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FLUID POWER CONTROL SYSTEM

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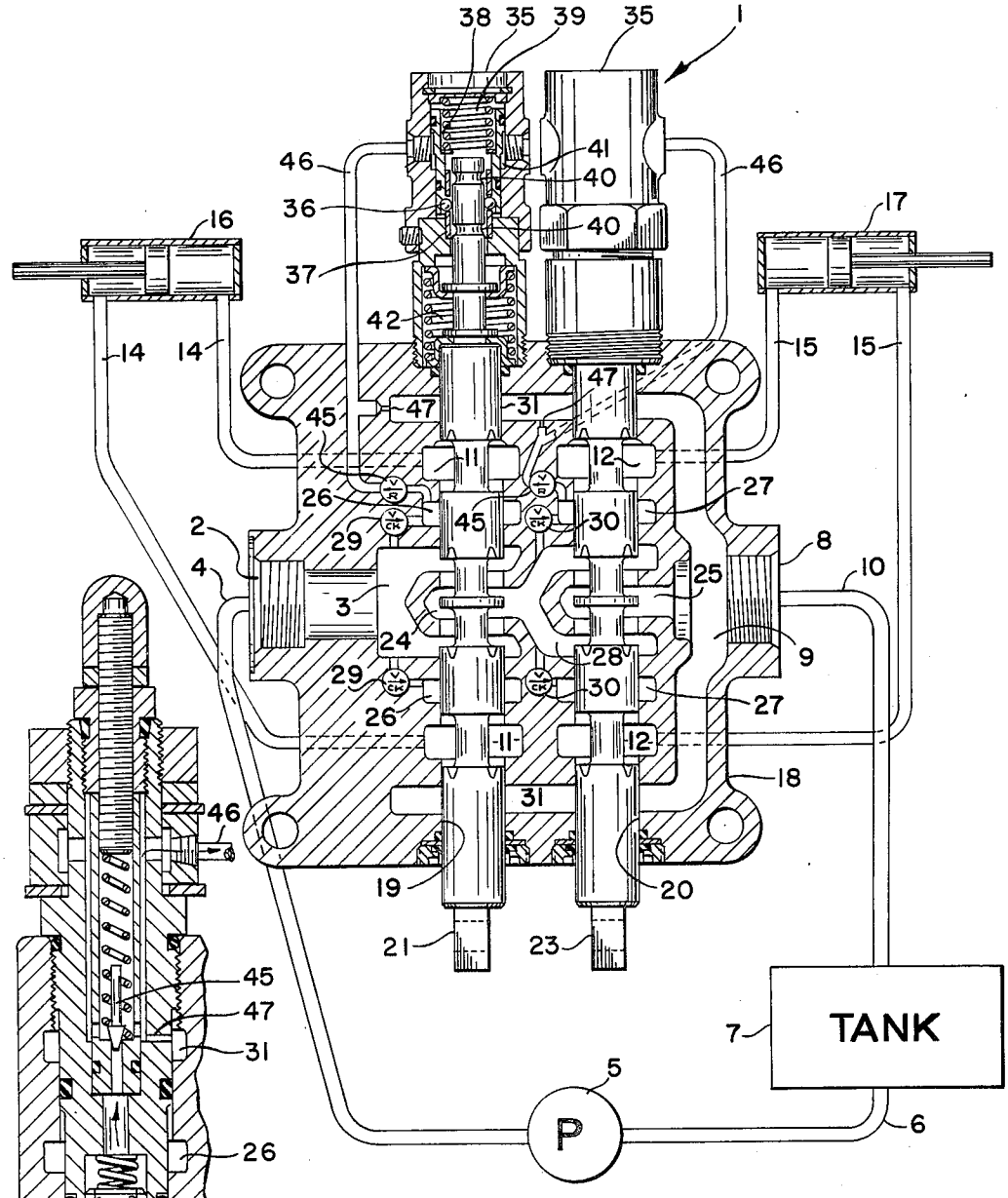


Fig. 1

Fig. 2

INVENTOR.
HUGH J. STACEY
BY
Oberlin, Maky & Donnelly
attorneys

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FLUID POWER CONTROL SYSTEM

Hugh J. Stacey, Chesterland, Ohio, assignor to Parker-Hannifin Corporation, Cleveland, Ohio, a corporation of Ohio

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The present invention relates generally as indicated to a fluid power control system and more particularly to a system having at least two fluid motors therein whose actuation is controlled by a corresponding number of control valves.

In the case of a garbage van, for example, there are provided two fluid motors for performing distinct and successive operations. For example, one fluid motor is employed first to compact the garbage and the other fluid motor is employed to push the compacted garbage into the truck. Normally, such operations would be performed by operating the respective control valves in that sequence. To do that, the operator actuates one control valve and when the operation of the corresponding motor has been completed, he then actuates the other control valve so that its associated motor will perform its operation.

It is a principal object of the present invention to provide a fluid power control system of the character indicated in which the control valves are simultaneously actuated but control the respective fluid motors in the desired sequence, the control valves being automatically returned to inactive position as the successive operations are completed.

It is another object of this invention to provide a fluid power control system of the character referred to in the preceding paragraph which is of simple and economical construction.

Other objects and advantages of the present invention will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawing setting forth in detail a certain illustrative embodiment of the invention, this being indicative, however, of but one of the various ways in which the principle of the invention may be employed.

In said annexed drawing:

FIG. 1 is a schematic diagram of a fluid power system in which a plurality of control valves are simultaneously actuated but are operative to actuate a corresponding number of fluid motors in sequence; and

FIG. 2 is a fragmentary cross-section view taken in a plane transverse to FIG. 1 and passing through the axis of the left spool valve.

Referring to FIGS. 1 and 2, the control valve assembly 1 has a pressure inlet port 2 and inlet chamber 3 to which the pressure line 4 from the pump 5 is connected, the intake line 6 for the pump 5 being connected with the fluid reservoir 7; an outlet or return port 8 from return chamber 9 to which the return conduit 10 is connected for returning fluid to the reservoir 7; and two pairs of motor ports 11; 11 and 12; 12 connected by the conduits 14; 14 and 15; 15 to the opposite ends of double acting fluid motors 16 and 17.

In the present system it is desired first to operate the motor 16 as, for example, in a garbage van installation to compact the garbage and then to operate the other fluid motor 17 to push the compacted garbage into the truck. Since garbage vans together with compactors and pushers are well known in the art the same have not been illustrated herein, and furthermore, it is to be understood that the fluid motors 16 and 17 may be operated in the above-noted sequence for other unrelated purposes.

In detail, the control valve assembly 1 comprises a housing 18 which, in the case of control of a pair of double acting fluid motors 16 and 17 has two bores 19 and 20 in which the respective valve spools 21 and 23 are reciprocable, each spool 21 and 23 herein being shown as being of the four-way open center type. Thus, starting at the middle of said bores, they are intersected by bypass passage portions 24 and 25 of which the bypass passage portion 24 communicates with the pressure inlet chamber 3 and of which the bypass passage portion 25 communicates with the return chamber 9. Straddling the respective bypass passage portions are pressure feed passages 26; 26 and 27; 27 which are communicated respectively with the inlet chamber 3 and the chamber 28 between bypass passage portions 24 and 25 via check valves 29; 29 and 30; 30. Straddling the pressure feed passages 26; 26 and 27; 27 are the respective motor ports, passages 11; 11 and 12; 12 which are connected by the aforesaid conduits 14; 14 and 15; 15 to the respective fluid motors 16 and 17. Straddling the aforesaid motor passages 11; 11 and 12; 12 are return passages 31; 31 communicating with the return chamber 9.

From the foregoing description it can be seen that the arrangement of the two spools 21 and 23 is series-parallel since only one motor at a time may be actuated by its respective spool. In other words, when both spools are in neutral or inactive position as shown, the bypass 24, 28, 25 is open and fluid is freely circulated through the valve assembly 1 from the inlet port 3 to the return port 8. When the upstream spool 21 is moved either upwardly or downwardly the bypass passage 24 is closed and one feed passage 26 is communicated with the adjacent motor passage 11 and the other motor passage 11 is communicated with the adjacent return passage 31, thus to actuate the fluid motor in one direction or the other, as desired.

In view of the fact that the second or downstream spool 23 obtains fluid pressure through the bypass passage 24 it can only be operated to actuate its associated fluid motor 17 when the first or upstream spool 21 is in neutral or inactive position; otherwise the operation of said downstream spool 23 is the same as just described for the upstream spool 21.

The valve assembly 1 herein has associated with each spool a centering spring and a detent mechanism 35 comprising balls 36 disposed in holes in a fixed sleeve 37. A cam sleeve 38 biased by the spring 39 tends to press the balls 36 radially inward against the end portion of the spool 21 (and 23). Each spool has a pair of axially spaced apart peripheral grooves 40 and when the spool 21 (and 23) is shifted axially to either active position, the cam sleeve 38 is effective to move the balls 36 into engagement with one or the other of said grooves 40 thus to yieldably retain the spool in that active position.

The cam sleeve 38 aforesaid is in the form of an annular plunger and when fluid under pressure is admitted into the chamber 41, it will be moved upwardly to release radial inward pressure on the balls 36, whereby the spool centering spring 42 will return the spool to neutral position. Such fluid pressure actuation of each cam sleeve 38 is effected by providing a corresponding relief valve 45 in the valve housing having an inlet port communicating with a pressure feed passage 26 and 27 respectively and an outlet port which is connected by the conduit 46 to the chamber 41. The outlet passage is provided with a restricted orifice 47 leading to the return passage 31 so that pressure can build up in the conduit 46 but when the relief valve closes, the pressure in the chamber 41 may be vented to the reservoir 7 through the

restricted orifice 47 to thus permit the spring 39 to return the cam sleeve 38 to its position as shown in the drawing.

Referring to operation of the system herein disclosed, in order to obtain sequential operation of the motors 16 and 17 all that the operator of the equipment, such as a garbage van, need do is to simultaneously move the spools 21 and 23 upwardly to one active detent-held position. When both spools 21 and 23 are in their upper operating position, only the fluid motor 16 will be actuated through the lower feed passage 26 which is then in communication with the adjacent motor passage 11. When the piston in said motor 16 has performed its desired function in compressing garbage, for example, or has reached the end of its stroke, the pressure in the inlet chamber 3 will build up to a relatively high value and will be present in both feed passages 26; 26 to act upon the relief valve 45. When this high pressure is sufficient to overcome the pressure for which the relief valve 45 has been set, fluid will flow through the conduit 46 into the chamber 41 thus to raise the cam sleeve 38 against the spring 39, whereupon the centering spring 42 will be effective to restore the spool 21 automatically to its neutral position. Since the downstream spool 23 is already in its upper operating position, fluid under pressure forthwith will be delivered to the other motor 17 through the lower feed passage 27 and the adjacent motor passage 12 and when the piston in motor 17 reaches the end of its stroke or encounters substantial resistance to continued movement, pressure will build up in the pressure feed passages 27; 27 sufficient to open the relief valve 45 and permit fluid under pressure to flow into the chamber 41 of the other detent release mechanism 35 to raise the cam sleeve therein and thus enable the centering spring to return the downstream spool 23 to its neutral position. When it is desired to reverse the actuation of the motors 16 and 17 in the same sequence, all that the operator has to do is to simultaneously move both spools 21 and 23 downwardly from neutral position and here again, the fluid motor 16 is actuated in the opposite direction by fluid pressure in the upper feed passage 26 being fed to the adjacent motor passage 11, and when the piston reaches the end of its stroke, or encounters a heavy load, pressure will build up in the feed passages 26; 26 sufficient again to open the relief valve 45 and cause fluid under pressure to build up in the chamber 41 for lifting the cam sleeve 38 to detent releasing condition, whereby the spool 21 is returned by the centering spring 42 to neutral position at which position fluid under pressure is conducted to the other motor 17 via the upper feed passage 27 which is in fluid communication with the adjacent motor passage 12.

Accordingly, it can be seen that operation of equipment of the character referred to is greatly facilitated since all that the operator need do is to simultaneously actuate the control valves 21 and 23 and the fluid motors 16 and 17 will be actuated automatically in desired sequence with the valves automatically restored to neutral or inactive position. It will be apparent to those skilled in the art that any number of fluid motors may be so sequentially actuated by simultaneously shifting all of the spools to an operating position from which they are released one by one as the respective and successive functions of the motors are completed.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims, or the equivalent of such, be employed.

I therefore particularly point out and distinctly claim as my invention:

1. A fluid power system comprising a pump; first and second fluid motors; first and second control valves arranged in series-parallel and having first and second valve members therein movable from spring-biased inactive position to detent-held active position for actuation of the respective motors by fluid under pressure flowing thereinto from said pump via said valves; and a fluid pressure actuated detent release mechanism associated with said first valve and responsive to build up of pressure in said first motor as at the end of its working stroke to release said first valve member for spring return to inactive position whereby, upon simultaneous movement of said valve members to active position, said first and second motors will be actuated automatically in that sequence.

2. The system of claim 1 wherein a relief valve is provided in the pressure circuit between said first valve and said first motor through which fluid pressure sufficient to open said relief valve flows to said detent release mechanism.

3. The system of claim 1 wherein a relief valve is provided in the pressure circuit between said first valve and said first motor through which fluid pressure sufficient to open said relief valve flows to said detent release mechanism; and wherein orifice means are provided between said relief valve and said detent release mechanism effective to vent said detent release mechanism upon closing of said relief valve and return of said first valve member to inactive position.

4. The system of claim 1 wherein said first and second fluid motors are of the double acting type; and wherein said first and second valve members are of the four-way type movable to another detent-held active position for actuation of the respective motors in the opposite direction; said detent release mechanism also being operative to release said first valve member for movement to inactive position from said another detent-held active position whereby, upon simultaneous movement of said valve members to said another active position, said first and second motors will be actuated in the opposite direction automatically in that sequence.

5. The system of claim 1 wherein another detent release mechanism is associated with said second valve responsive to build up of pressure in said second motor as at the end of its working stroke to release said second valve member for spring return to inactive position whereby, upon sequential actuation of said motors as aforesaid, both said first and second valve members are in inactive position ready for simultaneous actuation to an active position.

6. The system of claim 5 wherein relief valves are disposed between the respective valves and detent release mechanisms through which fluid pressure sufficient to open said relief valves flows to the respective detent release mechanisms.

7. The system of claim 6 wherein orifice means are provided between the respective relief valves and detent release mechanisms for venting the latter upon closing of the respective relief valves and return of said first and second valve members to inactive position.

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SAMUEL LEVINE, *Primary Examiner.*