Sept. 16, 1952 R. W. JENSEN 2,610,831

PROTECTED COOLER

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Fig. 1

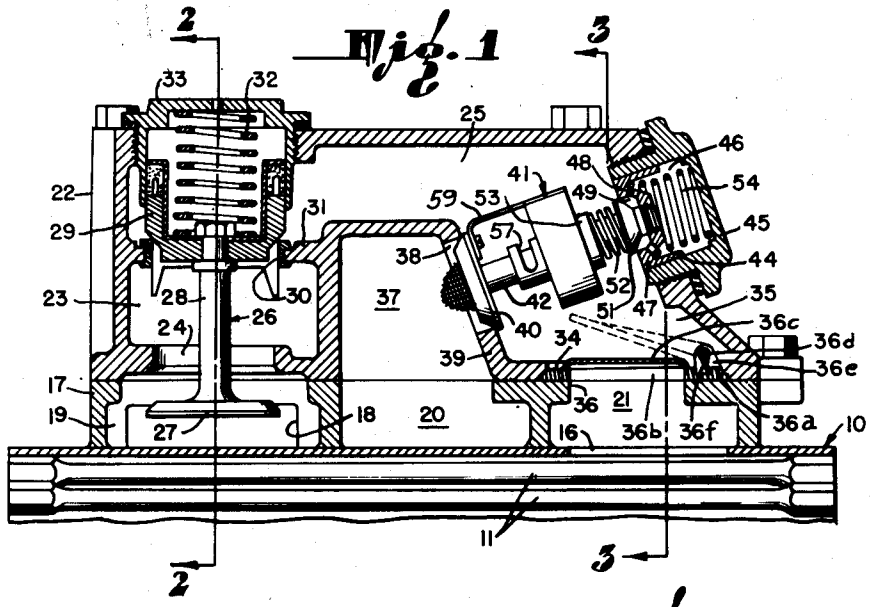


Fig. 3

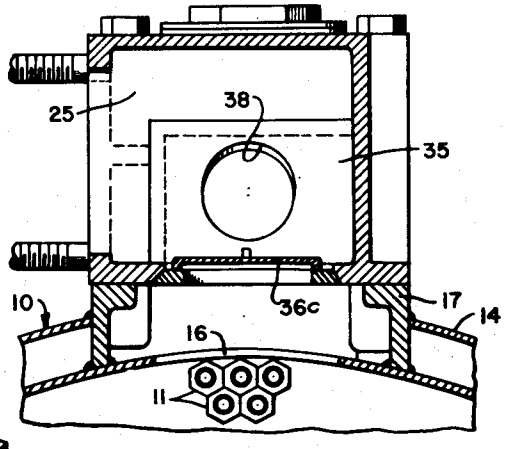
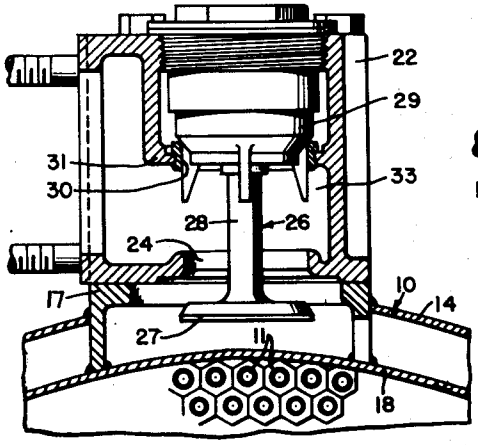
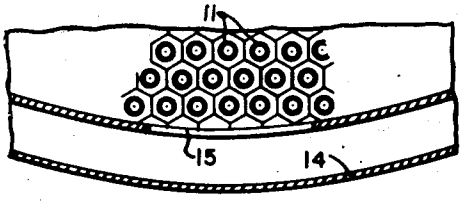


Fig. 2





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Fig. 4

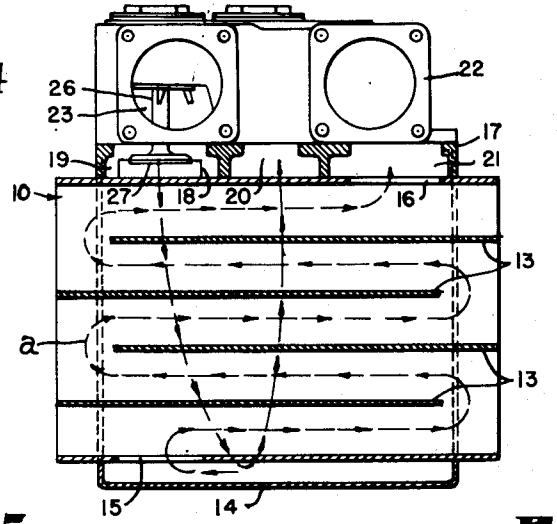


Fig. 5

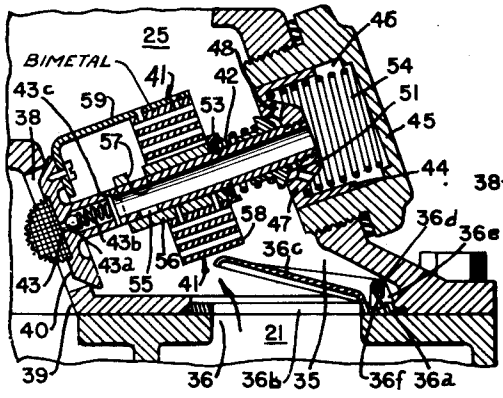


Fig. 6

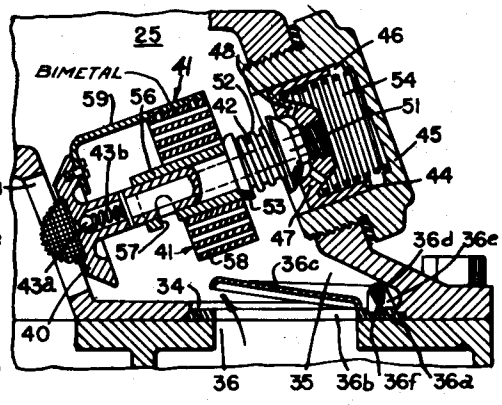
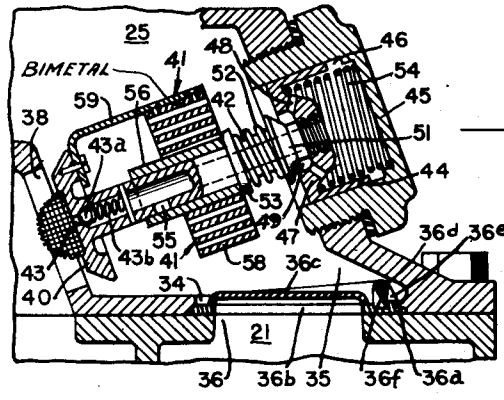


Fig. 7



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Fig. 8

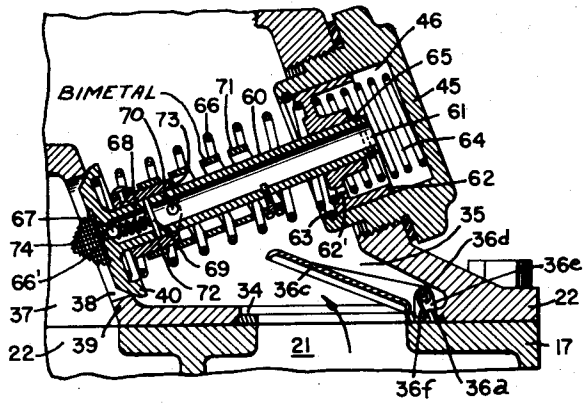


Fig. 9

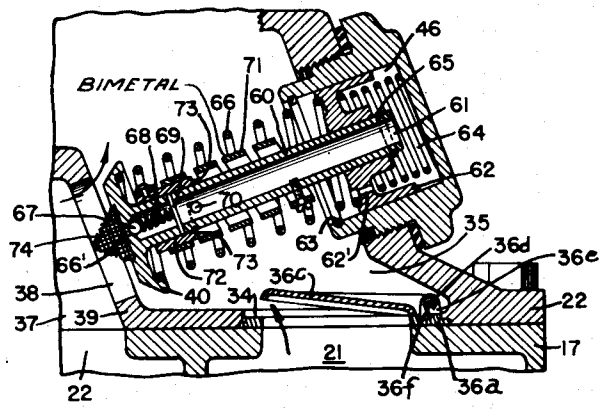
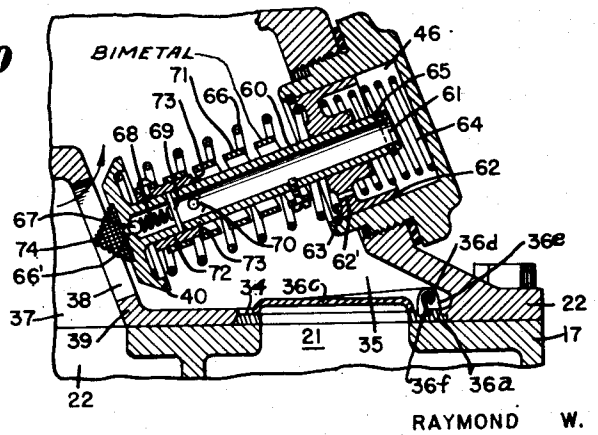


Fig. 10



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UNITED STATES PATENT OFFICE

2,610,831

PROTECTED COOLER

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Application September 24, 1946, Serial No. 699,033

24 Claims. (Cl. 257—2)

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This invention relates to heat exchangers, being a continuation in part of applicant's copending application for a Protected Cooler, Serial No. 521,510, filed February 8, 1944, now abandoned, and has particular reference to coolers for the oil used in lubricating internal combustion engines, especially of the type used in aeronautical apparatus, wherein conditions of heat and cold, and obstruction and impedance arise and must be met to provide the most satisfactory state for the efficient operation of the engine under all conditions of temperature, altitude and the composition of the oil.

The invention therefore relates also to a means in combination with a cooler for governing the conditions that contribute most effectually to the economic and efficient operation of combustion engines.

Heat exchangers or oil coolers are employed to maintain the oil of internal combustion engines in proper condition of fluidity and viscosity. It happens not infrequently that sudden and/or severe variations of temperature from a normal or ideal working temperature produces either partial or complete impedance to the circuit of the oil through the cooler, with a resultant pressure build-up that, unless relieved, would cause a rupture of the cooler units or an irreparable injury to the cooler. In high altitudes a total or partial functional inhibition of the cooler would result in serious danger to the pilot and occupants of the plane. To prevent these occurrences, the oil which cannot travel through the cooler, because of obstructions therein, is caused to circumvent the cooler and to return to the engine, the circumvented travel continuing until the condition of impedance or obstruction, which may arise from a number of causes, is eliminated.

To obviate the enumerated difficulties, the present device is designed, and it is an object of the invention, to provide in combination with a cooler, a valve and valve mechanism by which the flow of oil is controlled automatically and consistently whether through the cooler, its muff, or in circumvention of them, to the end that oil is always and under all conditions removed from and returned to the engine.

It is another object of the invention to provide a simple valve which is influenced by pressure to enable the oil to bypass the cooler, in case of obstruction or impedance therein, and by heat to reroute the travel of oil through the heat exchanger or cooler when the temperature of the oil rises and the restriction in the cooler is removed.

It is a further object of the invention to provide

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a valve assembly which is simple, substantial and compact and in which the valve may be shortened and made lighter than valves presently used, for the purpose of conserving space, without impairing the efficiency of the valve.

It is a further object of the invention to provide a valve assembly of the nature set forth in which the valve may be made as light and as small as possible, consistent with safety and surety of operation, and in which all parts of the assembly are readily accessible.

It is a further object of the invention to provide a valve which is readily adjustable to function in a wide range of pressures and temperatures, and which is inter-changeable with valves having similar purposes in view, and especially with the type known as "Sylphon."

It is a still further object of the invention to provide the device with means to protect the oil cooler against surge reaction or back pressures.

In the drawings, which are illustrative of a form of embodiment of the invention,

Fig. 1 is a sectional, elevational view showing my invention.

Fig. 2 is a section taken on line 2—2 of Fig. 1.

Fig. 3 is a section taken on the line 3—3 of Fig. 1.

Fig. 4 is a reduced elevational view partly sectioned, illustrating the oil flows.

Fig. 5 is an enlarged sectional view showing a flow control valve of my invention in normal position.

Fig. 6 is an enlarged sectional view showing the valve in another position as assumed when the oil flowing through the device is too cold.

Fig. 7 is an enlarged sectional view, showing the valve in still another position as assumed when a pressure builds up in the cooler.

Fig. 8 is a sectional elevation showing a modified form of valve.

Fig. 9 is a sectional elevation of the valve in another position.

Fig. 10 is a sectional elevation of the valve in still another position.

Like reference numerals designate like parts throughout the several views.

A form of oil cooler or heat exchanger 10 is shown in Figs. 1, 2, 3 and 4, as comprising a core 11 of spaced tubes or pipes, with horizontal baffle plates 13 extending alternately from one side to near the opposite side of the exchanger 10 to cause the oil to travel in a zigzag course, as indicated by the dotted line a in Fig. 4. A muff or jacket 14 encircles the core 11 and oil entering therein at the top passes through the opening 15

in the bottom to the core 11, eventually leaving the core, under normal conditions, through an outlet port 16 in the top of the exchanger 10, after giving up a substantial part of its heat while passing through the same. When, for any reason, the oil is prevented from passing through the core 11, it continues its circuit through the muff 14, around the core, eventually leaving the muff, circumventing the heat exchanger 10, in the manner and by the means hereinafter described.

It will be observed that the cooler 10 and the valve assembly act in cooperation to maintain the hot oil from the engine in proper condition of heat; to remove obstructing or constricting deposits which have accumulated on the outside of the core tubes and to reduce the viscous character of the oil by increasing the heat of the oil; and to prevent injury to the cooler by eliminating pressure build-up when the cooler obstructs the free flow of oil therethrough.

A fitting 17 is associated with the heat exchanger 10, and has communication with the muff 14 through an opening or port 18 whereby oil is caused to traverse the muff, from which it enters the core 11 of the heat exchanger 10 through the aforementioned opening 15 in the bottom of the core, as explained hereinafter.

The fitting 17 extends through the muff 14 and has passageways 19, 20, and 21, the passageways 19 and 20 being in communication with the muff 14 and the passageway 21 being in communication directly with the core 11 of the heat exchanger, whereby the oil, under normal conditions, is caused to traverse the muff 14 to enter the core 11 through the opening 15 and to leave the core through the outlet port 16 in the top of the heat exchanger. On the fitting 17 is mounted a housing 22 formed with a chamber 23, having a passageway or port 24 which communicates with the passageway 19 in the fitting 17. Oil from the engine is arranged to enter said chamber 23 and to pass therefrom through the ports 24 and 19, respectively in the chamber 23 and fitting 17, to the muff 14. In the event that the oil is obstructed in its flow through the chamber 23, it is caused to be diverted through a bypass 25 in said housing 22, and a means for accomplishing this diversion may comprise a double valve, generally indicated at 26, and including a valve member 27 on one end of a stem 28. The valve member 27 is arranged for seating in the opening 24 in said chamber 23. On the other end of said stem 28 is a cylindrical, hollow valve member 29, which is arranged for seating in an opening or passageway 30 in a wall 31 which separates the chamber 23 from the bypass 25. This cylindrical valve member 29 is held normally seated in the passageway 30, by a spring 32, contained within the cylindrical portion of the valve member 29, and is held in condition of compression by a cap 33 secured to the housing 22. During the normal flow of the oil from the engine, the cylindrical valve member 29 is seated and the companion valve 27 is unseated, thus enabling the oil to flow freely from the chamber 23, through the port 24 to the muff 14. When any obstruction occurs to impede the free flow of oil, the pressure resulting from the obstruction lifts the cylindrical valve member 29 from its seat, thereby establishing communication between the chamber 23 and the bypass 25. Simultaneously, the valve member 27 is caused to seat in the opening 24, thereby closing communication between the chamber 23 and muff 14, and causing all the oil to pass from the chamber 23 to the bypass 25, and from there through any desirable course to the engine. The traverse of the oil in this manner continues until the restriction or impedance responsible for the pressure build-up is removed.

The housing 22 has a chamber 37 which is in communication with the aforenamed passageway 20 in the fitting 17, and through said passageway 20 with the muff 14, and which is referred to hereinafter as a pressure chamber. The chamber 37 has an outlet opening or port 38 in a wall 39 thereof which is disposed at an angle to the horizontal. The said port 38 is arranged to be closed and opened under various conditions during the operation of the engine, as explained hereinafter, by a valve member 40, which constitutes a part of a composite valve structure, generally indicated at 41. The valve structure 41, is located in a valve chamber 35 which is connected with the passageway 21 through a port 34 controlled by a check valve, indicated generally at 36, and comprising a seat member 36a having an opening 36b therein, and a movable valve member or disc 36c which is pivoted on a pin 36d in ears 36e integral with the seat 36a. The valve disc 36c is urged in the seating direction by a light spring 36f and closes the opening 36b against back flow of oil toward the core.

The valve structure 41 includes said valve member 40 and a hollow stem 42, and an opening 43, which is diametrically smaller than the hollow or bore of the stem 42. The opening 43 is normally closed by a ball valve 43a yieldingly held on its seat by a spring 43b which is retained in position by any suitable means which, as shown, comprises a pin 43c extending transversely through the stem 42. At its other end, the valve stem 42 is secured to a piston 44, which is operably disposed within a cap 45 secured in the housing 22 at substantially an angle corresponding to the angle of the wall 39 in the pressure chamber 37. The longitudinal axis of the stem 42 thus lies at substantially right angles to the transverse plane of the valve member 40 and the cap 45. The angular positioning of the valve member 40 and its complementary parts enables the unitary valve structure to be reduced in size and weight, to be compacted within the smallest possible dimension without sacrifice of strength, and to be readily accessible. The cap 45 provides a chamber 46 in which the said piston 44 operates as presently explained. The piston 44 is cylindrical and has a transverse wall 47 which is provided with openings 48 which connect said chamber 46 with a recess 49. In the recess 49 is arranged to operate a valve 51, which is normally urged therein or thereagainst by a spring 52, on the stem 42 and supported on the stem by a snap ring 53 or any other device.

The valve 51 is slidable longitudinally of the stem 42 and functions as a relief valve in conjunction with openings 48 to relieve sudden increases in pressure in chamber 46 which may occur when the oil pressures in chamber 37 suddenly exceed the resistance of spring 54. This latter spring is contained within chamber 46 and, being compressed between said cylindrical piston 44 and cap 45, serves to normally urge valve member 40 onto its seat in port 38. The functions of valve 51 will be more clearly explained when discussing the operation of the entire valve assembly.

At a point intermediate its ends the valve stem 42 has a port 55, which is arranged to be opened and closed by a sleeve or other member 56,

rotatively associated with said valve stem 42; and provided with a slot 57. Rotative motion is imparted to said sleeve 56 through a bi-metallic thermostatic coil 58 connected at one end to said sleeve 56 and at the other end to a support 59, which, in turn, is fastened to said valve member 40. Under the influence of heat or cold—that is, hot oil or cold oil—and the resultant expansion and contraction of the thermostatic coil 58, the sleeve 56 is rotated about the stem 42 to move the slot 57 therein in register or out of register with the port 55, in the stem 42.

It will be noted that the port 55 in the stem 42 is sufficiently large to enable a greater quantity of oil to flow out therethrough than can enter through the narrower or smaller port 43 in the end of the stem 42. Since the hollow stem is in constant communication with the chamber 46, the result of such major flow of oil through the port 55 is to drain a portion of the oil from the chamber 46, and thus to create a low pressure therein. The piston 44 may then be moved in the chamber 46 against the resistance of the spring 54, and concurrently the valve member 40 unseated, the movement of the composite valve structure 41 in this manner being effectuated by pressure against the valve member 40. In surges of the oil, or conditions contributing to a sudden rise in pressure, the valve 40 will be unseated, regardless of the oil trapped in the chamber 46. Where such pressure exceeds the resistance of the spring 54 in the chamber 46, the relief valve 51 will open and relieve the pressure, thus enabling the valve 40 to open.

The normal position of the valve 40 and its complement is indicated substantially in Fig. 5, in which position the valve 40 is closed and the slot 57 in the sleeve 56 is out of register with the port 55 in the stem 42. By normal position, I mean that position of the parts produced when the oil is heated and traveling freely from the engine, through the heat exchanger and then back again to the engine.

At the outset of operation of the engine the oil is cold. It passes through the chamber 23 to the muff 14, from which a portion of the oil is diverted to circuit through the core 11 of the heat exchanger, which it leaves through the outlet opening 16 to enter the valve chamber 35. From the valve chamber 35, the oil passes to the bypass chamber 25 and then to the engine, directly or indirectly.

Frequently, if not commonly, the oil in passing through the heat exchanger congeals, on account of the cold therein, and is thus impeded in its free flow. This results in a pressure build-up which causes a portion of the oil in the muff to continue its travel therein to the pressure chamber 37, and another portion of the oil to pass out of the heat exchanger through the port 16 therein into the valve chamber 35 and thence into the bypass 25 for return to the engine. The cold oil, influencing the thermostatic coil 58, imparts a rotative movement to the sleeve 56 and registers the opening 57 therein with the port 55 in the stem 42. Simultaneously, the entire valve structure 41 is moved by the pressure in the pressure chamber 37 and the valve member 40 unseated, permitting in this manner the flow of oil to occur through the valve chamber 35 and the pressure chamber 37 to the bypass 25 from which it travels back to the engine. When the thermostatic coil operates the sleeve 56 to cause the registry of the ports 57 and 55 in the sleeve and stem respectively, a part of the oil enters the stem 42 through the port 43 therein and passes through the opening or port 55 to commingle with the oil traveling through the valve chamber 35. Since, as stated, the outlet port 55 is larger than the entry port 43, more oil will be allowed to flow from the stem than enters it and in this manner oil will be drained from the chamber 46, which will then be substantially pressure free. Thereby, the valve member 40 may be unseated, as and for the purposes related, as the entire valve structure 41 is moved by pressure exerted against the valve member 40 from the pressure chamber 37.

When the thermostatic coil 58 becomes heated by the oil surrounding it, the sleeve valve 56 closes the port 55, whereupon the oil will pass through the stem 42 to the chamber 46 and the pressure therein will become equalized to the pressure against the valve member 40.

The spring 54, therefore, in the chamber 46, will move the valve structure 41 and cause the valve member 40 to seat as shown in Fig. 5, thus shutting off the flow of oil from the muff and forcing the now heated oil to circuit through the heat exchanger.

Sudden surges of the oil through the system, and especially through the heat exchanger, which would subject the core of the exchanger to undue pressure and the danger of rupture or other damage, will force such pressure build-up to be exerted through the pressure chamber 37 against the valve member 40, which is thereby unseated, as shown in Fig. 7, permitting the oil to pass freely from said bypass chamber 37 through the valve chamber 35. The unseating of the valve 40 occurs against the pressure of oil that has been trapped in the chamber 46. This pressure is relieved by the oil passing through the passageways 48 in the cylindrical piston 44, and, unseating the relief valve 51, escaping into the valve chamber 35.

Should there be a surge of oil such as would cause back pressure in the chamber 35, the check valve 36c will close and, should the port 55 be open at this time, check valve 43a will prevent this pressure from being transmitted through the opening 43 to the chamber 37 and passages of the cooler anterior to said chamber 37. Briefly reviewing the operation of the valve unit, it will now be apparent that in the temperature range of normal operation, the valve 40 will be held closed by a combination of fluid pressure in the chamber 46 (substantially balancing the fluid pressure at the bypass outlet 20) plus the pressure of the spring 54, so that the net effective pressure of the valve 40 against its seat is that of the spring 54. The fluid pressure in the chamber 46 is equivalent to the pressure at the bypass outlet 20 because of the continuous bleed of oil from the bypass outlet 20 through the hollow stem 42 into the chamber 46, the outlet port 55 being closed by the thermostatically controlled pilot valve sleeve 56. On the other hand, when the temperature in the cooler is substantially below the normal operating range, the oil bleeding into the valve stem through the port 43, instead of building up pressure in the chamber 46, will all escape through the port 55 in the valve stem, which, being of greater area than the bleed opening 43, will permit the pressure in the chamber 46 to be released. This will permit the differential in pressure between the higher pressure in the bypass outlet 20 and the lower pressure in the core outlet 21 (caused by the resistance to flow through the core) to become effective to move

the valve 40 and piston 44 against the resistance of the spring 54 and permit the oil, or a portion thereof, to bypass through the muff 14 and escape through the bypass 25. However, when the pressure in the chamber 37 exceeds a predetermined maximum (either because of congealment or as a result of sudden pressure surges) the valve 40 will yield, even though the escape port 55 in the valve stem is closed and the valve accordingly subjected to full pressure in the chamber 46. The yielding of the valve 40 in this case is permitted by the release of excess pressure from the chamber 46 past the relief valve 51. Thus, the resistance of the spring 52 acting against the relief valve 51 determines the maximum pressure beyond which the valve 40 will yield in any event.

Figs. 8, 9 and 10 represent a modified form of valve. The valve member 40, operating to open and close communication between the chamber 37 and the valve chamber 35, is on one end of a hollow stem 60. The other end 61 of the stem 60 extends through and is operable relative to a piston 62, which is movably disposed within the chamber 46, formed by the cap 45 secured in the housing 22. The piston 62 is normally held against a stop 63 which limits the movement of the piston 62 outwardly in the cap 45 by a spring 64. The movement of said piston 62 relatively to the hollow stem is limited by a snap ring or other stop device 65. A spring 66 about the hollow stem 60 and interposed between the valve member 40 and piston 62 serves to hold the piston 62 against the snap ring 65. The stem 60 has an entry port 66' which is in communication with the hollow of the stem and in which port 66' a ball valve 67 is held normally seated by a spring 68, which is retained in position by any desired means, as, for instance, a pin 69 extending transversely through said stem. The stem 60, intermediate its length, has an outlet opening 70, of a diameter or size larger than the inlet or entry port 66', for the purpose of permitting more oil to flow from the hollow stem than can enter it through the entry port 66'. In this manner oil in the chamber 46 may flow out of the stem concurrently with the incoming oil, thus reducing the pressure therein and permitting valve 40 to unseat as shown in Figure 9.

It will be noted that the hollow of the stem 60 is in constant communication with said chamber 46. Encircling the hollow stem 60 is a thermostatic helix 71, at one end fastened to said stem, and at the other end connected to a sleeve 72 having a cam edge 73 that is designed to cooperate with the port 70 in the stem to open or close the same in response to the expensive and contractive action of the thermostatic helix 71. Under normal conditions—that is, when the coil is heated and freely circulating—the parts of the valve are substantially in the position illustrated in Fig. 8. When the oil is cold and under pressure, due to restricted flow through the heat exchanger, the pressure in the chamber 37 tends to unseat the valve 40. The cold oil acting upon the thermostatic 71, rotates the sleeve 72 and causes the cam edge 73 to uncover the port 70 in the stem 60, which, as stated, is in communication with the chamber 46 and thus releases the oil therefrom. The pressure against the valve 40 may then operate to unseat the valve.

In the event of a high pressure surge through the muff, produced, for instance, by a sudden impedance to the free flow of oil through the heat exchanger, the entire valve assembly described acts as a relief valve. The piston 62 in this instance is held against the stop 63 by the pressure in the chamber 46. The valve 40 under these conditions moves from its seal and simultaneously the valve stem 60 is projected through the piston 62 into the chamber 46. Through a port 62' in the piston 62, the oil trapped in the piston is released to enable the valve and stem to move relatively to the piston 62.

The check valves 43a (Figs. 5 to 7) and 67 (Figs. 8 to 10) are provided to prevent surge reaction back to the chamber 37 through the passage in the valve stem. For example, when the temperature of the oil in the system is subnormal, and particularly, when it is relatively cold, the thermostat effects opening of the port 55 in Figs. 5 to 7, and the port 70 in Figs. 8 to 10. Under such conditions, a sudden surge in the oil pressure in the chamber 23 may be sufficient to cause the valve member 29 to be unseated so that the surge pressure will be transmitted through bypass 25 to chamber 35 and through the port 55 (Figs. 5 to 7) or port 70 (Figs. 8 to 10), and the ball valve 43a (Figs. 5 to 7) or 67 (Figs. 8 to 10), will prevent the surge pressure from being transmitted to the chamber 37 and into the warm-up chamber or muff.

To protect the entry port 66' a screen 74 may be provided on the valve member 40.

The valve units shown in Figs. 8 to 10 inclusive, although of modified construction have the functions of the valve units shown in Figs. 5 to 7 inclusive. In the temperature range of normal operation, the pressure in the chamber 46 is equalized with the pressure in the chamber 37 by bleed through the restricted opening 66', and the full pressure of the spring 64 is therefore effective to maintain the valve 40 closed, thus causing the oil to circulate through the cooler core. Below this range of normal operation, however, the bimetal coil will effect the opening of the escape port 70, thus permitting the pressure in the chamber 46 to equalize with the pressure in the core outlet 21, and the higher pressure in the chamber 37 to overcome the resistance of the spring 64 and shift the valve 40 and piston 62 to effect opening of the valve 40. Under excessive pressure differential or surge conditions, even though the port 70 is closed and the chamber 46 under high pressure, the valve 40 may open as a result of the yielding of the spring 66, permitting the valve 40 to slide relative to the piston 62.

I claim as my invention:

1. An oil cooler comprising: a cooler core and a warm up bypass arranged in parallel with a common inlet and separate outlet and a main cooler outlet in communication with the core outlet and a port for establishing communication between the bypass outlet and said main cooler outlet; a valve unit including a valve head for closing said port and a tubular body, said valve head having a restricted aperture exposed to the fluid pressure in said port; means including said valve head and tubular body defining a fluid pressure chamber into which the fluid pressure from said port may be transferred through said aperture, whereby to apply said fluid pressure to said valve head in valve closing direction; a check valve for preventing back surge from said fluid pressure chamber to said port through said aperture; spring means for applying pressure to said valve head in valve closing direction

and adapted to cooperate with said fluid pressure in maintaining said valve in its closed position, said tubular body having a fluid escape opening adapted when opened to relieve said chamber of said bypass pressure so as to permit said valve to open under said fluid pressure acting against said head; a pilot valve member for closing said escape opening; and a thermo-responsive element adapted, when the temperature of the oil flowing to said main cooler outlet is within a normal operating range, to move said pilot valve element to a position closing said escape opening and permitting the pressure to build up in said chamber and, when said temperature is below said normal operating level, to move said pilot valve element to a position opening said escape opening, permitting the pressure in said chamber to substantially equalize with the pressure at the core outlet, and the bypass pressure to overcome the pressure of said spring means and permit a flow through said bypass.

2. In an oil cooler: a cooler core; means defining a warm up bypass arranged in parallel with said core, said core and bypass having a common inlet and separate outlet; a main cooler outlet in communication with the core outlet and a port for establishing communication between the bypass outlet and said main cooler outlet; means for controlling the flow through the core outlet and for preventing reverse flow therethrough; a valve adapted when closed to prevent flow through the bypass so as to cause the full flow to pass through the core, said valve being subject to fluid pressure tending to open the same; means for closing said valve when the temperature of fluid flowing through said oil cooler is within a normal operating range, said means comprising means for applying yielding mechanical pressure and means, including a fluid passage, for applying the aforesaid fluid pressure to the valve in the valve closing direction; a check valve in said passage; and thermo-responsive means adapted when said temperature is below said normal range, to relieve said valve of said fluid pressure in the valve closing direction so as to permit the fluid pressure acting against said valve in the opening direction to overcome the force of said mechanical means and cause the valve to open.

3. Control mechanism for a heat exchanger having a heat transfer core and a bypass, comprising: a valve which, when closed, prevents flow through the bypass so as to cause the full flow to pass through the core, said valve being subject to fluid pressure, said valve closing against fluid pressure; means exposed to said fluid pressure and applying the same to said valve in valve closing direction when the temperature of the fluid flowing through said heat exchanger is within a normal operating range; thermo-responsive means which, when the temperature of said fluid is below said normal range, relieves said valve of said fluid pressure acting in valve closing direction, whereby to permit said fluid pressure to open the valve; and a pressure relief valve associated with said means for applying fluid pressure to the valve in closing direction so as to open when said fluid pressure becomes excessive and permit excess fluid to escape from said pressure applying means so as to thereby allow said first mentioned valve to open under said excess pressure.

4. Control mechanism for a heat exchanger having a heat transfer core and a bypass, comprising: a valve which, when closed, prevents flow through the bypass so as to cause the full flow to pass through the core, said valve being subject to fluid pressure tending to open the same; means urging said valve closed when the temperature of fluid flowing through said heat exchanger is within a normal operating range, said means comprising yielding mechanical means and means for applying the aforesaid fluid pressure to the valve; passage means for relieving the fluid pressure applied in the valve closing direction; thermo-responsive means openable when said temperature is below said normal range to relieve said fluid pressure in valve closing direction so as to permit the fluid pressure acting against said valve in opening direction to overcome the pressure of said mechanical means and cause the valve to open; and a loaded pressure relief valve controlling said passage means and openable under excessive fluid pressure to permit the escape of excess fluid from said pressure applying means so as to permit the first mentioned valve to open irrespective of temperature.

5. An oil cooler comprising: a cooler core and a warm up bypass arranged in parallel with a common inlet and separate outlet and a main cooler outlet in communication with the core outlet and a port for establishing a communication between the bypass outlet and said main cooler outlet; a valve unit including a valve head for closing said port, and a tubular body, said valve head having a restricted aperture exposed to the fluid pressure in said port; means including said valve head and tubular body defining a fluid pressure chamber into which the fluid pressure from said port may be transferred through said aperture, whereby to apply said fluid pressure to said valve head in the valve closing direction; a check valve for preventing back surge from said fluid pressure chamber to said port through said aperture; spring means for applying pressure to said valve head in valve closing direction and cooperating with said fluid pressure in maintaining said valve in its closed position, said tubular body having a fluid escape opening for relieving said chamber of said bypass pressure so as to permit said valve to open under said fluid pressure acting against said head; a pilot valve member for closing said escape opening; a thermo-responsive element adapted, when the temperature of the oil flowing to said main cooler outlet is within a normal operating range, to remove said pilot valve element to a position closing said escape opening and permitting the pressure to build up in said chamber and, when said temperature is below said normal operating level, to move said pilot valve element to a position opening said escape opening, permitting the pressure in said chamber to substantially equalize with the pressure at the core outlet, and the bypass pressure to overcome the pressure of said spring means and permit a flow through said bypass; and pressure relief means, including a pressure responsive valve, for the means for applying fluid pressure to the valve in the valve closing direction, said relief valve being opened by excessive fluid pressure to permit the escape of excess fluid from said pressure applying means so as to permit the first mentioned valve to open irrespective of temperature.

6. In control mechanism for a heat exchanger having a heat transfer core and a bypass, comprising: a valve which, when closed, prevents flow through the bypass so as to cause the full flow to pass through the core, said valve being urged in the opening direction by fluid pressure there-

on; means, including a yielding mechanical device and said fluid pressure, urging the valve in the closing direction when the temperature of the fluid flowing through the heat exchanger is within its normal operating range; thermo-responsive means, openable when said temperature is below said normal range, for relieving the fluid pressure in the valve closing direction; and pressure relief means, opening under excessive fluid pressure, to permit the escape of excess fluid pressure urging the valve in the closing direction.

7. In control mechanism for heat exchangers having a heat transfer core and a bypass, comprising: a valve controlling said bypass, said valve being urged in opposite directions by fluid pressure in said bypass upstream thereof; yielding means urging the valve in the closing direction; temperature responsive means controlling the pressure urging the valve in the closing direction and relieving said pressure when the temperature of the fluid in the heat exchanger is below a normal predetermined value; and pressure responsive means for relieving the pressure urging the valve in the closing direction when the pressure tending to open the valve is a predetermined value.

8. An oil cooler comprising a heat transfer core and a warm up outlet in parallel relation with a common inlet and separate outlet, said cooler having a main cooler outlet, a thermostat chamber interposed between said main cooler outlet and said core outlet, and a bypass port for connecting said bypass outlet to said thermostat chamber; a valve including a valve head cooperable with said port to prevent flow through said bypass and cause the entire flow to pass through the core and a valve stem having a fluid transfer passage communicable with said bypass through a restricted aperture in said valve head; a piston slidable on said valve stem; stop means limiting outward movement of the piston on the stem; cylinder means cooperating with said valve stem and piston to define a fluid pressure chamber communicable with said bypass through said transfer passage so that said bypass pressure may be applied to said valve stem in valve closing direction, said valve head and restricted inlet being exposed to said bypass fluid pressure in valve opening direction, said valve stem having a fluid escape port adapted when opened to permit the pressure in said chamber to substantially equalize with core outlet pressure; stop means limiting outward movement of the piston in the cylinder; a spring urging the piston toward the first mentioned stop means; a spring urging the piston toward the second mentioned stop means; a pilot valve cooperable with said fluid escape port; and thermo-sensitive means disposed in said thermostat chamber, said thermo-sensitive element being operable to move said pilot valve element to a position closing said escape port when the temperature of the oil in said thermostat chamber is within a normal operating range, whereby to permit the pressure to build up in said fluid pressure chamber, and when said temperature is below said normal operating range, to open said escape port, permit the pressure in said fluid pressure chamber to substantially equalize with core outlet pressure, and thereby permit said valve head to yield under the pressure thereagainst and the fluid in said bypass and permit flow through said bypass into said thermostat chamber and thence to said main cooler outlet.

9. In an oil cooler: a cooler core; a warm up bypass arranged in parallel to said core, said core and bypass having a common inlet and separate outlets; a main cooler outlet, including a thermostat chamber, in communication with the core outlet and a port for establishing communication between the bypass outlet and said main cooler outlet; a check valve for preventing reverse flow through the core outlet; a bypass valve, including a valve head cooperable with said port, for preventing flow through said bypass and routing said flow through said core, said valve including a tubular valve body providing a fluid transfer passage communicable with said bypass through a restricted inlet in said valve head; a check valve in said fluid transfer passage for preventing fluid flow toward said valve head; a piston slidable on the end of said bypass valve body opposite said valve head; a cylinder in said control housing in which said piston is slidably mounted, said cylinder and piston cooperating to define a fluid pressure chamber into which the bypass fluid pressure may be transferred through said passage and be applied to said valve in the bypass valve closing direction; a spring under compression between said cylinder and said piston for urging said bypass valve in the closing direction; a spring under compression between said valve head and said piston adapted normally to transmit valve closing pressure from said piston to said valve head but to yield under excess pressure against said valve head, permitting said valve body to slide in said piston and said head to yield relative to said piston, said valve body having a fluid escape port through which the pressure in said fluid pressure chamber may substantially equalize with the pressure in said thermostat chamber; a pilot valve cooperating with said escape port; and a thermo-sensitive element in said thermostat chamber, connected at one end to said pilot valve and at its other end to said bypass valve, adapted, when the temperature within said thermostat chamber is within a normal operating range, to move said pilot valve element to a position closing said escape port and permitting the pressure to build up in said pressure chamber and, when the temperature is below said normal operating range, to open said escape port so as to permit said valve head to yield under the pressure thereagainst and allow fluid to pass through said bypass.

10. Control mechanism for a heat exchanger having a heat transfer core and a bypass, comprising: a valve adapted when closed to prevent flow through the bypass so as to cause the full flow to pass through the core, said valve being subject to fluid pressure tending to open the same; means for closing said valve when the temperature of fluid flowing through said heat exchanger is within a normal operating range, said means comprising means for applying yielding mechanical pressure and means for applying the aforesaid fluid pressure to the valve in valve closing direction; thermo-responsive means adapted when said temperature is below said normal range to relieve said valve of said fluid pressure in valve closing direction so as to permit the fluid pressure acting against said valve in opening direction to overcome the pressure of said mechanical means and cause the valve to open; and pressure relief means for relieving excess pressure on the valve in the valve closing direction upon a sudden increase of pressure against the valve in the opening direction.

11. In an oil cooler: a cooler core; means defining a warm up bypass arranged in parallel

with said core, said core and bypass having a common inlet and separate outlet; a main cooler outlet in communication with the core outlet, and a port for establishing communication between the bypass outlet and said main cooler outlet; means for controlling the flow through the core outlet and for preventing reverse flow therethrough; a valve adapted when closed to prevent flow through the bypass so as to cause the full flow to pass through the core, said valve being subject to fluid pressure tending to open the same; means for closing said valve when the temperature of fluid flowing through said oil cooler is within a normal operating range, said means comprising means for applying yielding mechanical pressure and means, including a fluid passage, for applying the aforesaid fluid pressure to the valve in the valve closing direction; a check valve in said passage; thermo-responsive means adapted, when said temperature is below said normal range, to relieve said valve of said fluid pressure in the valve closing direction so as to permit the fluid pressure acting against said valve in the opening direction to overcome the force of said mechanical means and cause the valve to open; and pressure relief means for relieving excess pressure on the valve in the valve closing direction upon a sudden increase of pressure against the valve in the opening direction.

12. Control mechanism for a heat exchanger, comprising: a housing having an inlet, an outlet, a bypass inlet and a bypass connecting said bypass inlet with said outlet; a valve adapted, when closed, to prevent flow through the bypass, said valve being urged in the opening direction by fluid pressure in the inlet side of said bypass; means for applying yielding mechanical pressure and means for applying said fluid pressure in the valve closing direction; thermo-responsive means for relieving said valve of the fluid pressure urging said valve in the closing direction when the temperature of the fluid adjacent the housing outlet is below a predetermined temperature range so that fluid pressure urging said valve open may overcome said yielding mechanical pressure and cause said valve to open; and an excess pressure relief means for relieving the pressure of fluid, urging the valve in the closing direction, when said pressure rises excessively.

13. A valve mechanism, comprising: a valve element adapted to control a fluid flow passage; a valve stem extending axially from said valve element, said stem having a restricted passage therethrough; a piston mounted on said stem adjacent the end opposite said valve element; a member having a cylindrical recess in which said piston is slidable, the passage in said stem communicating with said cylindrical recess; yielding means urging the valve element away from said member; an outlet port for relieving fluid pressure in said recess; thermo-responsive means for controlling said port and opening same when the temperature thereof is below a predetermined value; and excess pressure relief means which allows relief of excess pressure in said recess upon a sudden rise in the pressure of said recess.

14. The invention defined by claim 13 wherein there is a check valve controlling the passage in said valve stem so as to permit a flow of fluid toward said recess and preventing the flow of fluid in the reverse direction.

15. Control mechanism for a heat exchanger, comprising: a housing having an inlet, an outlet, a bypass inlet and a bypass connecting said bypass inlet with said outlet; a valve adapted, when closed, to prevent flow through the bypass, said valve being urged in the opening direction by fluid pressure in the inlet end of said bypass; means for applying yielding mechanical pressure in the valve closing direction; means for applying said fluid pressure to the valve in the closing direction; thermo-responsive means for relieving said valve of the fluid pressure urging said valve in the closing direction when the temperature of fluid adjacent the housing outlet is below a predetermined temperature range so that fluid pressure urging said valve open may overcome said yielding mechanical pressure and effect opening of said valve; and an excess pressure relief valve for relieving the pressure of fluid urging the valve in the closing direction when said pressure rises excessively.

16. A valve mechanism, comprising: a valve element adapted to control a fluid passage; a valve stem extending substantially axially from said element; a piston mounted on said stem adjacent the end opposite said valve element; a member having a cylindrical recess in which said piston is slidable, said stem having a passage therethrough in restricted communication with the front face of said valve element and communicating with the cylindrical recess; yielding means urging the valve element away from said member; an outlet port for relieving fluid pressure in said recess; thermo-responsive means for controlling said port and opening same when the temperature thereof is below a predetermined value; and an excess pressure relief valve for relieving excess pressure in said recess.

17. The invention defined by claim 16 wherein there is a check valve controlling the passage through the valve stem, said check valve permitting fluid flow through said passage from the end of the stem carrying the valve element for preventing reverse flow through said passage.

18. A valve mechanism, comprising: a valve element adapted to control a fluid passage; a valve stem extending axially from said element; a piston secured to said stem adjacent the end opposite said valve element; a member having a cylindrical recess in which said piston is slidable, there being a pressure chamber defined by the walls of said recess and said piston, said valve stem having a passage therethrough from the end having the valve element, said passage communicating with said chamber, the end of said passage adjacent the valve element being restricted; a spring urged check valve adjacent the restricted end of said passage for permitting a fluid flow toward said chamber but preventing a reverse flow through said passage; a pressure relief port in said stem between said check valve and piston; a port controlling valve operably mounted on said stem; a temperature responsive element secured to said valve element and to said port controlling valve for operating the latter; an excess pressure relief passage in said piston; an excess pressure relief valve controlling said passage and slidably mounted on said valve stem; and a spring disposed on said valve stem for urging the excess pressure relief valve in the closing direction.

19. Control mechanism for a heat exchanger, comprising: a housing having an inlet, an outlet, a bypass inlet and a bypass connecting said bypass inlet with said outlet; valve means for controlling fluid flow through the bypass, said valve means including a valve element urged in the opening direction by fluid pressure at the inlet end of said bypass; a valve stem extending

substantially axially from said element; a piston slidably mounted on said stem adjacent the end thereof opposite said valve element; a member having a cylindrical recess in which said piston is slidable, the walls of said recess and said piston defining a pressure chamber, said valve stem having a passage therethrough connecting the front face of the valve element with said chamber; yielding means urging said piston outwardly relative to said recess; yielding means disposed between said piston and the valve element urging said piston and valve element away from each other; thermo-responsive means for relieving the pressure in said chamber when the temperature of fluid adjacent the housing outlet is below a predetermined temperature range; and an excess pressure relief port for relieving pressure in said chamber, said port being of restricted size and open at all times.

20. A valve mechanism, comprising: a valve element adapted to control a fluid passage; a valve stem extending substantially axially from said element; a piston slidably mounted on said stem adjacent the end thereof opposite said valve element; a member having a cylindrical recess in which said piston is slidable and cooperable to form a pressure chamber, said valve stem having a passage therethrough connecting the front face of said valve element with said chamber; yielding means urging the piston outwardly relative to said recess; yielding means reacting between said valve element and piston; an outlet port for relieving fluid pressure in said chamber; thermo-responsive means for controlling said port and opening same when the temperature thereof is below a predetermined value; and an excess pressure relief port for relieving excess pressure in said chamber, said port being open at all times.

21. The invention defined by claim 20, wherein the passage in said valve stem is controlled by a check valve permitting fluid flow in said passage toward said chamber and preventing reverse flow through said passage.

22. A valve mechanism, comprising: a valve element adapted to control a fluid passage; a valve stem extending substantially axially from said element; a piston mounted on said stem adjacent the end opposite said valve element; a member having a cylindrical recess in which said piston is slidable, the walls of said recess and said piston defining a pressure chamber, said stem having a passage therethrough connecting the front face of the valve element with said chamber; yielding means urging the valve element away from said member, said yielding means and the fluid pressure in said chamber being adapted to urge the valve element in the closing direction and pressure in said passage on the front face of said valve element being adapted to urge said element in the opening direction; an outlet port for relieving the fluid pressure in said chamber; and thermo-responsive means controlling said port.

23. A valve mechanism, comprising: a valve element adapted to control a fluid flow passage; a valve stem extending axially from said valve element, said stem having a restricted passage therethrough; a piston mounted on said stem adjacent the end opposite said valve element; a member having a cylindrical recess in which said piston is slidable, the passage in said stem communicating with said cylindrical recess; yielding means urging the valve element away from said member; an outlet port for relieving fluid pressure in said recess; thermo-responsive means for controlling said port and opening same when the temperature thereof is below a predetermined value; and excess pressure relief opening for relieving excess pressure in said recess.

24. A valve mechanism, comprising: a valve element adapted to control a fluid passage; a valve stem extending substantially axially from said element; a piston slidably mounted on said stem adjacent the end thereof opposite said valve element; a member having a cylindrical recess in which said piston is slidable and cooperable to form a pressure chamber, said valve stem having a passage therethrough connecting the front face of said valve element with said chamber; yielding means urging the piston outwardly relative to said recess; yielding means reacting between said valve element and piston; an outlet port for relieving fluid pressure in said chamber; thermo-responsive means for controlling said port and opening same when the temperature thereof is below a predetermined value; a restricted excess pressure relief port for relieving excess pressure in said chamber, said port being open at all times.

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