Feb. 9, 1937. W. R. RAMSAUR 2,070,092

OIL COOLING SYSTEM

Original Filed April 11, 1929

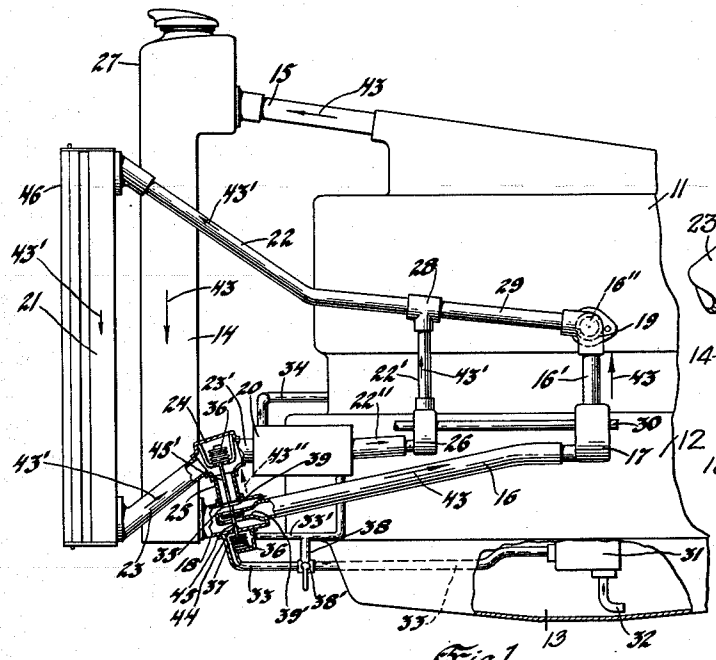


Fig. 1.

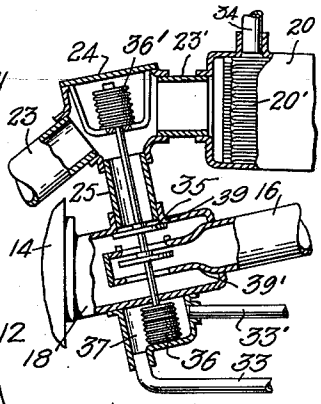


Fig. 3

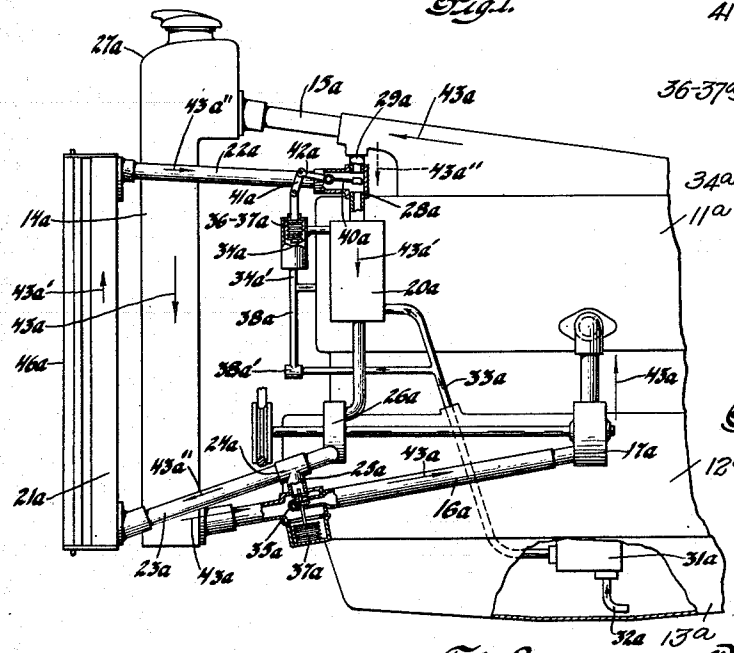


Fig. 2.

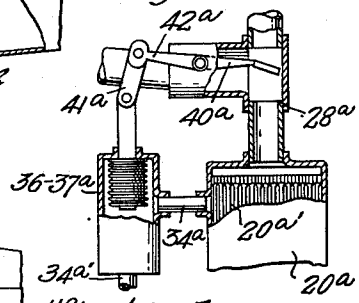


Fig. 5

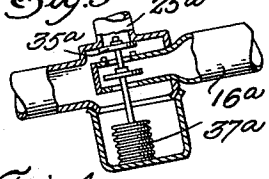


Fig. 4

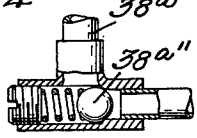


Fig. 6

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Patented Feb. 9, 1937 2,070,092

UNITED STATES PATENT OFFICE

2,070,092

OIL COOLING SYSTEM

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Application April 11, 1929, Serial No. 354,245
Renewed March 22, 1933

21 Claims. (Cl. 123—196)

As may be inferred from the above title, this invention relates to the cooling or thermal conditioning of lubricating oil as used in pressure lubrication or other lubrication of internal combustion engines.

It is an object of this invention to provide internal combustion engines with distinct but conditionally intercommunicating circuits for cooling water, one of said circuits being employed, in a known manner, to cool an engine block and associated parts, and the other of said circuits being employed mainly or exclusively in cooling a lubricating oil,—which may be circulated to bearings, and the like, from an oil pan, or its equivalent, by way of a special cooler through which the water of the last-mentioned circuit is also advanced.

All forms of this invention may include an oil cooling circuit which is provided with separate means for the advance of a cooling liquid therethrough; and preferred embodiments of said invention may include thermostatic means dependent upon either the temperature of the circulated oil or upon the temperature of the circulated water, or upon both, for varying the temperature and/or the rate of circulation of the water employed in heating or cooling the oil.

It should be understood that the term "cooler", as herein employed, is intended to refer to any suitable heat exchange unit, regardless of the direction of heat flow; and it is a particular object of this invention to provide means whereby a normally independent oil-cooling circuit may conditionally be so interconnected with an engine-cooling circuit as to provide means (effective, for example, during starting periods) for warming of the lubricating oil, whenever its temperature is undesirably low.

Other objects of this invention, including various provisions for interconnection of pipes and/or equalization or relief of pressures, may be best appreciated from the following descriptions of alternative embodiments thereof, taken in connection with the appended claims and the accompanying drawing.

Fig. 1 is a diagrammatic side elevational view of an internal combustion engine quipped with a cooling system in accordance with my invention, parts being broken away, parts immaterial to the invention being omitted, and some optional features being shown.

Fig. 2 is a view similar to Figure 1 but showing alternative features and relationships of parts.

Figure 3 is an enlarged view of the thermostatically operated valve unit and associated parts shown in Figure 1.

Figure 4 is an enlarged view of the lower thermostatically operated valve unit and associated parts illustrated in Figure 2.

Figure 5 is an enlarged view of the upper thermostatically operated valve unit and associated parts illustrated in Figure 2.

Figure 6 is an enlarged detail view of the pressure controlled valve illustrated in Figure 2.

Referring first to Fig. 1, an engine comprising a block 11, a crankcase 12 and an oil pan 13 is shown as provided with a cooling-water circuit including a main radiator 14, a radiator-feed or hot water pipe or conduit 15, return pipe sections or conduits 16, 16' and a pump 17,—the radiator or water-cooling element being connected with pipe 16 by means such as a special fitting 18, the pump 17 being interposed between pipe 16 and pipe 16', and the cooled water being returned to the block 11 by way of a second special fitting 19 and a pipe 16''.

There being no necessary novelty in the parts above referred to, with the possible exception of fittings 18 and 19, an oil-cooling water circuit is shown as comprising, in connection with an oil cooler 20 and an auxiliary water cooling radiator 21, an upper or radiator-feed pipe or conduit and a return pipe or conduit. The radiator feed pipe consists of sections 22'' and 22', between which is interposed a pump 26, and a section 22. The return pipe comprises sections 23, 23',—between which may be interposed a T 24. The oil cooler 20 consists of a housing within which there are located a number of tubes 20' through which water flows during its passage from the pipe 23' to the pipe 22'' and which are spaced apart intermediate their ends to provide passages through which oil flows during its passage from the pipe 33' to the pipe 34. To provide means for warming the "cooling" water at starting or as may be required, a conditionally-open intercommunication between the oil and engine cooling water circuits may be provided by means such as a pipe or conduit 25, disposed between the T 24, in the oil-cooling water circuit, and the special fitting 18, in the engine-cooling water circuit; the oil-cooling water may be normally advanced from the so-called cooler 20 to the pipe 22 (through pipes 22' and 22'', or the like) by the auxiliary water pump 26, shown as distinct from the pump 17; both pumps may be centrifugal; and, in order to permit a single water reservoir 27 to function in connection with both of the described circuits, and to permit of the alternative modes of operation hereinafter referred to, the special fitting 19, or an equivalent element of the engine-cooling water circuit, may be interconnected with an element such as a T 28, shown as interposed between pipes 22 and 22', by means such as a constantly open pressure-equalizing passage in the form of a pipe 29.

By way of suggesting that they may be structurally united or otherwise interconnected, the pumps 17 and 26 are diagrammatically shown as driven by a common shaft 30; and an oil pump

31, having its intake pipe 32 adapted to take oil from, for example, the oil pan 13, may be provided with an exit pipe comprising sections 33, 33' communicating directly or indirectly with the oil cooler 20. From the oil cooler, in the case of a pressure-feed system, an oil delivery pipe 34 may extend into the engine block 11, for delivery of oil to various bearings, not shown.

In preference to providing for intercommunication between the described engine cooling circuit and the described oil cooling circuit only by way of a constantly open passage such as may be provided by the pipe 29, a thermostatically controlled valve or valves are preferably provided in connection with the passage or pipe 25 or in connection with one or more of the fittings which are interconnected thereby. For example, the fitting 18 may provide not only for the housing and seating of a valve element or elements 35, but also for a transmission of "heat" to a thermostatic element 36,—exposed to the temperature of the water in one of the mentioned circuits and/or to the temperature of the pumped oil. For example, a chamber 37 may be formed integral with the fitting 18 and may be interposed between oil pipes 33 and 33', leading to the cooler 20.

If desired, a manually controllable or other bypass may be interposed between sections or pipes comprised in the oil circuit,—a manually controlled three way valve, short-circuiting the thermostatic chamber through a by-pass 38 and thereby abridging the path of oil feed being suggested at 38'; and, in any event, it will be understood that, under normal running conditions, valve element 35 is intended to occupy (by reason of the expansion of some thermal element or elements) an upper position of engagement with a seat 39,—thereby maintaining the oil-cooling circuit substantially distinct and independent of the engine cooling circuit; although conditionally permitting a flow from one circuit to the other.

Referring to Fig. 2 (in connection with which reference characters are correspondingly employed, an "*a*" being added to each character) it will be seen that the constantly open pipe 29*a* interconnects an outlet from the engine block 11*a*, rather than an inlet thereto, with the T 28*a*; and this latter fitting may be modified to enclose a valve 40*a*,—which may be additional to, or may serve as an alternative for, a valve organization controlling intercommunication through a lower pipe 25*a*. In this figure, the pumps 17*a* and 26*a* are shown as respectively advancing the engine-cooling water in an upward direction and as advancing the oil-cooling water in a downward direction; and the valve 40*a* is shown as operated by a thermostatic unit 36—37*a* with which (when not formed integral with cooler 20*a*) sections 34*a* and 34*a*' of the oil delivery pipe may be respectively connected,—a linkage 41*a* being used to interconnect the thermostat with a lever 42*a*, or the like, employed in manipulating the valve 40*a*.

In this instance, a pressure-controlled valve organization 38*a*', which includes a spring pressed ball valve 38*a*'' which normally prevents the passage of oil through the by-pass 38*a*, is shown as conditionally permitting a relief by-passing or abridgment of the path of pumped oil from the pipe 33*a* into the pressure delivery pipe 34*a*',—in order that, in case of a clogging of the cooler 20*a*, oil may nevertheless be delivered, under a desired pressure, to bearings and to the engine parts not shown; but it should be understood that, in this case, as in the embodiment illustrated in Fig. 1, the valve 35*a* and/or the valve 40*a* are intended, during normal operation, to occupy such positions as to render the oil cooling circuit substantially independent of the engine cooling circuit,—although permitting an equalization of pressures therein and a timely intercommunication.

Although a general mode of operation common to both of the illustrated forms of this invention has been indicated above, it will be noted that full-line arrows 43, 43' are so applied to Fig. 1 as to indicate the normal directions and paths of the circulations which occur, in the respective circuits, whenever the oil temperature lies within a predetermined optimum range,—valve element 35 then engaging its upper seat 39. It will be understood, however, that the engine-cooling water, on leaving radiator 14, may ordinarily still retain more heat than does the oil-cooling water; and, accordingly, whenever the oil is undesirably cold, a downward movement of valve element or elements 35 permits a limited rise of somewhat warmer water from the engine-cooling circuit through pipe 25,—as suggested by a dotted arrow 43''. The movement last referred to will be understood to reflect, in any desired ratio for which the organization may be designed, the temperature of the oil advancing through pipes 33, 33', and 34 as compared with the presumably higher temperature of the water advancing through fitting 18,—the valve element or elements 35 being never so closed against lower seats 39' as entirely to defeat the operation of pump 17.

If desired, an additional or alternative thermostatic element 36' connected to the valve 35 by a stem 45' may be so supported within T 24, or an equivalent fitting, as to effect or contribute to an upward closing of valve 35 whenever the temperature of the oil-cooling water rises to the appropriate level; but it will be understood that desired valve-operating effects may be rendered dependent, to any desired degree, upon the temperature or temperatures of any one or two or three of the mentioned fluids; and it will be evident that the admission of water, rather than oil, to thermostat chamber 37, or its equivalent, obviates the necessity of sealing the bearing 44 between the stem 45 of the valve 35 and the wall through which it passes. Shutters may be used at 46.

However, in the form illustrated in Figure 1, the thermostat 36 expands as the engine oil becomes heated, and the thermostat 36' likewise expands as the water used to cool the engine oil becomes heated. The expansion of the thermostats raises the valve 35, and shuts off the pipe 25 so that at this point the oil cooling circuit is independent of the engine cooling circuit. This insures a supply of cooler water to the oil cooler and hence better cooling of the oil. It should be remembered, however, that the two circuits are at all times connected by the pipe 29 which makes it possible to fill the two cooling systems by the introduction of water into the usual engine radiator.

As to the operation of the form shown in Fig. 2, it will be seen that the circulation in the oil-cooling circuit, as indicated by the solid arrows 43*a*'', is opposite in direction to the tendency of convection; but this form nevertheless has the advantage of enabling relatively hot water to be taken from an engine jacket element or from pipe 15*a* through pipe 29*a* (as indicated by the

dotted arrow 43a'') for a prompt heating effect at the time of starting with a cold engine; and the valve 40a may respond to delivered oil temperatures more promptly than a valve 35 or 35a,—optionally used therewith and continuing to function after valve 40a is upwardly closed. It will be obvious, however, that features diagrammatically shown or suggested in connection with either figure, or any desired combination or selection of features referred to, may be used in either of the described organizations, or in other organizations aiming at special effects appropriate to particular structures or conditions of operation. The water pump or pumps may be of a centrifugal or other type whose efficiency diminishes with the resistance or opposition to flow; and the oil pump may be of a "gear" type, delivering a practically constant volume, regardless of the viscosity of the oil, for a pressure-feed effect.

In the foregoing description and in the following claims, the term "cooler" is used as equivalent to the expression "heat exchange device" without reference to the direction of heat transfer therein; the term "water" is used without reference to the specific character of the circulating heat-transfer fluid or fluids passed through the respective radiators; the term "radiator" is used as equivalent to radiator section and/or cooling element; and although the foregoing description has included reference to but two specific embodiments of the present invention, with suggestions as to further alternatives and optional features, it should be understood not only that various features herein described might be independently employed but also that numerous additional modifications might easily be devised,—all without involving departure from the spirit or scope of the present invention.

I claim:

1. An engine having a water cooling system including a radiator, means for causing flow of water through the system, said engine being provided with a lubricating system including an oil cooler, a water cooling system for said oil cooler including an auxiliary radiator, means for causing flow of water through said last named system, and a connection between said cooling systems, said cooling systems being complete irrespective of said connection.

2. An engine having a water cooling system including a radiator and a pump for causing flow of water through the system, said engine being provided with a lubricating system including an oil cooler, a water cooling system for said oil cooler including an auxiliary radiator, connections from said radiator to said cooler, means for causing a flow of water through the oil cooling system, a pressure equalizing connection between said cooling systems, a second connection between said cooling systems, and means controlled by the temperature of the oil for controlling said second-named connection to provide increased cooling as the oil temperature rises.

3. An engine having a water cooling system including a radiator, means for causing flow of water through the system, said engine being provided with a lubricating system including an oil cooler, a water cooling system for said oil cooler including an auxiliary radiator, means for causing flow of water through said last named system, a connection between said cooling systems, said cooling systems being complete irrespective of said connection, and means for controlling flow through said connection.

4. An engine having a water cooling system including a radiator, means for causing flow of water through the system, said engine being provided with a lubricating system including an oil cooler, a water cooling system for said oil cooler including an auxiliary radiator, means for causing flow of water through said last named system, a connection between said cooling systems, a valve in said connection, and thermostatic means for controlling said valve to insure maintaining of the oil at proper temperatures for good lubrication.

5. In combination with an engine provided with a lubricating system, an oil cooler in said system, said engine being provided with a pressure feed cooling system, a pressure feed cooling system for said cooler complete in itself, and means controlled by the temperature of the oil in the lubricating system for diverting water from the engine cooling system to the oil cooling system to bring the oil to desirable working temperatures.

6. In combination with an engine provided with a lubricating system, an oil cooler in said system, said engine being provided with a pressure feed cooling system, a pressure feed cooling system for said cooler complete in itself, means controlled by the temperature of the oil in the lubricating system for diverting water from the engine cooling system to the oil cooling system to bring the oil to desirable working temperatures, and a constantly open connection between said cooling systems to permit filling of one from the other.

7. An engine having a water cooling system including a radiator, means for causing flow of water through the system, said engine being provided with a lubricating system including an oil cooler, a water cooling system for the oil cooler including an auxiliary radiator, means for causing flow of water through the last named system, a connection between the cooling systems, a valve in the connection, and means responsive to changes in the temperature of the water in one of the cooling systems for operating the valve.

8. An engine having a water cooling system including a radiator, means for causing flow of water through the system, the engine being provided with a lubricating system including an oil cooler, a water cooling system for the oil cooler including an auxiliary radiator, means for causing flow of water through the last mentioned system, a connection between the cooling systems, a valve in the connection, and means responsive to changes in the temperature of the water in one of the water cooling systems and to the oil in the lubricating system for operating the valve.

9. In an engine-cooling and lubricating system: a main radiator section in a circuit for an engine-cooling heat-transfer liquid; an auxiliary radiator section in a circuit for a lubricant temperature regulating liquid in which is included a heat transfer unit through which lubricant is adapted to flow in heat exchanging relation to the temperature regulating liquid; means for variably interconnecting and conditionally separating said circuits, to vary the temperature of the liquid fed to said unit; means for advancing the liquid in said circuits; and means automatically compensating, by overflow from one to the other, for unequal expansion and flow in said circuits.

10. In an engine-cooling and lubricating system: a main radiator section in a circuit for an engine-cooling heat-transfer liquid; an auxiliary radiator section in a circuit for a lubricant temperature regulating liquid in which is included a heat transfer unit through which lubricant is adapted to flow in heat exchanging relation to

the temperature regulating liquid; means for variably interconnecting and conditionally separating said circuits; means for advancing the liquid in said circuits; and means automatically compensating for unequal expansion and flow in said circuits,—said last-mentioned means including a valveless but conditionally effective communicating connection between said circuits.

11. In apparatus for regulating the temperature of a mechanism, two independently complete temperature regulating medium circuits, a heat exchanger in each circuit, a connection between the two circuits, and temperature controlled means for regulating flow through the connection.

12. In mechanism of the class described, a circuit through which lubricant is adapted to flow communicating with the mechanism, a circuit, including a heat exchanger, through which a temperature regulating medium is adapted to flow in heat exchanging relation with the mechanism, an independently complete circuit, including a heat exchanger, through which a temperature regulating medium is adapted to flow in heat exchanging relation with the lubricant in the first mentioned circuit, and means through which regulating medium may pass from one of the temperature regulating medium circuits to the other.

13. In mechanism of the class described, a circuit through which lubricant is adapted to flow communicating with the mechanism, a source of temperature regulating medium at a relatively low temperature, a source of temperature regulating medium at a relatively high temperature, means for conducting varying proportions of the media from the two sources into heat exchanging relation with the lubricant in the first mentioned circuit, and means controlled by the temperature of the lubricant in the first-mentioned circuit for regulating the proportion of the media from the two sources conducted into heat exchanging relation with the lubricant.

14. In mechanism of the class described, a circuit through which lubricant is adapted to flow communicating with the mechanism, a circuit, including a heat exchanger, through which a temperature regulating medium is adapted to flow in heat exchanging relation with the mechanism, a circuit, including a heat exchanger, through which a temperature regulating medium is adapted to flow in heat exchanging relation with the lubricant in the first-mentioned circuit, means through which temperature regulating medium may pass from one of the temperature regulating medium circuits to the other, and means controlled by the temperature of the lubricant in the lubricant circuit for regulating the passage of temperature regulating medium from one temperature regulating medium circuit to the other.

15. In a jacketed internal combustion engine, a liquid cooling radiator, passages connecting the radiator with the engine jacket, an oil cooler in which there is provided a passage for lubricant and a passage for another liquid, a liquid cooling radiator, passages connecting the last-mentioned radiator and the last-mentioned oil cooler passage, a passage connecting the discharge passages of the two radiators, and a passage connecting the intake passage of the second-mentioned radiator with the engine jacket.

16. In a jacketed internal combustion engine, a liquid cooling radiator, passages connecting the radiator with the engine jacket, an oil cooler in which there is provided a passage for lubricant and a passage for another liquid, a liquid cooling radiator, passages connecting the last-mentioned radiator with the last-mentioned oil cooler passage, and passages connecting the discharge passage of one radiator with the intake passage of the other and the intake passage of the first radiator with the discharge passage of the second radiator.

17. In apparatus for regulating the temperature of a mechanism: a circuit which includes a heat exchanger in which there are provided a fluid passage and a second fluid passage arranged in heat exchanging relation to the first mentioned fluid passage, and ducts for conducting fluid from the first mentioned fluid passage into heat exchanging relation with the mechanism and back into the first mentioned fluid passage; a circuit which includes a second heat exchanger in which there are provided two fluid passages arranged in heat exchanging relation, and ducts for conducting fluid from one of the fluid passages in the second heat exchanger into heat exchanging relation with the mechanism and back into the last mentioned fluid passage; and a circuit which includes a third heat exchanger in which there are provided two fluid passages arranged in heat exchanging relation, and ducts for conducting fluid from one of the fluid passages in the third heat exchanger into the second passage in the first mentioned heat exchanger and back into the last mentioned fluid passage in the third heat exchanger.

18. The apparatus claimed in claim 17 plus means through which fluid may pass from one to the other of the second and third described circuits.

19. The apparatus claimed in claim 17 in which the first described circuit is a lubricant circuit.

20. In combination, a liquid cooled internal combustion engine, a lubricating system therefor, a liquid cooling radiator, means for effecting an interchange of heat between engine lubricant and engine cooling liquid flowing from the radiator to the engine, and means for conducting engine cooling liquid from the radiator to the engine so that it is not brought into heat exchanging relation with the engine lubricant.

21. In an engine-cooling and lubricating system: a main radiator section in an engine-cooling circuit for a heat-transfer liquid; an auxiliary radiator section in a circuit for a lubricant temperature regulating liquid in which is included a heat transfer unit through which lubricant is adapted to flow in heat exchanging relation to the temperature regulating liquid; and means for advancing said liquid in said circuits; said circuits being provided with thermostatically operated valve means for conditionally separating and interconnecting the circuits at one point to vary the feed to the heat transfer unit and with a valveless overflow means of conditional interconnection at another point to compensate automatically for unequal expansion and flow in the circuits.

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