

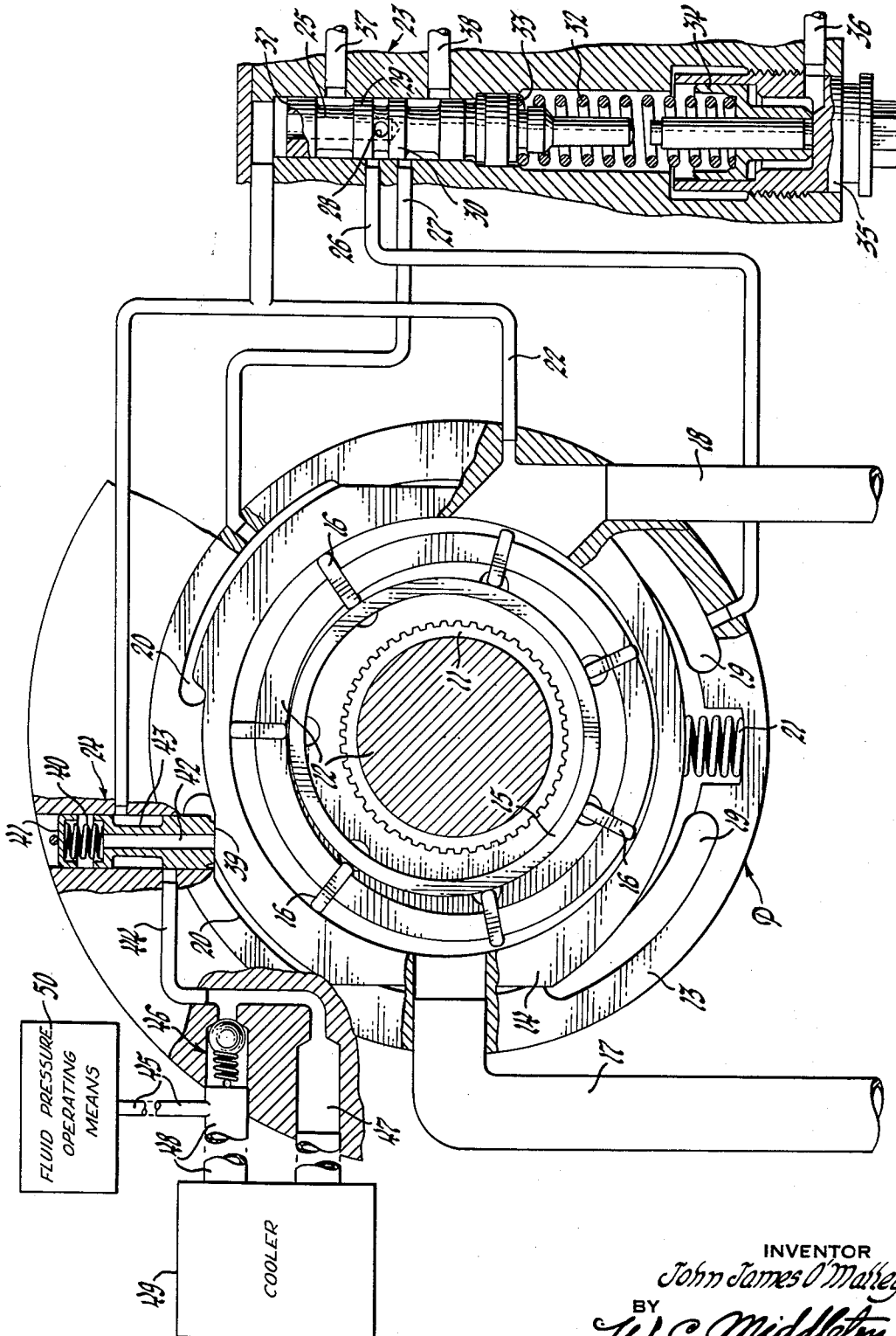
April 3, 1956

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2,740,256

VALVING ASSOCIATED WITH VARIABLE CAPACITY PUMP

Filed Dec. 27, 1954



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Application December 27, 1954, Serial No. 477,856

7 Claims. (Cl. 60—52)

This invention relates to valving associated with a variable capacity fluid pump to control the amount of oil to be cooled in accordance with the pumping capacity of the pump.

In motor vehicles equipped with automatic transmissions having fluid pressure operated power devices, fluid couplings, torque converters or the like, the temperature of the oil used to operate these devices tends at times to become dangerously high. Therefore, an oil cooling means is sometimes provided for cooling the oil as it is recirculated by the pump after its return to the transmission sump.

Therefore, it is an object of this invention to provide a valve associated with a variable capacity pump to admit oil from the pump to a cooling means whenever the pumping capacity of the fluid pump is below its maximum.

It is a further object to provide a cooling system wherein oil is supplied to a fluid operating means through a cooling means in such a manner that in the event that the cooling means becomes congested or unworkable, oil from a variable capacity pump can flow directly to the fluid operating means through a safety valve in a conduit by-passing the cooling means.

In the general operation of this device, a variable capacity pump is provided with a guide ring slidably mounted so as to be variably positioned eccentrically or concentrically of the driving means of the pump for maximum and minimum pumping capacities, respectively. This pump supplies fluid by one conduit to a pressure regulator valve, the position of which controls the output capacity of the pump by controlling the admission of oil to act on opposite portions of the guide ring. By means of a branch conduit, output from the pump is supplied to a second valve adapted to be actuated by the guide ring of the pump to admit oil to a fluid pressure operating device through a cooling means, or through a by-pass conduit if the cooling means is blocked.

Other objects, features and advantages of the invention will become apparent by reference to the following detailed description of the accompanying figure wherein is shown a diagrammatic arrangement of the valving associated with a variable capacity fluid pump.

Referring to the drawing, P indicates a variable capacity fluid pump for a transmission oil system having a core 11 adapted to be connected to a suitable drive member 12 which can be either a rotating part of the drive or driven shaft of a transmission. This pump is of a type well known in the art and of which an example is shown and described in detail in the co-pending application of Walter B. Herndon et al., entitled, "Variable Capacity Pump," S. N. 450,908, filed August 19, 1954. The pump P has a casing 13, a capacity-varying guide ring 14 adapted to be variably positioned radially within the casing, a guide vane ring 15 mounting pumping vanes 16 slidably within core member 12, a fluid suction inlet conduit 17, and a fluid discharge conduit 18. A hollowed out space 19 is provided for moving the guide

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ring 14 radially outwardly by fluid pressure to increase the pumping capacity of the pump due to the eccentric position of the guide ring with respect to the core. Corresponding spaces 20 are provided opposite space 19 for moving the guide ring inwardly by fluid pressure to decrease the pumping capacity. A spring 21 positioned between the casing and the guide ring normally biases guide ring 14 to a radially outermost position corresponding to maximum pumping capacity.

The main pump outlet conduit 18 has a branch conduit 22 leading to a plurality of valves 23 and 24. Valve 23 is a pressure regulating valve having a central bore 25 communicating selectively with conduits 26 and 27 by means of an opening 28 between the balanced areas of lands 29 and 30. Conduits 26 and 27 connect with spaces 19 and 20, respectively, to vary the position of guide ring 14. Movement of valve 23 in one direction is controlled by fluid pressure from conduit 18 acting on face 31 of one end of the valve 23. Positioned between a shoulder 33 of valve 23 and a plug member 34 slidable within a stop member 35 secured to the valve body, is a spring 32 which opposes the action of fluid pressure acting on face 31 and tends to restrain movement of the valve. 37 and 38 are exhaust ports connected to the sump (not shown).

In its initial position, the valve 23 is in the position shown connecting fluid pressure from conduit 18 to space 19 by way of bore 25 and conduit 26, aiding spring 21 to keep guide ring 14 in its maximum pumping capacity position. As fluid pressure increases, the valve moves to connect conduit 26 to exhaust port 37 and conduit 27 to the fluid pressure supply to move the guide ring to decrease the pumping capacity, thereby regulating the output pressure.

When it is desired to increase pump pressure above the substantially constant pressure level provided by the normal action of the pressure regulator valve, a conduit 36 is adapted to supply fluid pressure from the output of the pump to act on plug 34 to increase the spring force acting on shoulder 33, thereby inserting an additional force opposing movement of valve 23 to connect bore 25 and conduit 27. The supply of fluid to conduit 36 may be controlled by any well-known manually operated valve means (not shown).

In addition to the flow to valve 23, fluid pressure from line 22 is also supplied to a cooling means, designated by block 49, and fluid pressure operating means designated by block 50 through a valve 24. This valve is slidably positioned within casing member 13 with one end 39 abutting the guide ring 14 for movement therewith in both directions. The end 39 is positioned within space 20 so as to be subject to fluid pressure when oil is admitted to conduit 27. A spring 40 is positioned between the other end of valve 24 and a stop seal member 41 secured to the casing. A central bore 42 is provided to permit communication between opposite ends of the valve. The opposite ends of the valve are provided with faces whose areas are equal, thereby establishing a balance of fluid pressure forces acting in opposite directions on the valve, permitting spring 40 to bias valve 24 against ring guide 14 for movement therewith. A reduced portion 43 of the valve is provided to permit the oil to flow from line 22 to a line 44 when the guide ring 14 moves inwardly from the position shown. Line 22 supplies oil to a passage 45 through a safety ball-check valve unit 46 and to a passage 47 leading to the cooling means 49. Line 45 connects with the fluid pressure operating means. Line 48 is a return conduit from the cooling means and is connected with line 45. The safety valve unit operates in such a manner that oil from line 22 forces the ball off its seat against the spring pressure to supply oil directly to the line 45 in the event that the cooler becomes clogged

or congested preventing oil in line 47 from reaching the pressure operating means 50. This valve will also open when the oil is cold on entering the cooler, such as on a cold start of a vehicle, because the stiffness of the oil will prevent it from passing through the cooler quickly thereby building up the oil pressure to unseat the valve. Line 22 also supplies oil to the cooler through line 47. The ball-check valve will remain open until the stiffness or congestion due to dirt, etc. is relieved, thereby permitting the spring to seat the ball and cause all of the fluid in line 45 to be supplied from line 22 by way of the cooling means.

Referring more in detail to the actual operation of this device; with the pump at rest, spring 21 biases guide ring 14 to its outermost radial position which corresponds to the maximum pumping capacity. The pressure regulator valve 23, in its initial position, permits communication between lines 22 and space 19 through bore 25. Valve 24, in its initial position, is in the position shown in the figure, i. e., in a closed position preventing communication of oil from line 22 to line 44. In this position, valve 24 is held in contact with guide ring 14 by means of spring 40. As soon as rotation is imparted to shaft 12, valve 23 is supplied with fluid from pump output lines 18 and 22 to communicate with space 19 by means of bore 25 and conduit 26 to assist spring 21 in holding the guide ring in its maximum pumping capacity position. As soon as sufficient fluid pressure is built up behind the face 31 of valve 23, the valve will move against opposition by spring 32 to connect space 19 with exhaust passage 37 and connect the oil to spaces 20 by means of conduit 27, thereby tending to move guide ring 14 against the spring 21 to decrease the pumping capacity. As soon as oil is admitted to space 20, it flows through the bore 42 of valve 24 to act on opposite ends of the valve. Since the total areas of opposite ends of the valves are the same, the fluid pressure forces will be balanced thereby permitting spring 40 to keep the valve 24 in abutting relationship with guide ring 14. As soon as guide ring 14 moves radially inwardly, valve 24 will move to an open position permitting communication between lines 22 and 44.

Oil pressure admitted through valve 24 acts on the safety valve 46 and is also routed through line 47 to the cooling means 49 to return through line 48 to act on the pressure operating means 50 and to the opposite side of the safety valve unit 46. Since the oil pressure on opposite sides of the ball of the safety check valve are balanced, the spring will seat the ball, thereby assuring that all the oil supplied to line 45 will pass through the cooling means, as long as valve 24 remains in an open position. As valve 24 opens and closes intermittently, the supply of fluid to line 45 will be alternately by way of the ball-check valve or through the cooling means.

The determination of whether valve 24 will be in an open or closed position will depend upon the action of the pressure regulator valve 23. As valve 23 is moved by fluid pressure to decrease the pumping capacity of the pump, spring 32 tends to increase the capacity. Therefore, the valve will tend to seek a constant pressure level. Fluid may be admitted to line 36 to act on plug 34 to vary the opposition of spring 32 to increase the fluid pressure level above its normal range since the pressure in line 36 will tend to open communication between lines 22 and space 19 to increase the pumping capacity.

From the foregoing it will be seen that the present invention provides a reliable and efficient manner of cooling the oil being delivered to a transmission operating mechanism in accordance with variations in the pumping capacity of a variable capacity pump. The invention assures that under normal pumping conditions, the oil will be circulated through the cooler substantially at all times eliminating the danger of injury to the transmission. It will be understood that the invention can be modified beyond the illustrated embodiment, and therefore any limi-

tations to be imposed are those set forth in the following claims.

I claim:

1. In a cooling system, a variable capacity pump for providing a source of fluid pressure, said pump having movable slide means for varying the pumping capacity of said pump from a maximum to a minimum, means for causing movement of said capacity varying means, a valve associated with said capacity varying means, said valve having an open and a normally closed position, a cooling means, conduit means connecting said cooling means and said source, said valve being positioned within said conduit between said source and said cooling means, and biasing means for opening said valve to permit communication between said source and cooling means when said capacity varying means is moved from a maximum pumping capacity position.

2. In a cooling system, a variable capacity pump providing a source of fluid pressure and having a casing, a slide within said casing for varying the pumping capacity of said pump by movement between a maximum and other pumping capacity positions, fluid pressure means for moving said slide, a valve means associated with said slide, biasing means acting on said valve to bias said valve for a movement proportional to the movement of said slide when said slide is moved, a cooling means for cooling said fluid, conduit means connecting said source of fluid pressure, said valve and said cooling means, said valve means permitting communication between said source and said cooling means when said slide means is moved from its maximum pumping capacity position.

3. In a fluid system, a variable capacity pump providing a source of fluid pressure, said pump including a slide member movable to vary the output pressure of said pump, means for moving said slide member, valve means in abutting relationship with said slide member and adapted for movement therewith, said valve means having open and closed positions, a fluid pressure operating mechanism, conduit means connecting said source and said mechanism through said valve means, said slide having an initial position permitting said valve means to close, said valve mechanism permitting communication between said mechanism and said source when said slide is moved from its initial position.

4. A cooling system including a variable capacity pump providing a source of fluid pressure, a slide member within said pump for varying the capacity thereof, said slide member having maximum and other pumping capacity positions, means for moving said slide comprising fluid pressure means connected to said source, a cooling means for said fluid, conduit means connecting said source and said cooling means, valve means having open and closed positions controlling communication of said source with said cooling means, said valve means being positioned in abutting relationship at one end with said slide member, spring means biasing the other end of said valve means against said slide member, pressure regulating means controlling the slide moving means, said valve means being in communication at the one end with said fluid pressure means when said pressure regulating means permits, a bore in said valve connecting opposite ends of said valve to said fluid pressure means so as to cause a balance of pressures at both ends of said valve permitting said spring to maintain said valve against said slide means, whereby said valve means opens permitting fluid to flow from said source to said cooling means when said slide member is moved from its maximum position.

5. In a cooling system, a variable capacity pump providing a source of fluid pressure, a casing for said pump, a slide within said casing movable to vary the capacity of said pump, a cooling means for said fluid, conduit means connecting said source and said cooling means, said casing having a valve means therein adapted to be actuated in one direction by said slide, said valve having open and closed positions controlling communication between said

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source and said cooling means, a spring biasing said valve for movement in another direction, and conduit means connecting said source and said slide for moving said slide by fluid pressure, whereby when said slide is moved said valve will be actuated to control admission of fluid from said source to the cooling means.

6. In a cooling system, a variable capacity pump providing a source of fluid pressure, a fluid pressure operating device, conduit means connecting said source and said device, a casing for said pump, a pump varying capacity slide within said casing, means for moving said slide, a valve means in said casing having open and closed positions and adapted to be moved by said slide, said valve means controlling communication between said source and said device, a cooling means in said conduit between said valve means and said device, other conduit means connecting said valve and said device by-passing said cooling means, and valve means in said by-pass adapted to be actuated by fluid pressure from said source when said slide moves to open said first mentioned valve means to permit fluid pressure to be applied directly to said device by passing said cooling means prior to fluid being applied to said device through said cooling means.

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7. In a cooling system, a variable capacity pump providing a source of fluid pressure, slide means movably positioned within said pump to vary the pumping capacity thereof, said slide means having maximum and other pumping capacity positions, fluid pressure operated means for controlling movement of said slide means to thereby vary said pump capacity, a cooling means for cooling said fluid, fluid conduit means between said source and said cooling means, and valve means positioned within said conduit for controlling the admission of fluid from said source to said cooling means, said valve means being positioned adjacent said slide means for movement therewith to permit fluid to pass from said source to said cooling means whenever said slide means is in its other positions.

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