May 26, 1936. F. W. HILD 2,041,928

MULTIFLOW COOLING SYSTEM

Filed Aug. 14, 1931 2 Sheets-Sheet 1

Fig.1.

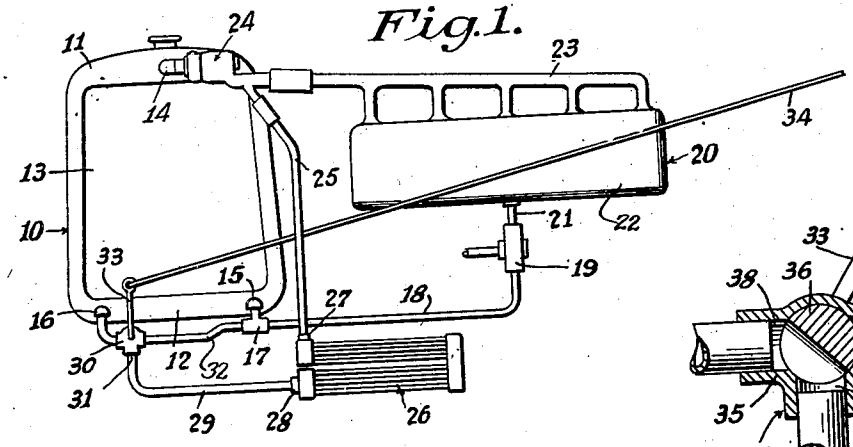






Fig.3.

Fig.4.

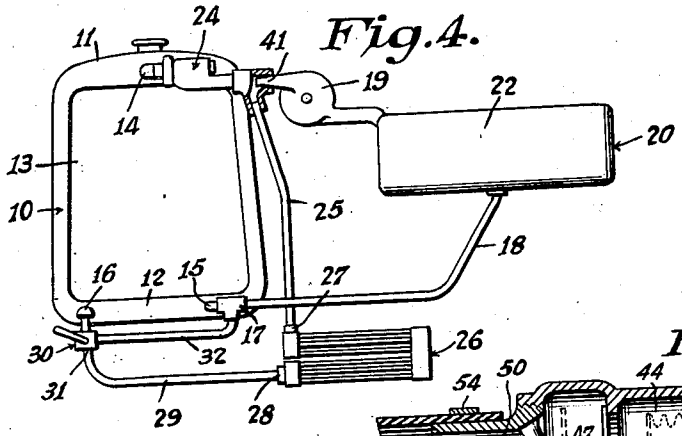



Fig.2.

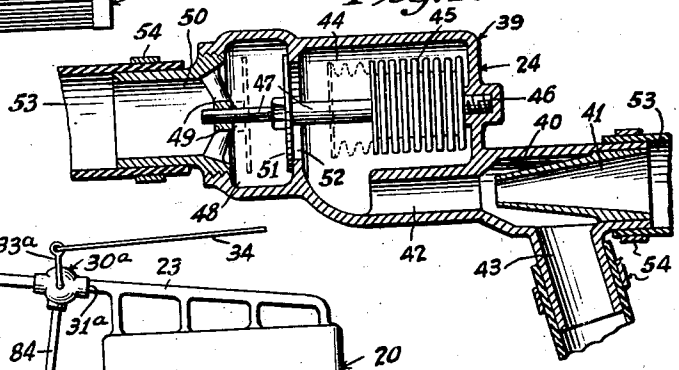
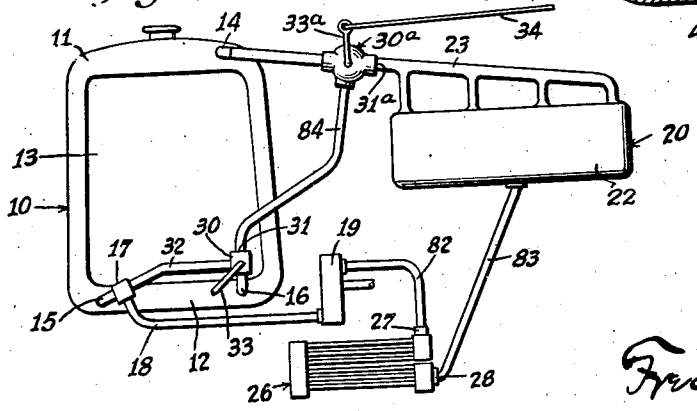



Fig.5.




Inventor.

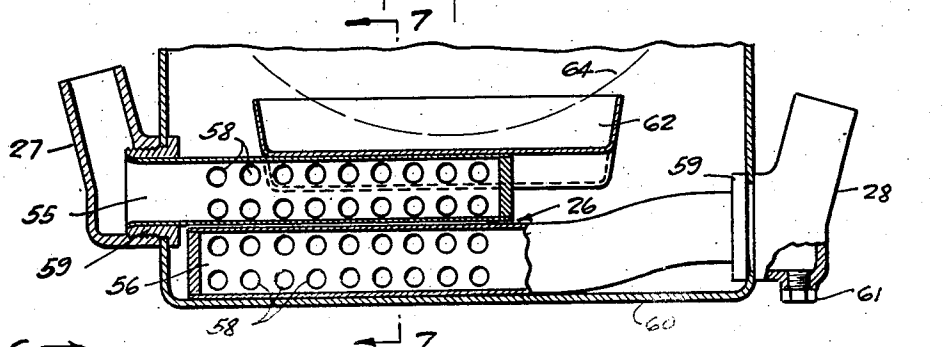
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MULTIFLOW COOLING SYSTEM

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Fig. 6



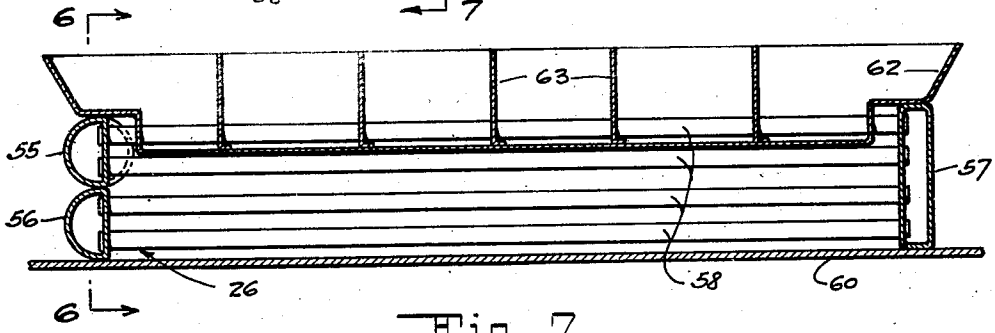




Fig. 7

Fig. 8

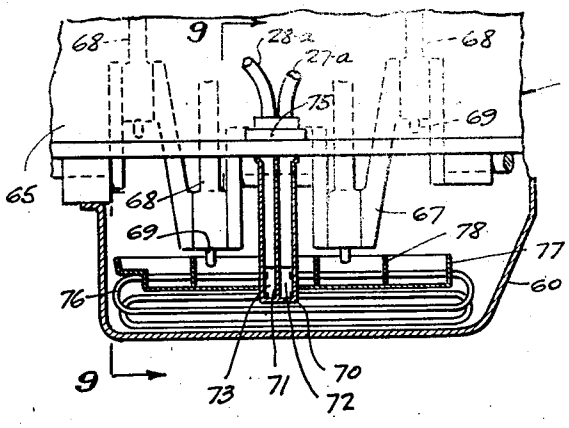
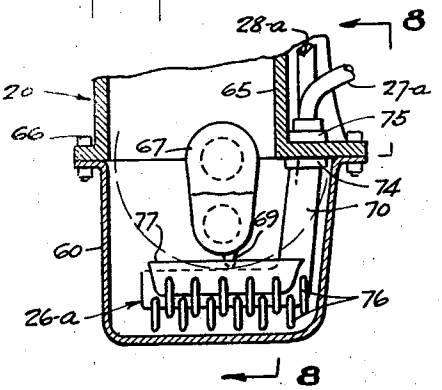



Fig. 9




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# UNITED STATES PATENT OFFICE

2,041,928

## MULTIFLOW COOLING SYSTEM

Frederic W. Hild, Los Angeles, Calif.

Application August 14, 1931, Serial No. 557,082

17 Claims. (Cl. 123—196)

My invention relates to cooling systems for internal combustion engines and particularly to multiflow cooling systems.

In my co-pending application Serial No. 494,567 filed November 10, 1930, I have disclosed a multiflow cooling system in which the flow inducer valve adjustment may be varied for the seasonal temperature range. It is an object of my present invention to provide regulating means for the cooling system which shall enable other adjustment for the atmospheric and other temperature changes. It is a further object to provide pump ejector means for circulating liquid by negative or vacuum pressure through two separate cooling channels of the engine.

In my co-pending application Serial No. 517,786 filed February 24, 1931, I have shown a novel oil cooler or "thermalizer" disposed in the crankcase of the engine and which in practical use has proven highly efficient. It is an object of my present invention to further improve my said oil cooler by making it simpler and less in cost. Still another object is to provide an oil cooler for engines employing the splash system of lubrication.

Other objects and advantages of my invention will be apparent from the following description and the accompanying drawings:

Figure 1 shows in semi-diagram the apparatus embodying my invention.

Figure 2 is a sectional elevation of the flow inducer.

Figure 3 is a sectional view of the T valve.

Fig. 4 shows in semi-diagram another arrangement of the apparatus embodying my invention.

Fig. 5 shows in semi-diagram still another arrangement of the apparatus embodying my invention.

Figure 6 is a transverse sectional elevation of the oil cooler taken on the line 6—6 of Figure 7.

Figure 7 is a longitudinal, sectional elevation of the oil cooler taken on the line 7—7 of Figure 6.

Figure 8 is a longitudinal, sectional elevation of another form of oil cooler taken on the line 8—8 of Figure 9.

Figure 9 is a transverse sectional elevation of said other form of oil cooler taken on the line 9—9 of Figure 8.

Referring to the drawings, the radiator 10 is conventional and its upper or hot water tank 11 is connected to the lower or cold water tank 12 by the cooling core 13 which may be either the tubular or the honey comb type. The upper tank has an inlet 14; and the lower tank has two outlets 15 and 16.

In Figure 1, the radiator outlet 15 is connected to the T 17 from which a pipe 18 leads to the suction end of the water pump 19. The pump is driven by the engine 20 in any of the established ways. A pipe 21 connects the discharge end of the pump to the engine cylinder jacket 22. A hot water discharge manifold 23 leads from the cylinder jacket to the nozzle of the flow inducer 24, the main discharge end of the flow inducer being connected to the inlet 14 of the upper tank of the radiator. The intermediate opening of the flow inducer receives the pipe 25 which leads to terminal connection 27 of the oil cooler 26. From the other terminal connection 28 of the oil cooler, a pipe 29 leads to the primary opening 31 of the T valve 30. The outlet 16 of the lower tank of the radiator is connected to one end of the two secondary openings of the T valve, the other secondary opening of the T valve being connected by the pipe 32 to the T 17. The T valve 30 has valve stem 33 which may be connected for remote operation by a rod 34 which may extend to the driver's compartment (not shown) of the auto-vehicle driven by the engine 20.

The T valve 30 may be any suitable three way valve; as here shown it has a body 35 containing the valve 36 which is a half cylinder secured to the valve stem 33. The valve 36 controls the two secondary ports 37 and 38 but not the primary port 31. The valve 36 when rotated may close either of the two secondary ports 37 and 38, but the valve cannot close them both at the same time. It is evident that both secondary ports may be partially open. The primary port 31 is always fully open.

The flow inducer 24 has a body 39 which forms a series of communicating chambers. The receiving or inlet end is the vacuum chamber 40 and contains the ejector nozzle 41. The large end of the nozzle receives the hot water from manifold 23; the small end of the nozzle jets the liquid into the the ejector passage 42. The intermediate inlet 43 leads into the vacuum chamber 40 and according to the well-known action of the ejector, liquid in the vacuum chamber will be ejected therefrom, into and through the ejector passage 42 by the action of the jet issuing from the nozzle 41. The ejector passage 42 leads into the thermostat chamber 44 which contains the thermostat 45.

The thermostat has threaded stud 46 at one end by which it is secured to the body 39. The other end of the thermostat is movable upon expansion or contraction of the thermo-sensitive fluid contained by the thermostat bellows. This movable end has a stem 47 which projects be-

yond the chamber 44 through the valve chamber 48 into the guide arms 49 of the outlet member 50. The outlet member 50 is threaded into the body 39 at the valve chamber 48. A valve disc 51 is secured to the stem 47 at the opening 52 between chambers 44 and 48. When the thermostat is contracted the valve disc is seated in closed position at the opening 52 so that liquid cannot then flow from the flow inducer through outlet member 50.

Radiator hose 53 and hose clamps 54 may be used to secure the flow inducer into the cooling system by connecting nozzle 41 to manifold 23 and connecting intermediate inlet 43 to pipe 25 which connects with oil cooler 26 at outlet 27.

The oil cooler 26 is a heat exchange device for heating and for cooling the lubricating oil of the engine. The oil cooler may be secured into the oil pan and made part thereof as shown in Figures 6 and 7 and in my aforesaid application Serial No. 517,786, or it may be secured to and made part of the engine block or frame and be free and independent of the oil pan as shown in Figures 8 and 9. In either arrangement the oil cooler may include an oil tray for use in engines employing the splash system of lubrication. The tray may be omitted when the splash system is not used.

Referring to Figures 6 and 7, the oil cooler 26 has the outlet and inlet headers 55 and 56 respectively and the return header 57. These headers are tubes suitably flattened as shown to receive the numerous small tubes 58 which are secured fluid tight into the headers. One end each of the inlet and the outlet headers and both ends of the return header are closed. The open ends of the outlet and inlet headers are secured fluid tight into bushings 59 which lead through the side walls of oil pan 60. The bushings are threaded to receive terminal connection 27 and terminal connection 28 which serve also as nuts to firmly secure the bushings and the headers fluid tight to the walls of the oil pan 60. Terminal connection 28 has a threaded hole into which is secured the taper drain plug 61, which being practically the lowest point in the cooling system is well adapted for draining it when required. The tubes 58 are so joined to the three headers that fluid entering the oil cooler at terminal inlet 28, must flow through connection header 56 then through one half in number of the tubes 58 into return header 57 then through the remaining half in number of the tubes 58 into outlet header 55 discharging therefrom through outlet terminal 27. The oil cooler 26 is immersed in the lubricating oil in the oil pan 60, so that liquid flowing through the oil cooler is in close thermal association but not in contact with the lubricating oil.

When the splash system is used, the oil tray 62 is secured to the upper part of the oil cooler. The tray has several transverse partitions 63 which divide the tray into compartments according to the number and spacing of the oil dippers or scoops on the crank shaft assembly. The path of the outermost part of the oil dippers through their compartments is indicated by the arc 64. All or some of the tubes 58 constituting the top row of these tubes, pass through the end walls of tray 62 and through the lower part of the partitions 63, so that these upper tubes are immersed in the oil in tray 62. Thus there is provided a main oil reservoir containing a plurality of auxiliary oil reservoirs, the oil cooler 26 being disposed in the various reservoirs in thermal association with the oil in all of the reservoirs. Overflow of oil from the tray 62 falls into the oil pan 60.

Referring to Figures 8 and 9, the engine 20 has the frame 65 from which is suspended the oil pan 60 secured to the frame by the bolts 66. Within the frame 65 and oil pan 60 and journaled in suitable stationary bearings in the frame 65, is the crank shaft 67 on which are the connecting rods 68. Each connecting rod has an oil dipper 69 which moves in the arc 64. Secured to the engine frame 65 and suspended therefrom free of the oil pan 60 is the oil cooler 26a. This oil cooler has an L shaped header 70 which is in the space radial to one of the said stationary bearings. The header 70 is of hollow rectangular section within which a partition 71 extends the full length of the header, thereby forming the outlet and inlet compartments 72 and 73 respectively. The header 70 has a shoulder 74 at which place the rectangular section changes to circular section in order to pass through a circular hole in the engine frame 65. The circular section may be threaded to receive nut collar 75 so as to firmly secure the header and thereby the oil cooler to the engine frame 65. The compartments 72 and 73 extend beyond the nut collar 75 and receive the terminal outlet 27a and terminal inlet 28a respectively.

Each of the numerous small tubes 76 is bent to form a loop; one end of each tube is secured fluid tight into outlet compartment 72 and the other end is correspondingly secured into inlet compartment 73. Each loop passes under the L shaped header 70, the tubes and the horizontal portion of the header being immersed in the oil in the oil pan 60. Liquid entering the oil cooler 26a at 28a, flows through inlet compartment 73, through the looped tubes 76 into outlet compartment 72 discharging therefrom through terminal outlet 27a. The liquid is thereby in thermal association with the oil but not in contact with it.

For the splash system of lubrication the oil tray 77 having partitions 78 is secured to the upper part of the oil cooler 26a in the same manner and relationship as described for oil cooler 26 in Figures 6 and 7.

The operation of the multiflow cooling system shown in Figure 1 is as follows: when starting cold, the thermostat 45 is contracted so that the valve 51 is in closed position. Water is drawn by the pump 19 from the radiator at outlet 15, through pipe 18 and discharged from the pump through pipe 21 into cylinder jacket 22 where the water is rapidly heated. The hot water discharges from the cylinder jacket into manifold 23 and thence into flow inducer 24. The valve 51 being closed, the hot water flows downward through pipe 25 into oil cooler 26 at terminal connection 27 and after passing through the tubes and headers of the oil cooler, the hot water flows therefrom at terminal connection 28 through pipe 29 to the T valve 30.

Depending upon the position of valve 36 of the T valve, the water may flow through either or both ports 37 and 38. If the port to outlet 16 be closed then all of the hot water will flow through pipe 32, T 17 and pipe 18 to the pump 19 with very little loss of heat, and consequently the engine temperature and the oil temperature will rise very rapidly. If the port to pipe 32 be closed, then the hot water will flow from the

T valve into radiator inlet 16 through the cold water tank 12 to the T 17 and thence to pump 19. Some heat will be lost from the hot water stream in its passage through the cold water tank 12, and consequently the rise of engine temperature and oil temperature will be less rapid than if the port to pipe 32 had been open. When neither port of the T valve is closed, the hot water flows in both directions, part of it directly to the pump with only slight loss of heat and the remainder through the cold water tank of the radiator where heat is extracted.

The thermostat 45 may be set permanently for the temperature corresponding to most efficient engine operation. When heavier engine duty causes higher temperature, the thermostat expands and opens valve 51 so that the hot stream from the manifold 23 divides and part of it now passes into the radiator at inlet 14 and is cooled in the cooling core 13. Upon sufficient opening of the valve 51, the flow inducer ejector will cause reversal of the stream through the oil cooler 26, so that cold water will be drawn from the lower tank 12 of the radiator through the T valve 30 and pipe 29, through the oil cooler and pipe 25 into the flow inducer 24 and thence into the upper tank of the radiator. Now all of the water in the cooling system is circulated through the cooling core 13 and subjected to forced cooling.

The flexibility and range of temperature control of this multiflow cooling system is readily apparent. With open ports of the T valve 30, the circulating water of the system may be divided into three streams, each subject to a different rate of cooling which may be changed by means of the T valve.

In Figure 4, the arrangement differs from Figure 1 in that the pump is interposed between the cylinder jacket and the ejector flow inducer. The pipe 18 leads directly from the T 17 to the intake of the cylinder jacket 22. The manifold 23 is omitted. The cylinder jacket discharges directly into the suction end of the pump 19. The discharge end of the pump 19 forms the nozzle 41 which is inserted into the ejector flow inducer 24 and is the ejector nozzle of the flow inducer. In all other respects, the arrangement and sequence of operation are the same as in Figure 1.

In Figure 4, the circulating water in the cylinder jacket is not subject to positive pressure, but is always under negative pressure due to the suction of the pump. At the flow inducer the pump pressure is undiminished by the friction losses of the cooling channel between the radiator and the discharge outlet of the cylinder jacket. The consequence is highly sensitive and efficient ejector action in the flow inducer. Thus in both cooling channels of the engine the circulating liquid is under negative or vacuum pressure.

In Figure 5, water is drawn by the pump 19 from radiator at outlet 15 through T 17 and pipe 18 to the suction end of the pump which then forces the liquid through pipe 82 into the oil cooler 26 at terminal connection 27, through the tubes and headers of the oil cooler, then through pipe 83 into the cylinder jacket 22 discharging therefrom into manifold 23 which discharges into the primary port 31a of T valve 30a. This valve is a duplicate of T valve 30. One of the secondary ports of the T valve 30a connects to inlet 14 of the radiator; the other secondary port is connected by pipe 84 to the primary port of the lower T valve 30. One of the secondary ports of the lower T valve 30 leads into the radiator inlet 16 and the other secondary port of lower T valve 30 leads into T 17.

In the operation of Figure 5, the two T valves provide similar flexibility of temperature control but to somewhat less degree than Figures 1 and 4. In Figure 5, there is no reversal of circulation. The oil cooler 26 is always subject to the full pressure of the pump 19. The two cooling channels of the engine, namely, the cooling jacket 22 and the oil cooler 26 are always in series relation.

Although I have described several specific embodiments of my invention, it will be obvious to those skilled in the art, that various modifications may be made in the details of construction, the general arrangement, the association of the several co-operating parts and the application of my invention without departing from the spirit thereof or the principles herein set forth.

I claim as my invention:

1. In a cooling system for an internal combustion engine having a crankcase oil pan, an oil cooler suspended from and supported by the engine frame independently of said oil pan, said oil cooler comprising two outlet compartments and a plurality of conduits immersed in the lubricating oil in said crank case oil pan, the ends of said conduits terminating in the two outlet compartments so that cooling fluid entering one compartment flows through all of said conduits into the other outlet compartment in thermal association with said oil.

2. In a cooling system for an internal combustion engine, the combination of: a plurality of adjacent oil reservoirs for the engine, an oil cooling means immersed in the oil in said reservoirs, said means having an inlet and an outlet for conducting a cooling fluid through said means in thermal association with the oil in both said reservoirs.

3. In a cooling system for an internal combustion engine, an engine crank case oil pan having a principal oil reservoir and a plurality of auxiliary oil reservoirs, adjacent said principal reservoir, an oil cooling means comprising a plurality of conduits disposed in said reservoirs, a common inlet and a common outlet for all of said conduits, said means being arranged for conducting a cooling fluid through the oil in all of said reservoirs in thermal association but not in contact with said oil.

4. In combination: a radiator, an internal combustion engine, a plurality of adjacent oil reservoirs for the engine, and oil cooling means immersed in the oil in all of said reservoirs, said means comprising a common inlet and a common outlet for conducting cooling liquid from the radiator through said oil cooling means in thermal association with the oil in said reservoirs.

5. In combination: a radiator, an internal combustion engine having a crank shaft arranged for splash lubrication, an oil cooler disposed in the lubricating oil in the crank case oil pan of the engine, said oil cooler comprising a tray for containing the oil for said splash lubrication, and means for connecting the oil cooler in liquid flow connection with the radiator.

6. In combination: a radiator, an internal combustion engine having a crank shaft arranged for splash lubrication, an oil cooler and a splash tray disposed in the crank case oil pan of the engine, said splash tray having a plurality of compartments for containing oil and for receiving the oil dippers of the crank shaft, said oil cooler comprising a plurality of conduits immersed in

the oil in said compartments and said oil pan, and means for connecting the oil cooler with the radiator.

7. In combination: an internal combustion engine having two separate cooling channels, a radiator having a hot water tank and having two spaced apart outlets for its cold water tank, flow regulating means comprising a pipe and a valve for connecting said outlets with each other, and means for connecting both of said cooling channels with said regulating means and with the hot water tank of the radiator.

8. In combination: a radiator having two outlets for its cold water tank, an internal combustion engine having two separate cooling channels one of which is in thermal association with the engine lubricant, connections for both of said outlets with both of said channels, and pressure creating means for connecting both of said channels with the hot water tank of the radiator.

9. In combination: a radiator for cooling a liquid and having a cold water tank and a hot water tank, an internal combustion engine having two separate cooling channels, means for connecting the cold water tank of the radiator with both said channels, and flow inducing means for said liquid comprising a pump and an ejector connecting both said channels with the hot water tank of the radiator.

10. In a cooling system for an internal combustion engine having cooling channels adapted to receive cooling fluid, a flow inducing means for circulating said fluid through said channels said means comprising a pump and an ejector the discharge end of the pump forming the nozzle of the ejector.

11. In combination: a radiator for cooling a liquid and having two outlets for its cold water tank, an internal combustion engine having a cooling jacket and an oil cooler through both of which said liquid may flow, means for connecting said outlets with said jacket and said oil cooler, a pump having its suction end connected to the hot water outlet of the jacket, and means comprising a nozzle ejector and a valve for connecting the oil cooler and the discharge end of the pump with the hot water tank of the radiator.

12. In combination: an internal combustion engine having two separate cooling channels, a radiator having an inlet tank and an outlet tank with two outlets, a by-pass comprising a pipe and means, including a valve, for connecting said outlets with each other and with both cooling channels, and means including a second valve for connecting both channels with the inlet tank of the radiator.

13. In combination: an internal combustion engine having two channels adapted to receive a cooling liquid, a pump having its suction end connected to one of said channels for inducing flow of said liquid therein, and an ejector connected to the discharge end of the pump and to the other channel for inducing flow of the liquid in said other channel.

14. In combination: an internal combustion engine having two cooling channels adapted to receive a cooling liquid one of said channels being in thermal association with the engine lubricant, and means for imparting pressure to said liquid and for regulating its flow, said means comprising serially a pump an ejector at the discharge end of the pump and a valve at the discharge end of the ejector.

15. In combination: an internal combustion engine having two cooling channels one a cooling jacket, the other a heat exchanger, both channels being adapted to receive a cooling liquid, a pump having its suction end at the outlet of the jacket, an ejector having its vacuum chamber connected to the exchanger, the discharge end of the pump forming a nozzle of the ejector, and a valve at the outlet of the ejector for controlling the flow of said liquid.

16. In combination: a water cooling radiator having an inlet tank a cooling core and an outlet tank, a water cooled engine in circulatory connection with the radiator, and means for bypassing either the entire radiator or only the inlet tank and the cooling core said means comprising a valve at the inlet tank and a valve at the outlet tank.

17. In combination: a water cooling radiator having an inlet tank a cooling core and an outlet tank with two outlets, a valve at the inlet tank, a valved by pass connecting the two outlets, and a water cooled engine in circulatory connection with the radiator at said inlet valve and said by-pass.

FREDERIC W. HILD.