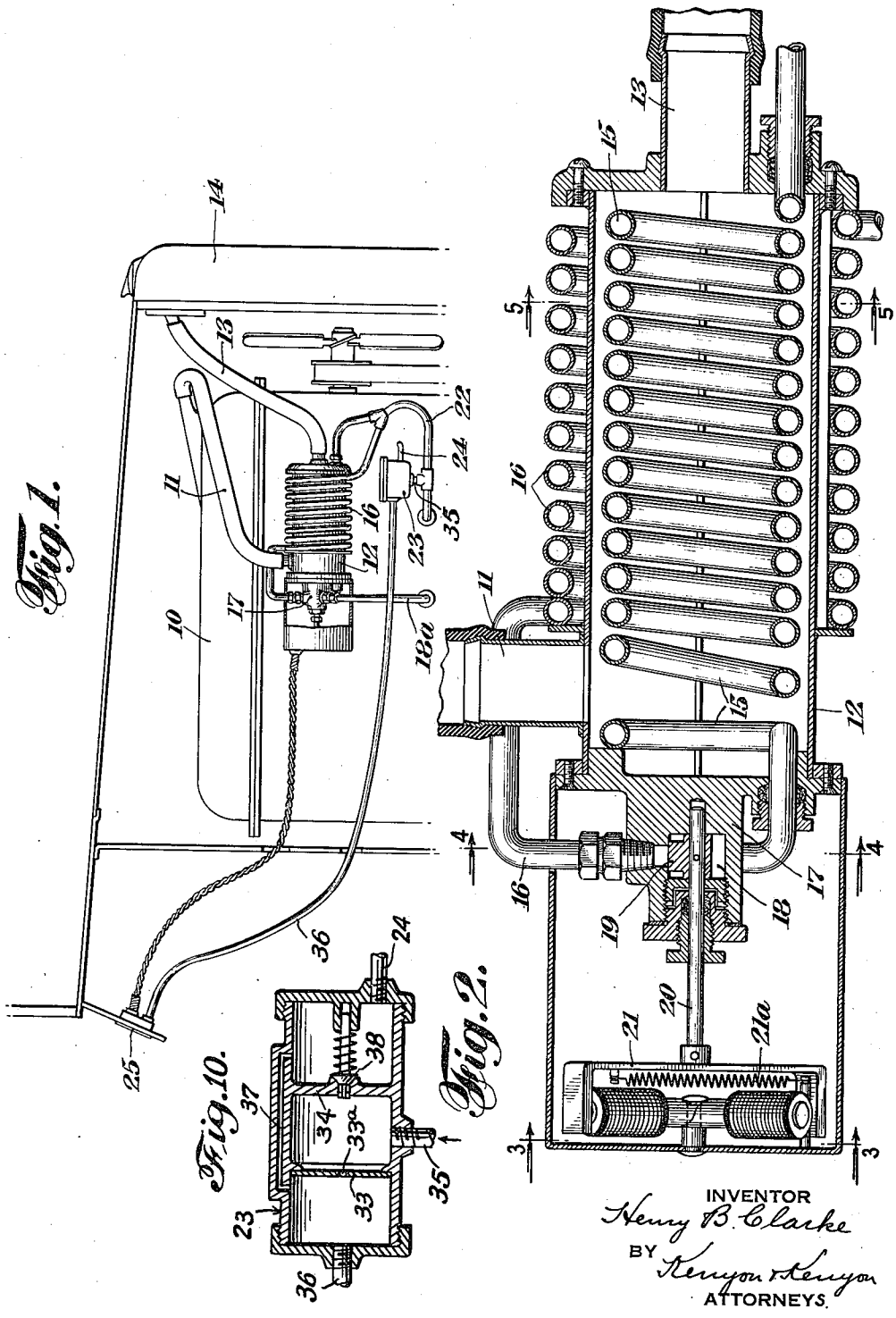
Nov. 8, 1938. H. B. CLARKE 2,136,040

VISCOSITY REGULATOR

Filed March 17, 1932 3 Sheets-Sheet 1



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VISCOSITY REGULATOR

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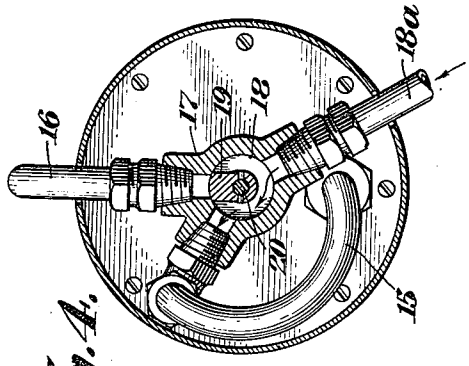


Fig. 4.

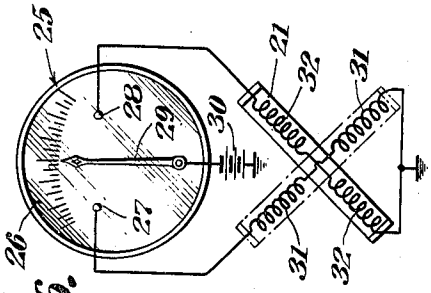


Fig. 6.

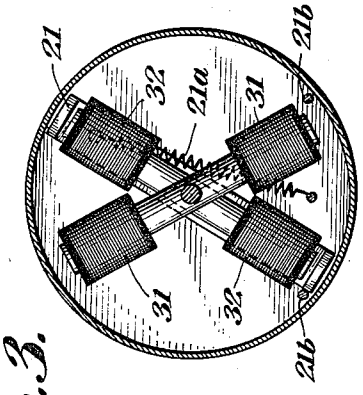


Fig. 3.

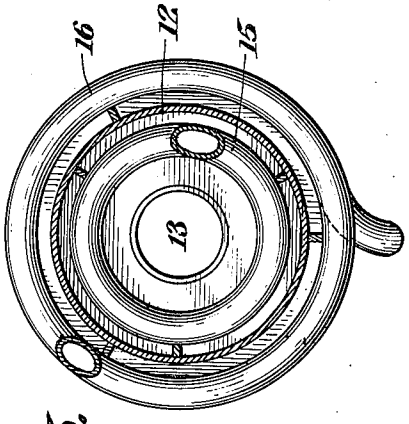


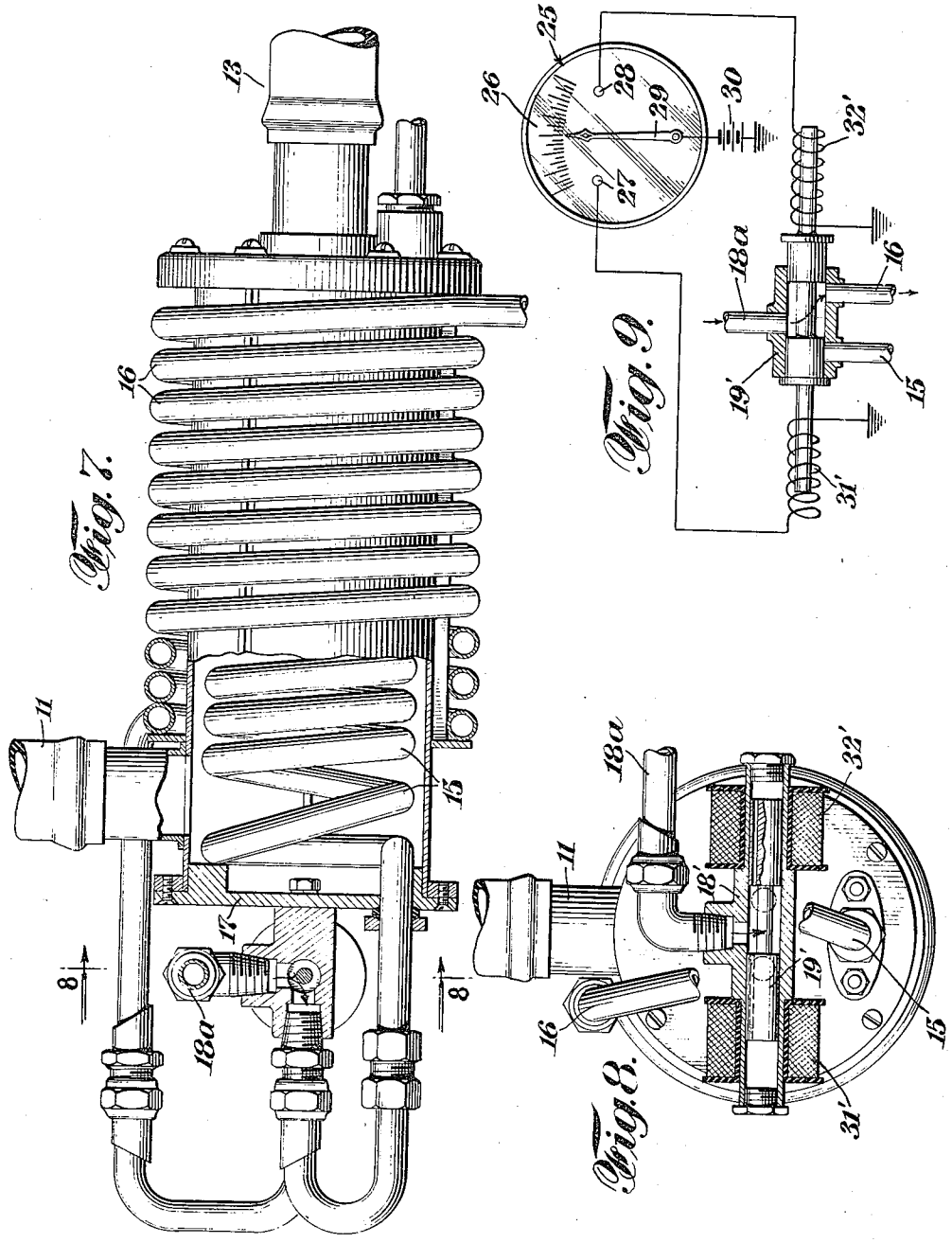
Fig. 5.

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VISCOSITY REGULATOR

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Patented Nov. 8, 1938 2,136,040

UNITED STATES PATENT OFFICE

2,136,040

VISCOSITY REGULATOR

Henry B. Clarke, Garden City, N. Y., assignor, by mesne assignments, to Henry R. Gross, Chicago, Ill.

Application March 17, 1932, Serial No. 599,493

22 Claims. (Cl. 123—196)

This invention relates to viscosity regulators and has for an object a simple, efficient, inexpensive and durable apparatus for use in connection with the lubricating system of an internal combustion engine for regulating the viscosity of the lubricant supplied to the bearings.

In an apparatus embodying the invention, the lubricating oil of an internal combustion engine is delivered from the pump to a valve box having two outlets, each being connected with a pipe coil, one of the pipe coils being arranged within a chamber included in the cooling system between the engine jacket and the radiator and the other coil being arranged around said chamber. The two coils discharge into a conduit leading to the bearings. In the valve box there is provided a valve adapted to close either of the outlet ports, this valve being electrically operated by means controlled by a viscosity responsive device connected to the discharge conduit.

The oil is directed through the inner coil except when its viscosity decreases to the lower limit of a predetermined permissible viscosity range, whereupon it is directed through the outer coil until its viscosity increases to the upper limit of the predetermined range when it is again directed through the inner coil. During the initial period of operation of the engine, the viscosity of the oil is high and the oil is directed through the inner coil and also during the same period, the temperature of the water delivered from the engine jacket to the chamber is higher than that of the oil passing through the inner coil and the oil is heated by the water, thereby decreasing the viscosity of the oil. After a period of operation, the temperature of the oil exceeds that of the water and then the water tends to cool the oil to prevent undue decrease of its viscosity. Should the viscosity of the oil decrease to the lower limit of the predetermined range, the oil is directed through the exterior coil in which it is air cooled to increase its viscosity. After the viscosity of the oil reaches the upper limit of the predetermined range, the oil is again directed through the inner coil.

Other objects, novel features and advantages of this invention will be apparent from the following specification and accompanying drawings, wherein:

Fig. 1 is a side elevation of an automobile engine equipped with a viscosity regulator embodying the invention;

Fig. 2 is an enlarged vertical sectional view of the regulator;

Fig. 3 is a section on the line 3—3 of Fig. 2;

Fig. 4 is a section on the line 4—4 of Fig. 2;

Fig. 5 is a section on the line 5—5 of Fig. 2;

Fig. 6 is a wiring diagram of the solenoid energizing circuit;

Fig. 7 is a side elevaton of a modified form of the invention;

Fig. 8 is a section on the line 8—8 of Fig. 7, and

Fig. 9 is a wiring diagram.

Fig. 10 is a section through a viscosity responsive device.

In Figs. 1 to 6 inclusive, the engine 10 is provided with a water outlet from its jacket to which is connected a pipe 11 leading into one end of a chamber 12 supported at the side of the engine. A conduit 13 leads from the other end of the chamber 12 to the radiator 14. A coil 15 is arranged within the chamber 12 and a coil 16 is arranged around the chamber 12. In the head 17 of the chamber there is provided a valve box 18 having outlets communicating with the coils 15 and 16. A valve 19 is mounted on a shaft 20 journalled in the head 17 and carrying at its free end a yoke 21. The arrangement of the valve 19 is such that in one position it closes one outlet with the other open and in another position it closes the second outlet with the first one open, thus establishing communication between the valve box and either of the two coils 15 and 16. A pipe 19a leads from the lubricant pump (not shown) into the valve box 18. The coils 15 and 16 discharge into a conduit 22 leading to the bearings.

A viscosity meter consisting of a viscosity responsive device 23 and a pressure gauge 25 is connected to the pipe 22 and has an outlet pipe 24 discharging into the sump of the engine 10. The gauge 25 of the viscosity meter 23 is mounted on the instrument board and the dial 26 of the gauge supports a pair of stationary contacts 27 and 28 arranged near each end of the swing of the pivoted pointer 29 of the gauge. The pointer 29 is connected in series with a battery 30 and is adapted to engage the contacts 27 and 28 to close electrical circuits hereinafter described. The contact 27 is connected with the field winding of a solenoid 31 while the contact 28 is connected with the field winding of the solenoid 32, these two solenoids being angularly related and being in alinement with the yoke 21. When the pointer 29 is engaged with the contact 27, the solenoid 31 is energized and when the pointer 29 is in engagement with the contact 28, the solenoid 32 is energized.

The arrangement of the yoke and solenoid is such that the yoke acts as the armature for both

solenoids and when the yoke is in alinement with one solenoid, the valve 19 closes one of the outlets from the valve box and when the yoke is in alinement with the other solenoid, the valve closes the other outlet. The yoke and valve are moved between the two positions by alternately energizing the solenoids 31 and 32. The arrangement of the solenoids relative to the valve 19 is such that when the pointer 29 engages the contact 27, the port leading to the coil 16 is open and when the pointer 29 engages the contact 28, the outlet to the coil 15 will be open. A spring 21*a* serves to exert pull on the yoke 21 tending to hold it against either of the stops 21*b*, the yoke in either of these positions being in alinement with one of the solenoids.

When the engine is at rest, the pointer lies to the left of the contact 27 and the yoke 21 is aligned with the solenoid 31, the valve 19 being so positioned that the outlet from the valve chamber communicates with the coil 16. When the engine is started, the viscosity of the oil is high and the pointer 29 is therefore immediately moved to the extreme right end of its swing and in moving to this position it engages the contact 28, thereby closing the circuit through the field winding of the solenoid 32 and energizing the same to draw the armature 21 into alinement therewith. The valve 19 is thus actuated to close off the coil 16 and direct the oil through the coil 15. During the initial period of operation of the engine, the water delivered from the engine jacket to the chamber is of higher temperature than the oil and therefore heats the oil, tending to reduce its viscosity. The pointer 29 moves to the left as the viscosity decreases and again engages the contact 28, but the position of the valve 19 is unchanged. Continued operation of the engine results in an increase in the temperature of the oil above that of the water so that the water then tends to cool the oil to prevent undue viscosity decrease. Should the oil viscosity continue to decrease, the pointer 29 will move further to the left and come into engagement with the contact 27, thereby closing the circuit through the field winding of solenoid 31 and energizing the same to draw the arm 21 into alinement therewith, thereby closing off the coil 15 and directing the oil through the coil 16. The oil passing through the coil 16 is air-cooled, thereby causing its viscosity to increase. As the oil viscosity increases, the pointer 29 is again moved to the right and when it again engages the contact 28 the solenoid 32 is again energized and the valve 19 actuated to close off the coil 16 and direct the oil through the coil 15. A repetition of the cycle above outlined maintains the viscosity of the lubricant within a predetermined range, the range being dependent upon the position of the contacts 27 and 28. When the engine is stopped, the viscosity meter ceases to function and the pointer 29 moves to the extreme left end of its swing and in so doing engages the contact 27, thereby energizing the solenoid 31 to actuate the armature 21 and valve 19 to close off the coil 15 and open the port leading to the coil 16.

The above described apparatus maintains the lubricating oil of an internal combustion engine within a predetermined viscosity range irrespective of the initial viscosity rating of the oil and irrespective of dilution. The water of the circulating system tends to maintain the oil at such temperature that its viscosity lies within the permissible range and the air-cooled coil provides means for restoring the oil to the upper limit of the permissible viscosity range in the event that the viscosity of the oil decreases to the lower limit of such range.

Referring now to Figs. 7 to 9 inclusive, the pipe 18*a* discharges into a valve box 18' having outlet ports communicating with the coils 15 and 16. In the valve box is mounted a slide valve 19' adapted in one position to close off the coil 16. Solenoids 31' and 32' surround extensions of the valve box 18' and the valve 19' constitutes a common core for these solenoids.

As in the modification disclosed in Figs. 1 to 6 inclusive, the dial 26 of the gauge 25 supports a pair of stationary contacts 27 and 28 arranged to be engaged by the pointer 29, which is connected in series with a battery 30 and is adapted to close electrical circuits hereinafter described by engagement with the contacts 27 and 28. The contact 27 is connected with the field winding of the solenoid 31' while the contact 28 is connected with the field winding of the solenoid 32'. When the pointer 29 engages the contact 27, the solenoid 31' is energized and when the pointer 29 engages the contact 28, the solenoid 32' is energized. Alternate energization of the solenoids 31' and 32' causes movement of the valve 19' from one of its positions to the other, thereby controlling the flow of the lubricant through the coils 15 and 16 in the manner described in detail in connection with the modification disclosed in Figs. 1 to 6 inclusive. In view of the detailed description of operation of the first modification, the operation of the second modification is offered without further explanation.

The viscosity responsive device 23 consists of a housing divided into three chambers by partitions 33 and 34. A pipe 35 leads from the pipe 22 to the middle chamber and a pipe 36 leads from the left hand chamber to the pressure gauge 25, the pipe 24 leading from the right hand chamber. The partition 33 is provided with an orifice 33*a*, the resistance of which to liquid flow is substantially independent of the viscosity of the liquid and a friction tube 37 leads from the left hand chamber to the right hand chamber, the resistance of the friction tube to liquid flow being dependent upon the viscosity of the liquid. The partition 34 is provided with a port which is adapted to be closed by a spring actuated valve 38, this valve serving to maintain constant pressure in the middle chamber. Oil is supplied to the middle chamber through the pipe 35 and flows through the orifice and friction tube at the same rate and is then discharged into the right hand chamber from which it is discharged through the pipe 24 into the sump and constant pressure is maintained within the middle chamber by means of the relief valve 38, the pressure of oil in the pipe 35 being at all times greater than the pressure required to actuate the valve 38. As constant pressure is maintained in the middle chamber, oil is supplied to the orifice at constant pressure and as its resistance to flow is independent of viscosity and the rate of flow through the orifice and the friction tube is the same, the pressure of the oil in the left hand chamber is a measure of the rate of flow through the friction tube and is a function of the oil viscosity. Change in the oil viscosity results in change of pressure applied to the gauge 25 and effects regulation of flow through the coils as above explained.

It is of course understood that various modifications may be made in the structure above described, without in any way departing from the

spirit of the invention as defined in the appended claims.

I claim:

1. In combination with an internal combustion engine having a cooling system, a chamber forming part of said cooling system, a coil of pipe in said chamber, a coil of pipe exterior of said chamber, a conduit into which both of said coils discharge, a lubricant supply pipe, valve means for connecting said supply pipe with either of said coils, viscosity responsive means including a chamber in which the pressure of liquid flowing therethrough is a function of its viscosity, connections for supplying lubricant from said conduit to said viscosity responsive means, and means responsive to the pressure in said chamber for controlling the position of the valve means.

2. In combination with an internal combustion engine having a cooling system, a chamber forming part of said cooling system, a coil of pipe in said chamber, a coil of pipe exterior of said chamber, a conduit into which both of said coils discharge, a lubricant supply pipe, valve means for connecting said supply pipe with either of said coils, viscosity responsive means including a chamber in which the pressure of liquid flowing therethrough is a function of its viscosity, connections for supplying lubricant from said conduit to said viscosity responsive means, and electro-magnetic means responsive to the pressure in said chamber for controlling the position of the valve means.

3. In combination with an internal combustion engine having a cooling system, a chamber forming a part of the cooling system, a coil of pipe within said chamber, a coil of pipe exterior of said chamber, a conduit into which said coils discharge, a valve box having an outlet port communicating with each of said coils, a valve in said box for closing either outlet, a lubricant supply pipe leading to said valve box, viscosity responsive means including a chamber in which the pressure of liquid flowing therethrough is a function of its viscosity, connections for supplying lubricant from said conduit to said viscosity responsive means, and means responsive to the pressure in said chamber for actuating said valve.

4. In combination with an internal combustion engine having a cooling system, a chamber forming a part of the cooling system, a coil of pipe within said chamber, a coil of pipe exterior of said chamber, a conduit into which said coils discharge, a valve box having an outlet port communicating with each of said coils, a valve in said box for closing either outlet, a lubricant supply pipe leading to said valve box, viscosity responsive means including a chamber in which the pressure of liquid flowing therethrough is a function of its viscosity, connections for supplying lubricant from said conduit to said viscosity responsive means, and electro-magnetic means responsive to the pressure in said chamber for actuating said valve.

5. In combination with an internal combustion engine having a cooling system, a chamber forming a part of the cooling system, a coil of pipe within said chamber, a coil of pipe exterior of said chamber, a conduit into which said coils discharge, a valve box having an outlet port communicating with each of said coils, a valve in said box for closing either outlet, a lubricant supply pipe leading to said valve box, viscosity responsive means including a chamber in which the pressure of liquid flowing therethrough is a function of its viscosity, connections for supplying lubricant from said conduit to said viscosity responsive means, a pair of angularly related solenoids, a rotatable common armature for said solenoids, connections between said armature and said valve, and means responsive to the pressure in said chamber for selectively energizing said solenoids.

6. In combination with an internal combustion engine having a cooling system, a chamber forming a part of the cooling system, a coil of pipe within said chamber, a coil of pipe exterior of said chamber, a conduit into which said coils discharge, a valve box having an outlet port communicating with each of said coils, a valve in said box for closing either outlet, a lubricant supply pipe leading to said valve box, viscosity responsive means including a chamber in which the pressure of liquid flowing therethrough is a function of its viscosity, connections for supplying lubricant from said conduit to said viscosity responsive means, a pair of angularly related solenoids, a rotatable common armature for said solenoids, connections between said armature and said valve, energizing circuits for said solenoids comprising a pair of stationary contacts and a contact movable into engagement with either of said stationary contacts, and means responsive to the pressure in said chamber for controlling the position of said movable contact.

7. In combination with an internal combustion engine having a cooling system, a chamber forming a part of the cooling system, a coil of pipe within said chamber, a coil of pipe exterior of said chamber, a conduit into which said coils discharge, a lubricant supply pipe, valve means for connecting said supply pipe with either of said coils, viscosity responsive means including a chamber in which the pressure of liquid flowing therethrough is a function of its viscosity, connections for supplying lubricant from said conduit to said viscosity responsive means, a pair of angularly related solenoids, a rotatable common armature for said solenoids, connections between said armature and said valve means, and means responsive to the pressure in said chamber for selectively energizing said solenoids.

8. In combination with an internal combustion engine having a cooling system, a chamber forming a part of the cooling system, a coil of pipe within said chamber, a coil of pipe exterior of said chamber, a conduit into which said coils discharge, a lubricant supply pipe, valve means for connecting said supply pipe with either of said coils, viscosity responsive means including a chamber in which the presure of liquid flowing therethrough is a function of its viscosity, connections for supplying lubricant from said conduit to said viscosity responsive means, a pair of angularly related solenoids, a rotatable common armature for said solenoids, connections between said armature and said valve means, energizing circuits for said solenoids comprising a pair of stationary contacts and a contact member movable into engagement with either of said contacts, and means responsive to the pressure in said chamber for controlling the position of the movable contact.

9. In combination with an internal combustion engine having a cooling system, a chamber, a coil of pipe within said chamber, a coil of pipe exterior of said chamber, a conduit into which said coils discharge, a valve box having outlet ports connecting with said coils, a lubricant supply pipe leading to said valve box, viscosity responsive means including a chamber in which the

pressure of liquid flowing therethrough is a function of its viscosity, connections for supplying lubricant from said conduit to said viscosity responsive means, a valve within said box rotatable to close either outlet, a pair of angularly related solenoids, a yoke rotatable with said valve and constituting a common armature for said solenoids, yieldable means tending to hold said yoke with the valve in either of its two port closing positions, and means responsive to the pressure in said chamber for selectively energizing said solenoids.

10. In combination with an internal combustion engine having a cooling system, a chamber, a coil of pipe within said chamber, a coil of pipe exterior of said chamber, a conduit into which said coils discharge, a valve box having outlet ports connecting with said coils, a lubricant supply pipe leading to said valve box, viscosity responsive means including a chamber in which the pressure of liquid flowing therethrough is a function of its viscosity, connections for supplying lubricant from said conduit to said viscosity responsive means, a valve within said box rotatable to close either outlet, a pair of angularly related solenoids, a yoke rotatable with said valve and constituting a common armature for said solenoids, yieldable means tending to hold said yoke with the valve in either of its port closing positions, energizing circuits for said solenoids comprising a pair of stationary contacts and a contact movable into engagement with either of said stationary contacts, and means responsive to the pressure in said chamber for controlling the position of said movable contact.

11. In combination with an internal combustion engine having a cooling system, a chamber forming a part of the cooling system, a coil of pipe within said chamber, a coil of pipe exterior of said chamber, a conduit into which said coils discharge, a lubricant supply pipe, valve means for connecting said supply pipe with either of said coils, viscosity responsive means including a chamber in which the pressure of liquid flowing therethrough is a function of its viscosity, connections for supplying lubricant from said conduit to said viscosity responsive means, a pair of solenoids having a common armature for actuating said valve means, and means responsive to the pressure in said chamber for selectively energizing said solenoids.

12. In combination with an internal combustion engine having a cooling system, a chamber forming a part of the cooling system, a coil of pipe within said chamber, a coil of pipe exterior of said chamber, a conduit into which said coils discharge, a lubricant supply pipe, valve means for connecting said supply pipe with either of said coils, viscosity responsive means including a chamber in which the pressure of liquid flowing therethrough is a function of its viscosity, connections for supplying lubricant from said conduit to said viscosity responsive means, a pair of solenoids having a common armature for actuating said valve means, energizing circuits for said solenoids comprising a pair of stationary contacts and a contact movable into engagement with either of said stationary contacts, and means responsive to the pressure in said chamber for controlling the position of said movable contact.

13. In combination with the lubricating system of an internal combustion engine, a pair of means for attemperating the oil in the system, a conduit into which said attemperating means discharge, a valve chamber communicating with both said attemperating means, means for supplying oil to said chamber, a slide valve movable to close off either attemperating means, viscosity responsive means including a chamber in which the pressure of liquid flowing therethrough is a function of its viscosity, connections for supplying oil from said conduit to said viscosity responsive means, and electro-magnet means responsive to the pressure in said chamber for actuating said valve.

14. In combination with the lubricating system of an internal combustion engine, a pair of means for attemperating the oil in the system, a conduit into which said attemperating means discharge, a valve chamber communicating with both said attemperating means, means for supplying oil to said chamber, a slide valve movable to close off either attemperating means, a pair of solenoids having said valve for a common core, viscosity responsive means including a chamber in which the pressure of liquid flowing therethrough is a function of its viscosity, connections for supplying liquid from said discharge conduit to said viscosity responsive means, and means responsive to the pressure in said chamber for selectively energizing said solenoids.

15. In combination with the lubricating system of an internal combustion engine, a pair of means for attemperating the oil in the system, a conduit into which said attemperating means discharge, a valve chamber communicating with both said attemperating means, means for supplying oil to said chamber, a slide valve movable to close off either attemperating means, a pair of solenoids for actuating said valves, energizing circuits for said solenoids comprising a pair of stationary contacts and a contact member movable into engagement with either of said stationary contacts, viscosity responsive means including a chamber in which the pressure of liquid flowing therethrough is a function of its viscosity, connections for supplying liquid from said conduit to said viscosity responsive means, and means responsive to the pressure in said chamber for controlling the position of said movable contact member.

16. In a fluid system comprising two fluid paths, attemperating means in each path, viscosity responsive means connected to said system for operation upon by a portion only of the fluid flowing from said paths under pressure and including a chamber wherein the pressure of the fluid flowing therethrough is a function of its viscosity, and means responsive to the pressure of the fluid in said chamber for controlling flow through said paths.

17. In a fluid system comprising two fluid paths, attemperating means in each path, valve means for controlling flow through said paths, viscosity responsive means connected to said system for operation upon by a portion only of the fluid flowing from said paths under pressure and including a chamber wherein the pressure of the fluid flowing therethrough is a function of its viscosity, and means responsive to the pressure in said chamber for actuating said valve means.

18. In combination with an internal combustion engine, a cooling system therefor, and a lubricating system therefor, said lubricating system comprising a pair of oil paths, one of said oil paths being in heat exchange relationship with the fluid of the cooling system, a common conduit into which both of said oil paths discharge and leading to the engine bearings, viscosity respon-

sive means connected to said conduit and including a chamber in which the pressure of liquid flowing therethrough is a function of its viscosity, and means responsive to the pressure in said chamber for controlling flow through said paths.

19. In combination with an internal combustion engine, a cooling system therefor and a lubricating system therefor, said lubricating system comprising a pair of oil paths, one of said oil paths being in heat exchange relationship with the fluid of the cooling system, a common conduit into which both of said oil paths discharge and leading to the engine bearings, valve means for regulating flow through said paths, viscosity responsive means connected to said conduit and including a chamber wherein the pressure of liquid flowing therethrough is a function of its viscosity, and means responsive to the pressure in said chamber to actuate said valve means.

20. In a system having a circulating liquid, means to indicate the viscosity of said liquid, means to heat said liquid, means to cool said liquid, and means operable by said first mentioned means selectively to cause said heating and said cooling means to function.

21. In a system having a circulating liquid, means to circulate said liquid, a viscosity measuring device, means to bypass a portion of said liquid through said device, heating means connected to said system, cooling means connected to said system, means selectively to permit the passage of the liquid through either the heating or the cooling means while inhibiting its passage through the cooling or the heating means, and a relay operable under control of said device to operate said last-mentioned means.

22. In a system having a circulating liquid, means to determine the viscosity of said liquid, a water cooling system, and means operable by said first mentioned means to cause said cooling system to cool said liquid under predetermined conditions of viscosity of said liquid.

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