

Jan. 8, 1952

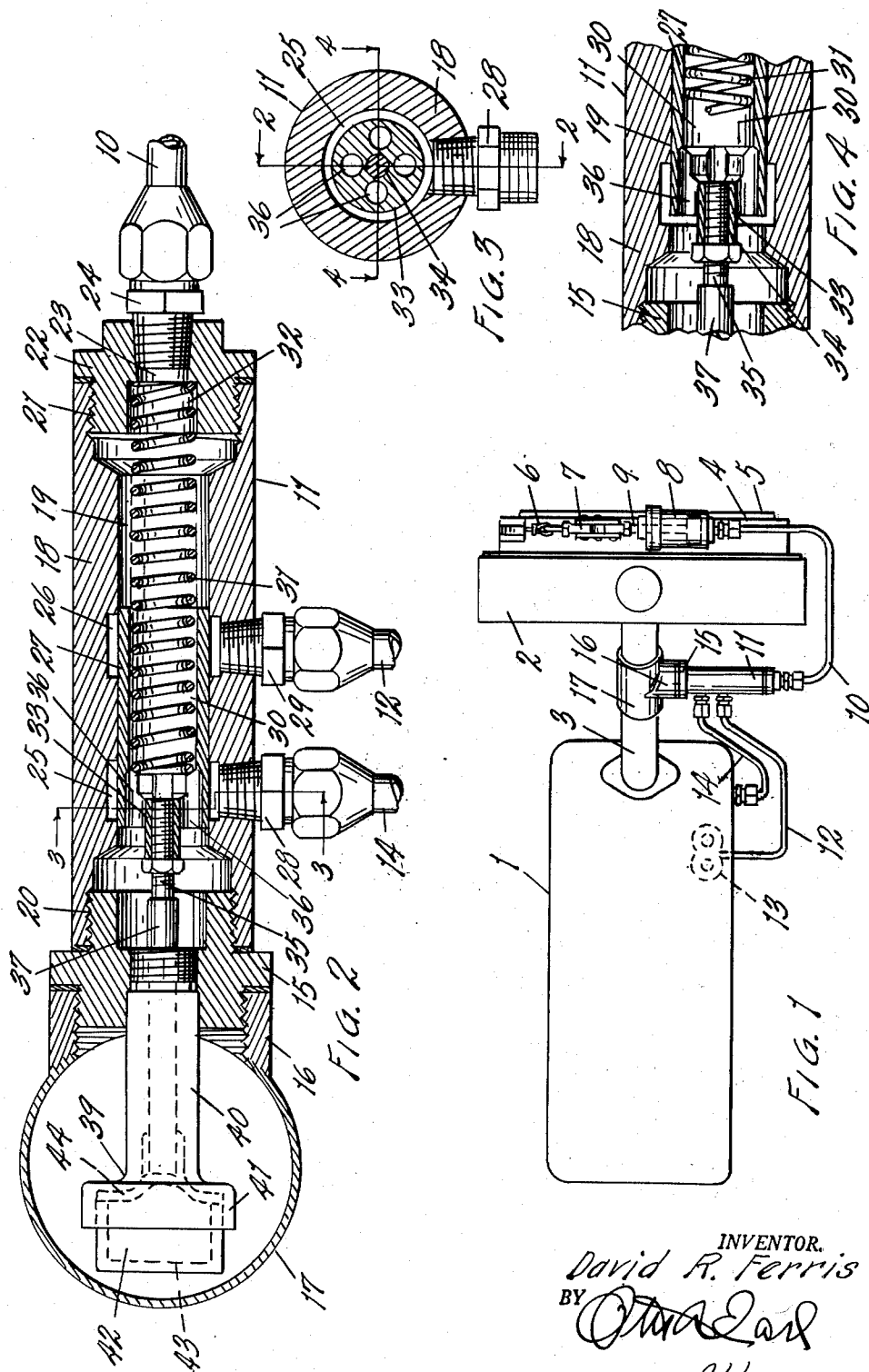
D. R. FERRIS

2,581,582

THERMOSTATICALLY OPERATED VALVE

Filed Nov. 28, 1949

2 SHEETS—SHEET 1



INVENTOR.
David R. Ferris
BY *Charles E. Ladd*
Attorney.

Jan. 8, 1952

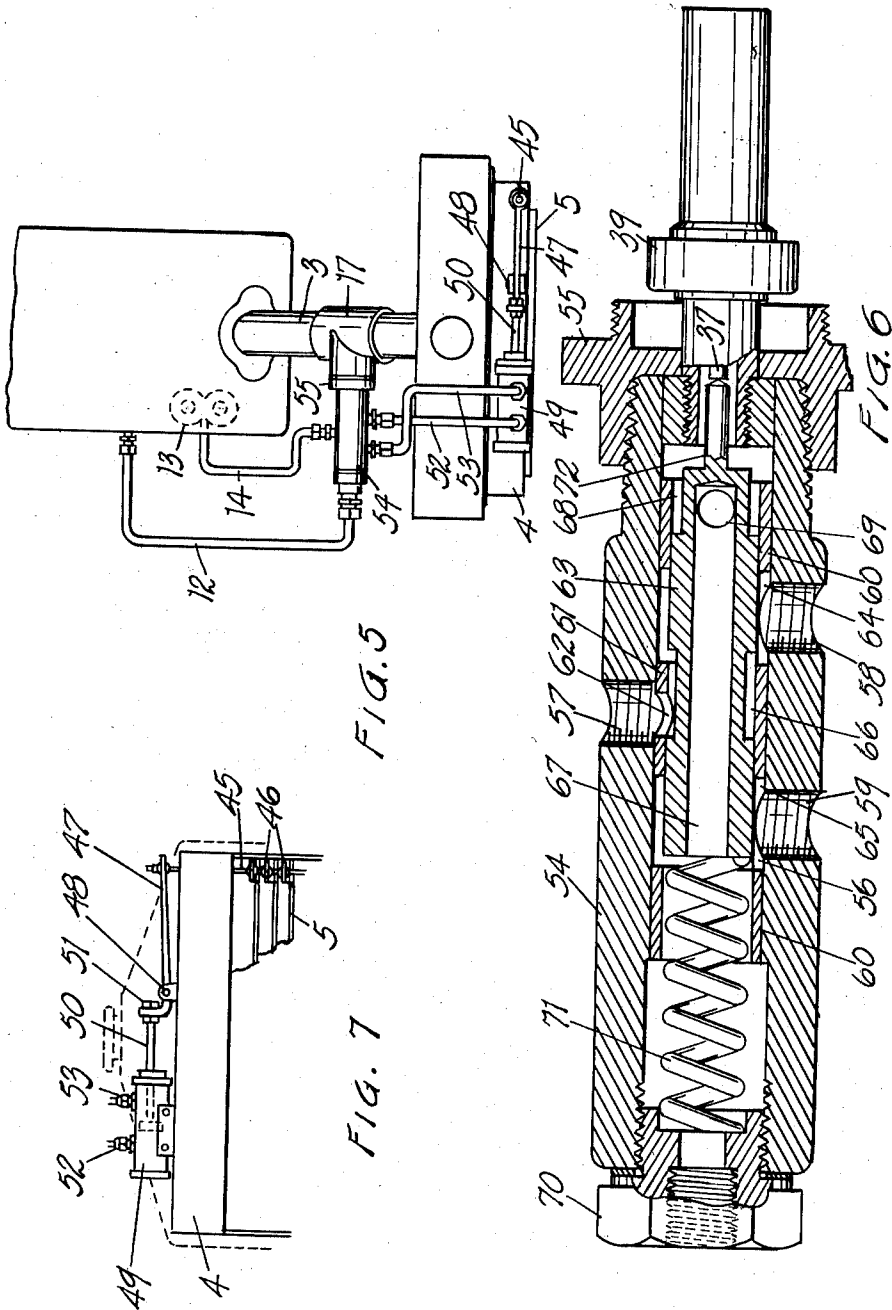
D. R. FERRIS

2,581,582

THERMOSTATICALLY OPERATED VALVE

Filed Nov. 28, 1949

2 SHEETS—SHEET 2



INVENTOR.
David R. Ferris
BY *O. A. Earl*
ATTORNEY.

UNITED STATES PATENT OFFICE

2,581,582

THERMOSTATICALLY OPERATED VALVE

David R. Ferris, Cadillac, Mich., assignor to
Kysor Heater Company, Cadillac, Mich.

Application November 28, 1949, Serial No. 129,802

8 Claims. (Cl. 236—99)

1

This invention relates to improvements in hydraulically operated and thermostatically controlled shutter for internal combustion engine radiators.

The principal objects of this invention are:

First, to provide a system for opening and closing shutter elements associated with a radiator by means of oil pressure created by an internal combustion engine associated with the radiator.

Second, to provide a thermostatically controlled valve for regulating the flow of oil under pressure from an internal combustion engine to a shutter operating cylinder and return to the engine.

Third, to provide novel forms of thermostatically controlled valves incorporating a mass of thermally expansible solid material for positively opening and closing oil supply and oil return passages to a hydraulic motor.

Fourth, to provide a system of shutter control for the radiator of an engine where the engine is not equipped with means for supplying compressed air or vacuum for operating the shutter.

Other objects and advantages relating to details of my invention will be apparent from a consideration of the following description and claims.

The drawings, of which there are two sheets, illustrate two practical forms of my system.

Fig. 1 is a plan view of the shutter control system operatively associated with an internal combustion engine and radiator, the engine, radiator, and shutter structure being illustrated conventionally.

Fig. 2 is an enlarged longitudinal cross sectional view through the thermostatically controlled valve for regulating the flow of oil in the system.

Fig. 3 is a transverse cross sectional view through the valve taken along the plane of the line 3—3 in Fig. 2.

Fig. 4 is a fragmentary longitudinal cross sectional view taken along the plane of the line 4—4 in Fig. 2 and illustrating the valve in a different operated position than the position shown in Fig. 2.

Fig. 5 is a fragmentary plan view similar to Fig. 1 of a modified form of valve and control system.

Fig. 6 is a longitudinal cross sectional view through the valve shown in Fig. 5.

Fig. 7 is a fragmentary front elevational view of the shutter shown in Fig. 5.

My invention relates to a modified method and structure for operating the shutters on the radiator of a vehicle for the same general purpose as

2

the shutter control system illustrated in Patent No. 2,248,094 issued July 8, 1941 to Walter A. Kysor for Shutter Mechanism and Thermostatic Control Therefor and the co-pending application of Walter A. Kysor, Serial No. 79,669 filed March 4, 1949, now Patent Number 2,512,548, dated June 20, 1950, for Thermostatic Control Valve. Each of the systems disclosed in the above patent and application utilize compressed air from a source available on the vehicle for opening and closing shutter vanes on a radiator responsive to temperature changes in the engine of the vehicle. My present invention substitutes the oil pressure of an engine for compressed air as a motive fluid for actuating the shutter vanes and further provides novel forms of thermostatically controlled valves particularly adapted to control the oil pressure. My present system is adaptable to either vehicle or stationary engine radiators.

In the drawings, I have conventionally illustrated an internal combustion engine 1 and its associated radiator 2. The engine and radiator are connected by the usual water pipe or tube 3 for delivering the heated cooling fluid from the engine to the radiator.

Mounted across the face of the radiator and preferably on the front side thereof is a shutter assembly 4 including a plurality of tiltable vanes 5 which are adapted to be tilted from parallel open positions to overlapping closed positions and prevent the flow of air through the radiator. The tilting of the vanes 5 is effected by tension on an operating cable 6, and the cable is actuated from one arm of a crank 7 pivotally mounted on the top of the shutter assembly. A fluid operated cylinder 8, also mounted on the shutter assembly, has its piston rod 9 connected to the crank 7 for operating the same. The details of construction and operation of the shutter assembly are described in detail in the previously mentioned patent to Walter A. Kysor and so are not disclosed in greater detail here.

The hydraulic cylinder 8 is arranged to be supplied with oil under pressure through the supply pipe 10, which extends to the valve assembly 11. An inlet pipe 12 provides a source of oil under pressure from the oil pump 13 of the engine to the valve assembly 11, and an oil return pipe 14 returns oil from the hydraulic cylinder and valve assembly to the sump or crank case of the engine. The valve assembly 11 is carried by a coupling 15 connected to the center branch 16 of a T fitting 17 connected in the water tube 3.

The construction of the valve assembly 11 is most clearly shown in Figs. 2 to 4. The valve

3

comprises a tubular body member 18 having a central bore 19 formed completely therethrough. One end of the bore is enlarged and internally threaded as at 20 for engagement with the threaded outer end of the coupling 15. The opposite end of the bore 19 is also enlarged and internally threaded as at 21 to receive the threaded connector 22. The connector 22 has a hole 23 formed therein for reception of the nipple 24 through which the pipe 10 communicates with the bore 19.

Intermediate of its ends, the bore 19 is provided with an enlarged annular outlet passage 25 and an annular inlet passage 26 spaced longitudinally along the bore from the outlet passage. A cylindrical valve element 27 is slidably positioned within the bore 19 and is of such diameter and length as to close off or seal both the outlet passage 25 and the inlet passage 26 from the bore in one position of the valve element as illustrated in Fig. 2. A nipple 28 connected through the side wall of the body element affords a connection and communication between the outlet passage 25 and the oil return pipe 14. A similar nipple 29 connects the inlet passage 26 with the oil pressure pipe 12.

The cylindrical valve element 27 is centrally bored as at 30 to receive the inner end of a coil spring 31. The outer end of the spring 31 is received in a recess 32 in the connector 22, and the spring serves to bias the valve element 27 toward the coupling 15 and the T section 17 of the water pipe. The bore 30 in the valve element terminates within the valve element leaving an end wall 33 against which the inner end of the spring bears. The end wall 33 is centrally bored and threaded as at 34 to receive an adjustable push screw 35 and is further provided with a plurality of axial bores 36 positioned around the screw 35 and affording fluid communication from end to end through the valve element. Preferably the threaded portion of the end wall projects beyond the end of the valve element proper to increase the length of the thread therein and thereby increase the range of adjustment of the valve.

The push screw 35 carried by the valve element projects into a recess in the coupling 15 and is engageable with the inner end of a thermostatically operated piston rod 37. A lock nut 38 adjustably clamps the push screw in adjusted position. The piston rod 37 is slidable in and forms a part of a thermostatic element 39. The element 39 consists of a tubular body 40 threadably engaged with the coupling 15 and projecting therefrom into the T section 17. Within the T section a body 40 is enlarged as at 41 to receive a hollow cap 42, thus forming an expansion chamber 43. The cap 42 secures a flexible or extensible diaphragm 44 to the end of the body 40, and the space within the chamber 43 is filled with a thermally expansive solid material. Expansion of this solid material by reason of increased temperature is effective to bulge or expand the diaphragm 44 and press the piston rod 37 out of the thermostatic element and into engagement with the push screw 35 in opposition to the spring 31.

The thermostatic element 39, including the body, piston rod, expansion chamber 43 and diaphragm 44, is a commercial product currently available from the Detroit Lubricator Company and so is not described in greater detail.

From the foregoing description, it will be apparent that the push screw 35 may be adjusted so that at any given temperature of the water

4

flowing over the thermostatic element 39, the mass of expansible solid in the thermostatic element will exert a sufficient force on the piston rod 37 to overcome the action of the spring 31 and move the valve element 27 away from the water pipe and open the return passage 25 to the bore 19 through the bores 36 in the end wall. Oil which has been retained under pressure in the hydraulic cylinder 8 will then return through the pipe 14 to the crank case of the engine, and the operating pressure on the piston rod 9 of the hydraulic cylinder will be released. It should be understood that the vanes 5 of the shutter assembly are spring biased to open position against the pressure of the piston rod 9 so that the shutter vanes will then open to increase the cooling capacity of the radiator 2.

When the temperature of the cooling fluid in the engine cooling system falls below a predetermined point, the expansible material in the thermostatic element 39 contracts thus permitting the spring 31 to move the valve element toward the water pipe and open the inlet passage 26 to the bore 19. Oil is then delivered from the pump 13 to the supply pipe 10 and hydraulic cylinder 8 to actuate the shutter vanes to closed position. Closing of the shutter vanes causes heat to be retained in the cooling fluid of the engine, and the temperature of the engine is rapidly raised to a desirable operating level.

Figs. 5 to 7 illustrate a modified form of my shutter and control in which the piston for actuating the shutters is double acting and positively actuated in both directions by fluid pressure. The shutter assembly 4 is provided with vanes 5 as in the first form of the invention, and the vanes are arranged to be tilted by the vertically extending rod 45 positioned at one end of the vanes as illustrated in Figs. 5 and 7. The rod 45 has positive two-way driving connection with the several vanes as by the fingers or lugs 46 projecting from the rod on each side of each vane. The rod 45 projects upwardly through the top of the shutter frame and is connected to one arm of the crank lever 47 pivoted at 48 on the frame. The hydraulic piston 49 for actuating the shutter vanes has its piston rod 50 connected to an upturned arm of the crank 47 as at 51 to effect upward or downward movement of the rod 45 and vanes 5. A piston 49 is provided with two fluid supply conduits 52 and 53 opening to opposite ends of the piston to form a double acting cylinder, as will be readily understood.

The supply of lubricating oil under pressure to the cylinder 49 and conduits 52 and 53 is controlled by a modified form of thermostatic valve 54. The valve 54 is connected by means of a coupling 55 to the center branch of a T-coupling 17 in the water tube 3 of the engine as in the first form of the invention. Oil under pressure from the oil pump 13 is supplied to the valve through the pressure conduit 14, and oil is returned from the valve to the crank case of the engine through the return conduit 12.

The details of construction of the valve 54 are illustrated in Fig. 6. The cylindrical body of the valve forms a central bore 56 having a threaded inlet passage 57 opening to an intermediate portion thereof. Spaced longitudinally of the bore on each side of the inlet passage 57 are a pair of threaded outlet passages 58 and 59 which receive the supply conduits 52 and 53 respectively. Positioned within the bore 56 toward each end thereof are a pair of annular and seal sleeves 60 and a central annular sleeve 61. The

5

sleeve 61 overlaps the inlet port 57 but defines a port 62 opening between the inlet port and the interior of the sleeve. Slidably positioned within the sleeves 60 and 61 is a tubular valve element 63 having cylindrical outer surface which is sealingly engageable with the interiors of the sleeves. Note that the valve element and the sleeves thus cooperate to form a first annular feed passage 64 opening to the outlet port 58 and a second annular feed passage 65 opening to the outlet port 59.

The mid-portion of the outer surface of the valve element 63 is cut away to form an annular groove 66 opening to the inlet ports 57 and 62 and adapted to communicate with either of the feed chambers 64 or 65 by movement of the valve element longitudinally of the valve body. Thus by moving the valve element to the right and inwardly toward the water tube, the inlet port 57 may be brought into communication with the outlet port 58 as illustrated in Fig. 6. A reverse movement of the valve element first seals off the inlet port 57 from each of the outlet ports and then opens the inlet port to the outlet port 59.

The return of oil from the ends of the cylinder 49 and conduits 52 and 53 is controlled by the valve element 63 which has a central return passage 67 formed longitudinally therein. The inner or right end of the valve element is cut away as at 68, and the passage 67 communicates with the space around the cut away portion through the port 69. As is evident from a consideration of Fig. 6, the conduit 53 and outlet port 59 are in communication with the interior of the valve body but are separated from the inlet port 57 when the valve element is moved to the right as illustrated. When the valve element is returned to the left to connect the outlet port 59 with the inlet port 57, the cut away portion 68 at the inner end of the valve element comes into registry with the outlet port 58, and that port then communicates through the port 69 and central passage 67 with the interior of the valve body.

The left or outer end of the valve body is closed by the coupling member 70 through which the outlet conduit 12 communicates with the interior of the valve body. Thus the outlet ports 58 and 59 are selectively placed in communication with the return conduit 12. The coupling 70 also acts as an abutment for the spring 71 positioned between the coupling and the outer end of the valve element to bias the valve element inwardly toward the water tube.

The thermostatic element 39 secured to the inner end of the valve body and projecting into the water tube is the same thermostatic element described in connection with the first form of the invention. The thermostatic element includes a rod 37 which is engageable with a pin 72 on the inner end of the valve element to act on the valve element in opposition to the spring 71 depending upon the expansion and contraction in the thermal element.

In operation of the valve and shutter control system, an increase in the cooling water temperature of the engine above a predetermined minimum will cause expansion in the thermal element 39 and move the rod 37 and valve element 63 outwardly to the left as viewed in the drawings. The supply conduit 53 and outlet port 59 will then be placed in communication with the inlet port 57, and the piston of the cylinder 49 will be moved to the left to raise the rod 45 and open the shutter vanes. Oil in the left end of the

6

cylinder 49 will be expelled through the conduit 52, port 58 and port 69 and passage 67 in the valve element to the return conduit 12. Upon cooling of the water in the engine, the expansible material in the thermal element 39 will contract permitting the spring 71 to first return the valve element to a neutral position and upon further cooling will open the conduit 53 to the oil pressure of the pump and positively close the shutters.

I have thus described two highly practical embodiments of my shutter control system, either one of which may be preferred to the other in certain operating conditions. Each form of the invention utilizes the pressure of the lubricating oil in the engine for operating the shutter mechanism of the engine radiator. Thus no auxiliary compressed air systems or vacuum systems are necessary for automatic power operation of the shutters.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A thermostatically controlled valve assembly including a body having a bore therein, a plug closing one end of said bore and forming a delivery connection to a supply pipe, an oil pressure conduit connection opening laterally to said bore, an oil return conduit connection opening laterally to said bore at a point spaced from said pressure conduit, a valve element slidable in said bore and being of such a length and shape as to simultaneously seal the openings of both said conduits into said bore in one position of said valve element, said valve element having an oil passage formed axially therealong and out of registry with the openings of said conduits into said bore, a spring seated against said plug and biasing said valve element away from said supply pipe and toward a position to open said pressure conduit to said bore, a coupling threadingly mounted on the end of said body opposite said supply pipe and forming a recess, said coupling having threads on its outer end connectable into a fluid conduit, a thermostatic device carried by said coupling to project into said fluid conduit, said device including a piston rod engageable with said valve element through said recess, and a housing enclosing a mass of thermally expansible solid material partially retained by a flexible wall for actuating said piston rod.

2. A thermostatically controlled valve assembly including a body having a bore therein, a plug closing one end of said bore and forming a delivery connection to a supply pipe, an oil pressure conduit connection opening laterally to said bore, an oil return conduit connection opening laterally to said bore at a point spaced from said pressure conduit, a valve element slidable in said bore and being of such a length and shape as to simultaneously seal the openings of both of said conduits into said bore in one position of said valve element, said valve element having an oil passage formed axially therealong and out of registry with the openings of said conduits into said bore, a spring biasing said valve element away from said supply pipe and toward a position to open said pressure conduit to said bore, a coupling threadedly mounted on said body, said coupling having threads on its outer end connectable into a fluid conduit, a thermostatic device carried by said coupling to project into said fluid conduit, said device including a piston rod engageable with said valve element, and a housing enclosing a mass of thermally expansible solid material partially re-

7

tained by a flexible wall for actuating said piston rod.

3. A thermostatically controlled valve assembly including a body having a bore therein, a plug closing one end of said bore and forming a delivery connection to a supply pipe, an oil pressure conduit connection opening laterally to said bore, an oil return conduit connection opening laterally to said bore at a point spaced along said bore from said pressure conduit and on the opposite side thereof from said supply pipe, a valve element slidable in said bore and being of such a length and shape as to simultaneously close the openings of both said conduits into said bore in one position of said valve element, said valve element having an oil passage formed axially therealong and out of registry with the openings of said conduits into said bore, a spring biasing said valve element away from said supply pipe and toward a position to open said pressure conduit to said bore, a thermostatic device carried by said body member and projecting therefrom to enter the cooling system of an engine, said device including a piston rod engageable with said valve element, and a housing enclosing a mass of thermally expansible solid material retained by a flexible wall, said wall being engageable with the opposite end of said piston rod from said valve element.

4. A thermostatically controlled valve assembly including a body having a bore therein, a plug closing one end of said bore and forming a delivery connection to a supply pipe, an oil pressure conduit connection opening laterally to said bore, an oil return conduit connection opening laterally to said bore at a point spaced from said pressure conduit, a valve element movable in said bore and being of such a shape as to simultaneously close the openings of both said conduits into said bore in one position of said valve element, a spring biasing said valve element toward a position to open said pressure conduit to said bore, a thermostatic device carried by said body and projecting therefrom to enter the cooling system of an engine, said device including a piston rod operatively engaged with said valve element to move the latter against said spring, and a housing enclosing a mass of thermally expansible solid material retained by a flexible wall, said wall being engageable with the opposite end of said piston rod from said valve element.

5. A thermostatically controlled valve for regulating the admission of liquid under pressure to a conduit comprising, a body member having a bore therein, a fitting on one end of said bore and connecting said bore to said conduit, a second fitting having a pressure port opening into said bore and forming a connection for a fluid pressure supply pipe, a third fitting having a port opening into said bore on the opposite side of said second fitting from said first fitting and forming a connection for an outlet pipe, a valve element sealingly slidable in said bore and being long enough to simultaneously close both of said ports in one position of said valve element, said valve element having a fluid passage formed there-through, a spring compressed between said valve element and said first fitting to bias said valve element away from said pressure port, means on the opposite end of said body from said first fitting for attaching said body to a fluid conduit carrying a fluid the temperature of which said valve is to be responsive to, a thermostatic element carried by said means and projecting therefrom to enter said fluid conduit, said thermostatic element including a housing having an extensible

8

wall and enclosing a mass of thermally expansible solid material, and a piston rod carried by said thermostatic element and engageable between said extensible wall and said valve element in opposition to said spring.

6. A thermostatically controlled valve for regulating the admission of liquid under pressure to a conduit comprising, a body member having a bore therein, a fitting on one end of said bore and connecting said bore to said conduit, a second fitting having a pressure port opening into said bore and forming a connection for a fluid pressure supply pipe, a third fitting having a port opening into said bore on the opposite side of said second fitting from said first fitting and forming a connection for an outlet pipe, a valve element slidable in said bore and being long enough to simultaneously close both of said ports in one position of said valve element, a spring positioned in said bore to bias said valve element away from said pressure port, means on the opposite end of said body from said first fitting for attaching said body to a fluid conduit carrying a fluid the temperature of which said valve is to be responsive to, a thermostatic element carried by said means and projecting therefrom to enter said fluid conduit, said thermostatic element including a chamber having an extensible wall and enclosing a mass of thermally expansible solid material, and a piston rod carried by said thermostatic element and engageable between said extensible wall and said valve element in opposition to said spring.

7. A valve of the thermostatic type comprising a body forming an elongated valve chamber with a central pressure inlet port opening thereto, said body having a pair of outlet ports opening to said valve chamber on opposite sides of said inlet port, a return conduit connection at the end of said valve chamber, means in said chamber including longitudinally spaced annular sleeves and an elongated reciprocable valve element sealingly slidable therein forming annular feed chambers opening to said outlet ports and isolated from said inlet port, said valve element having a groove formed in the outer surface thereof for alternatively connecting said feed chambers with said inlet port upon longitudinal movement of said valve element, said valve element having a central return passage formed therein and opening to each end of the valve element whereby each of said feed chambers can be alternatively connected through said valve chamber to said return conduit connection by movement of said valve element, an annular coupling having threads on each end and connected by one of said threads to the opposite end of said body from said return conduit connection, a thermostatic element supported internally of said coupling and extending therethrough from the opposite end of said coupling from said valve body and including a housing having a flexible wall enclosing a mass of thermally expansible solid material, an actuating rod extending between said wall and said valve element, a spring in said valve body acting on said valve element in opposition to said rod, and means mounting said valve body with said thermostatic element positioned in a cooling water passage of the engine.

8. A thermostatically controlled valve comprising a tubular body with threads on each end and having a bore extending therethrough, a pair of ports opening laterally to said bore and spaced longitudinally therealong, a valve element recip-

rocable in said bore and of such a length as to simultaneously close both said ports or open one or the other thereof to said bore, a plug threaded onto one end of said body and forming a third port opening to said bore, a spring compressed between said valve element and said plug to bias said valve element in one direction, a coupling member having threads on each end and threadedly engaged with the opposite end of said body from said plug, a thermostatic element carried by said coupling member and projecting from the outer end thereof, said thermostatic element including a housing of smaller diameter than the thread on the outer end of said coupling member whereby the outer thread may be engaged in a wall of a conduit with the thermostatic element

projecting into the conduit, a mass of thermally expansible solid material positioned in said housing and partially retained by a flexible wall, and a rod extending inwardly from said flexible wall into engagement with said valve element in opposition to said spring.

DAVID R. FERRIS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,871,733	Petersen	Aug. 16, 1932
2,352,058	Wood et al.	June 20, 1944