermediate the top and bottom of the chamber so as to provide a liquid space adjacent the bottom of the chamber through which its interior communicates with the liquid space, a heat dissipating unit for heating an apparatus of the engine, the same having a liquid passage provided with an inlet and an outlet, liquid conducting means leading from the outlet of the heat exchanger upwardly to and communicating with the bottom of the stand pipe and providing thereof a circuit including said unit and the coolant space of the engine and leading to the inlet of the heat exchanger.

4. In a heating system of the class set forth for use with an internal combustion engine incorporating a coolant space and a liquid circulating cooling system including said space, a heat exchanger having a liquid passage provided with an inlet and an outlet, a source of heat in operative relation to said heat exchanger, a vent chamber located at a higher elevation than said heat exchanger and in such relation to the cooling system that the plane of the maximum liquid level in the latter is intermediate the top and bottom of the chamber so as to provide a liquid space adjacent the bottom of the chamber and a vapor space thereabove, means venting said vapor space to the cooling system, a stand pipe rising through the bottom of said chamber and terminating a considerable distance above the plane of said liquid level, said stand pipe having an aperture adjacent the bottom of the chamber through which communication is established between the interior of the stand pipe and said liquid space, and liquid conducting means leading from the outlet of the heat exchanger to the bottom of the stand pipe and thence to the bottom portion of the coolant space of the engine, and liquid conducting means leading from the top portion of said space to the inlet of the heat exchanger, the last mentioned means including a trap for preventing reverse flow of liquid through the heat exchanger.

5. In a heating system of the class set forth for use with an internal combustion engine incorporating a coolant space and a liquid circulating cooling system including said space, a heat exchanger having a liquid passage provided with an inlet and an outlet, a source of heat in operative relation to said heat exchanger, a vent chamber located at a higher elevation than said heat exchanger and being so related to said cooling system that the plane of the maximum liquid level in the latter is between the top and bottom of said chamber, thereby to provide within the latter a liquid space adjacent the bottom of the chamber and a vapor space thereof, means venting said vapor space to the cooling system, a stand pipe rising through the bottom of said chamber and terminating a considerable distance above the plane of said liquid level, said stand pipe having an aperture adjacent the bottom of the chamber through which its interior communicates with the liquid space, a heat dissipating unit for heating an apparatus of the engine, the same having a liquid passage provided with an inlet and an outlet, liquid conducting means leading from the outlet of the heat exchanger upwardly to and communicating with the bottom of the stand pipe and providing thereof a circuit including said unit and the coolant space of the engine and leading to the inlet of the heat exchanger.

6. In a heating system of the class set forth for use with an internal combustion engine incorporating a coolant space and a liquid circulating cooling system including said space, a heat exchanger having a liquid passage provided with an inlet and an outlet, a source of heat in operative relation to said heat exchanger, a vent chamber located at a higher elevation than said heat exchanger.
chamber and being so related to said cooling system that the plane of the maximum liquid level in the latter is between the top and bottom of said chamber, thereby to provide within the latter a liquid space adjacent the bottom of the chamber and a vapor space thereabove, means venting said vapor space to the cooling system, a stand pipe rising through the bottom of said chamber and terminating a considerable distance above the plane of said liquid level, said stand pipe having an aperture adjacent the bottom of the chamber through which its interior communicates with the liquid space, a heat dissipating unit for heating an appurtenance of the engine, the same having a liquid passage provided with an inlet and an outlet, liquid conducting means leading from the outlet of the heat exchanger upwardly to and communicating with the bottom of the stand pipe and thence to the inlet of said heat dissipating unit, other liquid conducting means leading from the outlet of said unit to the bottom portion of the coolant space of the engine, and further liquid conducting means leading from the top portion of said coolant space to the inlet of the heat exchanger.

7. In a heating system of the class set forth for heating an internal combustion engine and an electric battery associated therewith, said engine incorporating a coolant space and a liquid circulating cooling system including said space, a heat exchanger having a liquid passage provided with an inlet and an outlet, a source of heat in operative relation to said heat exchanger, a vent chamber located at a higher elevation than said heat exchanger and so related to the cooling system that the plane of the maximum liquid level in the latter is between the top and bottom of said chamber thereby to provide a liquid space adjacent the bottom of the chamber and a vapor space thereabove, a stand pipe opening at its upper end into the chamber a considerable distance above the plane of said liquid level, said stand pipe having an aperture adjacent the bottom of the chamber through which its interior communicates with the liquid space of the chamber, a heat dissipating unit for heating the oil pan of the engine, a second heat dissipating unit in heating relation to the battery, liquid conducting means leading from the outlet of the heat exchanger upwardly to and communicating with the bottom of the stand pipe and thence to the inlet of said heat dissipating unit and providing a circuit including said dissipating units and leading to the inlet of the heat exchanger.

8. In a heating system of the class set forth for heating an internal combustion engine and an electric battery associated therewith, said engine incorporating a coolant space and a liquid circulating cooling system including said space, a heat exchanger having a liquid passage provided with an inlet and an outlet, a source of heat in operative relation to said heat exchanger, a vent chamber located at a higher elevation than said heat exchanger and so related to the cooling system that the plane of the maximum liquid level in the latter is between the top and bottom of said chamber thereby to provide a liquid space adjacent the bottom of the chamber and a vapor space thereabove, a stand pipe opening at its upper end into the chamber a considerable distance above the plane of said liquid level, said stand pipe having an aperture adjacent the bottom of the chamber through which its interior communicates with the liquid space of the chamber, a heat dissipating unit for heating the oil pan of the engine, a second heat dissipating unit in heating relation to the battery, liquid conducting means leading from the outlet of the heat exchanger upwardly to and communicating with the bottom of the stand pipe and thence to the inlet of said heat dissipating unit and providing a circuit including said dissipating units and leading to the inlet of the heat exchanger.