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(54) **Fluid motor control circuit with fast-acting quick-drop valve.**

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Fluid motor control circuit with fast-acting quick-drop valve

Technical field

This invention relates to control systems for fluid pressure-operated motors, such as fluid cylinders, fluid actuators or the like, and more particularly to a quick-drop valve which enables fast gravity-assisted lowering of a load or member by directing fluid which discharges from one motor port back to the other motor port.

Background art

Control systems for fluid cylinders or the like usually have a main control valve connected between the cylinder and a pump or other source of pressurized fluid. In many systems the main control valve has a raise position at which pressurized fluid is supplied to the rod end of the cylinder and at which fluid is discharged from the head end in order to move a load against gravity or against some other resistance. In this raise mode of operation the rate of cylinder retraction is determined by the rate at which the pump forces fluid into the cylinder. This is not necessarily the case when the main control valve is shifted to the lower or power-down position at which the pressurized fluid is applied to the head end of the cylinder and at which fluid discharges from the rod end back to tank. During the power-down mode of operation gravity or other forces may be capable of causing a rate of cylinder extension exceeding that established by the rate of flow of pressurized fluid to the head end of the cylinder. Severe negative pressures or cavitation may then cause a loss of precision in controlling the cylinder. The cylinder may not respond quickly to shifts of the control valve and other adverse effects occur such as erratic cylinder motion and vibration and bounce or temporary reversals of cylinder motion. While these effects can be avoided by restricting the rate at which fluid can discharge back to tank through the main control valve at the power-down position of the valve, this may undesirably limit the rate of lowering of the load.

To enable fast lowering of a load, a variety of quick-drop valves have heretofore been designed for connection between the two flow passages to the ends of the cylinder at a location relatively close to the cylinder and in some cases as a built-in component of the cylinder itself. Quick-drop valves provide a relatively short and low resistance fluid interchange path between the two ends of the cylinder that remains closed during the raise mode of operation but which is opened during gravity-assisted lowering of the load so that fluid which is discharging from one cylinder port is directed to the other port to supplement the incoming flow from the main control valve. Typically, the quick-drop valve senses cavitation in the cylinder during the power-down mode of operation and opens automatically while such condition is present.

The US—A—35 68 707 describes a fluid motor control circuit for powered multi-directional movement of a load member. The circuit includes a double acting positioning cylinder, a raise-lower valve connected to hoses which lead to the cylinder and a quick drop valve which is interposed between the hoses and cylinder and increases dropping speed for the load member by passing fluid between opposite ends of the cylinder in a direct path without the fluid passing through the control valve and cylinder hoses. The valve has a conventional check valve therein, and the only other movable valve part therein consists of a single valve sleeve.

The US—A—37 95 177 shows a system having a manually operated control valve for directing pressurized fluid to a pair of fluid motors while receiving fluid discharged therefrom which also has a fast motion valve for causing the motors to outrun the fluid supplied through the control valve by returning a portion of the discharged fluid directly to the motors. The circuit shifts to provide fast motion on detecting a predetermined flow rate between the control valve and the motors. As the operator can modulate this flow rate, the fast motion is always subject to operator control. To assure operator control under all conditions, the fast motion valve is spring biased to the unoperated position and return of a portion of the motor discharge flow to the control valve is a necessary condition for operation of the fast motion valve. The system is further arranged to prohibit fast motion, under any condition, during reversed motion of the motors.

Prior quick-drop valves of known forms are subject to certain operational disadvantages. Many prior quick-drop valves operate in response to a discharge pressure differential across a restriction in the flow path which connects the discharging end of the cylinder with the tank through the main control valve. Consequently the discharge flow path must remain at least partially open and part of the discharge flow must be returned to tank during the quick-drop mode of operation instead of being recirculated to the head end to inhibit cavitation. Some other prior quick-drop valves respond to a flow restriction situated in the flow path to the pressurized end of the cylinder, but in these cases the discharging flow path remains communicated with tank during the quick-drop mode of operation again preventing use of the entire discharge flow for the purpose of enabling fast lowering of a load without adverse effects.

The prior art has not provided a quick-drop valve which fully seals off the rod end flow passage from tank during the quick-drop mode

of operation and which fully returns all discharge fluid to the head end of the cylinder at that time.

Considering an additional problem encountered with prior quick-drop valves, there are fluid cylinder usages in which it is desired to continue lowering the load by reverting to a power-down mode of operation after gravity ceases to be effective for this purpose. The fluid cylinders used to raise and lower a bulldozer blade relative to a tractor body are typical of such systems. Control systems for such cylinders often provide a quick-drop mode of operation to speed the dropping of the bulldozer blade towards the ground in preparation for work operations. When the blade contacts the ground it may be necessary to convert to a power-down mode of operation to drive the blade forcibly downward a short distance into the ground. An undesirable time lag tends to occur between the quick-drop operation and the subsequent power-down operation and in some cases an undesirable bounce effect or momentary reversed motion of the bulldozer blade or other driven mechanism may occur. This effect is found in prior quick-drop systems which shift automatically by sensing increased resistance to lowering of the load as well as in systems in which the operator must manually shift the main control valve from a float or quick-drop setting to a power-down setting.

Disclosure of the invention

The present invention is directed to overcoming the problems as set forth above. The invention relates to a fluid motor control circuit having a source of pressurized fluid; a fluid motor having first and second ports; a control valve connected to said source and to said first and second ports through first and second fluid pathways respectively; a housing forming a valve chamber with first, second and third spaced apart valve ports having means for communication with said first motor port, said second motor port and said first fluid pathway respectively; a valve member in said valve chamber movable between a first position at which said first and third valve ports are intercommunicated while being blocked from said second valve port and a second position at which said first and second valve ports are intercommunicated while said third valve port is blocked from both thereof to cause all discharge fluid from said first motor port to be directed to said second motor port, and resilient means for biasing said valve member to said first position.

In such a fluid motor control circuit the invention provides flow restriction means situated in said second fluid pathway for developing a pressure differential in first and second spaced apart regions in response to fluid flow therethrough, said first region being between said flow restriction means and said control valve and said second region being between said flow restriction means and said second motor port.

The control system for one or more fluid cylinders or other fluid motors includes quick-drop valve means which shifts from a power-down mode of operation into a quick-drop mode upon sensing cavitation accompanied by a fluid flow into the cylinder which is above a predetermined level. The quick-drop valve means then completely blocks the discharge flow path from the cylinder back to tank in order to recirculate all discharge fluid directly back to the cylinder. This total regeneration of the discharge flow enables an extremely fast gravity lowering of a load without adverse effects. Upon sensing resistance to continued lowering of the load the quick-drop valve means automatically reverts to the power-down mode of operation rapidly and without bounce or other adverse effects, enabling continued lowering of the load without any significant interruption.

The quick-drop valve means is biased towards a normal position at which the two flow passages to the cylinder or the like are isolated from each other and separately communicated with the main control valve to enable raise, hold and power-down modes of operation to be selected by manipulation of the main control valve. A flow restriction is provided in the particular flow passage through which fluid is directed to the cylinder or the like during the power-down mode of operation. Pilot means respond to cavitation in the cylinder accompanied by a predetermined pressure differential across the flow restriction by shifting the quick-drop valve to an alternate position at which the discharge flow passage back to the main control valve is completely blocked and at which all discharge fluid is recirculated back to the cylinder or the like to supplement the flow arriving from the main control valve. The pilot means also respond to either or both of a drop of the pressure differential across the flow restriction and cessation of cylinder cavitation by quickly resetting the quick-drop valve back to to the power-down position.

The invention, together with further features and advantages thereof, will best be understood by reference to the following description of preferred embodiments taken in conjunction with the accompanying drawings.

Brief description of the drawings

Figure 1 depicts a fluid motor control circuit including a quick-drop valve under conditions which establish the raise mode of operation at which the motor lifts a load against gravity,

Figure 2 is a view of a portion of the apparatus of Figure 1 during the power-down mode of operation,

Figure 3 is a view of a portion of the circuit of Figures 1 and 2 during the quick-drop mode of operation,

Figure 4 illustrates a modification of a portion of the apparatus of Figures 1 to 3.

Best mode for carrying out the invention

Referring initially to Figure 1 of the drawing, a fluid circuit 11 includes a quick-drop valve means 12 for controlling a fluid motor 13 that has first and second motor ports 14 and 17 respectively each of which may receive or discharge fluid depending on the direction of motor motion. Motor 13 in this example is a fluid cylinder 13a in which the first motor port is a rod end port 14a to which pressurized fluid is directed to cause cylinder retraction and consequent raising of a load 16 and in which the second motor port is a head end port 17a to which the pressurized fluid may be directed to cause extension of the cylinder and lowering of the load.

The load 16 in this particular example is a bulldozer blade 18 coupled to the body of a tractor 19 through vertically pivotable push arms 21 to which the rod of cylinder 13a is coupled. Thus by supplying pressurized fluid to rod end port 14a while allowing fluid to discharge from head end port 17a, the cylinder 13a may be caused to retract to raise the blade 18 against gravity. Lowering of the blade 18 may be accomlished by directing pressurized fluid to head end port 17a while allowing fluid to discharge from rod end port 14a, but in this case two distinct modes of cylinder extension are possible.

If there is sizable resistance to lowering of the load, such as when the blade 18 is in contact with ground 22, the rate of cylinder extension is primarily determined by the rate at which pressurized fluid is directed into head end port 17a and the system is in the power-down mode of operation. Under other conditions, such as when the lower edge of the blade 18 is above the ground, cylinder extension may tend to outrun the incoming supply of pressurized fluid and the extension rate is then determined by gravity acting against mechanical friction and whatever degree of flow resistance may be present in the discharge path from rod end port 14a. It is often desirable to take advantage of the faster rate of cylinder extension obtainable by this gravity-induced or quick-drop mode of operation but this is practical only to the extent that the previously described adverse effects which accompany excessive cavitation within the head end of cylinder 13a can be prevented. The quick-drop valve means 12 of circuit 11 inhibits such effects during the quick-drop mode of operation to provide for extremely fast lowering of the load and further provides for an extremely quick automatic shift into the power-down mode of operation when resistance to lowering of the load increases from contact of blade 18 with the ground 22 or other causes.

The circuit 11 may utilize a fluid such as oil for example, stored in a tank 23, which is pressurized and delivered to a fluid inlet 25 of a main control valve 26 by a pump 24. Main control valve 26 also has a drain outlet 27 for returning discharge fluid to tank 23. A relief valve 28 is connected between the output of the pump 24 and tank 23 to establish a predetermined maximum fluid pressure and to return excess output fluid from the pump directly back to the tank.

The main control valve 26 in this example is of the manually operated form and has four positions or settings. At the raise position of the main control valve depicted in Figure 1, pressurized fluid is directed into a first or rod end flow path conduit 29 while a second or head end flow path conduit 31 is communicated with tank 23 through drain outlet 27. The main control valve 26 may be shifted to a hold position at which both flow path conduits 29 and 31 are closed at the main control valve, while inlet 25 is communicated with drain outlet 27, thereby immobilizing the cylinder 13a. At the third or lower position of the main control valve 26, head end flow path conduit 31 receives pressurized fluid from inlet 25 while the rod end flow path conduit 29 is communicated with drain outlet 27. The fourth position of the main control valve 26 is a float position at which flow path conduits 29 and 31 are inter-communicated with each other and with drain 27.

The quick-drop valve means 12 may have a housing 32 with a bore forming a cylindrical valve chamber 33 in which a movable valve member or spool 34 is disposed. An annular groove 36 is formed in housing 32 and communicates with chamber 33 and with the first or rod end port 14a of cylinder 13a through a first valve port 37 and a flow line 38. Another spaced-apart annular groove 40 opens into chamber 33 and is communicated with the second or head end port 17a of the cylinder 13a through a second valve port 41 and head end flow line 31. Still another annular groove 45 opening into chamber 33 is communicated with the rod end flow path conduit 29 at a third valve port 44. The head end flow path conduit 31 includes a flow restriction 47 situated between the main control valve 26 and the connection to second valve port 41.

Spool 34 is shiftable in the axial direction from a normal position depicted in Figure 1, at which the spool abuts the left end of chamber 33 as viewed in the drawings, to an alternate or quick-drop position depicted in Figure 3. Referring again to Figure 1, the spool 34 has three axially spaced-apart annular lands 48, 49 and 51 of which lands 48 and 49 jointly define a broad spool groove 52 while lands 49 and 51 jointly define a second spaced-apart broad spool groove 53. The lands 48, 49 and 51 are positioned on the spool to cause the first and third valve ports 37 and 44 to be communicated by spool groove 53 and to be isolated from the second valve port 41, by land 49, when the spool is at the normal position

depicted in Figure 1. When the spool 34 is shifted to the alternate or quick-drop position depicted in Figure 3, spool groove 52 communicates the first and second valve ports 37 and 41 while blocking and completely closing off the third valve port 44 from each of the other valve ports.

Referring again to Figure 1, shifting of the valve spool 34 between the normal position and the quick-drop position is controlled by first and second pilot means 54 and 56 respectively situated at the left and right ends of spool 34 as viewed in Figure 1.

The first pilot means 54 in this example is formed by the left end of valve chamber 33, spool 34 including land 48 and a first pilot signal line 57 which communicates the first pilot chamber 55 at the left end of valve chamber bore 33 with a first region 58 of the head end flow path conduit 31 which is between main control valve 26 and flow restriction 47. The second pilot means 56 includes a second pilot chamber 59 which is of greater diameter than the valve chamber 33 and which is within an enlarged right end section 32′ of housing 32. A pilot piston 61 is disposed in pilot chamber 59 and is movable in the axial direction between an unactuated position at which the pilot piston abuts the right end of the pilot chamber 59 as depicted in Figure 1 and an actuated position depicted in Figure 2 at which the pilot piston abuts the left end of the pilot chamber 59. Biasing means in the form of a resilient compression spring 62 is disposed in valve housing 32 between spool 34 and pilot piston 61 to bias the valve spool towards the normal position while biasing the pilot piston 61 towards the unactuated position as depicted in Figure 1. To exert a counter force on the pilot piston 61 under certain conditions to be described, a second pilot signal line 63 communicates the outer or right end of pilot chamber 59 with a second region 64 of the head end flow path 31 that is on the opposite side of restriction 47 from region 58. A drain passage 66 communicates with the opposite end of the pilot chamber 59, at the region of spring 62 to avoid accumulation of leakage fluid between the spool 34 and the pilot piston 61.

As will be discussed in connection with operation of the apparatus, second pilot chamber 59 including piston 61 have a larger diameter than the first pilot chamber 55 in order to prevent shifting of spool 34 to the quick-drop position until the pressure in chamber 55 exceeds that in chamber 59 by a sizable amount indicative of cavitation in the head end of cylinder 13a. Referring now to Figure 4, this same effect may be realized with a second pilot chamber 59′ which has the same diameter as quick-drop valve housing bore 33′ if the first pilot chamber 55′ has a smaller diameter. In this modification, the piston 61 and drain 66 of the quick-drop valve as depicted in Figures 1 to 3 are eliminated and, as shown in Figure 4, a relatively small piston 61′ is situated in the first pilot chamber 55′ and a drain 66′ is provided in the valve housing 32′ between piston 61′ and the valve spool 34′, the apparatus otherwise being similar to that previously described.

Industrial applicability of the first embodiment

In operation, raising of the load 16 against gravity is initiated by shifting the main control valve 26 to the raise position depicted in Figure 1 at which pressurized fluid from pump 24 is transmitted to rod end conduit 29 and at which the head end conduit 31 is opened to drain outlet 27. Spring 62 holds spool 34 at the normal position since the first pilot chamber 55 is open to drain and only lightly pressurized if at all. In addition, a somewhat higher pressure is present in the second pilot chamber 59 owing to the pressure differential created across restriction 47 by the discharging flow. If the discharge flow is sufficiently high this may shift pilot piston 61 but the practical effect is simply to increase the spring force which is holding spool 34 at the normal position depicted in Figure 1.

Accordingly, pressurized fluid from pump 24 is transmitted to the rod end port 14a of the cylinder 13a through main control valve 26, rod end conduit 29, valve ports 44 and 37 and flow line 38. The head end port 17a of the cylinder is open to drain outlet 27 through head end flow conduit 31 including restriction 47 and the main control valve 26. Thus cylinder 13a retracts to raise the load 16. As the main control valve 26 is of the infinitely variable form, the operator may, within limits, control the rate of raising of the load by adjusting the main control valve to regulate fluid flow rate to the cylinder.

To stop the retraction of the cylinder 13a, main control valve 26 may be shifted to the hold position at which both the rod end flow conduit 29 and the head end flow conduit 31 are blocked at the main control valve. The system has not been depicted in the drawings in the hold position as all components other than the main control valve 26 remain in the positions depicted in Figure 1. The load 16 is immobilized as fluid from rod end port 14a cannot flow back to drain owing to the closed condition of the main control valve and cannot flow into the head end of the cylinder owing to the position of land 49 which blocks first valve port 37 from second valve port 41. Similarly, fluid cannot flow into or out of the head end port 17a as the head end flow path conduit 31 is also blocked at the main control valve 26. The first and second pilot means 54 and 56 are unable to shift spool 34 or pilot piston 61 at this time since there is no flow across restriction 47 to create a pressure differential which might activate the pilot means. Additionally, the pressure within the pilot signal lines 57 and 63 tends to be low at this time as the weight of the

load 16 tends to create a high-pressure condition in the rod end of cylinder 13a and a relatively low-pressure condition in the head end.

Lowering of the load 16 is initiated by shifting the main control valve 26 to the third or lower position as depicted in both of Figures 2 and 3. The quick-drop valve means 12 may self-operate to either the power-down position depicted in Figure 2 or to the quick-drop position depicted in Figure 3 depending on the interrelationship between two factors. The first factor is the direction of the external forces acting on cylinder 13a. If external forces are such as to oppose lowering of the load, the circuit 11 assumes the power-down position depicted in Figure 2 without regard to the second factor. The second factor is the extent to which the operator has opened the main control valve 26 into the lower setting or, in other words, the rate at which pressurized fluid is being transmitted to the cylinder through restriction 47 and being discharged from the cylinder through the main control valve. If external forces such as gravity are acting to extend the cylinder, then the action of the circuit 11 depends on the relationship of the magnitude of the external force to the degree of opening of the main control valve 26. This action can best be understood by first considering the operation of the circuit in the power-down mode under conditions where there is external resistance to extension of the cylinder 13a or where the main control valve 26 has been opened only to a limited extent insufficient to enable the quickdrop mode of operation.

During the power-down mode of operation as depicted in Figure 2, spool 34 of the quick-drop valve 12 remains in the normal or leftward position while the pilot piston 61 is shifted to the actuated or leftward position by the second pilot means 56 as will hereinafter be discussed in more detail. At this normal position of spool 34, the first and third valve ports 37 and 44 remain communicated across spool groove 53 and remain blocked from the second valve port 41 by spool land 49. Pressurized fluid is therefore supplied to the head end port 17a of cylinder 13a through head end flow conduit 31, including restriction 47. The rod end port 14a of the cylinder is communicated to drain outlet 27 through flow line 38, valve port 37, spool groove 53, valve port 44, rod end flow path conduit 29 and the main control valve 26. The resulting high fluid pressure within the head end of the cylinder extends the cylinder to forcibly lower the load against the resistance to such movement.

Pilot piston 61 shifts to the actuated position at this time since the relatively high pressure within the head end of the cylinder 13a is transmitted to pilot chamber 59 by the second pilot signal line 63 where the pressure acts against the pilot piston 61 with a force greater than that of spring 62. The flow of fluid through restriction 47 creates a pressure drop thereacross causing a somewhat higher pressure to be present in the pilot chamber 55 of the first pilot means 54 than in the second pilot chamber 59 but owing to the difference in the diameters of the two pilot chambers and to the force exerted by spring 62, the pressure difference is insufficient to shift spool 34 and pilot piston 61 rightwardly. Spool 34 therefore remains at the normal position depicted in Figure 2 to establish the power-down mode of operation. The relative diameters of the two pilot chambers 55 and 59 and the force characteristics of spring 62 are fixed to offset the effect of the pressure drop across restriction 47 at times when the flow rate through the restriction 47 has been limited by opening of the main control valve only to a limited extent.

If the main control valve 26 is opened into the lower setting to a greater extent thereby increasing the flow rate across restriction 47 and if gravity is acting to extend the cylinder 13a more rapidly than provided for by that flow rate, the circuit 11 shifts to the quick-drop mode of operation depicted in Figure 3. With spool 34 in the power-down position of Figure 2, a reversal of the pressure relationship between the ends of cylinder 13a occurs at the time that gravitational cylinder extension starts to overrun the fluid pressure-caused extension. Pressure at rod end port 14a rises while the pressure at head end port 17a drops to a negative level at which vacuum or cavitation conditions are created in the head end. The pressure in second pilot chamber 59 is therefore reduced relative to the pressure in the first pilot chamber 55. The pressure differential across flow restriction 47 is then able to offset the effect of the difference of diameters of pilot chambers 55 and 59. Spool 34 and pilot piston 61 are then forced rightwardly as viewed in the drawing to the quick-drop position of Figure 3.

At the quick-drop position the rod end port 14a of the cylinder 13a is communicated with the head end port 17a within the quick-drop valve, specifically through flow line 38, first valve port 37, spool groove 52, second valve port 41 and head end flow conduit 31. At the full quick-drop position, land 49 completely blocks the discharge flow path from the rod end port 14a back to drain outlet 27 through rod end flow conduit 29 and the main control valve 26. As there is no discharge path back to drain, all discharge fluid from rod end port 14a is regenerated back to the head end port 17a to enable very fast gravitational cylinder extension without adverse effects from an inadequate supply of fluid in the head end.

Thus there are basically two conditions which must be present for the system to shift into the quick-drop mode of operation. First, the main control valve 26 must be shifted sufficiently into the lower position to provide a flow rate through restriction 47 which produces a pressure differential between pilot chambers 55

and 59 high enough to compress spring 62. Second, the head end of cylinder 13a must be voided of positive pressure.

The circuit 11 quickly and automatically reverts from the quick-drop mode of operation of Figure 3 back to the power-down mode of operation of Figure 2 when a substantial resistance to continued cylinder extension is encountered, for example, upon contact of the bulldozer blade 18 of Figure 1 with ground surface 22. Referring to Figures 2 and 3 in conjunction, this quick automatic reversion to the power-down mode occurs since slowing or stopping of the rate of cylinder extension eliminates the void or negative pressure in the head end of cylinder 13a and thus eliminates at least one of the two conditions which, as discussed above, are necessary to put the system in the quick-drop mode of operation. When the head end of the cylinder is no longer voided, pressure rises in the second pilot chamber 59. The force exerted on spool 34 by the larger pilot piston 61 and spring 62 then exceeds the opposing force on the spool exerted within first pilot chamber 55 causing the valve spool and pilot piston to be moved to the left, as viewed in the drawing, back to the power-down position depicted in Figure 2. Cylinder extension then continues at a slower rate in the manner described above with reference to the power-down mode of operation until such time as the operator shifts the main control valve 26 back to the hold or raise position or until such time as the limit of cylinder extension is reached.

Although the system shifts automatically between the power-down mode and the quick-drop mode, the operator may optionally restrict the circuit to the power-down mode and lower the load slowly by limiting the extent to which the main control valve 26 is opened into the lower position. This restricts the rate of flow through restriction 47 to a valve which is less than that needed to produce a pressure difference, between pilot chambers 55 and 59, sufficient to compress spring 62. With spring 62 uncompressed, valve spool 34 is necessarily at the leftward or power-down position of Figure 2. If the operator then opens the control valve 26 more completely, increasing the flow rate through restriction 47, the pressure differential between pilot chambers 55 and 59 increases to compress spring 62 and the quick-drop mode of operation may result if the hereinbefore-described necessary conditions are present.

The system has been described above with reference to a usage involving a single cylinder 13a, but it should be appreciated that the invention is equally applicable to systems which may employ a plurality of cylinders 13 or the like and it is preferable in such cases to provide a separate quick-drop valve 12 for each such cylinder. As a practical matter, it is more common to employ a pair of cylinders of this kind to manipulate a bulldozer blade 18. Similarly, it should be appreciated that the invention may also be applied to the control of other fluid actuated devices provided they are of a type in which the amount of fluid discharged from one port during the quick-drop mode of operation is less than the amount which can be admitted to the other port (which condition would not be met in the system of Figure 1 if cylinder 13a were inverted so that the head end coupled to the load 16).

Claims

1. In a fluid motor control circuit (11) having a source (24) of pressurized fluid:

a fluid motor (13) having first (14) and second (17) ports;

a control valve (26) connected to said source and to said first and second ports through first (29) and second (31) fluid pathways respectively;

a housing (32, 32′) forming a valve chamber (33, 33′) with first (37), second (41), and third (44) spaced apart valve ports having means for communication with said first motor port, said second motor port and said first fluid pathway, respectively;

a valve member (34, 34′) in said valve chamber (33, 33′) movable between a first position at which said first (37) and third (44) valve ports are intercommunicated while being blocked from said second valve port (41) and a second position at which said first (37) and second (41) valve ports are intercommunicated while said third valve port (44) is blocked from both thereof to cause all discharge fluid from said first motor port (14) to be directed to said second motor port (17); and

resilient means (62) for biasing said valve member (34, 34′) to said first position, characterized by flow restriction means (47) situated in said second fluid pathway for developing a pressure differential in first (58) and second (64) spaced apart regions in response to fluid flow therethrough, said first region being between said flow restriction means (47) and said control valve (26) and said second region being between said flow restriction means (47) and said second motor port (17),

pilot means (54, 56) for moving said valve member (34, 34′) to said second position in response to said pressure differential exceeding a predetermined value, said pilot means including first pilot means (54) having a first pilot chamber (55, 55′) at one end of the valve member (34) and connected to said first region (58) wherein pressure from said first region acts to urge the valve member (34, 34′) towards said second position and second pilot means (56) having a second pilot chamber (59, 59′) at the other end of the valve member and connected to said

second region (64), said second pilot chamber (59, 59') having a greater diameter than said first pilot chamber (55, 55'), said second pilot means (56) having a pilot piston (61) of said larger diameter disposed in said second pilot chamber (59, 59') and being positioned therein to urge said valve member (34, 34') towards said first position thereof in response to said fluid pressure from said second region.

2. The fluid motor control circuit as set forth in claim 1, wherein said biasing means includes a compressible spring (62) disposed between said pilot piston (61) and said other end of said valve member (34, 34').

Patentansprüche

1. In einer Strömungsmittelmotorsteuerschaltung (11) mit einer Quelle (24) von unter Druck stehendem Strömungsmittel,

ein Strömungsmittelmotor (13) mit ersten (14) und zweiten (17) Öffnungen,
einem Steuerventil (26) verbunden mit der Quelle und den ersten und zweiten Öffnungen über erste (29) bzw. zweite (31) Strömungsmittelkanäle,
ein Gehäuse (32, 32'), welches eine Ventilkammer (33, 33') mit ersten (37), zweiten (41) und dritten (44) mit Abstand angeordneten Ventilöffnungen bildet, die Mittel aufweisen zur Verbindung mit der ersten Motoröffnung bzw. der zweiten Motoröffnung bzw. dem ersten Strömungsmittelkanal,
einem Ventilglied (34, 34') in der Ventilkammer (33, 33') beweglich zwischen einer ersten Position, in der ersten (37) und dritte (44) Ventilöffnungen miteinander verbunden sind, während sie gegenüber der zweiten Ventilöffnung (41) blockiert sind, und mit einer zweiten Position, in der die ersten (37) und zweiten (41) Ventilöffnungen miteinander verbunden sind, während die dritten Ventilöffnung (44) gegenüber beiden blockiert ist, um zu bewirken, daß das gesamte Austrittsströmungsmittel von der ersten Motoröffnung (14) zu der zweiten Motoröffnung (17) geleitet wird, und elastische Mittel zum Vorspannen des Ventilglieds (34, 34') in die erste Position,
gekennzeichnet durch Strömungseinschränkungsmittel (47) angeordnet in dem zweiten Strömungsmittelkanal zur Erzeugung einer Druckdifferenz in ersten (58) und zweiten (64) mit Abstand angeordneten Zonen infolge des hindurchgehenden Strömungsmittelflusses, wobei die erste Zone zwischen den Strömungseinschränkmitteln (47) und dem Steuerventil (26) liegt, und die zweite Zone zwischen den Strömungseinschränkmitteln (47) und der zweiten Motoröffnung (17) liegt,
Pilotmittel (54, 56) zur Bewegung des Ventilglieds (34, 34') in die zweite Position infolge der einen vorbestimmten Wert übersteigenden Druckdifferenz, wobei die Pilotmittel erste Pilotmittel (54) und zweite Pilotmittel (56) aufweisen, wobei die ersten Pilotmittel (54) eine erste Pilotkammer (55, 55') an einem Ende des Ventilglieds (34) besitzen, und zwar verbunden mit der ersten Zone (58), wo der Druck von der ersten Zone das Ventilglied (34, 34') zur zweiten Position hindrückt, und wobei die zweiten Pilotmittel (56) eine zweite Pilotkammer (59, 59') am anderen Ende des Ventilglieds aufweisen, und zwar verbunden mit der zweiten Zone (64), wobei ferner die zweite Pilotkammer (59, 59') einen größeren Druchmesser besitzt als die erste Pilotkammer (55, 55'), und wobei die zweiten Pilotmittel (56) einen Pilotkolben (61) mit dem erwähnten größeren Durchmesser angeordnet in der zweiten Pilotkammer (59, 59') aufweisen, und zwar derart darin positioniert, daß das Ventilglied (34, 34') zur ersten Position hin gedrückt wird, und zwar infolge des Strömungsmitteldruckes von der zweiten Zone.

2. Strömungsmittelmotorsteuerschaltung nach Anspruch 1, dadurch gekennzeichnet, daß die Vorspannmittel eine zusammendrückbare Feder (62) angeordnet zwischen dem Pilotkolben (61) und dem anderen Ende des Ventilglieds (34, 34') aufweisen.

Revendications

1. Dans un circuit de commande (11) pour moteur à fluide, comportant une source (24) de fluide sous pression:

— un moteur à fluide (13) ayant un premier (14) et un second (17) orifices;
— une valve de commande (26) reliée à ladite source et auxdits premier et second orifices respectivement par un premier (29) et un second (31) trajets de fluide;
— une enveloppe (32, 32') formant un chambre de valve (33, 33') avec un premier (37), un second (41) et un troisième (44) orifices de valve espacés ayant des moyens pour communiquer avec ledit premier orifice du moteur, ledit second orifice du moteur et ledit premier trajet de fluide respectivement;
— un organe de valve (34, 34') dans ladite chambre de valve (33, 33') déplaçable entre une première position dans laquelle lesdits premier (37) et troisième (44) orifices de valve sont interconnectés, tout en étant isolés dudit second orifice de valve (41), et une seconde position dans laquelle lesdits premier (37) et second (41) orifices de valve sont interconnectés, tandis que le troisième orifice de valve (44) est isolé de ceuxci afin

d'obliger tout le fluide déchargé dudit premier orifice du moteur (14) à être dirigé vers ledit second orifice du moteur (17), et
— un moyen élastique (62) pour solliciter ledit organe de valve (34, 34') à ladite première position,

caractérisé par:

— des moyens de restriction de circulation (47) situés dans ledit second trajet de fluide, pour développer une différence de pression dans une première (58) et une seconde (64) régions espacées en réponse au passage d'un courant de fluide en eux, ladite première région étant située entre lesdits moyens de restriction de circulation (47) et ladite valve de commande (26), tandis que ladite seconde région est située entre lesdits moyens de restriction de circulation (47) et ledit second orifice de moteur (17),
— des moyens pilotes (54, 56) pour déplacer ledit organe de valve (34, 34') à ladite seconde position lorsque ladite différence de pression dépasse une valeur prédéterminée, lesdits moyens pilotes comprenant un premier moyen pilote (54) ayant une première chambre pilote (55, 55') située à l'une des extrémités de l'organe de valve (34) et reliée à ladite première région (58) dans laquelle la pression de ladite première région agit pour solliciter ledit organe de valve (34, 34') vers ladite seconde position et un second moyen pilote (56) ayant une seconde chambre pilote (59, 59') située à l'autre extrémité de l'organe de valve et reliée à ladite seconde région (64), ladite secondre chamber pilote (59, 59') ayant un plus grand diamètre que ladite première chambre pilote (55, 55'), ledit second moyen pilote (56) ayant un piston pilote (61) dudit plus grand diamètre disposé dans ladite seconde chambre pilote (59, 59') et étant placé dans celle-ci pour solliciter ledit organe de valve (34, 34') vers sa première position en réponse à ladite pression du fluide de ladite seconde région.

2. Circuit de commande pour moteur à fluide selon la revendication 1, dans lequel ledit moyen de sollicitation comprend un ressort compresssible (62) disposé entre ledit piston pilote (61) et ladite autre extrémité dudit organe de valve (34, 34').

Fig. 1

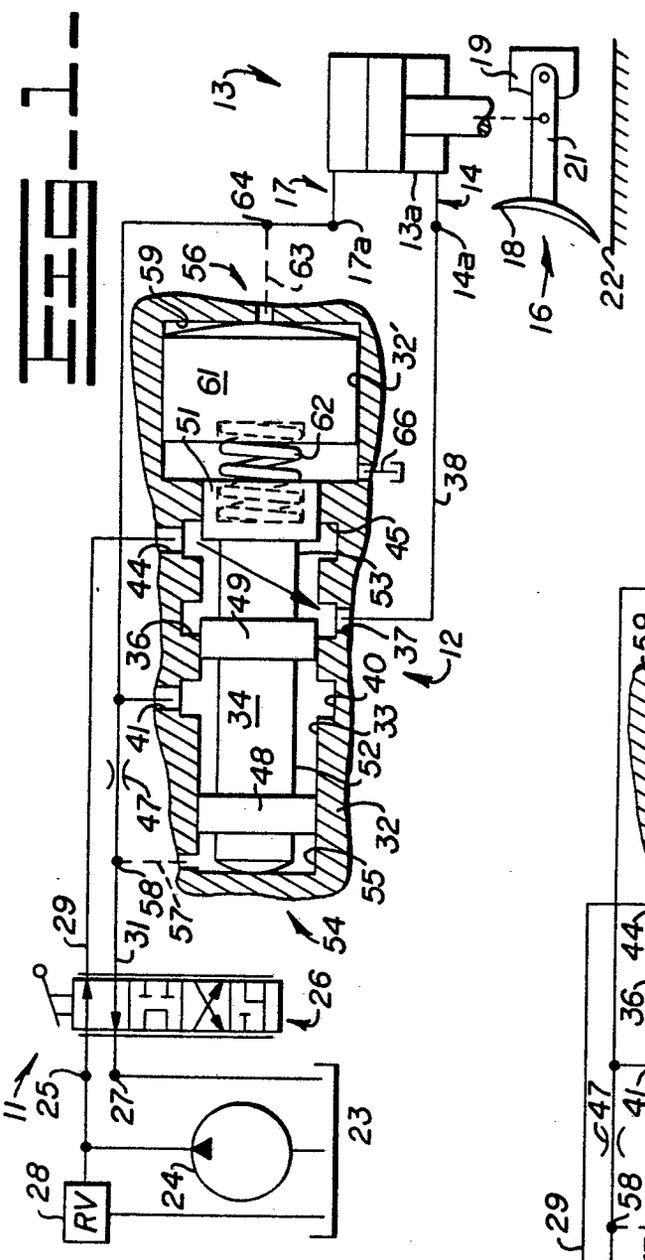
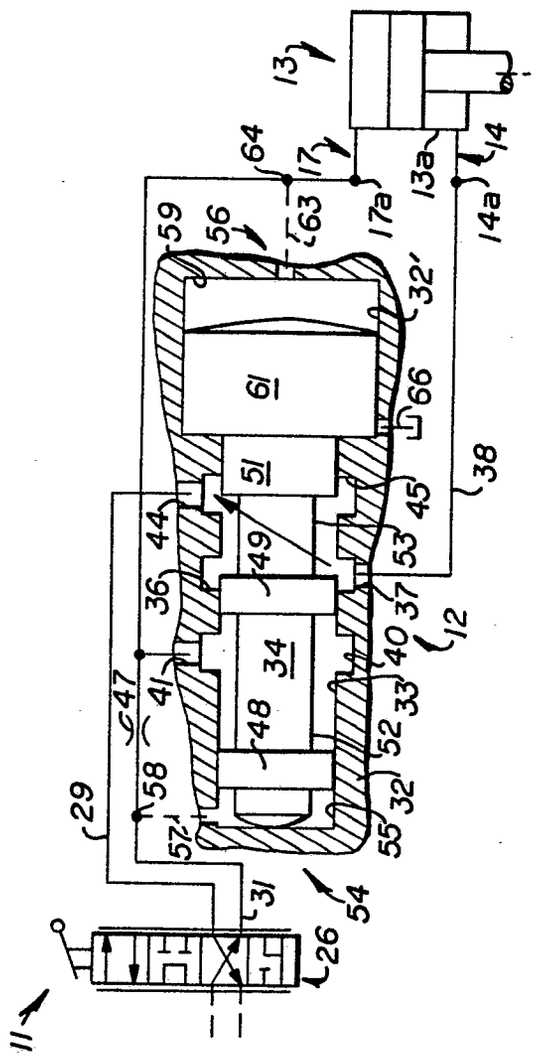
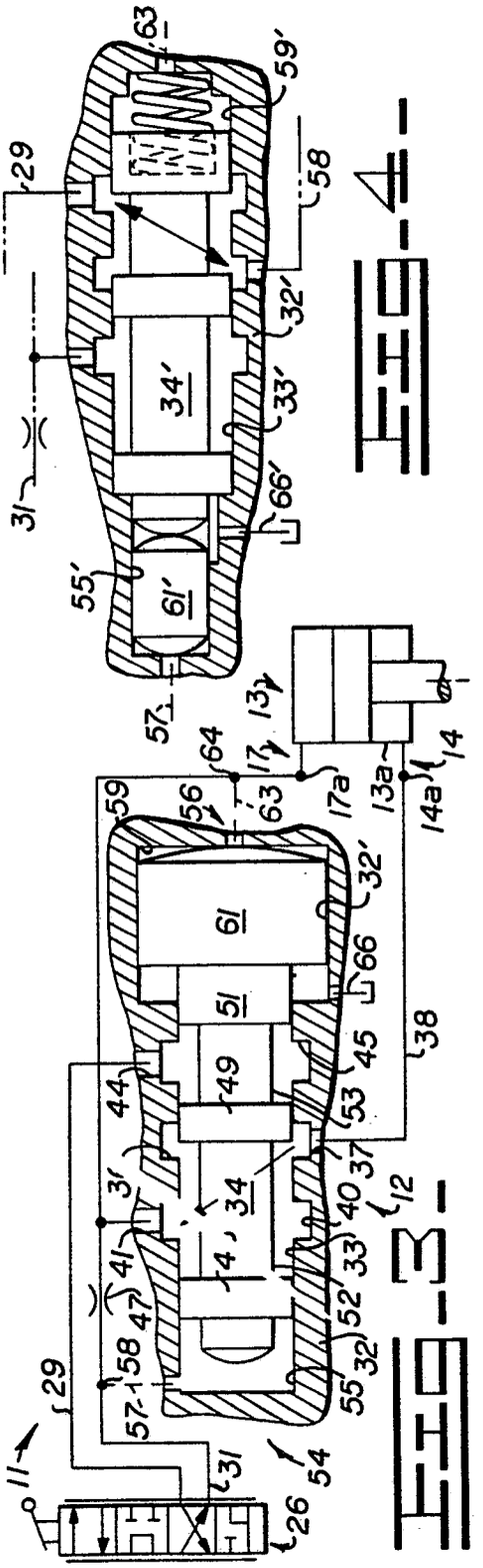


Fig. 2

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