

[54] **OVERRIDE CONTROL FOR A VARIABLE DISPLACEMENT PUMP**[75] Inventors: **Allyn J. Hein, Joliet; Vergil P. Hendrickson, Decatur, both of Ill.**[73] Assignee: **Caterpillar Tractor, Peoria, Ill.**[22] Filed: **Mar. 1, 1973**[21] Appl. No.: **336,941**[52] U.S. Cl. **417/222, 60/413, 60/445**[51] Int. Cl. **F04b 1/26**[58] Field of Search **60/402, 404, 413, 415, 60/445, 452; 417/212, 213, 222; 123/179 F; 418/32**

[56]

References Cited**UNITED STATES PATENTS**

2,285,604	6/1942	Mercier	60/404
2,554,381	5/1951	Patterson	60/413
2,628,476	2/1953	Grier	60/413
2,970,440	2/1961	Dmitroff et al.	60/404
3,126,707	3/1964	Hann et al.	60/389
3,130,540	4/1964	Manning et al.	60/413
3,175,509	3/1965	Kuze	417/270

3,252,426	5/1966	Parr	417/222
3,350,881	11/1967	D'Amato	417/222
3,450,054	6/1969	Halwas et al.	60/452
3,533,234	10/1970	Futamata et al.	123/179 F
3,738,779	6/1973	Hein et al.	417/213

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[57]

ABSTRACT

An override control, for a variable displacement pump having an actuator system which shifts the pump between a maximum displacement condition and a minimum displacement condition with the actuator system having a control device responsive to a primary source of pressurized fluid which is dependent upon operation of a prime mover drivingly connected to the pump, including a passage in communication with the actuator system and a secondary source of pressurized fluid selectively connectable to the passage and operable independently of the prime mover to override the control device causing the actuator system to shift the pump to one of the extreme displacement conditions.

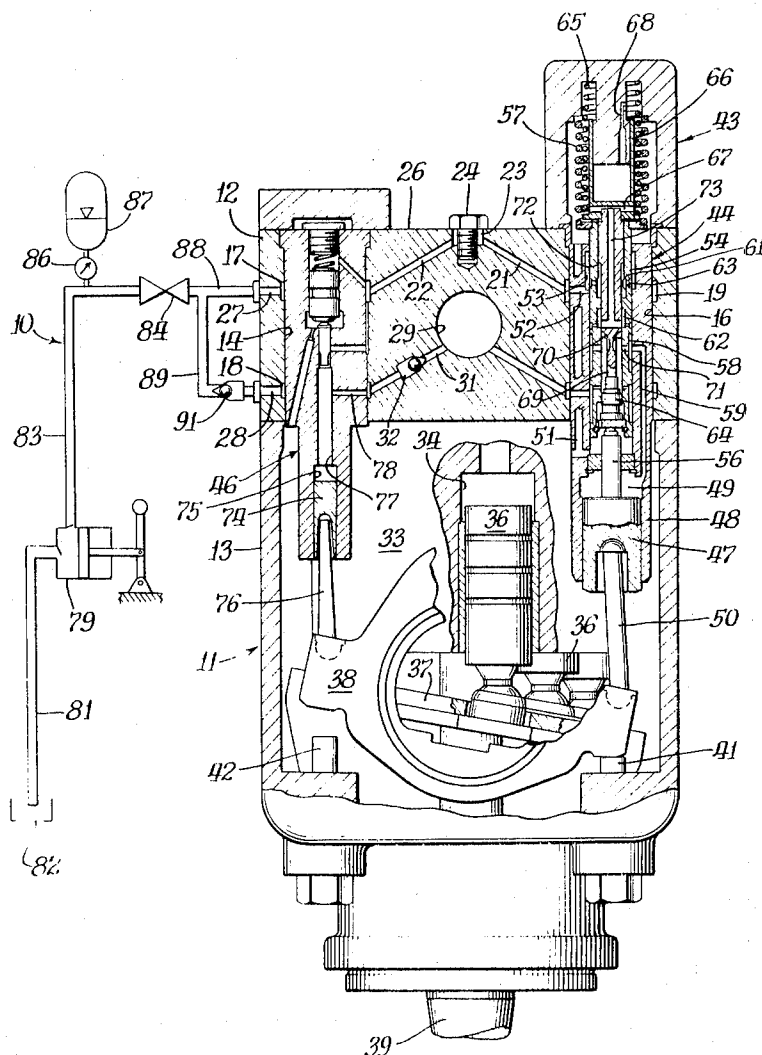
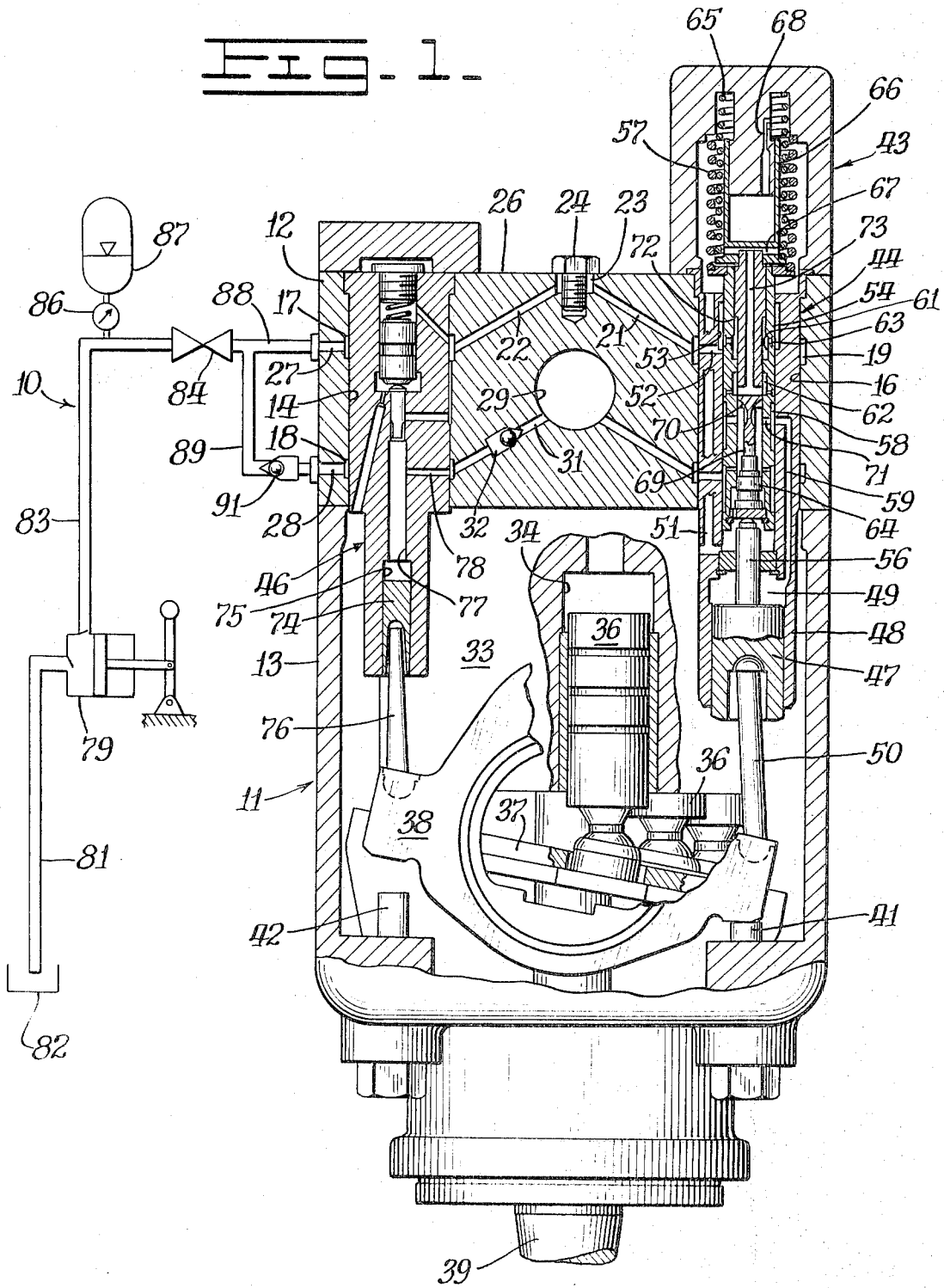
2 Claims, 1 Drawing Figure

FIG. 1



OVERRIDE CONTROL FOR A VARIABLE DISPLACEMENT PUMP

BACKGROUND OF THE INVENTION

Variable displacement pumps are often utilized in earthmoving machinery since they can be equipped with pressure compensator controls to reduce the flow output of the pump in response to fluid pressure in the fluid delivery circuits which they supply thereby reducing the amount of engine horsepower required to drive the pump. Normally, when the pump is idle, such as when the engine is stopped, the pressure compensator controls automatically condition the pump for maximum displacement. One of the problems encountered with such arrangements is that the pumps are commonly drivingly connected to the engine and when disposed in the maximum displacement position, adds to the resistance or torque load on the starter during cranking of the engine for engine start-up. In warm weather, this added resistance does not impose any serious drawbacks. However, in cold weather the resistance is greater due to the stiffness of the cold hydraulic fluid and the added drag coupled with the reduced efficiency of the cold battery reduces the cranking speed of the starter such that the engine is difficult to start.

Another problem occasionally encountered with such pumps is the need for a manual override control for over-riding the pressure compensator control to shift the pump to a minimum displacement condition while the engine is running. However, heretofore, the pumps have not had such manual override capability.

OBJECTS OF THE INVENTION

Accordingly, an object of this invention is to provide an improved override control for a variable displacement pump driven by a prime mover.

Another object of this invention is to provide such an improved override control for overriding a primary actuator system which normally controls the displacement of the pump between its maximum and minimum displacement positions.

Another object of this invention is to provide such an improved override control which utilizes a source of fluid that is operable independently of the prime mover in combination with the actuator system selectively to shift the pump to one of its extreme displacement positions.

Other objects and advantages of the present invention will become more readily apparent upon reference to the accompanying drawing and following description.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 of the drawing is a schematic view of an override control embodying the principles of the present invention shown connected to a variable displacement pump.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring more particularly to the drawing, an override control embodying the principles of the present invention is generally indicated by the reference numeral 10 and is disposed in association with a variable displacement pump 11.

The variable displacement pump and operation thereof is best described in this assignee's copending U.S. Pat. application Ser. No. 157,535 filed June 28, 1971 which is hereby incorporated by reference. Briefly, and in order to establish a representative environment for the override control of the present invention, the pump has a head 12 seated upon a housing 13 with the head having a pair of spaced bores 14 and 16 extending therethrough. The bore 14 has a pair of annular grooves 17 and 18 formed therein. An annular groove 19 is formed in the bore 16 and communicates with the annular groove 17 through a pair of passages 21 and 22 formed in the head and which intersect with an annulus 23 formed by a plug 24 screw-threadably secured in a top surface 26 of the head. A pair of inlet ports 27 and 28 are provided in the head in communication with the annular grooves 17 and 18, respectively. A pump discharge passage 29 is formed in the head with annular groove 18 being in communication therewith through a passage 31 and a check valve assembly 32 is provided in the passage 31. The housing 13 is vented to a fluid supply tank, not shown, in the usual manner to maintain a relatively low pressure in the housing.

A pump cylinder barrel 33 is mounted for rotation within the pump housing 13 and has a plurality of axially oriented bores, one of which is shown at 34, formed therein. A plurality of pistons 36 are individually reciprocally mounted within the respectively associated bores and each is guided by a slipper pad 37 rotatably slidably mounted on a tiltable swash plate 38. The pump cylinder barrel is rotated by a shaft 39 connected to a prime mover such as an internal combustion engine, not shown. The angle of the swash plate with respect to the axial direction of the bores 34 determines the amount of stroke or displacement of the pistons within their respective bores in the usual manner. The pump is shown in its maximum displacement condition with the swash plate in abutment with a maximum displacement stop 41. Rotating the swash plate counterclockwise decreases the pump displacement with the minimum displacement condition occurring when the swash plate contacts a minimum displacement stop 42.

During pump operation, the angle of the swash plate 38 is normally controlled by an actuator system 43 in response to the pressure build-up in the pump discharge passage 29. The actuator system includes a servo mechanism 44 disposed in the bore 16 and a pressure reducing assembly 46 disposed in the bore 14. The servo mechanism 44 includes a piston 47 slidable in a cylindrical casing 48 forming a variable volume chamber 49 therein. The piston is interconnected to the swash plate 38 through a push rod 50. A longitudinal passage 51 communicates the upper end of the casing with the inside of the housing 13. A radial passage 52 extends through the wall of the casing and connects the annular groove 19 with an annular groove 53 formed in the casing. A hollow follow-up sleeve 54 is slidably disposed within the cylindrical casing and is urged against the end of a rod 56 by a spring 57. An annular groove 58 is formed on the exterior of the follow-up sleeve and communicates with the variable volume chamber 49 through a passage 59. A pair of annular grooves 61 and 62 are formed on the interior of the follow-up sleeve with the annular groove 61 connected to the annular groove 53 through a plurality of radial pas-

sages 63. A servo valve spool 64 is slidably disposed within the follow-up sleeve and is urged downwardly by a spring 65 through a damper element 66 which is seated on the upper end of the valve spool. The damper element has a passage 67 extending transversely through its base in communication with the valve spool. An orifice 68 meters the flow of fluid into and out of the damper element to dampen the movement of the valve spool.

The valve spool 64 has an annular groove 69 and a plurality of throttling slots 70 formed on the exterior thereof. The annular groove 69 is connected to the annular groove 58 through a plurality of radial passages 71. An annular shoulder 72 is formed on the valve spool in communication with the annular groove 61. The valve spool has a passageway 73 formed therein which opens to the exterior of the valve spool adjacent to the throttling slots 70.

The pressure reducing assembly 46 includes a piston 74 which is slidably disposed in a bore 75 and is interconnected to the swash plate 38 through a push rod 76. An axial passage 77 and a radial passage 78 connect the bore 75 with the annular groove 18 of the head 12.

The override control 10 of the present invention includes a hand-actuated pump 79 of any suitable type having an intake conduit 81 connected to a reservoir 82. An output conduit 83 extends between the pump 79 and a manually operable control valve 84. A pressure gauge 86 and an accumulator 87 are connected to the output conduit between the pump and the control valve. A conduit 88 connects the control valve to the inlet port 27 while a conduit 89 connects the control valve with the inlet port 28 in the head 12 through a check valve 91.

OPERATION

While the operation of the present invention is believed clearly apparent from the foregoing description, further amplification will subsequently be made in the following brief summary of such operation. When the variable displacement pump 11 is in operation, the actuator system 43 controls the pump displacement in response to the fluid pressure in the pump discharge passage 29. The swash plate 38 is automatically shifted to the minimum displacement position against the stop 42 when the fluid pressure reaches a predetermined high value. When the prime mover is shut off such that the pump is inactive and there is an absence of fluid pressure in the pump discharge passage, the servo mechanism 44 of the actuator system resiliently urges the swash plate against its maximum displacement stop 41.

Prior to starting of the prime mover, particularly in cold weather when the cold, stiff hydraulic fluid greatly increases the resistance of rotating the pump 11, the override control 10 is utilized to shift the swash plate 38 against its minimum displacement stop 42. This is accomplished by manual actuation of the hand pump 79 with the manual control valve 84 in a closed position so that fluid pressure is stored in the accumulator 87. When a predetermined pressure is reached, as indicated on the pressure gauge 86, the control valve is opened allowing fluid to pass simultaneously through the conduits 88 and 89 and the check valve 91, through the inlet ports 27 and 28, and into the annular grooves 17 and 18. The fluid in the annular groove 17 is communicated to the annular groove 19 through passage

22, annulus 23, and passage 21 of the head 12. The fluid in the annular groove 19 is directed to the annular groove 61 of the follow-up sleeve 54 through the radial passage 52, annular groove 53, and the radial passages 63. The pressurized fluid in the annular groove 61 works against the annular shoulder 72 of the servo valve spool 64 to urge it upwardly against the bias of the spring 65. Movement of the valve spool upwardly creates a drain path from the variable volume chamber 49 to the inside of the housing through the passage 59 in the cylindrical casing 48, the annular groove 58 and the radial passages 71 of the follow-up sleeve, annular groove 69 and throttling slot 70 of the valve spool, annular groove 62 of the follow-up sleeve, passageway 73 of the valve spool, and through the longitudinal passage 51 in the cylindrical casing.

The pressurized fluid in the annular groove 18 is blocked from the pump discharge passage 29 by the check valve assembly 32 and is communicated to the bore 75 of the pressure reducing assembly 46 through the radial passage 78 and axial passage 77. The pressurized fluid in the bore 75 reacts against the piston 74 urging it downwardly to shift the swash plate 38 against the minimum displacement stop 42. The piston 47 of the servo mechanism 44 is urged upwardly against the bias of the spring 57 with the fluid in the variable volume chamber 49 being vented back to the inside of the housing through the drain path previously described. With the pump 18 shifted to the minimum displacement position, the prime mover is started in the usual manner with the control valve 84 then being manually closed to isolate the variable displacement pump from the override control. The check valve 91 prevents the pressurized fluid in the pump discharge passage 29 from being directed to the annular groove 17 to permit normal operation of the actuator system when the pump is operating.

It is apparent that the override control would also function to override the actuator system 43 with the prime mover and pump 11 running since the accumulator 87 could be charged with a fluid pressure greater than the fluid pressure normally experienced in the annular groove 17 and passages 22 and 21. Thus the greater fluid pressure from the accumulator would override the control signal to the valve spool 64 urging it upwardly. As previously described, this vents the chamber 49 above the piston 47 and the pressurized fluid from the pump 11 reacts against the piston 74 urging it downwardly to shift the swash plate against the minimum displacement stop 42.

In view of the foregoing, it is readily apparent that the structure of the present invention provides an improved override control for a variable displacement pump with which the actuator system controlling the displacement of the pump can be selectively overridden. Since the override control utilizes a source of fluid that is operable independently of the prime mover, the variable displacement pump can be selectively conditioned to one of its extreme displacement conditions regardless of whether the prime mover is shut down or in operation.

While the invention has been described and shown with particular reference to the preferred embodiment, it will be apparent that variations might be possible that would fall within the scope of the present invention which is not intended to be limited except as defined in the following claims.

What is claimed is:

1. An override control, for a variable displacement axial piston pump having a fluid discharge port, comprising;

an angularly adjustable swash plate movable between minimum and maximum displacement positions for determining pump displacement;

an actuator system in fluid communication with the fluid discharge port for controlling the position of said swash plate as a function of pump discharge pressure during pump operation but adapted to urge the swash plate toward its maximum displacement position when the pump is not in operation;

means providing a passage connecting the fluid discharge port of the pump with the actuator system;

a manually actuated pump;

a conduit connecting said manually actuated pump to said passage;

an accumulator connected to said conduit and adapted to receive and store pressurized fluid from said manually actuated pump;

a manually operable control valve disposed within said conduit between said accumulator and said passage, said control valve being actuatable between a closed and an open position for selectively controlling communication between said accumulator and the actuator system to override the actuator system causing it to shift the swash plate to its minimum displacement position when the variable displacement pump is not in operation;

a first check valve disposed within said passage between the fluid discharge port and the actuator system for blocking flow of fluid from said manually actuated pump to the fluid discharge port; and a second check valve disposed in said conduit for blocking flow of fluid from the fluid discharge port to said manually actuated pump.

2. An override control, for a variable displacement axial piston pump having a fluid discharge port, comprising;

an angularly adjustable swash plate movable between

minimum and maximum displacement positions for determining pump displacement;

pressure responsive means in fluid communication with such fluid discharge port for urging said swash plate toward its minimum displacement position;

a servo-mechanism in fluid communication with the fluid discharge port for controlling the swash plate position as a function of discharge pressure during pump operation;

resilient means coacting with said servo-mechanism for biasing the swash plate to its maximum displacement position in the absence of pump discharge pressure;

means providing a passage connecting the fluid discharge port with said pressure responsive control means and said servo-mechanism;

a manually actuated pump;

a conduit connecting said manually actuated pump to said passage;

an accumulator connected to said conduit and adapted to receive and store pressurized fluid from said manually actuated pump;

a manually operable control valve disposed within said conduit between said accumulator and said passage, said control valve being actuatable between a closed and an open position for selectively controlling communication through said conduit simultaneously to said servo-mechanism for actuating it to a venting condition and to said control means causing it to move the swash plate to its minimum displacement condition against the bias of said resilient means when the variable displacement pump is not in operation;

a first check valve disposed in said passage between the fluid discharge port and the pressure responsive control means for blocking fluid flow from said manually actuated pump to the fluid discharge port; and

a second check valve disposed in said conduit for blocking flow of fluid from the fluid discharge port to said manually actuated pump.

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