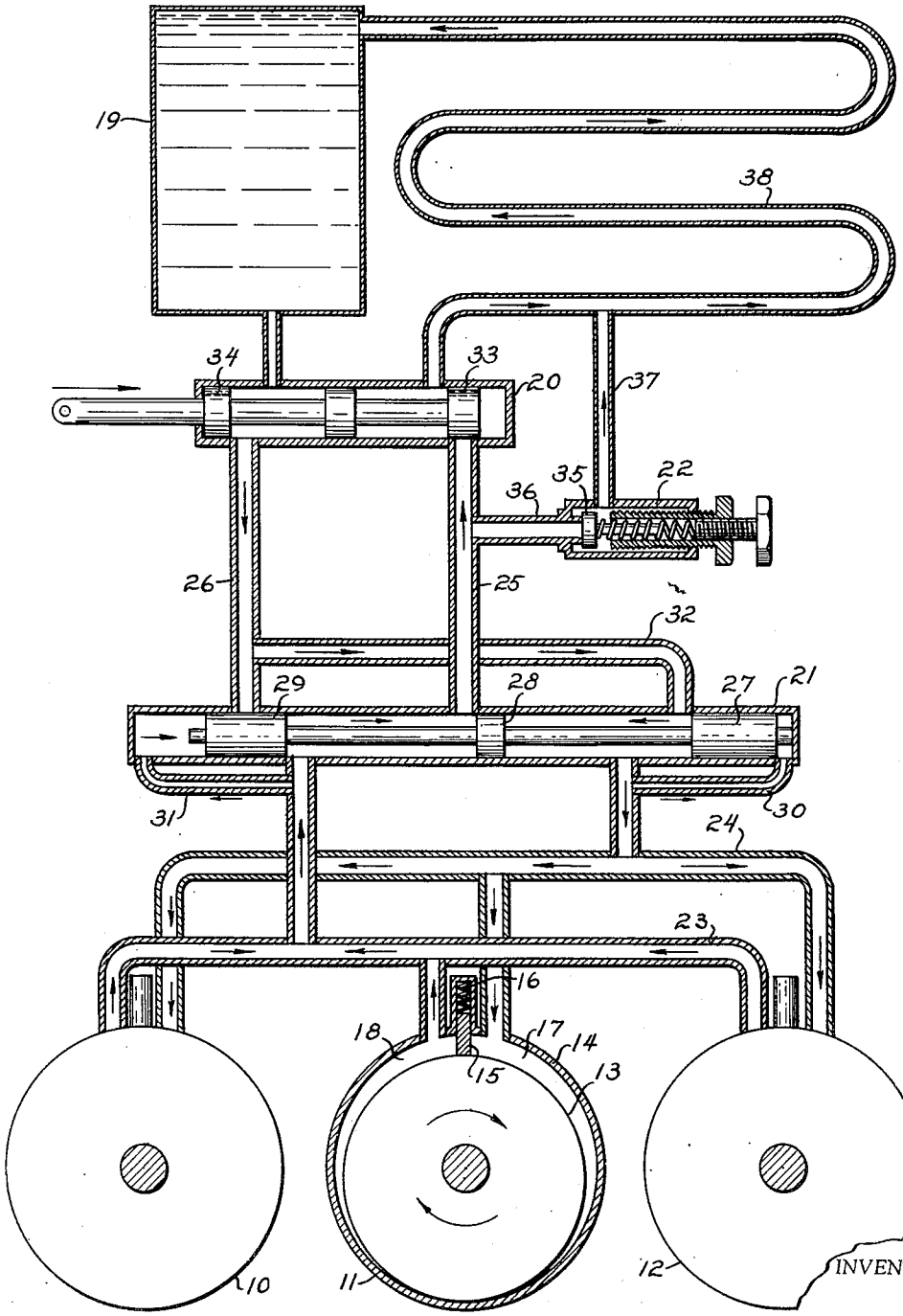
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INTERNAL RESISTANCE FLUID PRESSURE CLUTCH OR BRAKE

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INTERNAL RESISTANCE FLUID PRESSURE CLUTCH OR BRAKE

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This invention relates to fluid pressure operated devices such as clutches and brakes. More particularly, this invention is concerned with a control system for varying the fluid pressure loading on one or more reversible positive displacement pumps used as a fluid pressure clutch or brake.

The basis of the present invention derives from the known fact that if the high pressure outlet of a positive displacement pump is closed, and the low pressure inlet side of the pump is connected to a fluid reservoir, the pump rotor will be positively locked against rotation. By varying the degree of restriction of the outlet of the pump commensurately with the extent of opening of the pump inlet, various degrees of resistance to rotation of the pump rotor may be achieved. There has been a considerable development of devices of this broad general type for use as brakes and clutches, but none to date have enjoyed substantial commercial success for a number of reasons.

Accordingly, it is the principal object of the present invention to provide a control system for varying the fluid pressure load on the rotors of positive displacement pumps used as clutches or brakes, which will overcome previous deficiencies in apparatus of this type.

It is a further object of this invention to provide a control system for devices of this type in which a remote master control valve may be used to control the loading on one or a plurality of positive displacement pump rotors which will be effective irrespective of the direction of rotation of the rotor.

A further object is to provide an adjustable relief valve in the system so connected as to by-pass the control valve on the high pressure side of the system, in the event that fluid pressure loading rises above a predetermined maximum.

A still further object of this invention is to provide in a system of this kind a heat exchange coil through which fluid circulating from the high pressure side of the pumps must pass before returning to the reservoir.

Other objects will be apparent from the following description read in conjunction with the attached sheet of drawing in which the single figure shows in diagrammatic form a preferred embodiment of the invention.

Referring now to the attached drawing, there are shown a plurality of positive displacement pumps **10**, **11** and **12**. The pump **11** is shown in section in order to illustrate the working parts thereof. The latter include a rotor **13**, which is mounted eccentrically with respect to the outer casing **14**. A single vane **15** is spring pressed as at **16** into engagement with the outer periphery of the rotor and further serves to divide the pump housing into two sides **17** and **18**. For clockwise rotation of the rotor, **18** will be the high pressure side, and conversely, for counterclockwise rotation, **17** will be the high pressure side. It will of course be understood that three pumps are shown in the drawing merely for illustrative purposes. The actual number used is not critical.

The fluid supply for the entire control system is indicated by the reservoir **19**. The master control valve shown at **20**, an automatic reversing valve shown at **21**, and the pressure relief valve shown at **22**, constitute together with the reservoir and the pump, the basic components of the system.

Corresponding sides of the pumps are connected by a pair of manifolds **23** and **24**, and therefore one of these manifolds will be under high pressure and the other under low pressure, depending upon the direction of rotation of the pumps. The function of the automatic reversing valve **21** is to insure that regardless of the direction of rotation of the pumps, of the two lines which ultimately carry the working fluid from the pumps to the master control valve, one will always be the high pressure line and the other will always be the low pressure line. The advantages of such an arrangement are that the remote control valve can be greatly simplified. Line **25**, therefore, will always be the high pressure line while **26** will always be the low pressure line.

The automatic reversing valve **21** includes three interconnected slidably mounted pistons **27**, **28** and **29**. Pilot lines **30** and **31** supply fluid pressure to the pistons **27** and **29** to shift the valve **21** to one or the other of its ends of travel depending on the direction of rotation of the pumps. If we assume, therefore, that the direction of rotation of the pumps is clockwise as indicated on the drawing, then manifold **23** will be the high pressure manifold and this pressure transmitted through the pilot line **31** will serve to maintain the valve **21** in the position shown, thus affording free communication between the high pressure manifold and the high pressure line **25**. If, on the other hand, the direction of rotation of the pumps is reversed, manifold **24** becomes the high pressure line and fluid pressure transmitted through pilot line **30** will act on the piston **27** to move the entire valve assembly to the opposite end of its path of travel. When in this position, the piston **28** will occupy a position to the left of the high pressure line **25** and, therefore, there will be free communication between the manifold **24** and the high pressure line **25**. The piston **29** will be positioned to uncover the lower end of low pressure line **26** which will then have free communication with manifold **23**. At the same time, the piston **27** will be positioned to close the lower end of line **32** so that high pressure fluid cannot gain access to the low pressure line **26**.

The master control valve **20** includes a pair of interconnected pistons **33** and **34**, constituting valve members slidably mounted in a housing. In the position shown, piston **33** is positioned to block the high pressure outlet of line or passageway **25**, and the piston **34** is positioned to allow free communication betweeen the reservoir **19** and the low pressure or inlet line or passageway **26**. With the valve **20** in this position, the rotors of all three pumps will be positively locked against rotation.

In some applications, conditions could obviously occur giving rise to fluid pressures above and beyond safe working pressures of the control system. To provide for such contingencies, the valve **22** shown as a spring biased by-pass valve is included. The valve member **35** is normally positioned, as shown in the drawing, to close off a by-pass path comprising the lines **36** and **37**. The latter lines simply provide a path for high pressure fluid around the valve member **33** of the master control valve **20**. Whenever the fluid pressure exceeds a predetermined maximum, therefore, the valve member **35** will be unseated and high pressure fluid will by-pass piston **33** through lines **36** and **37**, and return to the reservoir **19**. Under these conditions, there will be a considerable amount of heat generated in the working fluid and, therefore, a heat exchange coil **38** may be connected between the reservoir and the high pressure pump outlet.

The valve 22 discharges high pressure fluid through this heat exchange coil in order that it may be cooled therein before entering the reservoir 19. The coil 38 serves as an inlet connecting the valve housing to the reservoir 19. An outlet from the reservoir 19 is also connected to the valve housing. A third piston is interposed betweeen the pistons 33 and 34 and connected thereto by a rod. There are spaces between the third piston and the other two, the one on the right serving as passage means to connect the high pressure passageway to the inlet and the one on the left serving to connect the outlet from the reservoir to the low pressure passageway.

For the purposes of description of the operation of a complete system in accordance with this invention, we can assume that the housing 14 of the pumps is rigidly secured, for example, to the body of a vehicle. The rotors of the pumps are positively connected to moving portions of the vehicle such, for example, as the wheels. If the valve 20 is moved to the opposite end of its path of travel from that shown in the drawing, and if the vehicle is moving, it will be seen that the connection between the reservoir 19 and the pump inlets will be closed by the piston member 34 of valve 20 and that the outlet or high pressure side of the pumps will be placed in free communication with the heat exchange coil 38. There will, therefore, be a path for the circulation of fluid extending from the manifold 33 to the valve 21, thence through high pressure line 25, valve 20, heat exchange coil 38, and reservoir 19. As long as the inlet is closed at the valve 20 by piston 34, there will be no circulation of fluid in the system after the level in each of the pumps falls below a certain point. This is an important feature of the present invention as it results in practically zero loading on the pumps. Assume now, however, that it is desired to apply a braking force to the vehicle. If the valve 20 is moved partially back to the position shown in the drawing, the piston 33 will partially restrict the high pressure line 25 and the piston 34 will partially open the inlet to line 26 from the reservoir 19. Under these conditions, a certain braking force will be applied. That is to say, there will be a certain fluid pressure loading on the rotors of each of the pumps. There will also be a proportionate amount of heat generated in the circulating fluid. As long, however, as the piston 33 does not completely block the outlet in line 25, this circulating fluid is forced to pass through the heat exchange coil 38 before it returns to the reservoir 19. If now the valve 20 is moved to the extreme end of its path of travel, as shown in the drawing, the rotors of all the pumps will be locked against further rotation. As long as the fluid pressure load on the rotors does not rise above a predetermined maximum, there will be no further circulation of fluid in the system. On the other hand, however, if the momentum of the vehicle is such that the predetermined pressure loading of the system is exceeded, the relief valve 22 will open and will remain in its open position until the system pressure falls below the predetermined value.

The applicability of the control system of this invention to clutches as well as brakes will be obvious to those skilled in the art. The basic concept of varying the fluid pressure load on the rotor of a positive displacement pump lends itself admirably to such applications. Accordingly, while the present invention has been described principally with reference to braking systems, it is not in fact limited thereto. The true scope is defined by the appended claims.

I claim:

1. A control system for subjecting the rotor of a positive displacement pump to variable fluid pressure loads between about zero and a value sufficient to lock the rotor, said system comprising in combination: a pump; a fluid reservoir including an inlet connection thereto and an outlet connection therefrom; a high pressure passageway connected to said pump; a low pressure passageway connected to said pump; a pair of valve members; housing means for said valve members connected to said inlet and outlet connections and to the ends of said passageways; means coupling said valve members together for movement in unison, said valve members having a sliding relation to said ends, the distance between the centers of said ends being less than the distance between the centers of said valve members, each of said valve members being movable from a closed overlapped relation to one of said ends to open said one of said ends as the other valve member closes the other end, the closing movement of one valve member being in direct proportion to the opening movement of the other; passage means operable when one of said valve members is in open position to connect the high pressure passageway to the inlet connection, said one of said valve members being movable to render said passage means inoperative; and additional passage means operable when the other of said valve members is in open position to connect the low pressure passageway to the outlet connection, said other of said valve members being movable to render said additional passage means inoperative, and means in said housing means separating said passage means.

2. A control system for subjecting the rotor of a reversible positive displacement pump to variable fluid pressure loads between about zero and a value sufficient to lock the rotor, said system comprising in combination: a pump; a fluid reservoir including an inlet connection thereto and an outlet connection therefrom; a high pressure passageway connected to said pump; a low pressure passageway connected to said pump; a pair of valve members; housing means for said valve members connected to said inlet and outlet connections and to the ends of said passageways; means rigidly securing said members together as a unit, said unit being adjustable to a position where one of said valve members will completely close the end of said high pressure passageway while the end of said low pressure passageway is fully open and to a position where the other valve member will completely close said low pressure passageway while the high pressure passageway is fully open; passage means operable when one of said valve members is in open position to connect the high pressure passageway to the inlet connection; said one of said valve members being movable to render said passage means inoperative; additional passage means operable when said other of said valve members is in open position to connect the low pressure passageway to the outlet connection, said other of said valve members being movable to render said additional passage means inoperative; automatic valve means connected to the other ends of said passageways and a pair of additional passageways each connected to said pump at one end and to said automatic valve means at the other, said valve means being reversible and being operable in one position to connect said high pressure passageway to one of said additional passageways and said low pressure passageway to the other of said additional passageways and being operable on reversal to connect said low pressure passageway to said one of said additional passageways and to connect said high pressure passageway to said other of said additional passageways and means operative on the reversal of said pump to reverse said automatic valve means.

3. A system as defined in claim 2 in which said pair of valve members are pistons mounted on a common rod, each spaced laterally from an opposite side of a third piston, mounted on said rod, said passage means being the spaces on opposite sides of the third piston.

4. A system as defined in claim 2, including a bypass connecting said inlet connection to said high pressure passage and bypassing said housing means, and escape valve means in said bypass, said escape valve means including a valve element, a compression spring urging said element to a closed position, adjustable means for

varying the compression on said spring and adjustable means for limiting the length of movement of said valve element and thus limiting the volume of flow through said bypass.

References Cited in the file of this patent

UNITED STATES PATENTS

1,470,804	Buckingham	Oct. 16, 1923
2,042,539	Maisch	June 2, 1936
2,152,570	Scates	Mar. 28, 1939
2,551,677	Hoffstrom	May 8, 1951
2,681,713	Chambers	June 22, 1954

FOREIGN PATENTS

812,657	France	Feb. 8, 1937
909,346	France	Dec. 20, 1945