

Oct. 15, 1957

J. H. CASLOW
HYDRAULIC APPARATUS

2,809,652

Filed Aug. 9, 1954

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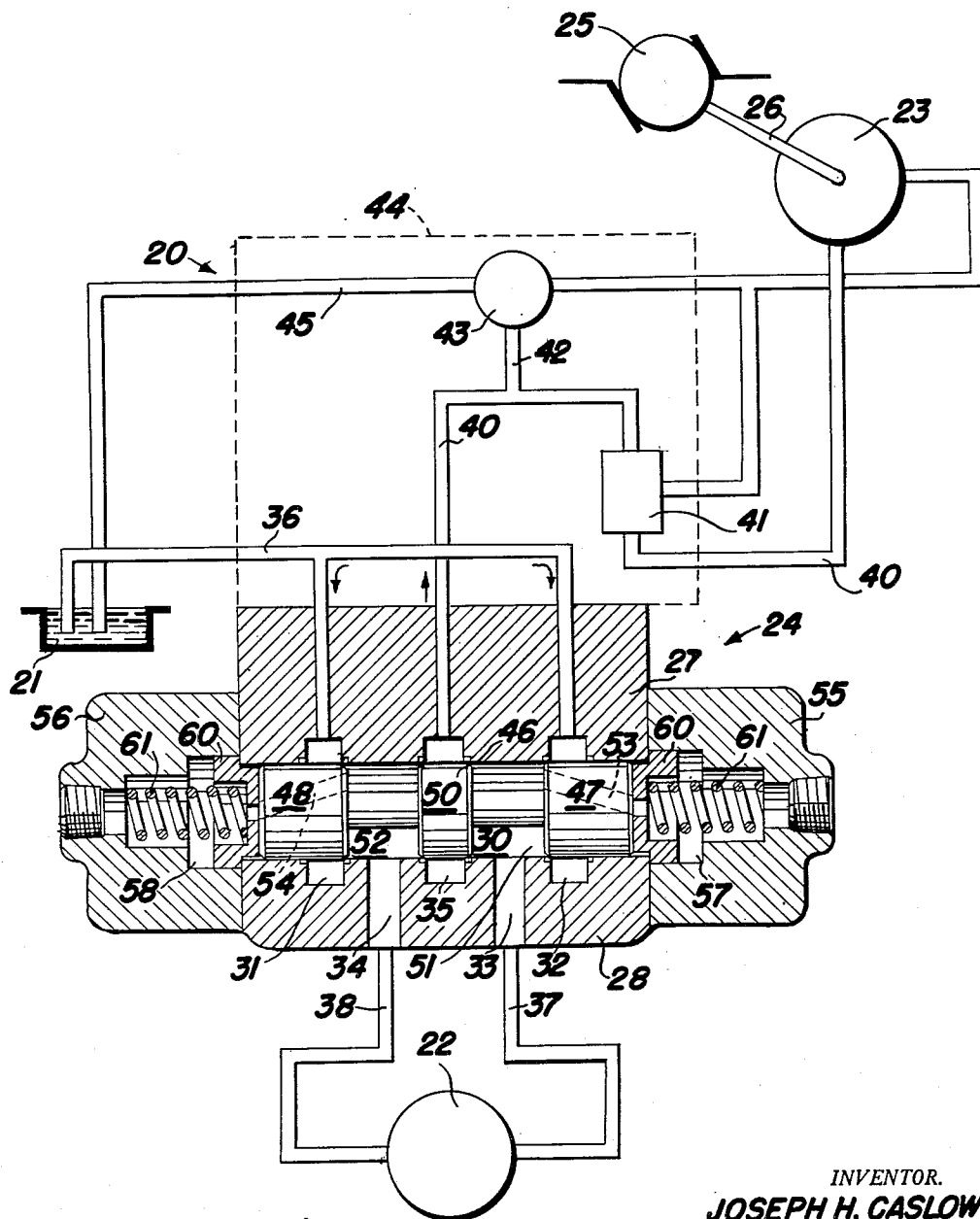


FIG. 1

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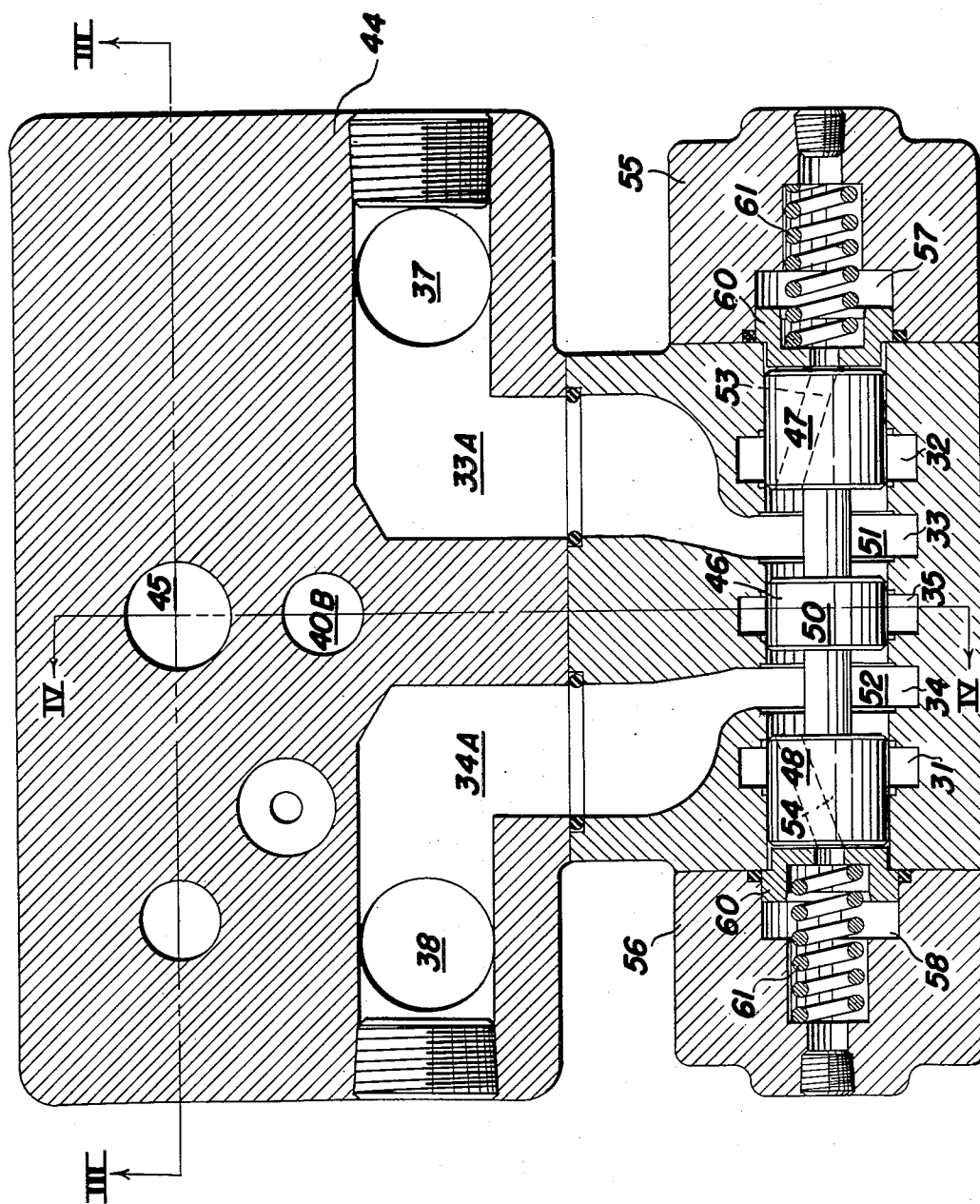


FIG. 2

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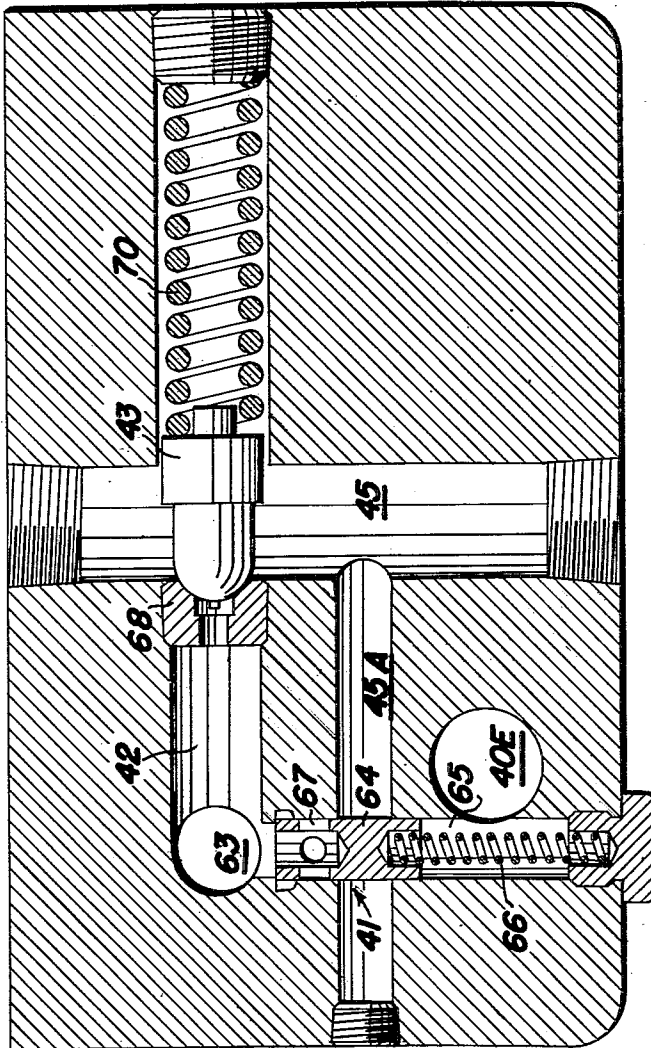


FIG. 3

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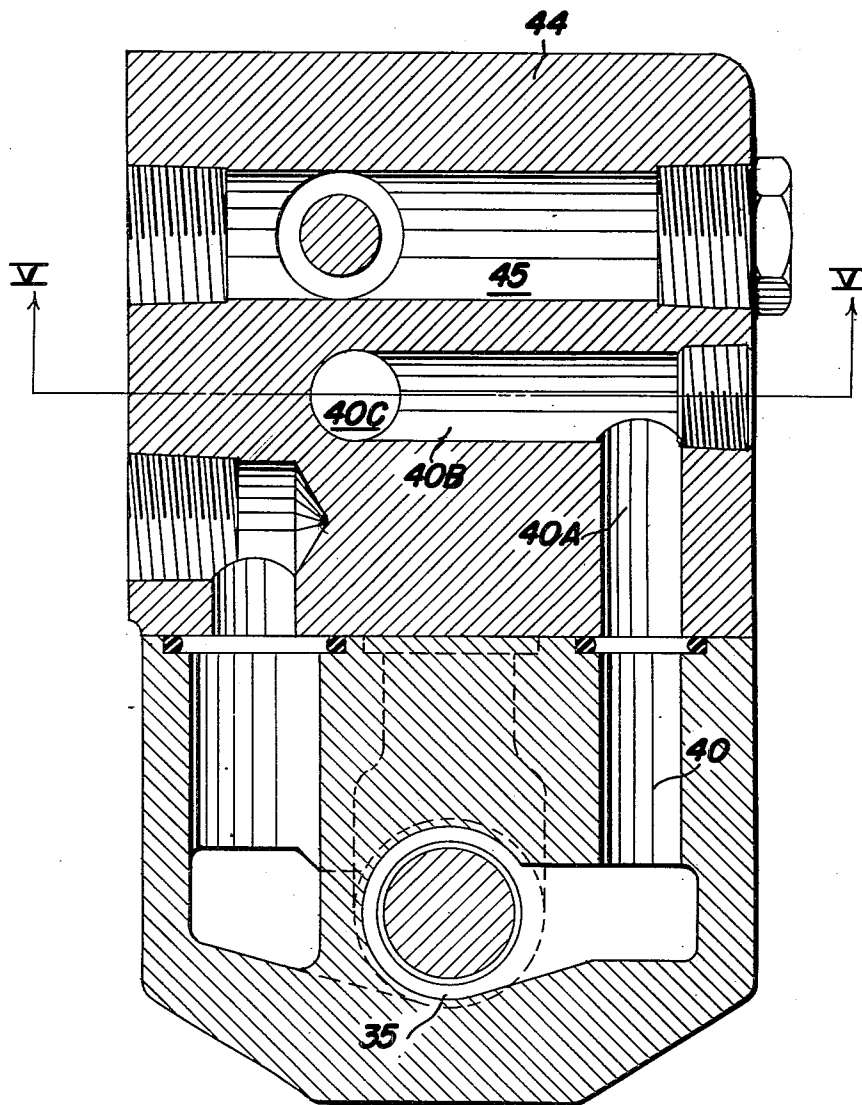


FIG. 4

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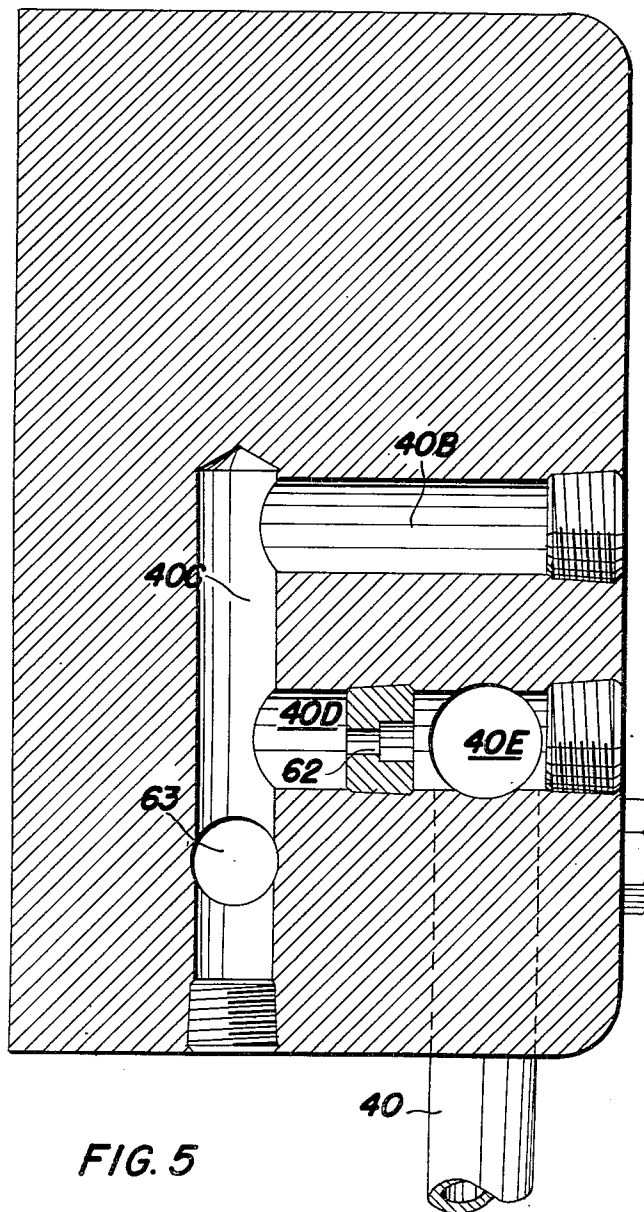
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1

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HYDRAULIC APPARATUS

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Application August 9, 1954, Serial No. 448,700

3 Claims. (Cl. 137—106)

This invention relates generally to hydraulics and more particularly to an automatic valve which may be employed with facility, for example, in a hydraulic system for use on a rail or similar car to drive an electric current generator with power derived from the motion of the car in either forward or reverse direction.

An object of this invention is to provide an automatic valve which may be connected in a hydraulic system of the type specified in the preceding paragraph and will operate to connect either of a pair of combination inlet and outlet ports of a reversible pump to the pressure section of the hydraulic system depending upon the direction of operation of the pump.

Another object of this invention is to provide an automatic valve having the general characteristics of a four-way valve but being modified by the addition of means for causing a part of the valve to assume an inactive position when the pump in the system served by the valve is inoperative, the valve being further modified by the addition of passages which will cause fluid pressure to be applied to the aforesaid part of the valve to render it active when operation of the system pump in either direction is initiated.

A still further object of the invention is to provide a valve mechanism so constructed and connected with a reversible pump that, irrespective of the direction of operation of the pump, a superatmospheric pressure will be applied to a surface of a part of the valve and a subatmospheric pressure applied to an oppositely directed surface of such part so that the part will be moved to and retained in position to direct the discharge from the pump into a predetermined part of the system served by the pump; if the direction of operation of the pump is reversed, the said valve part will be shifted to a second position in which the discharge from the pump now issuing from a different port will still be directed into the same predetermined part of the hydraulic system. This action of the valve is entirely automatic and no attention by the operator of the car or other vehicle equipped with the device is required.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred form of embodiment of the invention is clearly shown.

In the drawings:

Fig. 1 is a diagrammatic view of a hydraulic system in which the present invention has been incorporated;

Fig. 2 is a longitudinal sectional view taken through a valve and manifold combination used in carrying out the present invention, these elements being shown diagrammatically in Fig. 1;

Fig. 3 is a detail longitudinal sectional view taken through the manifold on the plane indicated by the line III—III of Fig. 2;

Fig. 4 is a vertical transverse sectional view taken through the valve and the manifold on the plane indicated by the line IV—IV of Fig. 2; and

2

Fig. 5 is a horizontal sectional view taken on the plane indicated by line V—V of Fig. 4.

Referring more particularly to the drawings and especially to Fig. 1, the complete hydraulic system to which the valve including the invention has been applied is indicated by the numeral 20. This hydraulic system includes a reservoir 21, a reversible pump 22, a fluid motor 23, and combined automatic valve and manifold mechanism indicated generally by the numeral 24. The hydraulic system, as mentioned in the objects, is provided for the purpose of driving an electric current generator shown diagrammatically at 25, this generator being mechanically connected with the shaft 26 of the fluid motor 23. The pump 22 is suitably connected to the running gear of a rail or other vehicle (not shown) so that, when the vehicle moves either forwardly or rearwardly, the pump 22 will be operated. It is, as pointed out in the objects, desired to transmit rotary motion to the electric current generator when the pump 22 operates and to cause the generator to rotate in the same direction irrespective of the direction of operation of the pump 22. To accomplish this purpose, the novel valve and manifold mechanism 24 and the hydraulic system connected therewith has been provided. In general, the valve mechanism, per se, indicated by the numeral 27, is of the four-way type and includes a casing 28 in which a bore 30 is formed.

This casing is provided with a plurality of ports 31 to 35, inclusive, which are spaced longitudinally of the bore and communicate therewith. Ports 31 and 32 are disposed adjacent the ends of the body 28 while port 35 is disposed substantially equidistantly from the ends of the bore. Ports 33 and 34 are arranged between port 35 and ports 31 and 32, the port 33 being on one side of port 35 and the port 34 being disposed at the other side of port 35. These ports are hereinafter identified as follows: Ports 31 and 32 are designated as tank or low pressure ports, ports 33 and 34 are termed pump ports, and port 35 is termed a pressure port. As shown in the diagram in Fig. 1, ports 31 and 32 are connected by a conduit 36 with the reservoir 21, branches of conduit 36 extending to the ports 31 and 32. Fluid lines 37 and 38 establish communication between ports 33 and 34, respectively, and combination inlet and outlet ports of the pump 22. These pump ports are termed combination inlet and outlet ports because each serves in either capacity depending upon the direction of operation of the pump.

Port 35 is connected by a passage 40 with the inlet of the fluid motor 23, passage 40 containing a flow control mechanism 41 and communicating, as at 42, with a relief or safety valve 43. The flow control 41, portions of passages 40 and 42, and the valve 43 are contained within the manifold 44, this manifold forming a part of the mechanism designated generally by the numeral 24. The manifold also contains portions of return line 45 which leads back to the reservoir 21.

The bore 30 is formed for the slidable reception of a spool 46 having right and left end sections or lands 47 and 48 and a center section or land 50, these sections being spaced to provide right and left hand grooves 51 and 52. The end sections 47 and 48 have passages 53 and 54, respectively, extending therethrough from the grooves 51 and 52 to the ends of the bore 30. The body 28 has cap sections 55 and 56 secured thereto, these cap sections being provided with bore extensions 57 and 58, each of which has a counterbored portion for the slidable reception of a spring abutment 60; each abutment projects slightly into the adjoining bore 30 for engagement by the adjoining end of the spool 50. The abutments engage the ends of the body 28 and are thus limited in their movement toward the spool. When, however, both

abutments engage the ends of the body, as shown in Figs. 1 and 2, the spool will be centered longitudinally of the body.

The abutments 60 transmit the force of springs 61 to the spool 50, the springs serving to move the spool to the centered inactive position, shown in Figs. 1 and 2 of the drawing, when the pump 22 is inoperative. The outer ends of the springs 61 engage shoulders provided in the caps 55 and 56. When the hydraulic system is inoperative, the spool will occupy the centered inactive position shown. In this centered position, the spool provides, or permits, communication between the adjacent ports whereby that fluid line 37 or 38 which will be called upon to act as the suction line for pump 22 will not be blocked when operation of the pump 22 is initiated.

With the system described, either forward or reverse movement of the vehicle will cause the pump 22 to operate in a forward or reverse direction. When so operated, pump 22 will draw fluid from one or the other of the ports 33 or 34 and discharge fluid into the other port. The withdrawing of fluid from one port and discharging it into the other port will cause different pressures to obtain in these ports and in grooves 51 and 52 then registering therewith. These differential pressures will be transmitted through the passages 53 and 54 to the corresponding ends of the bore 30 where the pressures will be applied to the opposite ends of the spool 46. Due to the differential in pressures, the spool 46 will be moved in one direction or the other to establish communication between the line 37 or 38 then serving as the inlet and one of the ports connected with the reservoir 21. The other of lines 37 and 38 will be connected with port 35 and the discharge of the pump will then be directed to the pressure line 40 leading to the fluid motor 23. The motor will then operate to drive the generator 25.

When the motion of the vehicle is interrupted, operation of pump 22 will be discontinued and fluid pressures at the ends of the spool 46 will be equalized permitting the springs 61 to move the spool back to the centered position. If the vehicle is again moved in the same direction, the valve spool will be actuated as before. If the direction of movement of the vehicle is reversed, the valve spool will be moved in the opposite direction and the connections between the pump ports, the reservoir and the pressure line will be reversed; the pressure line, however, will at all times receive the discharge from the pump 22.

Figs. 2 to 5, inclusive, show the valve mechanism and manifold in detail. In Fig. 2, ports 33 and 34 are connected by passages with openings 33A and 34A in the manifold 44 to which the lines 37 and 38 are connected. These lines, as shown in the diagram of Fig. 1, lead to the combination inlet and outlet ports of the pump 22. Fig. 4 shows the port 35 connected with passage 40 which is formed by a plurality of holes 40A, 40B, 40C, 40D, and 40E drilled in the manifold 44. As shown in Fig. 5, hole 40D of passage 40 is provided with a restriction 62 through which the oil or other fluid flows during the operation of the pump 22. This restriction creates a pressure differential between the inlet and outlet sides thereof, which pressure differential is employed to operate the flow control 41 used to govern the speed of operation of the fluid motor 23. The flow control 41 is shown in detail in Fig. 3. This flow control 41 is connected with line 40 by a hole 63 drilled into the manifold 44 to intersect the hole 40C.

The pressure at the inlet side of the orifice or restriction 62 is conducted through the hole 63 to one end of the flow control valve spool 64 while the pressure at the out let side of the restriction is conducted through passage 65, drilled in the manifold to connect with hole 40E as shown in Fig. 3, to the other end of the flow control spool 64. This spool 64 is urged by a coil spring 66 to a position preventing the establishment of communication between hole 63 of passage 40 and the tank line 45 via drilled hole 45A. When the pressure at the inlet side of the orifice or restriction 62 reaches a predetermined value,

however, spool 64 will be moved in opposition to the force of the spring 66 and the pressure at the outlet side of the restriction to a position in which ports 67 in the spool establish communication between hole 63 of the passage 40 and hole 45A which leads to passage 45 and some of the fluid being delivered by the pump will then be bypassed directly to the reservoir. If the discharge of the pump should increase, valve spool 64 will move a distance sufficient to bypass the additional fluid to the reservoir so that fluid motor 23 will continue to operate at the same predetermined rate.

In the event the pressure in the line 40 should exceed the capacity of the flow control valve or it should for some other reason fail to bypass the excess fluid, some of the fluid will be by-passed directly from the hole 63 of passage 40 through branch 42 to the tank passage 45 by the safety or relief valve 43; the fluid pressure will thus be prevented from exceeding a predetermined safe maximum. The valve 43 is of the poppet type having a seat 68 between branch passage 42 and passage 45 for engagement by the valve element 43. The element 43 is resiliently urged toward the seat at all times by a coil spring 70. The pressure at which the relief valve will open may be varied by the substitution of a different spring. A different spring may also be substituted for the spring 66 if it is desired to change the rate of operation of the fluid motor 23.

While the form of embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

I claim:

1. A four-way type pressure operated fluid distributing valve including a body having a bore with closed ends; a high pressure outlet port communicating with said bore; a pair of pump ports communicating with said bore one on each side of said outlet port, one of said pump ports being adapted to receive fluid under high pressure flowing from a pump and the other being adapted to receive fluid under low pressure flowing to said pump, the order being reversible; a pair of low pressure inlet ports communicating with said bore, one of said inlet ports being adjacent each of said pump ports and at the side thereof opposite said outlet port; a solid longitudinally shiftable valve spool in said bore including three lands separated by two grooves, the center land of said three lands being of less width than said outlet port and the distance between said center land and the end lands being slightly greater than the distance between said outlet port and said motor ports whereby restricted communication is had between all of said ports when said valve spool is centered in said bore; a pair of conduit means in said spool, one extending from each of said grooves to the adjacent end of said valve spool; and means for resiliently centering said valve spool in said bore including a pair of springs one at each end of said valve spool, said valve operating when fluid under pressure is supplied to either of said pump ports to shift said valve spool to a position in which it fully disconnects said pump port from the adjacent low pressure port and fully connects it with said outlet port and simultaneously fully disconnects the other of said pump ports from said outlet port and fully connects it with the adjacent low pressure port.

2. A four-way type pressure operated fluid distributing valve including a body having a bore with closed ends; a high pressure outlet port communicating with said bore; a pair of pump ports communicating with said bore one on each side of said outlet port, one of said pump ports being adapted to receive fluid under high pressure flowing from a pump and the other being adapted to receive fluid under low pressure flowing to said pump, the order being reversible; a pair of low pressure inlet ports communicating with said bore, one of said inlet ports being adjacent each of said pump ports and at the side thereof opposite said outlet port; a longitudinally shiftable valve spool in

5

said bore including three lands separated by two grooves, the distance between said end lands being greater than the distance between said inlet ports whereby communication is had between said inlet ports and said pump ports when said valve spool is centered in said bore; a pair of conduit means in said spool, one extending from each of said grooves to the adjacent end of said valve spool; and means for resiliently centering said valve spool in said bore including a pair of springs one at each end of said valve spool, said valve operating when fluid under pressure is supplied to either of said pump ports to shift said valve spool to a position in which it fully disconnects said pump port from the adjacent low pressure port and fully connects it with the adjacent low pressure port.

3. A four-way type pressure operated fluid distributing valve including a body having a bore with closed ends; a high pressure outlet port communicating with said bore; a pair of pump ports communicating with said bore one on each side of said outlet port, one of said pump ports being adapted to receive fluid under high pressure flowing from a pump and the other being adapted to receive fluid under low pressure flowing to said pump, the order being reversible; a pair of low pressure inlet ports communicat-

6

ing with said bore, one of said inlet ports being adjacent each of said pump ports and at the side thereof opposite said outlet port; a longitudinally shiftable valve spool in said bore including three lands separated by two grooves, said inlet ports being open to said pump ports when said valve spool is centered in said bore; a pair of conduit means, one extending from each of said pump ports to opposite ends of said valve spool; and means for resiliently centering said valve spool in said bore including a pair of springs one at each end of said valve spool, said valve operating when fluid under pressure is supplied to either of said pump ports to shift said valve spool to a position in which it fully disconnects said pump port from the adjacent low pressure port and full connects it with said outlet port and simultaneously fully disconnects the other of said pump ports from said outlet port and fully connects it with the adjacent low pressure port.

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