

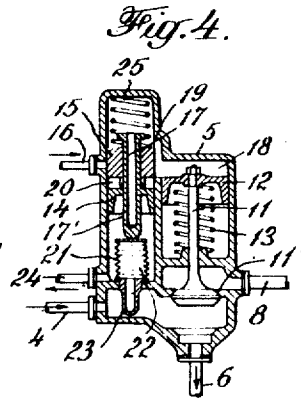
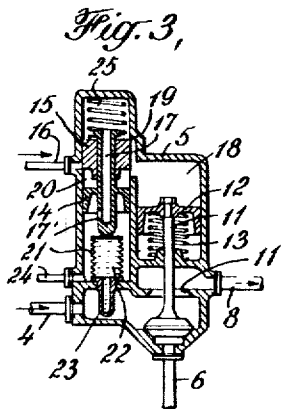
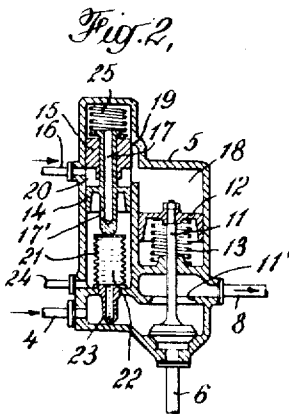
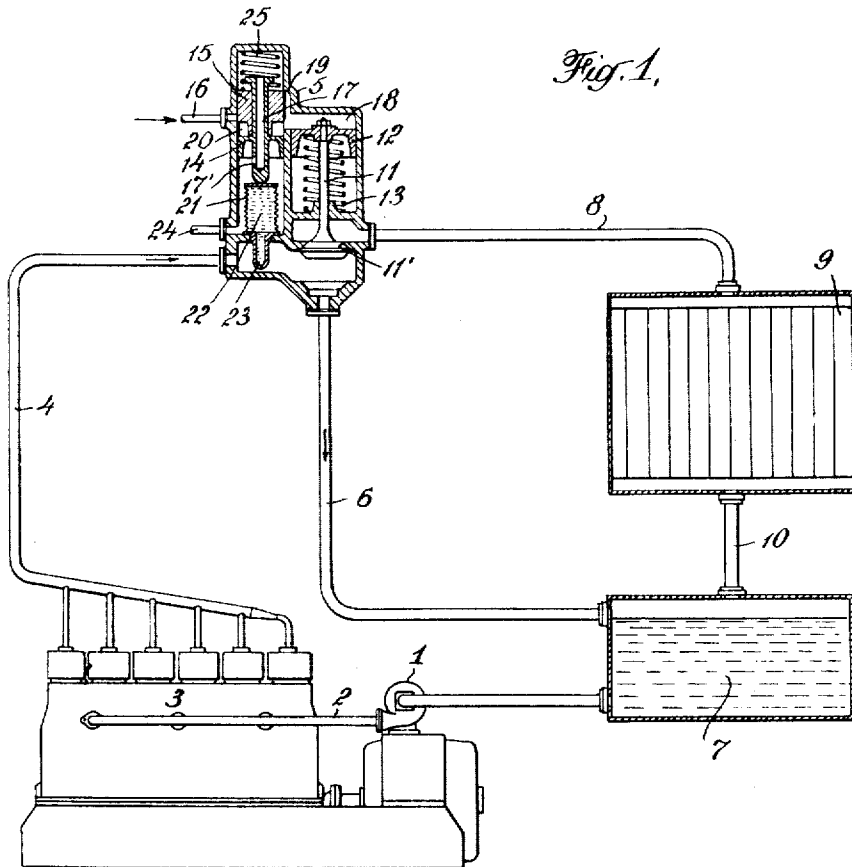
Dec. 28, 1948.

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2,457,618

TEMPERATURE REGULATED COOLING CIRCUIT

Filed Oct. 17, 1944



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## UNITED STATES PATENT OFFICE

2,457,618

TEMPERATURE REGULATED COOLING  
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terthur, SwitzerlandApplication October 17, 1944, Serial No. 559,080  
In Switzerland February 8, 1944

7 Claims. (Cl. 123—178)

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This invention relates to a system for circulating a fluid requiring to be cooled controlled by the temperature of the circulating fluid, in particular to the cooling-water or lubricating-oil circuits of an internal combustion engine in which a device is employed to redeliver the fluid, when below a certain temperature, to the internal combustion engine without cooling, and to conduct the fluid, when over a certain temperature, to a cooler. The invention consists in that, for changing over to service with or without a cooler the flow-changing device provided as conditions may require, has no stable position of transition. The system employing this device should be arranged so that when in service with the cooler cut out that element is drained of fluid.

For a preferred form of the flow-changing device, a valve operated by a servomotor may be provided, the control member of this valve being designed in two parts. One part of the control member may follow the movements of an expansion body and the second part may have a travel limited relatively to the first part by means of stops provided on this first part. The admission and discharge openings for the control medium may be arranged in the casing of the control member in such a way that the part of the control member not connected to the expansion body moves immediately from one stop to the other of the other control member part when the control edge of the former part begins to open or completely closes the pressure medium admission and thus rapidly frees a large cross-section of flow for the admission or discharge respectively of the control medium to or from the servomotor piston of the valve.

Devices dependent on temperature are known which influence the circulation of the fluid to be cooled in such a way that above a certain temperature all the fluid, for instance the cooling-water, is conducted to the cooler, while under this temperature it bypasses the cooler and flows again to the internal combustion engine. These devices, however, have the disadvantage that the change-over takes place gradually, which may lead to trouble in service for the following reasons. When the temperature of the fluid lies below freezing point and the device frees the passage from one pipe to the other only gradually, the heat supplied to the cooler through the water, when the pipe to the cooler is almost closed, is so small in proportion to the heat led off in the cooler at a certain water temperature that the water freezes within a very short time.

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If then the device gradually opens wider the admission to this pipe, the cooler may already be so badly frozen that practically no water now flows through it. The stoppage of circulation does not only render it impossible for the cooler to thaw out again but may also lead to serious damage in the cooler or in the internal combustion engine as a result of the great increase in temperature of the cooling-water. The provision of a device dependent on the temperature as proposed in the invention eliminates this disadvantage in that the changeover from one pipe to the other is not effected gradually but rapidly and without any stable position of transition. Moreover, when the cooler is not "on stream," it is drained. It is thus sufficiently ensured that so much water flows through the cooler whenever water flows at all that the freezing-up of the latter is impossible.

The advantage of this invention is apparent, however, not only with water but also with lubricating oil, since this can cool down to such an extent, when the quantity flowing through the cooler is very small, that as a result of the increase in viscosity the resistance of the cooler reaches so high a value that the pressure in the oil system becomes too high, that is to say, that the oil, instead of flowing through the cooler, flows off by way of a safety valve in order to prevent the cooler being damaged as a result of inadmissibly high pressure. The rewarming of the oil stuck in the cooler would thus be rendered impossible and the oil temperature elsewhere in the system would rise inadmissibly high.

An embodiment of the invention, applied to the cooling system of an internal combustion engine, is shown diagrammatically in the drawings, in which:

Fig. 1 illustrates in section the flow-changing device of this invention, in one operating position, arranged according to the system of this invention in a diagrammatically illustrated complete cooling plant; and

Figs. 2-4 show the temperature-controlled, low-changing device of this system in three further operating positions.

In the system as shown in Fig. 1, a cooling-water pump 1 draws water from a collector 7, delivers it through a pipe 2 into the water jacket of an internal combustion engine 3 and from there through a pipe 4 to the temperature-controlled, flow-changing device 5. According to the working position of the device 5, the water passes (at high temperature) through a pipe 8, a cooler

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or radiator 9 and a pipe 10 back to the collector 7, or it flows (at low temperature) through a pipe 6 direct to the collector 7 and the cooler 9 stands emptied. In the arrangement illustrated in Fig. 1, the radiator 9 empties by gravity into the collector 7, as it would in the ordinary automobile cooling plant. No difficulty will be met by those skilled in the art in providing other means of emptying should gravity not be available in a particular installation.

Inside of the device 5 is a valve 11 which is operated by the piston 12 acting as a servomotor piston and which controls the admission of water to the pipes 6 or 8. The control of the piston 12 is effected by the two-piece slide valve 14, 15, which in its turn is actuated by the expansion body 21.

The method of working of the device is as follows:

When the engine 3 is put in service with cold cooling-water and the pump 1 runs, cold water flows over the temperature gauge 23. The medium present in the expansion body 21, for instance fluid, then takes up its smallest space, so that the valve 14 is pressed downwards by the spring 25 and the valve 15 stops the supply out of the pipe 16 (Fig. 4). No pressure then prevails in the space 18 above the piston 12, as the control medium present in this space can escape at 19 and pass through the passages 17, 17' in the valve 14 and through the pipe 24. The spring 13 thus pressed the valve 11 upwards, so that its base comes to lie against the upper seat 11' and thus connects the pipe 4 with the pipe 6.

If the temperature of the cooling-water now gradually rises, the fluid 22 expands the body 21 upwards and presses the valves 14, 15 upwards. There is no change, however, in the position of the valve 11, until the valves 14, 15 have arrived in the position which is shown in Fig. 1. If the temperature of the cooling-water rises higher, the valves 14, 15 also rise, so that pressure medium can pass from the pipe 16 into the space 20. The valve 15 is then lifted from the valve 14 and takes up the position shown in Fig. 2. It thus immediately frees a large cross-section of flow for the admission of the pressure medium to the piston 12, so that the piston 12 moves downwards rapidly, that is without there being any stable position of transition, and brings the valve 11 immediately into its lower end position and thus closes the pipe 6. The water then flows from the pipe 4 through the pipe 8 to the cooler 9.

When the cooling-water temperature again sinks, the expansion body 21 once more contracts. The valve 14 and the valve 15 move downwards initially as a unit. The downward forces acting on valve 14 are then its own weight and the pressure in the space 20. The downward forces acting on the valve 15 are then its own weight and the spring 25. The pressure in space 20 exerts an upward force on valve 15. The spring 25, moreover, is not capable of moving the valve 15 independently of the valve 14, as the pressure in the space 20 is greater than that exerted by the spring 25. On the motion of the valves 14, 15 as a unit, just described, in their relative position shown in Fig. 2, the pressure in the space 20 has no influence, as it acts upwards and downwards on the same cross-section. The valves 14, 15 thus obey only their own weight and the pressure of the spring 25. There is no change in the position of the valve 11 until the valve 15 has arrived in the position shown in Fig. 3. The space 20 is now cut off by valve 15 from the pressure pipe 16.

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As this space 20 is connected with the space 18 above the piston 12 but the latter is relieved by the opening coming into existence between the edge 19 and the valve 15, the pressure in the space 20 disappears and the valve 15 moves rapidly downwards until it again comes up against the valve 14 as shown in Fig. 4. At the same time the spring 13 presses the piston 12 and with it the valve 11 rapidly and without any stable position of transition as far upwards as possible, as the pressure medium present above the piston 12 escapes through the passage 17 in the valve 14 and through the pipe 24. The cooling-water then flows back once more, as at the beginning (Fig. 1), through the pipe 6 and the process described can begin again.

In place of the expansion body 21 filled with fluid, a solid body may also be used.

The servomotor 14, 15, 12 of the valve 11 is so designed that the piston 12 is operated with pressure medium when the pipe 8 leading to the cooler 9 is opened, while the spring 13 effects the closing of this pipe. The servomotor can naturally be equally well designed for working with these functions interchanged.

I claim:

1. A system for circulating a fluid requiring to be cooled including, in combination, a heat source imparting heat to said fluid, a radiator, a collector, passages for passing said fluid through a circuit including said heat source, said radiator and said collector in series, a by-pass in said circuit connecting said heat source to said collector in parallel to said radiator, and controllable flow-changing means in said circuit without a stable position of transition for cutting said radiator in and out of the circuit, said circuit being so arranged that the radiator is emptied when none of said fluid is fed to it.

2. The system for circulating a fluid requiring to be cooled including, in combination, a heat source imparting heat to said fluid, a radiator, a collector, passages for passing said fluid through a circuit including said heat source, said radiator and said collector in series, a by-pass in said circuit connecting said heat source to said collector in parallel to said radiator, a flow-changing device in said circuit for changing the flow distribution through radiator and by-pass, and servomotor means without a stable position of transition controlling said flow-changing device for cutting said radiator in and out of said circuit, said circuit being so arranged that the radiator is emptied when none of said fluid is fed to it.

3. The combination of claim 2 in which the servomotor means include a source of fluid under pressure, a piston operatively connected to the flow-changing device and control means intermediate said pressure fluid source and said piston that include a two-part valve.

4. The combination of claim 3 in which the control means include an expansion body, one part of the two-part valve following the movement of said expansion body and the other part of the two-part valve having a travel limited by contact with stop portions of the first part.

5. The combination of claim 2 in which the servomotor means include a casing, a source of fluid under pressure opening into said casing, a cylinder in said casing, a piston operatively connected to the flow-changing device running in said cylinder, a discharge passage leading from said casing and control means arranged within said casing that include an expansion body and a two-part valve, one part of which valve follows

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the movements of said expansion body and the other part of which has a travel limited by contact with stop portions of the first part, said control means, said pressure opening and said discharge passage being so arranged that when movement of the first part of said valve causes a control edge of the second part of said valve partially to uncover either said opening or said passage, said second part moves immediately the full distance of its travel relative to said first part, thus rapidly freeing the whole available cross-sectional area of said opening or said passage for the admission or discharge of the pressure fluid to or from said piston.

6. As a sub-combination, a device including a flow-through chamber having at least three flow passages therein, valve means for closing alternatively one or the other of a pair of said passages, and servomotor means without a stable position of transition for shifting said valve means from the closed position for one of said pair of passages to the closed position for the other.

7. As a sub-combination, a device including a flow-through chamber having at least three flow passages therein, valve means for closing alternatively one or the other of a pair of said passages, and a hydraulic servomotor assembly controlling said valve means, said assembly including a source of fluid under pressure, a pressure fluid discharge, a single-action, spring-loaded piston connected to said valve means to close one of said pair of passages under influence of fluid under pressure and the other, under influence of the spring-loading, and means to con-

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trol the fluid pressure action on said piston that include an expansion body responsive to temperature in said chamber and a two-part valve to control the passage of fluid to and from said piston from and to said pressure source and said discharge, respectively, the first part of said two-part valve being in contact with said expansion body and the second part having a travel limited by contact with stop portions of the first part, said control means being so arranged that, when a movement of the first part causes a control edge of the second part partially to connect said piston to either said pressure source or said discharge, said second part moves immediately the full distance of its travel relative to said first part, thus rapidly freeing the whole cross-sectional area of flow from and to said source or discharge, respectively.

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