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PROCESS OF OPERATING THE SAME
Filed Nov. 20, 1922

2 Sheets-Sheet 1

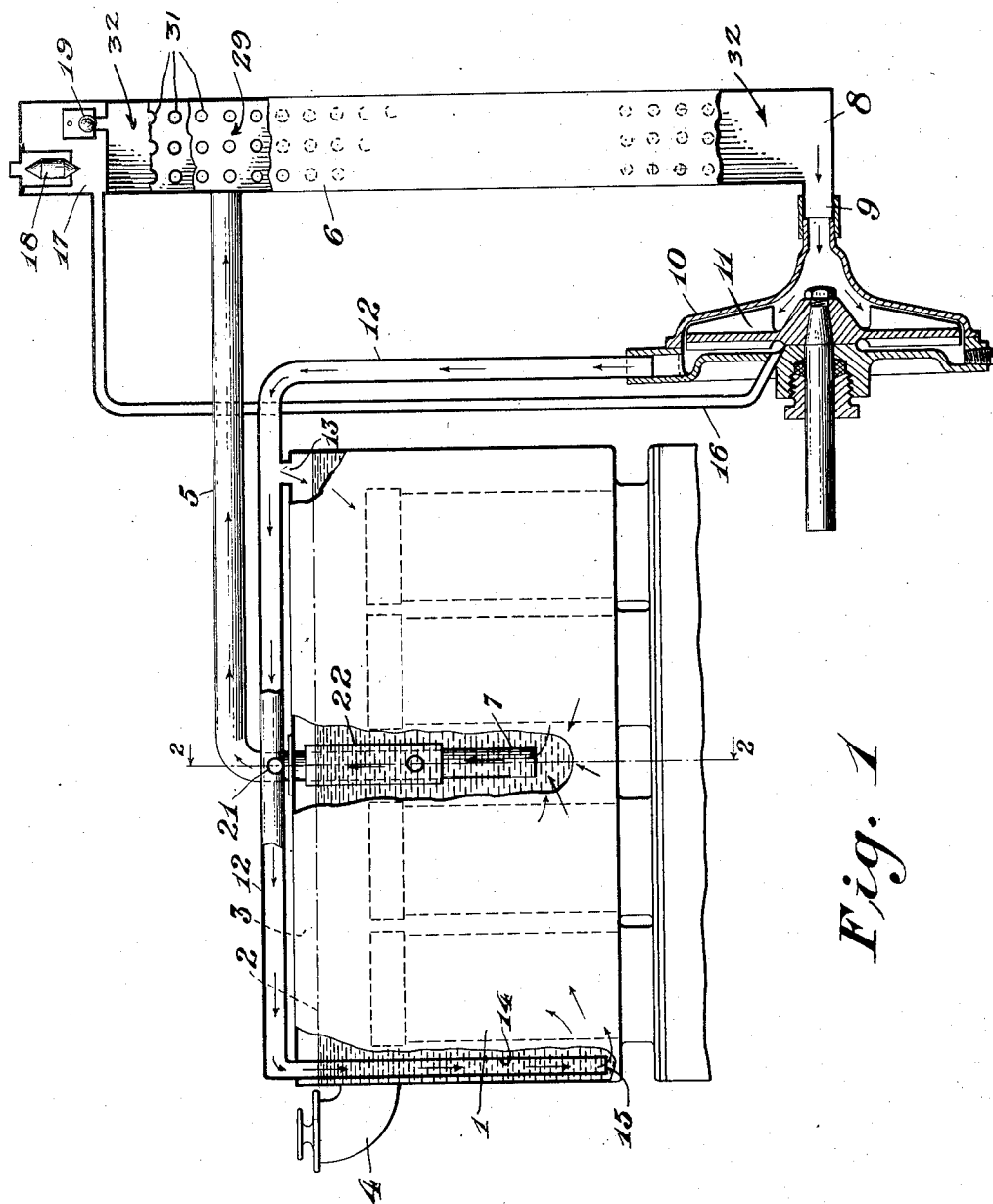


Fig. 1

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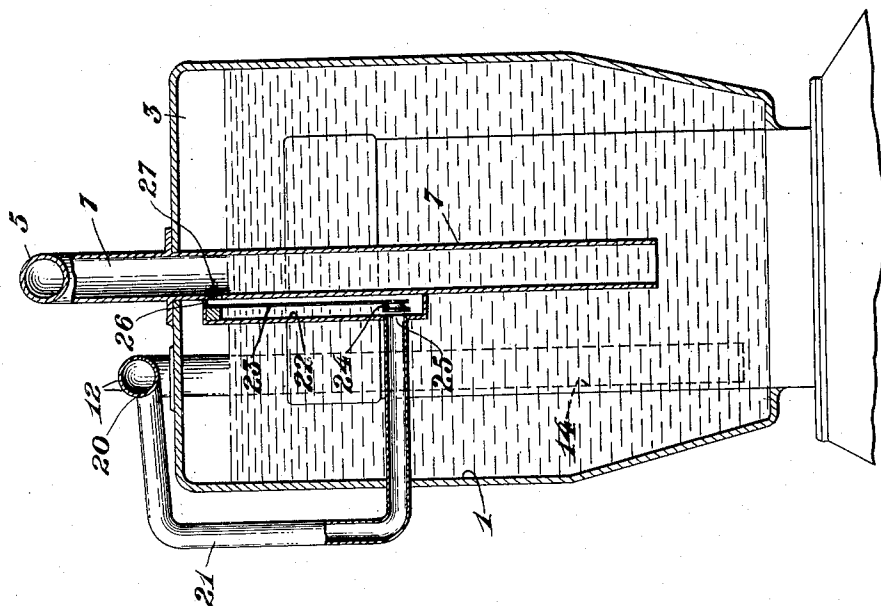


Fig. 2

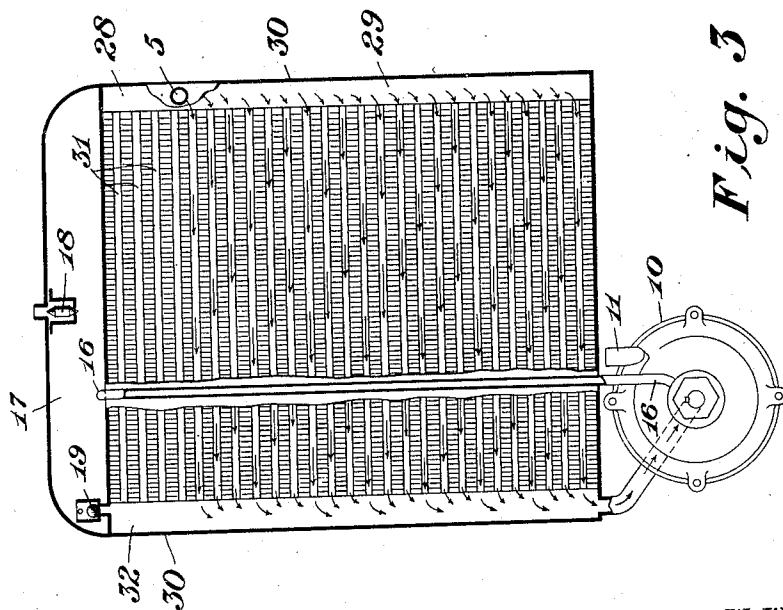


Fig. 3

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COOLING SYSTEM FOR INTERNAL-COMBUSTION ENGINES AND PROCESS OF OPERATING THE SAME.

Application filed November 20, 1922. Serial No. 602,265.

This invention relates to a cooling system for internal combustion engines, and the process of operating the same, and has for its object to provide a system which will be comparatively inexpensive to construct, certain in action, and more efficient in use than those heretofore proposed.

With these and other objects in view, the invention consists in the novel details of construction and combinations of parts constituting the apparatus, and in the novel steps and combinations of steps constituting the process, all as will be more fully hereinafter disclosed and particularly pointed out in the claims.

Referring to the accompanying drawings forming a part of this specification, in which like numerals designate like parts in all the views:

Figure 1 is a diagrammatic sectional and elevational view partially broken away of a cooling system made in accordance with this invention;

Figure 2 is a sectional view taken on the line 2—2 of Figure 1, looking in the direction of the arrows; and

Figure 3 is a front elevational view of a somewhat modified form of the radiator that may be employed in this system, and having its associated pump parts connected at a lower level than in Figure 1.

1 indicates the jacket of the engine, 2 the level of the liquid therein, 3 a restricted vapor space above said level 2, 4 a filling means which limits the level of the liquid 2 in the jacket, 5 a pipe leading from the jacket to the radiator 6, 7 an extension of said pipe dipping down below the level 2 of the liquid in the jacket, 8 the bottom of the radiator, 9 a connection between the radiator and the pump 10 having its pressure or delivery side at 11 to which is connected the delivery pipe 12 provided with the orifice 13 delivering into the top portion of the jacket and the extension 14 having the orifice 15 delivering into the bottom portion of the jacket.

It should be said that the purpose of thus delivering in the top and bottom portions of the jacket simultaneously is to equalize the temperature therein. That is to say, as

is well known, jacket spaces are often provided with restricted portions, so that should the temperature in a bottom portion of the jacket which happens to be closed to the combustion chamber unduly rise, the liquid is liable to give off a considerable amount of vapor, and steam pockets are liable to form. The accumulation of steam or vapor thus had is liable to cause the liquid to surge through the restricted portions of the jacket aided by the pressure in the space 3 at the top part of the jacket, and this surging is liable to suddenly flood the radiator 6, and to empty the jacket. By delivering the cooled liquid, however, simultaneously in the bottom and top portions of the jacket, as at the points 13 and 15, this tendency to unequal heating is partially obviated and the danger of surging is greatly lessened.

At or near the center of the pump 10 there is joined the vent pipe 16 which connects with the space 17 at the top of the radiator 6, and said space is controlled by the float valve 18 as shown. A check valve 19 is also provided to relieve any undue pressure which may accumulate for any cause in the radiator 6.

At a convenient point such as 20 in the delivery pipe 12, I join the branch pipe 21 and lead the same into the jacket to the thermostatic chamber 22, as best shown in Figure 2. In said chamber 22 is located the thermostat 23 having a thermostatic valve 24 controlling the delivery 25 of the said branch pipe 21, as will be readily understood. Said restricted vapor space 3 is connected with said thermostatic chamber by means of the opening 26 and said branch 7 of the pipe 5 is connected to said thermostatic chamber 22 by means of the opening 27, all as will be clear from Figure 2.

The said pipe 5 joins the radiator 6 at a point somewhat below its top, as is plainly shown in Figure 1. It likewise joins the modified form of radiator 30 shown in Figure 3, at about the same distance from its top, as shown, thus providing, a space 28 above said pipe 5 and another space 29 below said pipe. As a matter of fact, the radiators in both Figures 1 and 3 below the pipe 5 may frequently fill with liquid while

those portions of the radiators 6 and 30 above said pipe 5 seldom or never fill with liquid.

The operation of this cooling system is as follows:

The thermostat valve 24 is closed until, say, a temperature of 160° F. is reached in the jacket liquid. In the meantime, the orifices 26 and 27 are open to the pipe 5, so that the pressure in the space 3 is substantially the same as the pressure in the said pipe 5. The engine being started, the temperature in the jacket will rapidly increase until 160° is reached. In the meantime, any vapor that may accumulate in the space 3 will pass through the orifices 26 and 27, pipe 5, radiator 6, and be condensed. Then it will be passed back through the pipe 9 and pump 10 into the jacket 1. When the temperature of 160° is exceeded, however, the thermostat 23 will open valve 24, which will permit water to pass from the pipe 12 into the branch pipe 21, and past the thermostatic valve into the thermostatic chamber 22. Water will thus pass up to the orifices 26 and 27, and close the same. The parts are so dimensioned and disposed that there will always be a sufficient pressure in the chamber 22 to cause the closing of the orifices 26 and 27 when the valve 24 is open. These said orifices being closed, the pressure in the space 3 will rapidly increase, which will force water up through the pipes 7 and 5 into the radiator 6, and through the pump, and the pipe 12, back into the jacket. Any air or other gases which may pass over with the water into the pump will be separated out at the point 11, the air finding its way toward the center of the pump, and will escape up through the pipe 16, into the chamber 17, and past the valve 18 to the atmosphere.

The radiator 6, is made of a capacity sufficient to abundantly take care of the maximum amount of heat which will be dissipated by this system, and therefore it may cool the jacket water down to any temperature desired. It thus results that the more water that enters the jacket from radiator 6, the cooler will become the jacket liquid, and thus the sooner will the valve 25 be again closed. As long, however, as the valve 25 is open, the dissipation of heat will continue. But when the speed of the engine is reduced the amount of water delivered by the pump to the jacket is reduced and the amount of heat dissipated is likewise reduced for the circulation decreases. When the temperature drops below 160°, in the jacket, the valve 25 will again close, whereupon the level in the jacket being lowered, the liquid closing the ports 26 and 27 will be displaced, and said ports be again opened. Under these conditions the liquid will rapidly heat up until it flows again through

the radiator 6 and back into the jacket. It thus results that the temperature of the jacket is maintained substantially constant or at any predetermined point desired, depending upon the setting of the thermostat.

Referring to the modified form of radiator shown in Figure 3, it will be observed that the pipe 5 enters the radiator 30 below the top thereof. This divides the said radiator into an upper space 28, and a lower space 29, as above stated. Any alcoholic vapor that may pass over with the water will naturally accumulate in the space 28, because the section of the radiator below the pipe 5 is naturally full of water at low speeds. Said alcoholic vapor will leave this water, and pass through the passages 31 over to the space 32, where it having been cooled will find itself in a condensed form, and thus be saved to the system. The valve 19, however, will lift and permit any air to escape that separates out. The valve 18 prevents any air from entering the system when one goes from a high speed or load to a low speed or load, and thus creates a vacuum in the lower portion of the radiator 30. It will thus be seen that this cooling system consists of what may be termed a "hot" side or section and a "cold" side or section, the engine jacket and the horizontally disposed crossflow passages of the radiator forming the point of division between the two sections. In other words, the "hot" section includes the engine jacket, the connections 5 between the engine jacket and the radiator, the vertical side tank 29 of the radiator, and the greater portion of each of the crossflow passages 31 of said radiator. The "cold" section of said system includes the remaining portion of each of the crossflow passages 31 of said radiator, the vertical side tank 32 associated therewith, the connections 9 from said tank 32 to the pump 10, said pump, and the connection 12 from the pump to the engine jacket.

One of the advantages of this system resides in the fact that one may employ only a sufficient amount of water to fill the jacket, and he may therefore maintain the radiators 6 and 30 empty at all times, when the engine is idle and thus prevent freezing. Another advantage is due to the fact that one may regulate the amount of flow through the radiator by controlling the difference in pressure in the space 3 and in the pipe 5. This difference in pressure is controlled in turn by blocking the openings 26 and 27, or opening the same in the manner above described. That is, the thermostatic valve 25 serves to maintain the temperature of the jacket substantially constant, because it controls the pressure in the space 3 by permitting the water to open and close the orifices 26 and 27.

In other words, I have devised a method of operation which consists in maintaining

the temperature of the jacket substantially constant through a control of the difference in pressure between the space 3 and the pipe 5, which pressure in turn controls the rapidity of the circulation from the jacket through the pipe 5 and through the radiator and pump back to the jacket. The valves 18 and 19 enable one to produce the partial vacuum above mentioned, because, as the pump draws the liquid out of the radiator, these valves prevent any air from taking its place. And if the pump goes from a high load to a low load, it will draw the liquid out of said radiators somewhat faster than the pressure causes it to enter under certain conditions. The thermostat here disclosed is of a comparatively inexpensive type; one gets rid of the air in this system automatically, and at the same time he saves all of his alcoholic vapor.

Another advantage of this system, as will be apparent from an inspection thereof, resides in the fact that only the jacket is filled with liquid, leaving no liquid normally in the radiator at all, and therefore the system can be raised to its working temperature in a much shorter period of time than has been possible with the prior systems.

A still further advantage of this system resides in the fact that the system can be worked under a pressure less than that of the atmosphere due to the particular construction of the pump and the vent pipe 16 which carries the air out of the system as fast as it comes in. Therefore, the pressure of the air entering the system would prevent any leaks of alcoholic vapor or other liquid to the outside.

It is obvious that those skilled in the art may vary the details of construction, the arrangement of parts, and the process of cooling without departing from the spirit of the invention, and therefore I do not wish to be limited to the foregoing disclosure except as may be required by the claims.

What is claimed is:

1. The method of operating a cooling system for internal combustion engine jackets having a restricted vapor space which consists in maintaining a pressure in said space below that of the atmosphere, and controlling the said pressure in said space by the temperature of the liquid in said jacket while controlling the circulation of liquid through the system, and venting any air present in the liquid after the latter has been cooled.

2. The method of operating an internal combustion engine liquid cooling circuit provided with a heat absorbing section and a heat dissipating section said circuit further provided with a normal liquid level in the heat absorbing section which consists in evolving vapors from said liquid in the heat absorbing section causing the liquid to pre-

vent the escape of said vapors from above the liquid level in the heat absorbing section to the heat dissipating section when the engine is running and when the temperature of said liquid is above a predetermined point; causing the pressure of the entrapped vapors to create a flow of said liquid to the heat dissipating section for cooling; and returning the cooled liquid to the heat absorbing section.

3. The method of operating an internal combustion engine liquid cooling circuit provided with a heat absorbing section and a heat dissipating section said circuit further provided with a normal liquid level in the heat absorbing section which consists in causing the liquid to prevent the escape of vapors from above the liquid level in the heat absorbing section to the heat dissipating section when the engine is running and when the temperature of said liquid is above a predetermined point, in order to increase the vapor pressure in said heat absorbing section and the flow of liquid through said circuit; and causing said liquid to permit the escape of vapors from above the liquid level in said heat absorbing section when the engine stops in order to prevent said liquid from leaving said section.

4. The method of cooling the fluid of an internal combustion engine system having a hot and a cold section as well as a vent without loss of said fluid from said system which consists in circulating said fluid between said hot and cold sections; and permitting any vapor collecting in said system, under pressure, to pass from the hot section to the cold section for condensation when the fluid is not being circulated and while the air is passing to said vent.

5. The method of operating a cooling system for internal combustion engines provided with a liquid circuit including a heat dissipating region, a heat absorbing region, and a vapor region, which consists in raising the temperature of said liquid to evolve vapors therefrom in said heat absorbing region; and preventing the escape of said vapors from said heat absorbing region to said heat dissipating region when the engine is running and when the temperature of said liquid is above a predetermined point.

6. The method of operating a liquid cooling circuit for an internal combustion engine provided with a heat absorbing region and a vapor region, which consists in controlling the pressure of the fluid above the level of the liquid in the heat absorbing region by the temperature of the liquid therein while controlling the circulation of liquid through the circuit; and clearing the circuit of any air present above the level of liquid therein.

7. The method of operating a cooling sys-

tem for internal combustion engines provided with a liquid circuit comprising a heat dissipating region and a heat absorbing region which consists in causing said liquid
 5 to prevent the escape of vapors from said heat absorbing region to said heat dissipating region when the engine is running and when the temperature of said liquid is above a predetermined point, in order to increase
 10 the vapor pressure in said heat absorbing region; and the flow of liquid through said circuit; and causing said liquid to permit the escape of vapors when the engine stops in order to prevent said liquid from leaving
 15 said heat absorbing region.

8. A cooling system for internal combustion engines including an engine jacket, a pump, a cooler connected therebetween, and conduits for conveying the fluid from the
 20 jacket to and through the cooler without displacing from said system any liquid in a flooded portion of said cooler as well as for returning the cooled fluid to said jacket when said pump is operating, said system
 25 provided with a vent directly connected to the return conduit.

9. A cooling system for internal combustion engines including an engine jacket, a liquid circulating pump, and a cooler in
 30 combination with a vented tank adjacently communicating with the passages of said cooler permitting any air or vapor collecting in said system under pressure to enter said cooler and readily pass from the hot
 35 to the cold side thereof when said pump is not in operation, without withdrawing fluid from the circulatory system.

10. A cooling system for internal combustion engines including an engine jacket, a
 40 liquid circulating pump, and a cooler in circuit combination with a vented tank communicating with all the passages of said cooler permitting any air or vapor collecting in said system under pressure to enter said
 45 cooler and readily pass from the hot to the cold side thereof without displacing the liquid in said cooler when said pump is not in operation.

11. A cooling system for internal combustion engines including an engine jacket, a
 50 liquid circulating pump, and a cooler in circuit combination with a vented tank communicating with all the passages of said cooler permitting any air or vapor collect-
 55 ing in said system under pressure to enter said cooler and readily pass from the hot to the cold side thereof without displacing the liquid in said cooler when there is only a small difference in pressure between the
 60 hot and cold sides thereof, as at low engine speeds.

12. A cooling system for internal combustion engines including an engine jacket, a
 65 liquid circulating pump, and a vapor condenser in circuit combination with a tank

adjacently communicating with all the passages of said condenser permitting any air or vapor collecting in said system under
 pressure to enter said condenser and readily
 70 pass from the hot to the cold side thereof without displacing the liquid in said condenser when there is only a small difference in pressure between intake and outlet sides of said pump as at low speeds; and means
 75 associated with said tank for separating any air from the liquid between the condenser and said pump.

13. A cooling system for internal combustion engines including an engine jacket, a liquid circulating pump, and a cooler pro-
 80 vided with a plurality of passages each of which is in circuit combination with a tank; and a vent permitting any vapor collecting in said system under pressure to enter and
 85 pass through said passages for condensation when said cooler is 90% full of liquid.

14. A cooling system for internal combustion engines including an engine jacket, a pump connected thereto for supplying said
 90 jacket with cooling fluid, and a radiator connected to said jacket and said pump for cooling liquid and condensing vapor received from said jacket, said system including
 95 means connected to a tank in said supply circuit, permitting a continued passage of liquid and the vapor therethrough when the pump is operating at small differences
 100 of pressure as at low speeds, said tank communicating with the passages of said radiator.

15. A cooling system for internal combustion engines including a jacket, a condenser connected thereto provided with a plurality
 105 of fluid conducting passages and a pump for circulating a jacket cooling fluid therebetween, said system provided with vented means extending above and below and communicating with all of said passages pre-
 110 venting the condenser from becoming air-bound when the circulating pump is operated at small differences in pressure between its inlet and discharge, whereby said circulation is insured.

16. In a cooling system for internal combustion engines the combination of a jacket
 115 for the engine; heat dissipating passages; a circulating pump for the cooling fluid; a vent; and connections between said jacket, said passages, said vent, and said pump for
 120 conducting said fluid, said passages and said pump having disposed therebetween in circuit relation with the passages a tank to freely receive at all times air or vapor collecting
 125 in the system under pressure, and having passed through some of said passages when said pump is stopped and the other of said
 130 passages are closed with liquid.

17. A cooling system for internal combustion engines comprising a hot section includ-
 135 ing the engine jacket and heat dissipating

passages connected thereto, and comprising a cold section including a pump and a conduit leading therefrom connecting with said jacket, said hot and cold sections being connected by a vertically disposed tank vented to the atmosphere at its top, said tank being in open communication at its bottom with a second conduit connecting with said pump, and in further open communication at its side with said passages, whereby any vapor in the jacket under pressure may pass over to and through said passages for condensation when the pump is not in operation.

18. In a cooling system for the jacket fluid of an internal combustion engine provided with a jacket and a condenser having a plurality of passages for cooling said fluid while conducting the same in a lateral direction from one side to the other side of said condenser the combination of vented means to circulate said fluid between said jacket and said condenser; and means associated with the top of said condenser to vent air alone at all times when the lowermost portion of said condenser is flooded with liquid.

19. In a cooling system for internal combustion engines provided with a jacket for the cooling fluid and a condenser having a plurality of passages for cooling said fluid while conducting the same in a lateral direction from the inlet side to the outlet side thereof the combination of vented means for forcibly circulating said fluid between said jacket and said condenser; and means for preventing pressure from forming between said passages of said condenser and said circulating means at all engine speeds.

20. A cooling system for internal combustion engines including a jacket, a condenser connected thereto, provided with a plurality of substantially horizontal fluid conducting passages, and a pump adapted to separate air from liquid for circulating a jacket cooling fluid therebetween, said system provided with means for preventing the escape of fluid therefrom regardless of the temperature thereof when said pump is operated at small differences in pressure head between its inlet and its outlet.

21. In a cooling system for internal combustion engines the combination of a jacket having means to maintain a restricted vapor space above the level of liquid in said jacket; a condenser; a circuit pipe connecting said jacket and condenser below the top of the cooling tube section in said condenser; check valves for permitting the escape of air from said condenser but preventing the ingress of air thereto; means comprising a pump for returning the liquid from said condenser to said jacket; a vent tube leading from the center of said pump to the top of said condenser; and thermostatic means for

controlling the difference of pressure between said vapor space and said circuit pipe.

22. In a cooling system for internal combustion engines the combination of a jacket; means to restrict the level to which liquid may be filled into said jacket to provide a restricted vapor space in the top thereof; a condenser; a pipe having an extension dipping below the level of liquid in said jacket provided with an opening communicating with said vapor space and connected to said condenser; a pump joined to said condenser; a return connection between said pump and said condenser; a thermostatic valve controlled by the temperature of the jacket; and means associated with said valve for controlling the circulation of liquid through said condenser and pump.

23. In a cooling system for internal combustion engines the combination of a jacket; means to restrict the level to which liquid may be filled into said jacket to provide a restricted vapor space in the top thereof; a cooler; a pipe dipping below the level of liquid in said jacket connected to said cooler; a pump joined to said cooler; a return connection between said pump and jacket; a thermostatic valve controlled by the temperature of the jacket; and means associated with said valve comprising a thermostatic chamber provided with a plurality of openings adapted to be closed by liquid for controlling the circulation of liquid through said cooler and pump.

24. In a cooling system for internal combustion engines the combination of a jacket having means to maintain a restricted vapor space above the level of liquid in said jacket; a condenser; a circuit pipe connecting said jacket and condenser and extending below the liquid level in said jacket; means for returning the liquid from said condenser to said jacket; and means comprising a chamber disposed on the submerged portion of said circuit pipe, a thermostatic valve in said chamber and a pair of passages leading therefrom for controlling the difference of pressure between said vapor space and said circuit pipe.

25. In a cooling system for internal combustion engines the combination of a jacket having means to maintain a restricted vapor space above the level of liquid in said jacket; a condenser; a circuit pipe connecting said jacket and condenser; means for returning the liquid from said condenser to said jacket; and means comprising a branch pipe from said last named means, and a thermostatic valve governing the exist of said branch pipe, for controlling the difference of pressure between said vapor space and said circuit pipe.

26. In a cooling system for internal combustion engines the combination of a jacket

having means to maintain a restricted vapor space above the level of liquid in said jacket; a condenser; a circuit pipe connecting said jacket and condenser below a portion of the vapor passages in the latter; means for returning the liquid from said condenser to said jacket; a plurality of valves permitting the egress of air from said condenser and said last named means; and means for controlling the difference of pressure between said vapor space and said circuit pipe. 10

In testimony whereof I affix my signature.
WELLINGTON W. MUIR.