Sept. 24, 1946. L. T. MILLER 2,408,265

AUTOMATIC DILUTION SYSTEM

Filed Oct. 3, 1942 2 Sheets-Sheet 1

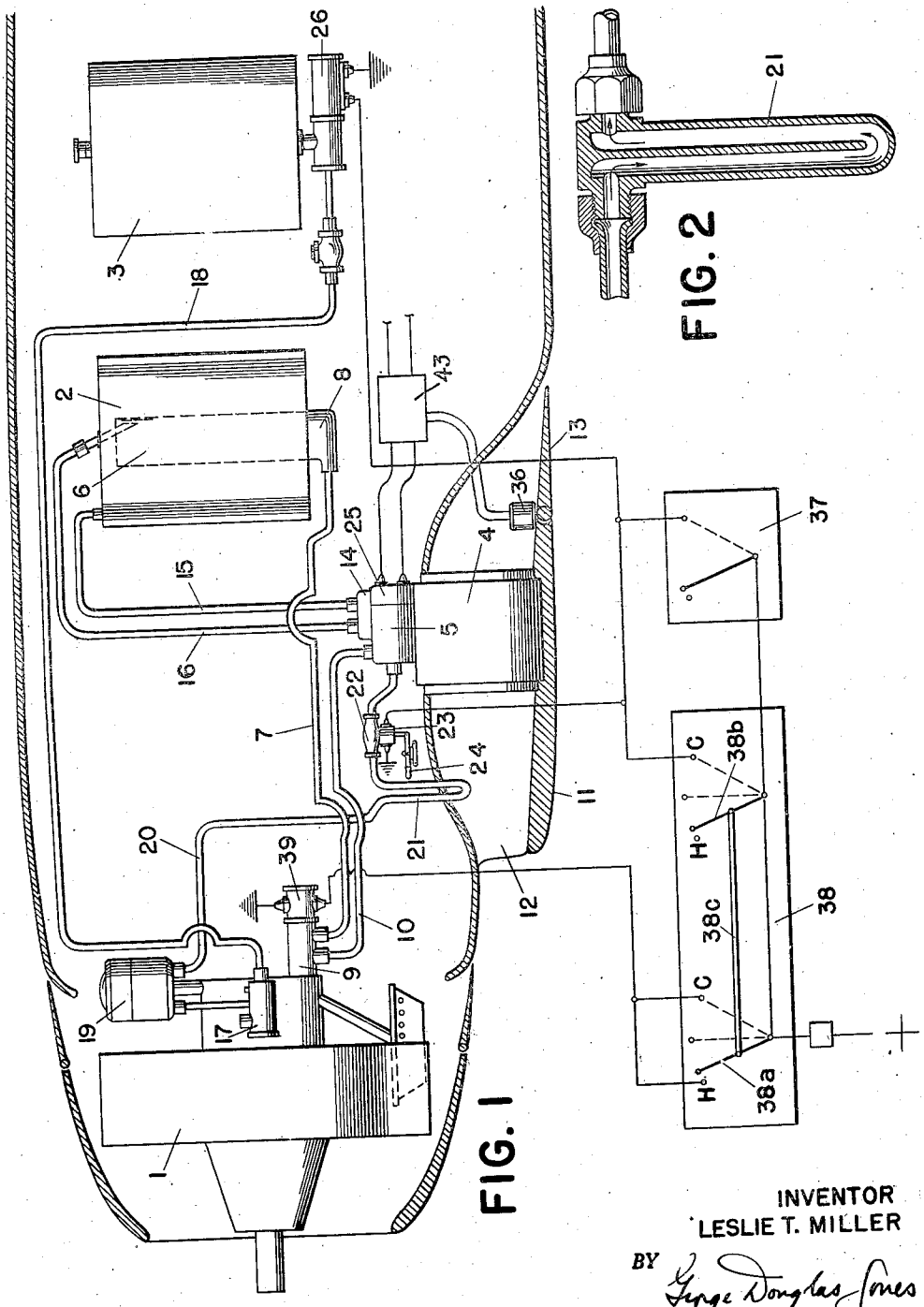

FIG. 1

FIG. 2

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FIG.3

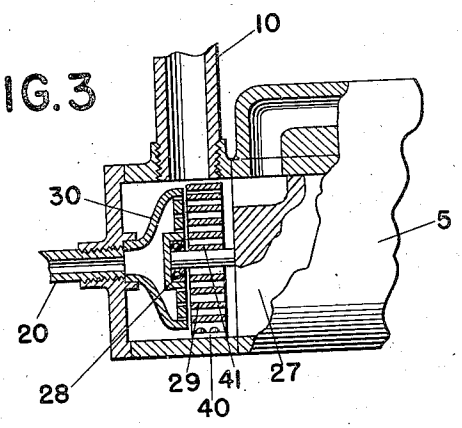


FIG.4

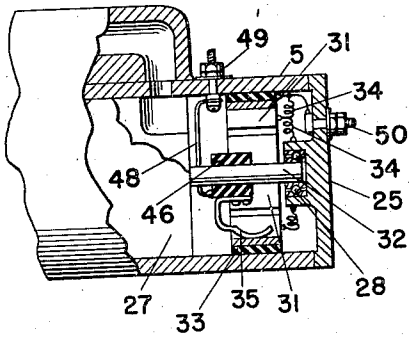
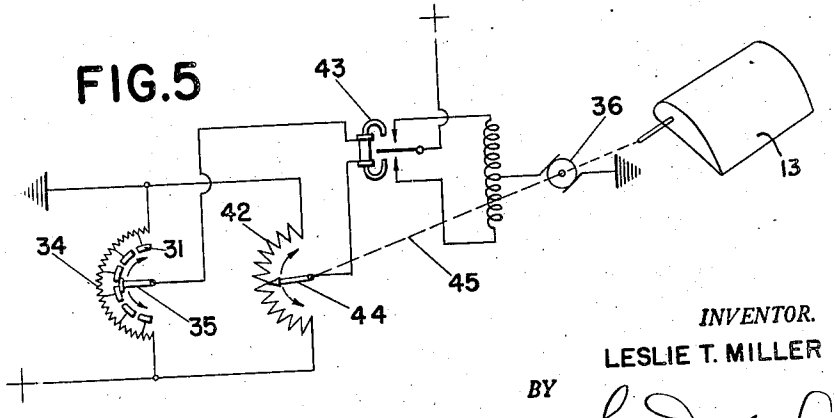


FIG.5



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AUTOMATIC DILUTION SYSTEM

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5 Claims. (Cl. 123—196)

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This invention relates to a cold weather lubrication system, and is particularly directed to an improved system and a control valve for accomplishing a novel result over the co-pending application, Serial Number 402,569, filed July 16, 1941, now Patent No. 2,311,069, issued February 16, 1943, of which this application is a continuation in part.

In the above mentioned co-pending application, a lubrication system is disclosed wherein the cold weather starting of an internal combustion engine may be facilitated by the introduction of a diluent to decrease the viscosity of the lubricant.

In co-pending application, Serial No. 414,005 filed October 7, 1941, now Patent No. 2,374,639, the advantages of controlling and directing the flow of oil in the lubricating system to ensure the safe and dependable operation of the lubricating system is set forth. These advantages and features are also obtained by the present invention.

As set forth in the co-pending applications, this lubrication system for an internal combustion engine is a departure from the usual expedients employed for systems designed to accomplish a similar purpose and embody several novel features.

The present application sets forth novel structural features and functions of an improved lubrication system wherein the dependability and efficiency are increased by the automatic operation of the elements of the system.

The difficulty of starting an internal combustion engine in cold climates is well known. This system is designed to overcome this difficulty by providing a certain and definite quantity of lubricant of low viscosity for the engine during the starting period. The general feature of this system consists of adding a diluent, such as gasoline, to the lubricant in the return line from the engine to the reservoir.

The primary object of this invention is to provide a system wherein this diluent may be added to the return line and automatically, by means of the flow control valve, control the flow of fluid in a predetermined manner.

Another object is the provision of means whereby, when the diluent is added, the lubricant is directed through a return line to the warm-up compartment of the reservoir rather than the main section of the reservoir.

Another object is that in the construction and arrangement of the valve, a by-pass is always provided when the oil is cold. When the oil is

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cold and most viscous and liable to create excessive pressures, the valve affords a wide open by-pass around the cooler, thus protecting it from damage. Relief valves might be used but they do not function until the pressure builds up while the open by-pass prevents the building up of excessive pressures. In case of a surge of pressure, damage to the cooler might occur before the relief valve functions, while an open by-pass is positive protection for the cooler.

Another object is the provision of means to circulate the oil after the engine has stopped to return the oil to the reservoir. By the circuit disclosed in this invention, this object is made possible, and in cold climates it may be accomplished with the addition of a diluent and in hot climates where difficulty in starting will not be encountered the diluent will not be added.

Another object is the provision of means whereby diluent may be cooled before being added to the lubricant in the control valve.

A further object of this invention is to set forth features of the valve wherein the above object may be accomplished and further features of a device for controlling the action of a flap on the oil cooler in conjunction with the addition of a diluent.

Further objects of the invention will become apparent from the accompanying description of the drawings which form a part of the disclosure and wherein like numerals refer to like parts.

In the drawings:

Fig. 1 is a diagrammatic view showing the arrangement of the elements comprising the cold weather lubrication system.

Fig. 2 is a view, partially in section, showing a cooling device for the diluent line.

Fig. 3 is a fragmentary view, partially in section, of one end of the flow control valve.

Fig. 4 is a fragmentary view, partially in section, of the flap control device actuated by the valve.

Fig. 5 is a diagram of the flap control circuit.

Figure 1 of the drawings discloses an engine 1, an oil reservoir 2, a gasoline tank 3, an oil cooler 4, and a valve 5, all inter-connected by means of conduits, the connections and functions of which will be presently set forth.

The oil reservoir 2 has a warm-up compartment 6 located within the main section of the reservoir. This warm-up compartment incloses a small portion of the lubricant in the reservoir 2, and it is so named because the lubricant is drawn from this small compartment to the engine by the pump 9, during the initial starting

of the engine, and lubricant is returned from the engine to this compartment so that by circulating this small quantity of lubricant, it reaches a high temperature more rapidly than circulating the whole body of lubricant in reservoir 2. In other words, this compartment is called the warm-up compartment because it confines the oil used during the warming-up period of the engine.

Oil is supplied to the engine through conduit 7 from fitting 8 on the lower portion of the reservoir. Oil pump 9 forces the lubricant to the engine and returns lubricant by way of conduit 10 to the distribution valve 5. This pump may be driven by the engine or independently of the engine by motor 39. It will be noted that oil cooler 4 is located in an air duct 11, which has a forwardly directed opening 12. Flap 13, on the rear portion of the air duct, is operated to open or close this rear portion thereby controlling the flow of air through duct 11. The oil cooler is of the conventional type having a central core for extensive heat exchange between the oil and the cooling medium, air, and a jacket portion through which the oil may be directed for partial cooling during the warming up period of the engine. Valve 5 is so arranged that the lubricant returning through conduit 10 can be directed to flow through the core of the oil cooler or through the jacket, or by-pass the oil cooler entirely through by-pass 14 of the valve. When the return lubricant is directed through the main portion of the oil cooler, the lubricant flows to the reservoir 2 by means of pipe 15. If the valve directs the return lubricant through the jacket of the oil cooler or through the by-pass the lubricant will be returned to the warm-up compartment of the reservoir by way of pipe 16.

An engine-driven fuel pump 17 draws gasoline from tank 3 through pipe 18 to the carburetor 19. A pipe 20 conducts some gasoline from the carburetor to the valve 5. It will be seen from the drawings that pipe 20 has formed therein a loop 21 which projects into the air stream ahead of the oil cooler to insure the diluent being cooled. The diluent may, of course, be conducted directly to the control valve without any additional cooling. A diluent valve 22 is inserted in line 20 to control the flow of diluent to the control valve 5. The diluent valve is a solenoid operated valve, the solenoid being shown at 23, or the valve may be controlled manually through linkage 24.

The flap control mechanism 25 is shown attached to the control valve 5 at the opposite end from the diluent inlet. This will be described in more detail in connection with Figure 4.

An electrically operated motor-pump unit 26 is shown which affords a means of circulating gasoline independently of the engine driven pump 17.

Figure 2 shows the constructional details of a fitting that may be inserted in line 20 which will project into the air stream and afford a diluent cooling means. As pointed out above, this feature is optional.

Figure 3 shows a fragmentary view of the control valve 5 illustrating the end of the valve at which the diluent is introduced. It should be pointed out that any type of multiple control valve of the slide or rotary type may be used but in the preferred form, a rotary valve is shown having multiple ports which are so arranged that for various angular positions of the valve, the distribution functions set forth above are attained; that is, the valve, in response to the temperature of the lubricant, may direct the lubricant through the core of the oil cooler and then

to the main section of the reservoir or through the jacket of the oil cooler to the warm-up compartment of the reservoir or by-pass the oil cooler entirely and direct the lubricant from the engine to the warm-up compartment of the reservoir. The end of such a rotary valve 27, is shown in Figure 3 mounted for rotation in a bearing 28. A thermal responsive bi-metallic element 29 is shown having one end 40, attached to the casing of the valve and the other end secured to the shaft of valve 27. Upon variations in temperature the bi-metallic element will rotate the valve in a predetermined manner. The oil returning through pipe 10 flows over the bi-metallic element 29 before it is distributed by the valve 27; thus, it will be seen that the temperature of the oil determines the position of the valve and thereby the return path of the oil to the reservoir. A spray nozzle 30 is positioned adjacent the bi-metallic element 29 and receives a diluent from pipe 20. By this arrangement, it will be seen that upon the operation of diluent valve 22, the diluent, gasoline, will be introduced into the lubricant by means of the spray nozzle 30 adjacent the bi-metallic element and, if the oil is hot, will cool the oil in the vicinity of the bi-metallic element, thus causing the bi-metallic element to move the valve to a position corresponding to that of a lower temperature lubricant. The diluted oil will flow from the valve to the warm-up compartment of the reservoir by conduit 16.

To the end of the valve 5 remote from the diluent line 20, will be mounted flap control mechanism 25. This flap control mechanism is illustrated in the valve in Fig. 4 and diagrammatically in Fig. 5 and consists essentially of a ring 33 of insulating material which is inserted in the end of the housing of valve 5 on which are mounted contacts 31. These contacts are shown in Figure 5 having intermediate resistors 34, binding post 50 affords electrical connection for this series of resistors. Binding post 49 and lead wire 48 permit contacts 35 to be connected in the electric circuit shown in Figure 5. Member 46 is an insulating collar to which contact 35 is attached and rotates wtih shaft 32 of valve 27. This assembly in the valve housing 5 is essentially an oil immersed potentiometer. Thus, it will be seen that the contacts 31 can be connected in the manner shown in Figure 5 to operate a motor 36 which controls the flap. The motor 36 is operated by means of polarized relay 43 when the contact 35 of the potentiometer is moved. Potentiometer 42, contact 44 and mechanical connection 45 are part of a conventional followup circuit to prevent overcontrol or hunting. The position of the flap is thus determined by the position of the valve 27.

The difficulty in starting an internal combustion engine in cold weather is due primarily to the fact that the viscosity of the oil increases with a decrease in temperature. If an attempt is made to start an engine with oil of high viscosity any of several things may happen. One, the oil pump may circulate the oil of high viscosity and create tremendous pressures in the oil lines and associated equipment such as the oil cooler, such pressures being far in excess of those for which the oil cooler would be designed to promote efficient heat exchange, and as a result, would damage the cooler. Secondly, due to tremendous resistance to the flow of the oil of high viscosity, the supply of lubricant at the bearings and working parts of the engine may be inadequate to properly lubricate the bearing, and failure of the engine may result. To overcome the above dif-

ficulties by this invention, it is possible to provide an adequate quantity of diluted lubricant in the warm-up compartment of the oil reservoir for cold start.

The operation of the above described invention is as follows: Before the engine is shut down, the operator may close electric switch **37** which starts auxiliary gasoline pump **26** and energizes the diluent valve solenoid **23**, thus causing the diluent to be admitted to the lubrication system in the inlet to valve **5**. Since the lubricant flowing in the system at this time will be hot, the diluent will cool lubricant adjacent the thermal element **29** and cause the valve to move to a position that will return the oil to the warm-up compartment of the reservoir. Slight cooling may cause the oil to flow through the jacket of the oil cooler and then to the warm-up compartment or a greater degree of cooling will cause the oil to flow through the by-pass directly to the warm-up compartment. Thus, it will be seen that the oil returned to the warm-up compartment **6** will be diluted, by the addition of gasoline, and a body of oil of low viscosity will be provided in the warm-up compartment for the next cold start of the engine.

If the engine has been shut down so that the lubricant is not circulated by the pump driven by the engine, by means of switch **38**, which comprises two switches **38***a* and **38***b* actuated by the link **38***c*, the circuit of motor **39** may be closed by throwing the switch to the "cold weather" position *c* to circulate the lubricant through the system and at the same time operate the diluent valve and motor-pump unit **26** to add a diluent as required. Thus, if the diluent has not been added to the lubricant before shutting off the engine, it is possible to add diluent without the necessity of restarting the engine. A body of diluted lubricant is thereby provided in the warm-up compartment **6** in the manner described above. If the switch **38** is thrown to the "hot weather" position H, the motor **39** merely drives the lubricant pump and returns the lubricant to the oil tank without the addition of a diluent.

The operation of the flap control in conjunction with the motion of the valve should be obvious from the description of the drawings. This mechanism is so designed that when maximum cooling is desired; that is, when the valve is moved by the temperature of the oil to cause the oil to flow through the core of the oil cooler, the flap control mechanism operates to open flap **13** to permit maximum flow of air. During the initial stages of warming up the engine, it is desirable to retain the heat in the oil until enough has accumulated to lower the viscosity of the oil and, therefore, the oil is not directed through the main body of the cooler but flows through either the by-pass or the jacket of the cooler depending upon the heat content of the oil. Again, due to the coupling of the flap control circuit with a position of the valve, the flap assumes position to restrict the air flow and prevent heat exchange and loss of heat from the lubricant.

By way of example, when the temperature of the lubricant is below 60° F., the valve is actuated by the bi-metallic element to direct oil flow through the by-pass. Above 175° F., the lubricant is directed through the core of the oil cooler. In the range of 100° to 140° F., the flow of lubricant is through the jacket of the oil cooler. In the in-between temperature ranges, the flow is split between the paths of the two adjacent temperature ranges. The valve is also set so that

oil above 160° F. is returned to the main section of the oil reservoir and below 130° F., the oil is returned to the warm-up compartment of the reservoir. It can be readily seen that the valve may be so designed and its relation to the thermal responsive element present so that the above described paths for the various temperature ranges may be varied. The main purpose is to insure that the valve will direct the lubricant to the warm-up compartment of the oil reservoir upon the addition of a diluent.

It is to be understood that certain changes, alterations, and modifications may be made in the above described structure without departing from the spirit and scope of the appended claims.

I claim as my invention:

1. In a lubricating system for an engine, a reservoir for lubricant having a warm-up compartment, a supply conduit for conducting lubricant from said reservoir to said engine, an oil cooler, a normal return conduit through said oil cooler to the main section of said reservoir, a secondary return conduit to said warm-up compartment, valve means to direct flow of lubricant through either said normal or secondary return conduits, said valve means being operated by a thermal responsive element which is responsive to the temperature of the lubricant, means to introduce diluent into the lubricant flowing toward said thermal responsive element to decrease the temperature of the lubricant adjacent the thermal responsive element to move the valve to direct the flow of lubricant through the secondary return conduit during the introduction of diluent.

2. In combination in a lubricating system for an engine having an oil reservoir and an oil cooler, a thermal operated lubricant flow control valve in said lubricating system, a thermal responsive element in said valve in the flow path of the lubricant for actuating said valve to direct flow through a by-pass around said cooler when the lubricant is cold, or through a stage or stages of said cooler depending upon the heat content of the lubricant, a member mounted adjacent said thermal responsive element for admitting diluent into said lubricant as it flows around said thermal responsive element to reduce the temperature of the lubricant adjacent said thermal responsive element to cause the valve to move to the by-pass position.

3. In combination in a lubricating system for an engine, a reservoir for lubricant, an oil cooler in a cooling air duct, a plurality of return lines for conducting lubricant from said engine to said reservoir, one line affording direct passage from said engine to said reservoir when the oil is cold, other lines conducting lubricant from said engine through a stage or stages of said cooler to said reservoir, a thermal responsive valve means for directing the flow of lubricant through the proper return line in accordance with the lubricant temperature, means to introduce a diluent into the lubricant in the flow line ahead of the thermal responsive element of said valve to effect a reduction in temperature of the lubricant to move the valve toward the direct-flow position and means actuated upon the movement of said valve to control the flow of air in the air duct.

4. In combination in a lubricating system having an engine, a reservoir for lubricant, an oil cooler in a cooling air duct, a plurality of return lines for conducting lubricant from said engine to said reservoir, one line affording direct pas-

sage from said engine to said reservoir when the oil is cold, other lines conducting lubricant from said engine through a stage or stages of said oil cooler to said reservoir, a thermal responsive valve means for directing the flow of lubricant through the proper return lines in accordance with the lubricant temperature, means to introduce a diluent into the lubricant in the flow line ahead of the thermal responsive element of said valve to effect a reduction in temperature of the lubricant to move the valve toward the direct-flow position, means to cool said diluent and means actuated upon the movement of said valve to control the flow of air in the air duct.

5. In combination, in a lubricating system for an internal combustion engine, a tank for the storage of gasoline and a line to conduct gasoline to said engine, a reservoir for lubricant, conduits

for conducting lubricant from the reservoir to said engine and back to said reservoir, engine driven pump means to circulate lubricant and other engine driven pump means to pump gasoline from the fuel tank to said engine, electric motor-driven means to pump lubricant in said system, and a separate electric motor-driven means to pump gasoline independently of said engine, electrically operated valve means interconnecting said gasoline and said lubrication systems adapted to be opened to introduce some gasoline into said lubrication system while the engine is operating, and selector switch means for operating said electric lubricant and gasoline pumps and said valve to introduce gasoline into the circulating lubricant after the engine has stopped.

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