Jan. 16, 1945. P. G. CALDWELL 2,367,197

LIQUID CIRCULATING SYSTEM AND HEATING MEANS THEREFOR

Filed Sept. 23, 1943 2 Sheets-Sheet 1

FIG. 1.

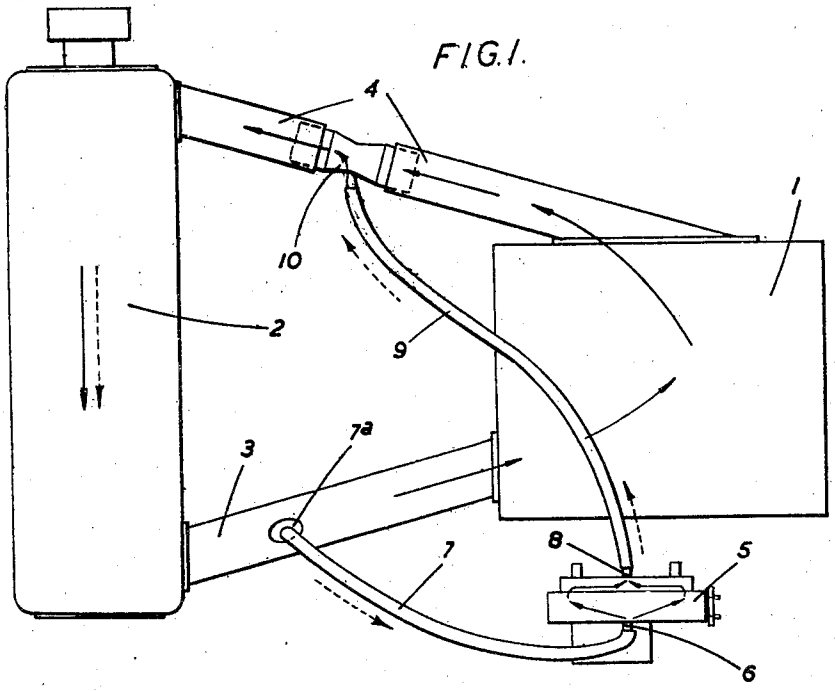
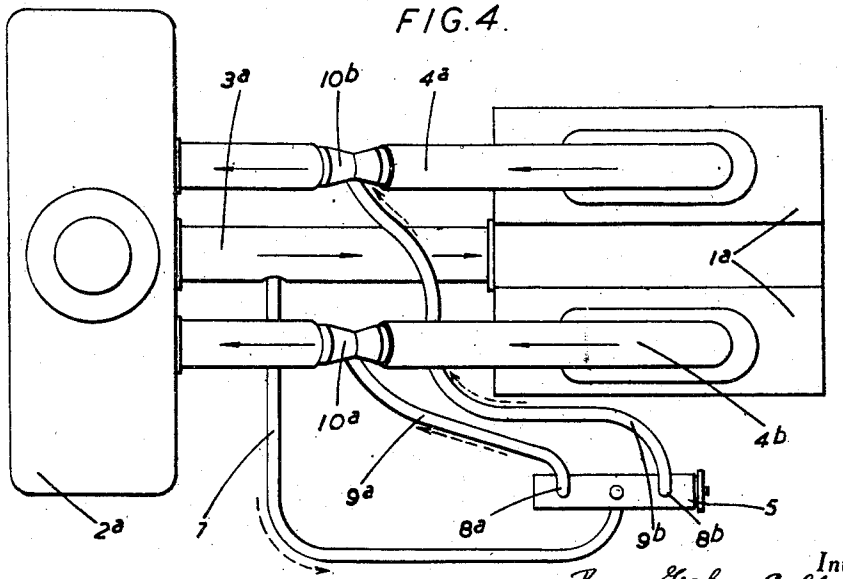


FIG. 4.



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FIG. 2.

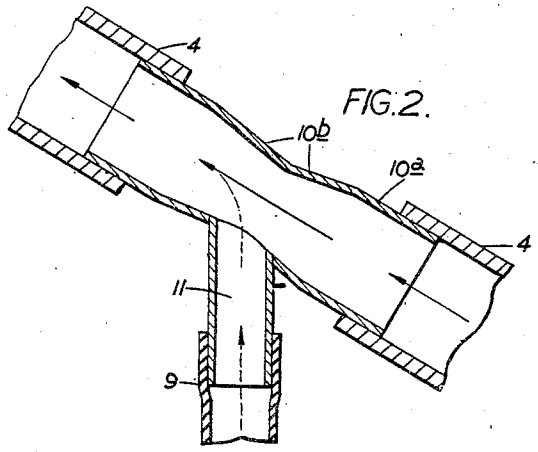
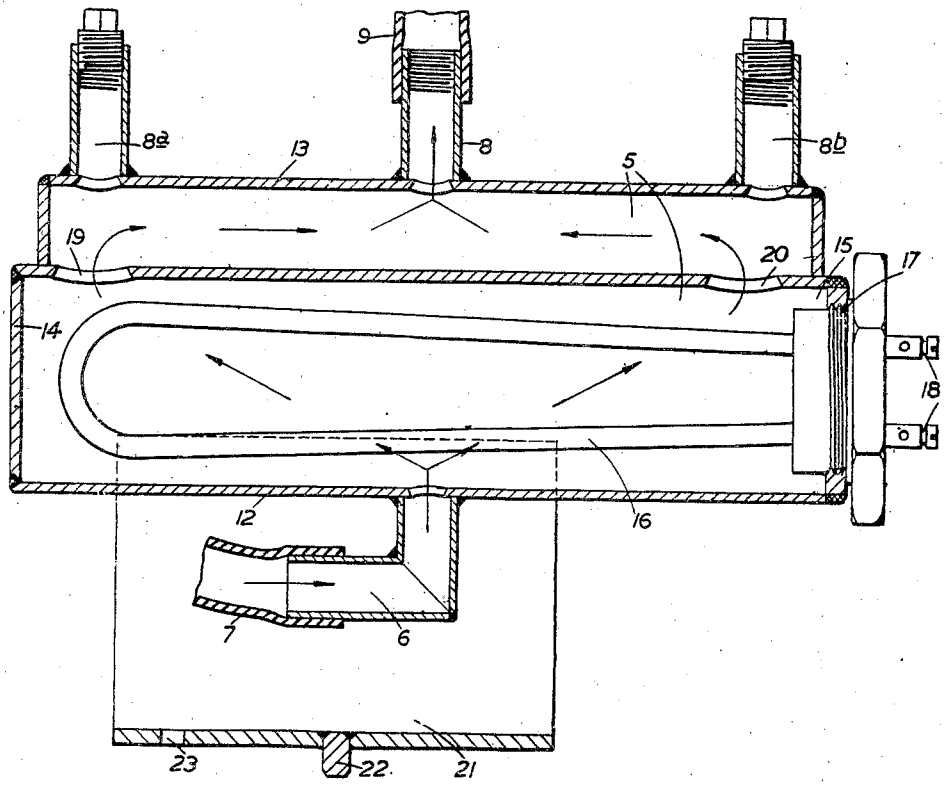


FIG. 3.



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UNITED STATES PATENT OFFICE

2,367,197

LIQUID CIRCULATING SYSTEM AND HEATING MEANS THEREFOR

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Application September 23, 1943, Serial No. 503,495
In Great Britain April 16, 1943

14 Claims. (Cl. 219—38)

This invention relates to liquid circulating systems for heating by the circulation of a hot liquid and incorporating a liquid heating means as for instance an electric heater of the flow through type. Since the invention is particularly applicable to heating the liquid, usually water, of the engine cooling system of a motor vehicle so as to minimise the risk of damage to the engine or radiator in frosty weather, or to maintain the engine at a satisfactory temperature for efficient working when started up, it will be hereinafter described in that application, although other circulating systems are not excluded.

With a view to obviating the well known disadvantages and difficulties of starting a motor vehicle engine from cold and permitting it to drive the car before it has warmed up sufficiently to function efficiently, various forms and arrangements of heaters have been previously proposed whereby, in order to promote heating of the cooling liquid on the thermo-siphonic principle while the vehicle is standing idle, such heaters have been provided with an inlet connected by a circulating pipe with the drain pipe of the radiator, or upflow from the radiator to the engine, and an outlet connected by a circulating pipe either with the engine water jacket at a suitable point elevated above the heater or to a pipe which normally connects the highest point of the engine water jacket to the top of the radiator.

Now, it is an object of the present invention to provide for satisfactory heating of the liquid in a liquid circulation cooling system and at the same time to enhance in simple manner the circulation of the liquid undergoing movement due to the thermo-siphonic action.

For achieving this object, the present invention resides broadly in a thermo siphonic liquid circulating system having two circuits including a common descending column in which heat is applied to one of the circuits and liquid in that circuit is caused to flow through a venturi so situated as to promote circulation in the other circuit.

More particularly the present invention consists in a method of heating and circulating the liquid in a liquid circulating system arranged so that circulation can take place in a predetermined direction under thermo siphonic action in a main circuit including inflow and outflow portions with respect to a body to be heated, which consists in causing a part of the liquid contained in the inflow portion to be diverted or to drain into a path communicating with the inflow and outflow portions so as to form a second thermo-siphonic circuit adapted for operation in common with part of the main circuit but bypassing the body, applying heating to the liquid received in said path at a position enabling thermo-siphonic action to be started or sustained in such circuit thereby serving to heat and circulate the liquid in the main circuit, and causing the liquid in the second circuit being heated to flow through a venturi so situated as to promote the circulation in the other circuit.

Advantageously the liquid which flows in the communicating path towards the outflow part of the main circuit is introduced obliquely into the venturi in such part and towards the descending column, the path preferably opening into the venturi at or near the most constricted part thereof and so as to direct the liquid forwardly thereof.

Moreover it is preferred to use an electric heater of the flow through type for applying the heating to the liquid received in the path which inter-communicates the inflow and outflow portions, and this path is conveniently furnished by flexible hose, for instance of rubber, forming pipe connections from said inflow portion to an inlet of the heater and from an outlet of the heater to said outflow portion.

The invention, both as to its organization and method of operation, may best be understood by the following description taken in connection with reference to the accompanying drawings in which—

Fig. 1 is a diagrammatic representation of the invention as applied to a liquid circulation engine cooling system of a motor vehicle;

Fig. 2 is a sectional detail view of a Venturi device for incorporation with the connections shown in Fig. 1,

Fig. 3 is a part sectional elevation of a heater suited for use in the system shown in Fig. 1, and Fig. 4 shows schematically a modification of the invention, using the heater according to Fig. 3.

Referring firstly to Fig. 1 the engine block 1 of a motor vehicle is arranged to be cooled in well known manner by the circulation therethrough of cooling water received from the lower end of a radiator 2 by way of a lower inflow pipe or like connection 3, an upper outflow pipe 4 or the like being connected from the upper portion of the block 1 so as to be in rising communication with the top of the radiator 2. These elements form the usual components of a water circulating system in which the water is caused to circulate by thermo-siphonic action in a prede-

termined direction in what is conveniently termed herein a main circuit as shown by the arrows in full line, when influenced by the heat of the engine.

Situated at a level below the inflow pipe 3 of the main circuit is an electric heater 5 of the flow through type having an inlet 6 at the lower part thereof to which is connected the lower end of a downtake pipe 7 consisting preferably of rubber hose and having its upper end connected at 7a in communication with the lower inflow pipe 3. This downtake pipe 7 has a diameter which is smaller than that of the inflow pipe 3 of the main circuit, and as the said inflow pipe is usually also formed as a flexible hose the connection of the inflow pipe 3 thereto at 7a can be made in a comparatively simple manner. At an upper part of the heater 5 is provided an outlet 8 from which is led an uptake pipe 9, also preferably consisting of rubber hose, communicating at its upper end with the upper outflow pipe 4 of the main circuit. In this manner the heater 5 together with the downtake pipe 7 and uptake pipe 9 connected therewith forms, when the heater 5 is in use, a second thermo-siphonic circuit which leads through the radiator 2 but bypasses the block. This second thermo-siphonic circuit is indicated in the figure by dotted line arrows.

To promote directional flow of the liquid in the region where it emerges from the uptake pipe 9 of the heater into the outflow 4 of the main circuit, a Venturi device 10 is included in the outflow 4 and the uptake pipe 9 is led into such device. As will be seen more clearly from Fig. 2, the outflow 4 which may consist of flexible hose has interposed therein a Venturi-action tube 10a presenting inner and outer coned surfaces 10b of conventional form, the uptake pipe 9 being connected with the constricted interior formed by the coned surfaces by means of a connector 11 so making junction with the venturi and disposed obliquely with respect to its axis as to cause the flow as it enters through the connector 11 to proceed forwardly of the venturi in the same sense as the flow which occurs in the main circuit.

It will be understood that when the second thermo-siphonic circuit is rendered operative in response to the heating furnished by the heater 5, the liquid contained in the main circuit will acquire heat from the liquid in at least that part of the second circuit which is in common with the main circuit, so that eventually the liquid throughout the main circuit becomes heated.

A suitable constructional form of the electric heater already referred to is shown in Fig. 3 and comprises a heating chamber 5 composed of a horizontally arranged cylinder 12 and a surmounted adjoining header 13 extending substantially over the length of the cylinder 12. The cylinder 12 is closed at one end 14 and adapted at the other end 15 to have inserted therein an electric immersion heater unit 16 preferably of the loop rod resistance type. The heater unit 16 makes a screw-in connection 17 at its outer end with the open end 15 of the cylinder 12, appropriate terminals 18 for connecting the leading in wires being provided.

Midway along its lower side the cylinder 12 is provided with the inlet 6 previously referred to as adapted to have the downtake pipe 7 of small diameter connected thereto, and in its upper side at each end the cylinder is provided with ports 19, 20 communicating with the header 13. By means of the ports 19, 20 the flow of liquid through the inlet 6 into the cylinder 12 can be caused to divide in directions longitudinally of the cylinder and to be turned again so that the two streams meet in the header 13 in the region of the medial vertical line through the heater and then rise up a common outlet 8 forming the previously described heater outlet from which is to be led the uptake pipe 9 already referred to.

The heater 5 may also serve for the heating of duplicate second thermo-siphonic circuits in applying the invention to a V-type engine block. To this end two further outlets 8a, 8b are arranged, preferably in line with the aforesaid common outlet 8, at opposite ends of the header 13 and more or less directly above the respective ports 19 and 20. When using the heater in association with a single main thermo-siphonic circuit, such as applies with an engine consisting of a single block, only the aforesaid common outlet 8 will be employed, the two further outlets 8a, 8b being suitably plugged. On the other hand one and the same heater according to Fig. 3 may have the common outlet 8 plugged and the two further outlets 8a, 8b liberated so as each to be connected to an appropriate one of duplicate outflow pipes which are usually to be found leading to the radiator from a double or V-type engine block. This latter arrangement wherein, of course, the flow through the heater cylinder ports 19, 20 takes place more or less directly towards the respective end outlets 8a, 8b from the header 13 is shown schematically in Fig. 4.

Referring to Fig. 4, duplicate outflow pipes 4a, 4b are shown in plan leading from the top of a V-type engine block 1a to the tops of a radiator 2b, the lower end of the radiator 2a being connected to the lower end of the block 1a by a lower inflow pipe 3a corresponding to the inflow pipe 3 of the system shown in Fig. 1. Duplication of the uptake pipe 9 and the venturi 10 shown in Fig. 1 is represented in Fig. 4 by the parts therein designated 9a, 9b and 10a, 10b respectively. With a downtake pipe 7 interconnecting the inflow pipe 3a and the heater 5 as indicated and in the manner described already with reference to Fig. 1, and with the heater outlets 8a and 8b connected respectively to the Venturi devices 10a and 10b it will be apparent that in each of the duplicated liquid circuits thus established the circulation can be set up in the same manner as occurs with the system shown in Fig. 1.

Proportions of the heater and heating capacity of the flow heating units are so chosen that the tendency of the heater is to maintain a quiet continuous flow of the engine cooling water. For heating the engine cooling water of an engine of 20 H. P. or below a heater consuming 500 watts may be found to be satisfactory, whilst for an engine of more than 20 H. P. it is desirable that the consumption should be of the order of 1,000 watts.

Attachment of the heater to a motor vehicle may be conveniently effected by a bracket such as that indicated generally at 21 in Fig. 3 suited to the particular construction of the vehicle. Thus the bracket may be provided with a projection or dowel 22 adapted for location in a hole in a part of the chassis frame, the final attachment being made by means of a bolt passing through a bolt hole 23 also provided in a part of the bracket.

The heater may be included as a resistance unit in the circuit of a battery charger, a rectifier being inserted in the battery circuit when A. C. supply is used. In this connection it may be desirable to adopt the circuit arrangement dis-

closed by my concurrent United States application of 1943.

While I have shown particular embodiments of my invention it will, of course, be understood that I do not wish to be limited thereto, since different modifications may be made both in the instrumentalities employed and in the arrangement thereof, and I aim by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What claim is:

1. In a liquid circulating system, the combination of two circuits arranged for thermo-siphonic circulation of liquid therein and including a common descending column, means for heating one of said circuits so as to cause the liquid in that circuit to flow under thermo-siphonic action, and a venturi arranged in such relation to each of said circuits that the liquid which is caused to flow in the one circuit by said heating means flows through said venturi and simultaneously promotes the circulation of liquid in the other circuit.

2. In a liquid circulating system, the combination of two circuits arranged for thermo-siphonic circulation of liquid therein and including a common descending column, means for heating one of said circuits so as to cause the liquid in that circuit to flow under thermo-siphonic action, and Venturi-action means so included in common with said two circuits as to pass the flow of liquid in the one circuit due to said heating means and to constrain the liquid in the other circuit to circulate in response to said flow.

3. In a thermo-siphonic liquid circulating system, the combination of two circuits arranged for circulation of liquid therein through a common descending path means for applying heat to one of said circuits for promoting the circulation of liquid in that circuit, a Venturi device, said device having a Venturi-action passage therein forming a part of the other circuit and aiding the flow of liquid in the direction of the descending path, and said first-mentioned circuit having a part thereof opening into said Venturi-action passage.

4. In a thermo-siphonic liquid circulating system, the combination of two circuits arranged for circulation of liquid therein through a common descending path, means for applying heat to one of said circuits for promoting the circulation of liquid in that circuit, a Venturi device, said device having a Venturi-action passage therein forming a part of the other circuit and aiding the flow of liquid in the direction of the descending path, and said first-mentioned circuit having a part thereof opening obliquely into said Venturi-action passage so as to direct the liquid towards the descending path.

5. In a thermo-siphonic liquid circulating system, the combination of two circuits arranged for circulation of liquid therein through a common descending path, means for applying heat to one of said circuits for promoting the circulation of liquid in that circuit, a Venturi device, said device having therein a Venturi-action passage including a constriction and forming part of the other circuit so as to aid the flow of liquid towards the descending path and said first-menitoned circuit having a part thereof opening obliquely into said passage in the region of said constriction so as to direct the liquid forwardly thereof.

6. A method of heating and circulating liquid in a system arranged for liquid circulation in a predetermined direction under thermo-siphonic action in a main circuit including inflow and outflow portions with respect to a body to be heated, which consists in causing a part of the liquid contained in said inflow portion to be diverted into a path leading to said outflow portion so as to form a second thermo-siphonic circuit operatable in common with part of the main circuit but by-passing said body, locally applying heat to the liquid received in said path at a position enabling flow of said liquid to occur in said second circuit under thermo-siphonic action thereby also imparting heat to the liquid in said main circuit, and causing the liquid being heated in said second circuit to flow through a venturi so included with said main circuit as to promote the circulation in said main circuit.

7. A method of heating and circulating liquid in a system arranged for liquid circulation in a predetermined direction under thermo-siphonic action in a main circuit including inflow and outflow portions with respect to a body to be heated which consists in causing a part of the liquid contained in said inflow portion to be diverted into a path leading to said outflow portion so as to form a second thermo-siphonic circuit operatable in common with part of the main circuit but by-passing said body, locally applying heat to the liquid received in said path at a position enabling flow of said liquid to occur in said second circuit under thermo-siphonic action thereby also imparting heat to the liquid in said main circuit, and causing the liquid being heated in said second circuit to flow through a venturi so included at the juncton of said path with said outflow portion so as to promote the predetermined directional circulation of liquid in said main circuit.

8. A method of heating and circulating liquid in a system arranged for liquid circulation in a predetermined direction under thermo-siphonic action in a main circuit including inflow and outflow portions with respect to a body to be heated, which consists in causing a part of the liquid contained in said inflow portion to be diverted into a path leading to said outflow portion so as to form a second thermo-siphonic circuit operatable in common with part of the main circuit but by-passing said body, locally applying heat to the liquid received in said path at a position enabling flow of said liquid to occur in said second circuit under thermo-siphonic action thereby also imparting heat to the liquid in said main circuit, and causing the liquid being heated in said second circuit to flow through a venturi so included at the junction of said path with said outflow portion as to promote the predetermined directional circulation of liquid in said main circuit, the delivery into said venturi of said liquid flowing in said second circuit being effected obliquely in a direction causing said liquid to proceed in the same sense as the flow which occurs in said main circuit.

9. A liquid circulating system comprising in combination a body to be heated, a heat radiator spaced from said body, inflow and outflow circulating pipes connected with said body so as to form therewith and with said radiator respectively lower and upper components of a liquid cooling main circuit operatable on the thermo-siphonic principle during heating of said body, a further circulating pipe system communicating with said inflow and outflow pipes and including a heater and said radiator and forming a second thermo-siphonic circuit by-passing said body, said second circuit including a venturi-action tube so situated

as to promote the circulation of liquid in said main circuit.

10. A liquid circulating system comprising in combination a body to be heated, a heat radiator spaced from said body, inflow and outflow circulating pipes connected with said body so as to form therewith and with said radiator respectively lower and upper components of a liquid cooling main circuit operatable on the thermo-siphonic principle during heating of said body, a further circulating pipe system communicating with said inflow and outflow pipes and including a heater and said radiator and forming a second thermo-siphonic circuit by-passing said body, said second circuit including a Venturi-action tube so situated as to promote the circulation of liquid in said main circuit, and said further circulating pipe system including a pipe having a delivery end in connection with the interior of said Venturi-action tube, said connection being made obliquely with respect to the axis of said tube and in a direction tending to cause the flow from said delivery end to proceed in the same sense as the flow which occurs in the main circuit.

11. A liquid circulating system comprising in combination a body to be heated, a heat radiator spaced from said body, inflow and outflow circulating pipes connected with said body so as to form therewith and with said radiator respectively lower and upper components of a liquid cooling main circuit operatable on the thermo-siphonic principle during heating of said body, a further circulating pipe system communicating with said inflow and outflow pipes and including a heater and said radiator and forming a second thermo-siphonic circuit by-passing said body, said heater comprising an electric heater of the flow through type and having a lower inlet connected by a circulating pipe to said inflow pipe of said main circuit and an upper outlet connected by a further circulating pipe to said outflow pipe of said main circuit, and said second circuit including a Venturi-action tube so situated as to promote the circulation of liquid in said main circuit.

12. A liquid circulating system comprising in combination a body to be heated, a heat radiator spaced from said body, inflow and outflow circulating pipes connected with said body, so as to form therewith and with said radiator respective lower and upper components of a liquid cooling main circuit operatable on the thermo-siphonic principle during heating of said body, a further circulating pipe system communicating with said inflow and outflow pipes and including a heater and said radiator and forming a second thermo-siphonic circuit by-passing said body, said heater comprising an electric heater of the flow through type and having a lower inlet connected by flexible hose to said inflow pipe of said main circuit and an upper outlet connected by flexible hose to said outflow pipe of said main circuit, and said second circuit including a Venturi-action tube so situated as to promote the circulation of liquid in said main circuit.

13. A liquid circulating system comprising in combination a body to be heated, a heat radiator spaced from said body, inflow and outflow circulating pipes connected with said body so as to form therewith and with said radiator respectively lower and upper components of a liquid cooling main circuit operatable on the thermo-siphonic principle during heating of said body, a further circulating pipe system communicating with said inflow and outflow pipes and including a heater and said radiator and forming a second thermo-siphonic circuit by-passing said body, said heater comprising an electric heater of the flow through type and having a lower inlet connected by flexible hose to said inflow pipe of said main circuit, said flexible hose having a diameter smaller than that of said inflow pipe, and an upper outlet connected by flexible hose to said outflow pipe of said main circuit, and said second circuit including a Venturi-action tube so situated as to promote the circulation of liquid in said main circuit.

14. A liquid circulating system comprising in combination a body to be heated, a heat radiator spaced from said body, a lower inflow pipe and upper duplicate outflow pipes connected with said body so as to form therewith and with said radiator a liquid cooling main circuit operatable on the thermo-siphonic principle during heating of said body, a further circulating pipe system interconnecting said inflow pipe and each of said outflow pipes, said further pipe system including a heater and forming with said radiator a second thermo-siphonic circuit having duplicate portions by-passing said body, said second circuit including in each of said duplicate portions a Venturi-action tube so situated as to promote the circulation of liquid in said main circuit.

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