Dec. 8, 1959 C. A. L. RUHL ET AL 2,916,049

MULTI-POSITION CONTROL VALVE

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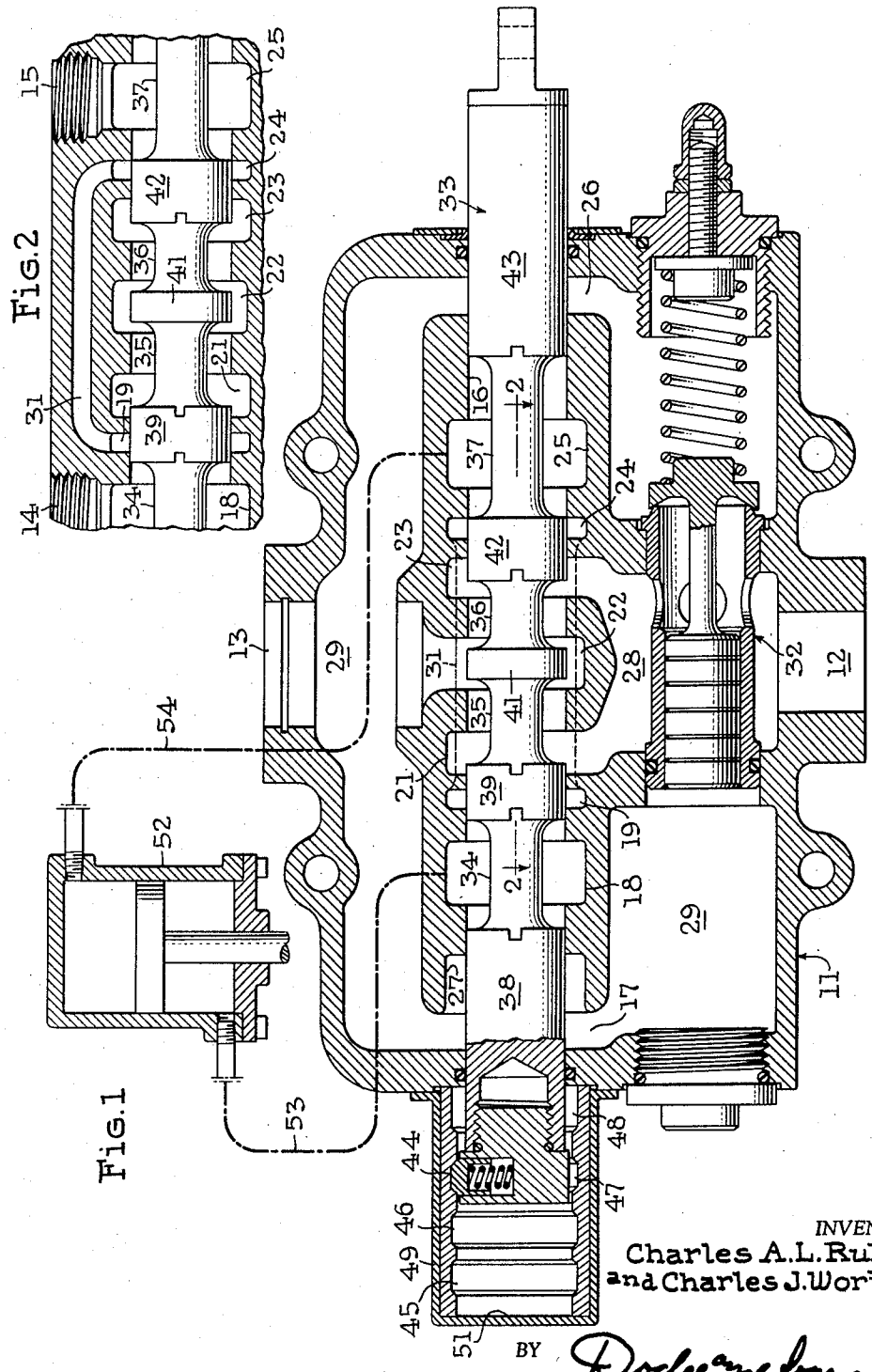


Fig. 1



Fig. 2

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Fig. 3

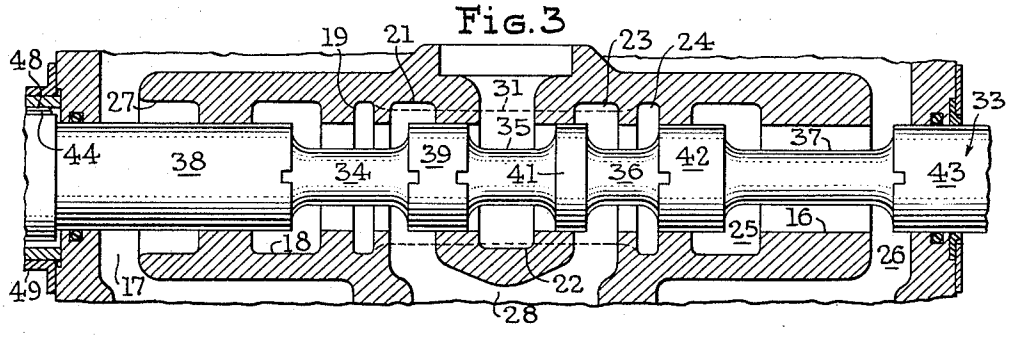



Fig. 4

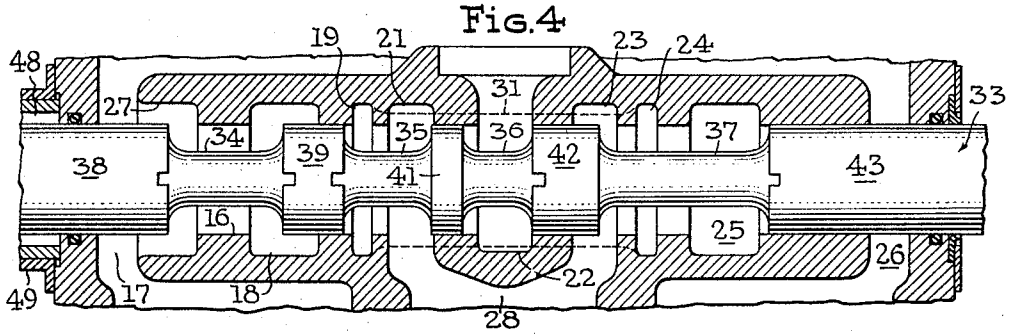



Fig. 5

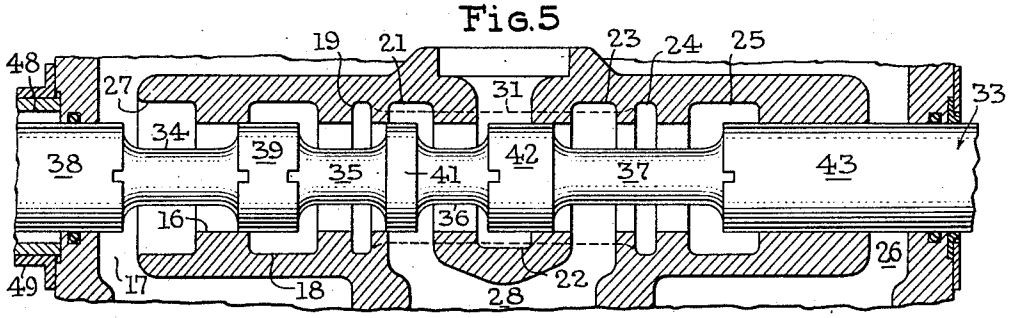
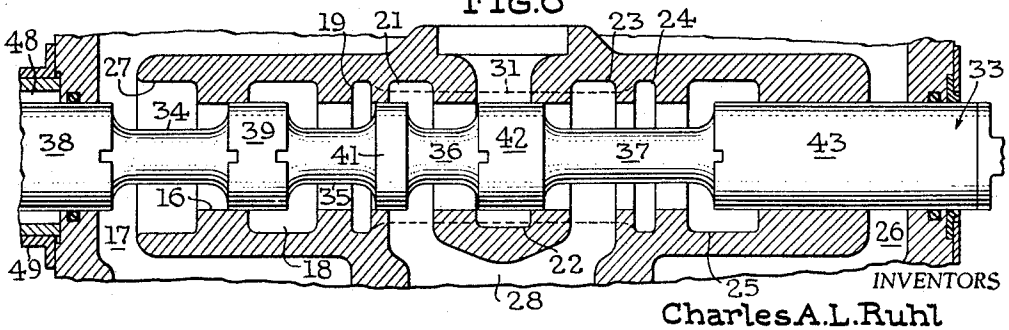



Fig. 6




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# MULTI-POSITION CONTROL VALVE

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Application September 15, 1958, Serial No. 761,145

6 Claims. (Cl. 137—622)

This invention relates to control valves, and more particularly to control valves of the solid plunger type. As used herein, the term "solid plunger valve" means a valve in which one of the relatively movable valving elements contains no internal passages.

A typical device of this type is an open-center valve which, together with a reservoir, a pump and a double-acting differential area piston motor, forms a control system for positioning the earth-moving blade of a bulldozer. Usually these valves have four operative positions, viz: a "raise" position in which the pump and reservoir are connected with opposite sides of the motor; a "lower" position in which the pump and reservoir connections with the motor are reversed; a "neutral" or "hold" position in which the connection with each side of the motor is blocked and the pump is unloaded to the reservoir; and a "float" position in which both sides of the motor are placed in communication with the pump and an unloading path is established between the pump and the reservoir. In the past, solid plunger valves affording these four operative positions provided only a single flow path between the pump and the motor in the "raise" and "lower" positions. Because of this, the pressure losses in these valves were relatively high.

The object of this invention is to provide a solid plunger control valve capable of affording the four operative positions mentioned above which establishes two parallel flow paths between the pump and the motor in both the "raise" and "lower" positions and yet is simple and inexpensive to manufacture.

In addition, the valve of this invention affords a fifth or "power float" position in which both sides of the motor are connected with the pump and the two sides of the motor and the pump are connected in restricted communication with the reservoir. The provision of this fifth position permits dropping of the bulldozer blade without causing the piston motor to cavitate. The advantages of having both a "float" and a "power float" position are described in detail in copending application Serial No. 702,147 of Henry A. Vander Kaay, filed December 11, 1957, and assigned to the same assignee as the present application.

The preferred embodiment of the invention will be described in detail with reference to the accompanying drawings, in which:

Fig. 1 is an axial section of an open-center longitudinally reciprocating plunger valve incorporating the invention; the plunger being shown in its "neutral" position.

Fig. 2 is a sectional view taken on line 2—2 of Fig. 1 showing the cross-over passageway 31.

Fig. 3 is a view similar to Fig. 1 but showing the plunger in its "raise" position.

Fig. 4 is a view similar to Fig. 1 but showing the plunger in its "lower" position.

Fig. 5 is a view similar to Fig. 1 but showing the plunger in its "float" position.



Fig. 6 is a view similar to Fig. 1 but showing the plunger in its "power float" position.

Referring to Figs. 1 and 2, the valve comprises a housing 11 having inlet and exhaust passages 12 and 13, respectively, and two motor passages 14 and 15. Extending through the housing is a valve bore 16 encircled by nine longitudinally spaced annular ports 17 through 19 and 21 through 26. The valve bore 16 is counterbored at 27 to provide a longitudinal extension of annular port 17. Ports 21 and 23 communicate with inlet passage 12 via passage 28, while ports 17, 22 and 26 communicate with exhaust passage 13 via passage 29. A cored passageway 31 interconnects annular ports 19 and 24. Conventional relief valve 32 by-passes pressure fluid from passage 28 to passage 29.

Mounted in bore 16 is a slidable solid plunger 33 formed with four longitudinally spaced grooves 34, 35, 36 and 37 which define valve lands 38, 39, 41, 42 and 43. Associated with the left end of the valve plunger 33 is a spring-biased detent 44 which is arranged to seat in the annular grooves 45, 46, 47 and 48 formed in the cap 49 to define four operative valve positions. A fifth operative valve position is afforded when the plunger is moved to the left so that detent 44 overtravels groove 45 and the end of the plunger 33 contacts the wall 51 of the cap 49.

*Operation*

In operation, inlet and exhaust passages 12 and 13 are connected with a pump and reservoir (not shown), respectively, and motor passages 14 and 15 are connected with the opposite sides of a piston motor 52 by lines 53 and 54, respectively. With the plunger 33 in its "neutral" position (Figs. 1 and 2), fluid entering inlet passage 12 passes freely to the reservoir via passage 28, annular ports 21 and 23, plunger grooves 35 and 36, annular port 22, passage 29, and exhaust passage 13. The motor passages 14 and 15 are isolated from each other and from inlet and exhaust passages 12 and 13 by plunger lands 38, 39, 42 and 43.

In order to raise the piston of motor 52, the operator moves the valve plunger 33 to the right to the "raise" position shown in Fig. 3. In this position, plunger lands 39 and 41 interrupt communication between inlet and exhaust passages 12 and 13 and the fluid delivered by the pump flows to the rod end of motor 52 via passage 28, annular port 21, plunger groove 34, annular port 18, motor passage 14, and line 53. Pressure fluid is also delivered to the rod end of the motor 52 along a path including annular port 23, plunger groove 36, annular port 24, passageway 31, and annular port 19. Fluid is exhausted from the piston end of the motor 52 to the reservoir via line 54, motor passage 15, annular port 25, plunger groove 37, annular port 26, passage 29, and exhaust passage 13. When the piston of motor 52 has moved the desired distance, the operator returns the plunger 33 to its "neutral" position, cutting off flow to and from the motor 52 and unloading the pump.

In order to lower the piston of motor 52, the operator moves the plunger 33 to the left from the Fig. 1 position to the "lower" position shown in Fig. 4. In this position, plunger lands 41 and 42 interrupt communication between inlet and exhaust passages 12 and 13. High pressure fluid flows to the piston end of motor 52 via passage 28, annular port 23, plunger groove 37, annular port 25, motor passage 15, and line 54. A parallel supply path is provided by annular port 21, plunger groove 35, annular port 19, passageway 31, and annular port 24. The rod end of the motor is exhausted to the reservoir via line 53, motor passage 14, annular port 18, plunger groove 34, annular port 17, passage 29, and exhaust passage 13.

When the valve plunger 43 is shifted further to the

left and detent 44 engages groove 45, the valve will be in the "float" position shown in Fig. 5. In this position, the two motor passages 14 and 15 are interconnected by annular port 18, plunger groove 35, annular port 19, passageway 31, annular port 24, plunger groove 37, and annular port 25. This interconnecting path communicates with inlet passage 12 via plunger groove 37, annular port 23, and passage 28. It should be noted that the unloading path between inlet passage 12 and exhaust passage 13, comprising passage 28, annular port 21, plunger groove 36, annular port 22, and passage 29, is unrestricted. Therefore, in this position, motor 52 can reciprocate freely under the influence of external forces without loading the pump.

Shifting of the plunger 33 to the left from the Fig. 5 position causes it to take up the "power float" position shown in Fig. 6. The interconnections between the passages 12, 13, 14 and 15 in this position are the same as those established in the "float" position of Fig. 5 except that in this case, the left edge of valve land 42 restricts communication between annular ports 21 and 22 through plunger groove 36. The amount of this restriction depends on the characteristics of the particular installation in which the valve is used. In some cases, it may be necessary to interrupt this communication in order to provide the volume and pressure required to maintain the expanding chamber of motor 52 filled with fluid. Because of this, it will be understood that the term "restricted" is used herein to mean partially obstructed as well as closed.

It should be observed that passageway 31 functions as an active fluid conduit in all operative positions except the "neutral" position shown in Fig. 1. This fact contributes to the simplicity of the valve housing. Furthermore, it should be noted that in both the "raise" and "lower" positions of the plunger 33, the passageway 31 provides a parallel flow path between the inlet passage 12 and the motor 52. This feature reduces the pressure losses in the valve because, as is well known, the total restriction to flow between two points through a plurality of parallel paths is less than the restriction afforded by any one of the paths acting alone.

As stated previously, the drawings and description relate only to a preferred embodiment of the invention. Since many changes can be made in the structure of this embodiment without departing from the inventive concept, the following claims should provide the sole measure of the scope of the invention.

What is claimed is:

1. A valve comprising a housing containing a first valving surface having nine spaced ports, namely, a central exhaust port, right and left outer exhaust ports located on opposite sides of the central exhaust port, right and left motor ports located between the central exhaust port and the two outer exhaust ports, right and left cross-over ports located between the central exhaust port and the two motor ports, and right and left inlet ports located between the central exhaust port and the two cross-over ports; a flow passage connecting the two cross-over ports; a second valving surface cooperating with the first valving surface and having five valve lands separated by four valve grooves, there being a central land, left and right outer lands located on opposite sides of the central land and left and right middle lands located between the central land and the two outer lands; and means for moving one valving surface relatively to the other, the ports, grooves and lands being so dimensioned that the valve has: a first operative position in which the two middle lands and the two outer lands isolate the two motor ports; a second position in which the central land and the left middle land isolate the central exhaust port, the groove between the right middle and right outer lands connects the right motor port with the right outer exhaust port, the groove between the left middle and left outer lands connects the left motor port with both the left cross-over and left inlet ports, and the groove between the central land and the right middle land connects the right inlet port with the right cross-over port; and a third operative position in which the central land and the right middle land isolate the central exhaust port, the groove between the left middle and left outer lands connects the left motor port with the left outer exhaust port, the groove between the right middle and right outer lands connects the right motor port with both the right cross-over and right inlet ports, and the groove between the central land and the left middle land connects the left cross-over and left inlet ports.

2. The valve defined in claim 1 in which there is a fourth operative position in which the groove between the central land and the right middle land connects the left inlet port with the central exhaust port, the groove between the central land and the left middle land connects the left motor port with the left cross-over port, and the groove between the right middle and right outer lands interconnects the right inlet, right cross-over and right motor ports.

3. The valve defined in claim 2 in which there is a fifth operative position having the same port interconnections as in the fourth position but in which the right middle land restricts the communication between the left inlet port and the central exhaust port through the groove between the central land and the right middle land.

4. The valve defined in claim 1 in which in the first operative position the two grooves separating the central land and the two middle lands connect the two inlet ports with the central exhaust port.

5. The valve defined in claim 4 in which there is a fourth operative position in which the groove between the central land and the right middle land connects the left inlet port with the central exhaust port, the groove between the central land and the left middle land connects the left motor port with the left cross-over port, and the groove between the right middle and right outer lands interconnects the right inlet, right cross-over and right motor ports.

6. The valve defined in claim 5 in which there is a fifth operative position having the same port interconnections as in the fourth position but in which the right middle land restricts the communication between the left inlet port and the central exhaust port through the groove between the central land and the right middle land.

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