Dec. 26, 1967 R. L. HOFFMAN ETAL 3,359,868

HYDRAULIC CYLINDER ASSEMBLY

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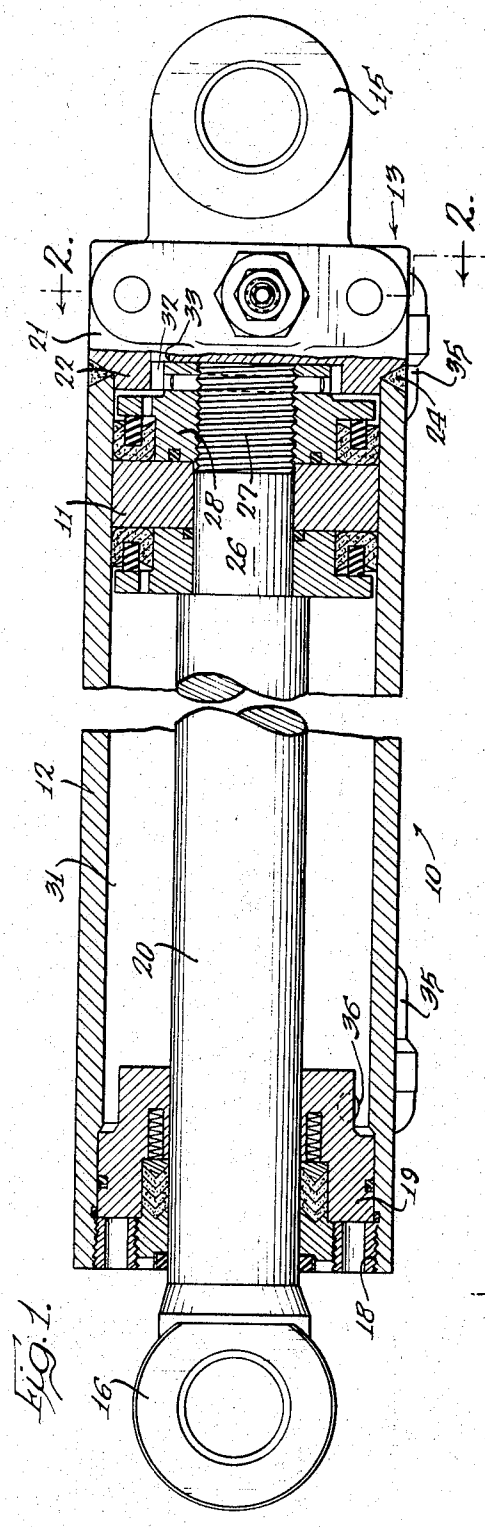


Fig. 1.

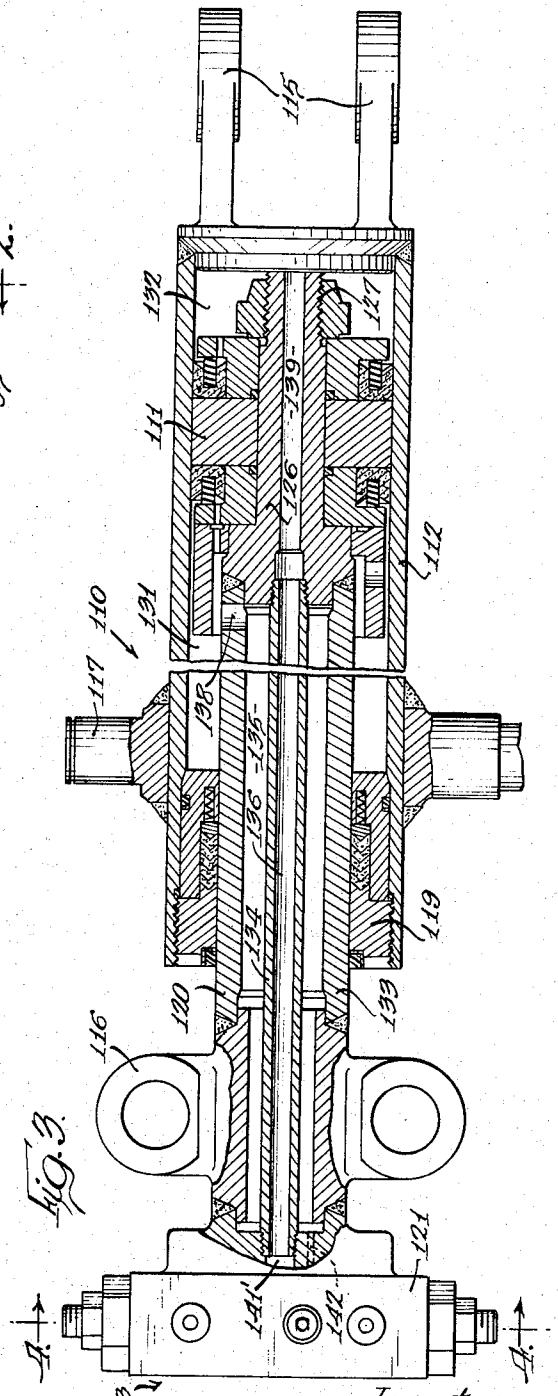


Fig. 3.

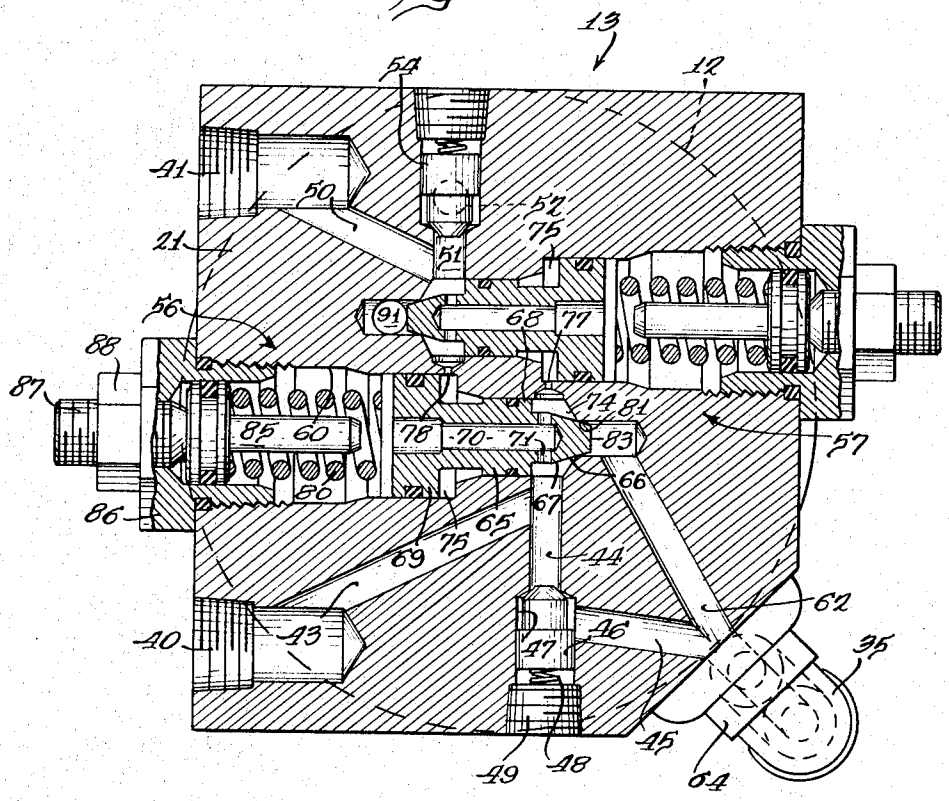
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Attys

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Fig. 2.



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Fig. 4.

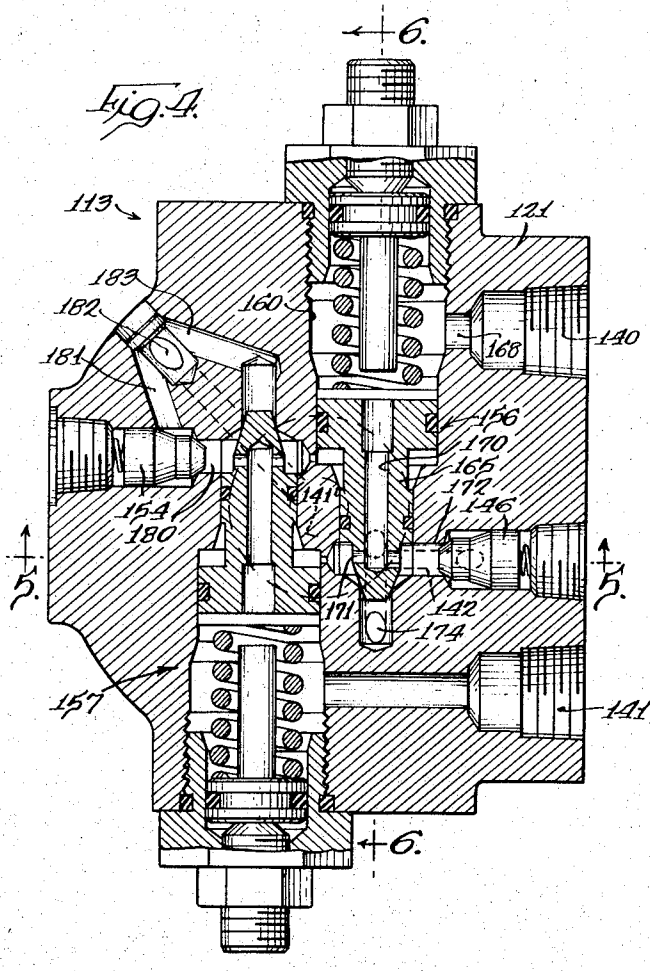


Fig. 6.

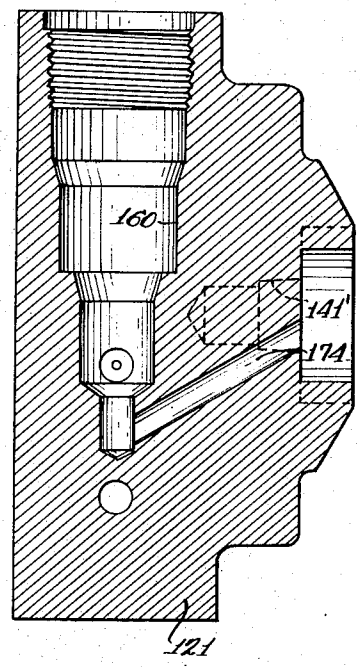
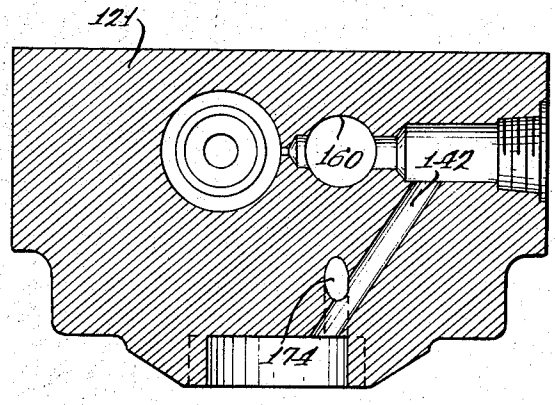


Fig. 5.



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Fig. 7.

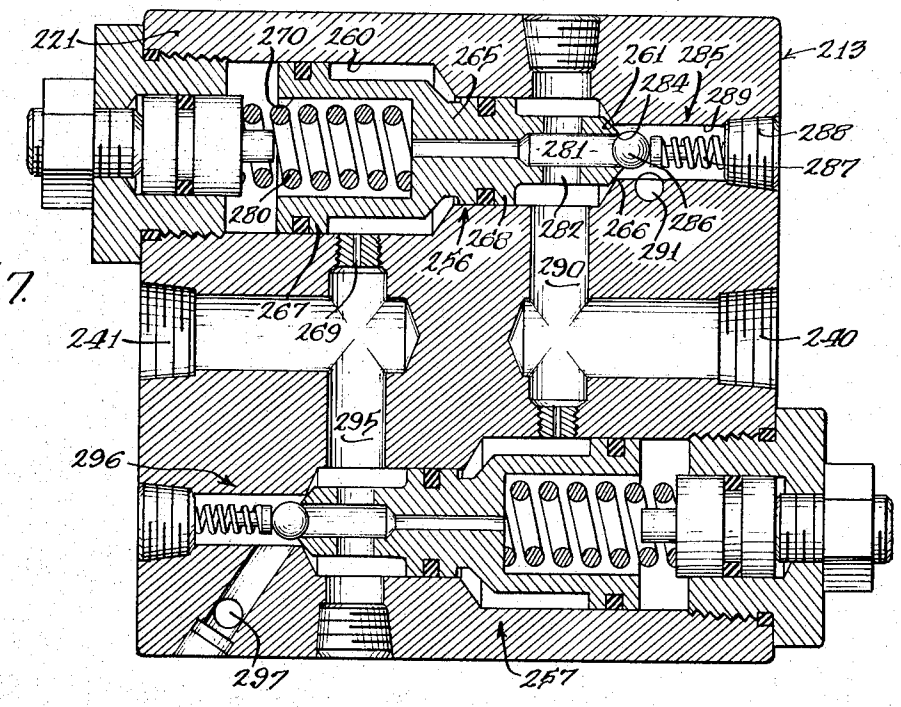


Fig. 8.

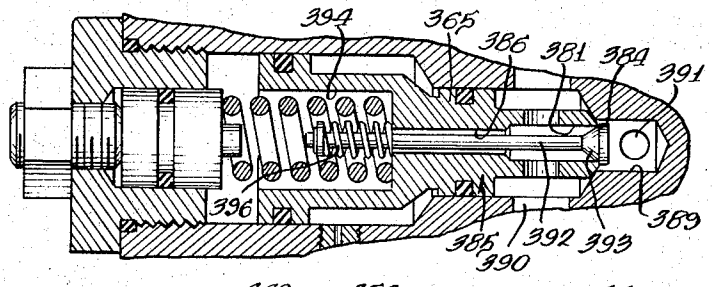
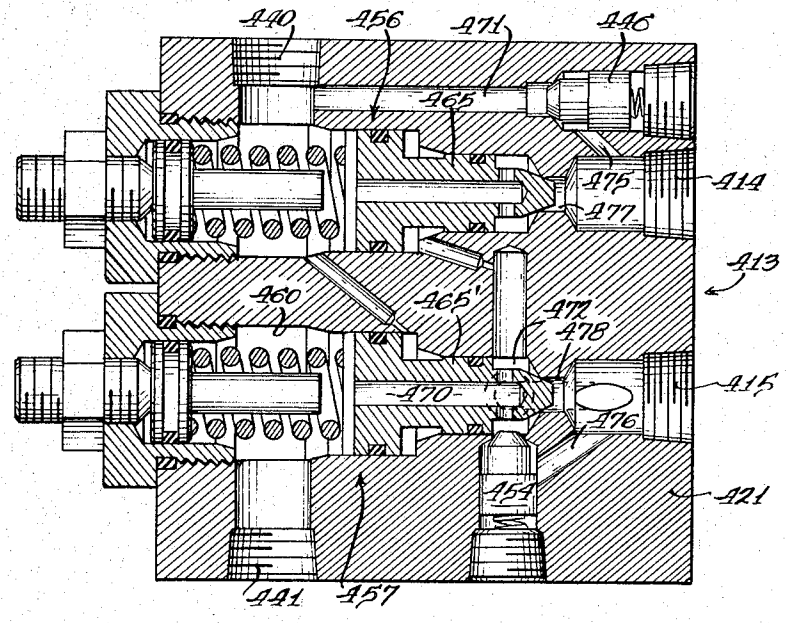


Fig. 9.



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HYDRAULIC CYLINDER ASSEMBLY

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Filed Apr. 8, 1965, Ser. No. 446,654
14 Claims. (Cl. 91—447)

ABSTRACT OF THE DISCLOSURE

A holding valve for selectively prevented discharge flow from a hydraulic motor, the valve being biased to a closed position against the force of fluid tending to discharge from one side of the motor with a fluid operable device for opening the valve permitting discharge from one side of the motor when fluid is ported to the other side of the motor.

This invention relates to the control of reciprocating hydraulic motors and more particularly to a holding valve for controlling the flow of fluid relative to a hydraulic cylinder.

In hydraulic systems where a reciprocating hydraulic motor is employed to raise and lower a movable load, a directional control valve is conventionally employed to selectively port fluid to and from the hydraulic motor. In such devices the directional control valve is movable to a block position to prevent discharge flow from either end of the hydraulic motor to thereby attempt to hold the load stationary. However, the force of gravity acting on the load produces an increased pressure in one end of the cylinder which causes fluid to leak around the directional control valve resulting in load creepage.

Counterbalance holding valves have been provided in the past in an attempt to obviate this creepage problem. These prior valves have been interposed in the hydraulic circuit between the hydraulic cylinder and the directional control valve to selectively prevent flow from the cylinder when the directional control valve is in the block position. These holding valves must also be capable of permitting fluid flow from one side of the cylinder when the directional control valve ports drive fluid to the other side thereof. For this purpose the holding valve is overridden usually by means of a pressure responsive actuator located between the hydraulic cylinder and the holding valve.

The serious disadvantage of these prior valves is that they have been dependent for their holding ability upon the integrity of certain packings or seals used in their construction. Since these packings and seals have a relatively short life, they have proved a detriment in the use of these valves and in some cases have been a negative factor from a safety standpoint.

It is therefore a primary object of the persent invention to provide a new and improved holding valve assembly for a hydraulic motor in which the valve has a holding ability far superior to any heretofore known valves. In the present device the holding ability of the valve is dependent entirely on the metal-to-metal contact between the valve seats thereby minimizing the possibility of leakage.

It is another object of the present invention to provide a new and improved counterbalance holding valve for a hydraulic cylinder including a piston formed on the movable valve member which is responsive to inlet fluid pressure to selectively open the holding valve. This actuator piston is on the low pressure side of the system when the associated directional control valve is in the block position so that any leakage will take place on the reservoir

side of the system and not on the hydraulic cylinder side thereby preventing load creepage.

A further object of the present invention is to provide a new and improved holding valve of the type described above including a strong compression spring for biasing the holding valve to its closed position in opposition to the force of the fluid on the valve from the hydraulic cylinder.

A still further object of the present invention is to provide a new and improved holding valve construction of the type described above capable of holding the hydraulic motor from movement in either direction.

Another object of the present invention is to provide a new and improved holding valve construction of the type described above including a valve plate for enclosing said holding valve structure, and a bypass passage having a check valve therein permitting fluid flow to the hydraulic cylinder but preventing flow in the reverse direction.

Another object of the present invention is to provide a new and improved holding valve construction of the type described above in which the bypass passage and the check valve are an integral part of the movable holding valve member. In one embodiment the bypass check valve is of the ball type and in another embodiment the check valve is of the plunger type extending completely through the movable valve member.

Still another object of the present invention is to provide a new and improved hydraulic cylinder assembly including a holding valve construction of the type described above in which the holding valve includes a valve plate mounted on one end of a main piston rod consisting of concentric sleeves. The spaces within the sleeves define the fluid flow conduits to both sides of the main piston within the hydraulic motor cylinder thereby providing a simplified construction not heretofore known in the art.

Other objects and advantages will be apparent from the following detailed description, taken in connection with the accompanying drawings in which:

FIG. 1 is an elevational view partially in cross section showing the hydraulic cylinder assembly;

FIG. 2 is a sectional view taken generally along line 2—2 of FIG. 1 showing the counterbalance holding valve assembly;

FIG. 3 is an elevational view, partially in cross section, showing another embodiment of the hydraulic cylinder assembly in which the holding valve assembly is connected to the piston rod;

FIG. 4 is a sectional view taken generally along line 4—4 of FIG. 3 showing another form of the holding valve assembly;

FIG. 5 is a cross section taken generally along line 5—5 of FIG. 4 showing the fluid passages which connect the main piston rod with the holding valve assembly;

FIG. 6 is a cross section taken generally along line 6—6 of FIG. 5 showing one of the holding valve bores;

FIG. 7 is a cross section of another embodiment of the holding valve assembly;

FIG. 8 is a fragmentary cross section of still another embodiment of the holding valve; and

FIG. 9 is a cross section of another ambodiment of the holding valve assembly.

Referring to FIG. 1, the hydraulic piston and cylinder assembly **10** includes a reciprocating piston **11**, a cylinder **12**, and a holding valve assembly **13** fixed to the stationary cylinder **12**. A pivot mount **15** is adapted to be pivotally mounted on a suitable pin on a relatively stationary portion of a lifting device (not shown) associated with the hydraulic cylinder **10**. Another pivot mounting **16** is adapted to be connected through another pin to the load. As fluid is selectively ported to either side of the piston **11**, the mount **16** will extend and retract with respect to the cylinder **12**.

More specifically, the cylinder 12 has cylindrical outside and inside surfaces with one end threaded as at 18 to receive a suitable end cap and seal assembly 19 which slidably receives piston rod 20.

The holding valve assembly 13 includes a rectangular valve plate 21 with an annular projection 22 on one side thereof which fits within the right end of cylinder 12. The holding valve assembly 13 is suitably welded as shown at 24 to the cylinder 12. The piston rod 20 has a reduced end portion 26 received within the piston 11 with a threaded portion 27 threadedly receiving a piston cap 28 which functions to maintain the piston assembly 11 on the reduced piston rod portion 26.

The piston 11 devides the cylinder 12 into chamber 31 and chamber 32. Fluid is ported to and from chamber 32 through passage 33 in the holding valve assembly 13. Fluid is ported to and from chamber 31 through a suitable conduit 35 which communicates with a port 36 in the cylinder 12 and with the holding valve plate 21 in a manner more fully described below.

Turning now to the detailed construction of the holding valve assembly 13 as shown in FIG. 2, inlet ports 40 and 41 are provided both of which function to convey supply and discharge fluid between a directional control valve (not shown) and the hydraulic cylinder 12. Port 40 supplies and returns fluid to and from hydraulic cylinder chamber 31 while port 41 supplies and returns fluid to and from hydraulic chamber 32. Port 40 communicates with the hydraulic cylinder chamber 31, when pressurized by the directional control valve, through passages 43, 44 and 45, and through a poppet valve 46 slidably mounted with clearance in bore 47. Poppet valve 46 permits flow from passage 44 to passage 45 but prevents flow in the reverse direction. Spring 48 seated against plug 49 threaded in bore 47 urges the poppet valve 46 to its closed position. A similar inlet fluid circuit is provided associated with port 41 including passages 50, 51 and 52, the latter communicating with passage 33 opening to hydraulic cylinder chamber 32. A poppet bypass valve 54 is identical in construction to poppet valve 46 and permits flow from passage 51 to passage 52 but prevents flow in the reverese direction.

Holding valves 56 and 57 are provided in the valve plate 21 for selectively preventing fluid flow from the hydraulic cylinder chambers 31 and 32 to the ports 40 and 41. The holding valves 56 and 57 are of the counterbalance type in that they are biased in opposition to fluid pressure in the hydraulic cylinder chambers. Holding valve 56 prevents the flow of fluid from chamber 31 and holding valve 57 prevents the flow of fluid from chamber 32. The holding valves 56 and 57 are identical in construction and for this reason the details thereof will be described with reference only to holding valve 56.

The holding valve 56 includes a stepped bore 60 which intersects the passage 44 and a discharge passage 62 which communicates with conduit 35 through a suitable fitting 64.

A movable valve member 65 is slidably received in the stepped bore 60. Valve member 65 has a conical valve surface 66, a reduced portion 67, a central piston 68 and an end piston 69. An axial bore 70 is formed in the valve member 65 which communicates with radial passages 71 opening to the reduced portion 67. The reduced portion 67 defines a chamber 74 in bore 60. Pistons 68 and 69 define a chamber 75 in bore 60 which together constitute a differential piston mechanism for operating the valve in a manner described below. Restricted passages 77 and 78 meter fluid from passages 43 and 50, respectively, to the chambers 75 between the differential pistons. As the area of piston 69 is greater than that of piston 68 within chamber 75 the fluid metered into chambers 75 moves the valve members to their open positions.

A counterbalance spring 80 is provided for biasing the valve member 65 to its closed position wherein the conical valving surface 66 tightly engages circular edge valve seat 81 in the right end of bore 60. The spring 80 is of the coil compression type and it is of sufficient strength so that it will maintain the valve surface 66 in tight engagement with the seat 81 against the force of fluid tending to discharge through passage 62 and acting against the right end 83 of the valve member 65. This discharge flow tendency is created by the load when the associated directional control valve is in its block position. Spring 80, mounted within the bore 60, engages the large end of the valve member 65 and reacts against a plunger 85 slidably mounted in a hollow hexagonal cap 86 threaded into bore 60. An adjusting screw 87 threaded into cap 86 abouts the end of the plunger 85 and permits adjustment of the plunger 85 to vary the compressive force of spring 80 on valve member 65. A suitable locking nut 88 is provided for screw 87.

Counterbalance valve 57 is provided with a discharge passage 91 in valve plate 21 which communicates with passages 52 and 33, thereby providing the same function as the discharge passage 62 provides with respect to holding valve 56.

In an exemplary operation of the FIGS. 1 and 2 embodiment, assume that the directional control valve is positioned so that port 41 is connected to a suitable source of supply fluid and that port 40 is connected to the reservoir. High pressure fluid flows through passages 50 and 51 opening poppet valve 54 permitting fluid to flow through passages 52 and 33 into the hydraulic cylinder chamber 32. At the same time a small portion of this fluid in passage 51 is metered through the restricted orifice 78 to the differential piston chamber 75 in valve 56. The valve member 65 then moves to the left in bore 60 to its open position against the force of spring 80. With holding valve 56 open, discharge flow is permitted from the hydraulic cylinder chamber 31 through conduit 35, discharge passage 62, chamber 74, passage 43 (then a return passage) and out port 40. The piston 11 then moves to the left as shown in FIG. 1.

When it is desired to hold the load connected to pivot mount 16, the directional control valve is placed in its blocking position preventing fluid flow to or from either of the ports 40 or 41. In this position the passages 43, 44, 50 and 51 are under what may be termed low pressure. Because of this the pressure in differential chamber 75 of valve 56 drops and the spring 80 moves the valve member 65 to the right to its closed position. Both valves 56 and 57 are then in their closed position. Regardless of the direction of the static load on the pivot mount 16 the holding valves 56 and 57 will prevent any creepage of the piston 11. If the static load has a tendency to force fluid from chamber 31 the pressure in discharge passage 62 will be relatively high but the compression spring 80 maintains the movable valve member 65 closed preventing any leakage.

It should be noted that there are no packings or seals in discharge passage 62, or the discharge or right end of bore 60, so that leakage and resulting piston creeping is minimized. Any leakage around the differential piston does not affect the integrity of the valves holding ability because it is solely on the low pressure or directional control valve side of the valve seat 81.

If the directional control valve is reversed so that high pressure fluid is ported to port 40 and the reservoir connected to port 41, the operation of valves 56 and 57 is reversed. That is, high pressure fluid flows through passages 43 and 44 opening poppet valve 46 permitting fluid to flow through passage 45 and into the hydraulic cylinder chamber 31. A portion of this flow is metered through restricted passage 77 opening holding valve 57 in the same manner as that described above with respect to valve 56. Discharge flow from hydraulic cylinder chamber 32 then passes through discharge passage 91, between the open valve seats, passages 51 and 50, and out port 41. Piston 11 then moves to the right.

A second embodiment of the hydraulic piston and

cylinder assembly is shown in FIGS. 3, 4, 5 and 6. Hydraulic piston and cylinder assembly **110** is generally similar in construction to the embodiment of FIGS. 1 and 2 except that the valve assembly is connected to the piston rod and fluid is ported to the cylinder through the rod. The hydraulic cylinder assembly **110** consists generally of a piston **111** slidable relative to a cylinder **112** and a holding valve assembly **113** affixed to one end of a piston rod **120**. Pivot mounting bosses **115**, connected to cylinder **112**, and trunnions **117**, also connected to the cylinder, are provided for connection to the load or driven element of the associated machine. Mounting bosses **116** form a part of the piston rod **120** and are adapted to be connected to a stationary portion of the associated machine. A suitable end cap and seal assembly **119** is provided for the left end of cylinder **112**.

The piston rod **120** consists of an outer sleeve member **133** and an inner sleeve member **134** threaded at one end in the valve plate **121** and at the other end in piston support **126**. The outer sleeve member **120** is welded at one end to the valve plate and at the other end to the piston support **126**. Sleeves **133** and **134** define an annular passage **135** and an axial passage **136**. Passage **135** communicates with hydraulic cylinder chamber **131** through port **138**. Passage **136** communicates with hydraulic cylinder chamber **132** through axial passage **139** in the piston support **126**. Passage **141'** in valve plate **121** communicates with passage **136**, while passage **142** in valve plate **121** communicates with passage **135**.

Referring to FIG. 4 wherein the valve plate assembly **113** for the hydraulic cylinder **110** is shown in detail, holding valves **156** and **157** are provided in valve plate **121** and are of identical construction to the holding valves **56** and **57** shown in FIG. 2. For this reason the details of the valves themselves will not be described in detail. However, the various inlet and discharge passages are different though similar in function and operation. Ports **140** and **141** in valve plate **121** are adapted to be selectively connected to either a source of supply fluid or a drain through a suitable directional control valve (not shown). Each port communicates with the enlarged end of its respective valve bore **160** through passage **168**. Passages **170** and **171** in movable valve members **165** function in the FIG. 4 embodiment to convey high pressure fluid to the hydraulic cylinder and discharge fluid from the hydraulic cylinder.

When port **140** is pressurized fluid flows through passage **168**, bore **160**, passage **170**, passage **171**, passage **172** and through poppet valve **146** which permits flow through passage **142** to the hydraulic cylinder chamber **131**. Discharge fluid from chamber **132** then passes through passages **136**, **141'**, **182**, **183**, through the open valve surfaces in holding valve **157** through the center of the holding valve, and out port **141**.

When port **141** is pressurized and port **140** connected to drain, valve **156** opens, and discharge fluid from hydraulic chamber **131** passes through passage **135** in piston **120**, diagonal passage **174** (shown more clearly in FIGS. 5 and 6), passages **171** and **170**, the large end of bore **160**, and outport **140**. Pressurized inlet fluid flows at that time through the movable valve member in holding valve **157**, passage **180**, opening poppet valve **154** which permits flow through passages **181**, **182**, **141'**, **136** and **139** into the hydraulic chamber **132**. Cylinder **112** then moves to the right as shown in FIG. 3.

The operation of the holding valve assembly **113** is otherwise identical to that of the FIG. 2 embodiment and for this reason will not be described in any further detail.

Referring now to FIG. 7 wherein another embodiment of the holding valve assembly is shown, generally designated by the numeral **213**, holding valve **213** is functionally similar to the holding valves **13** and **113** but differs structurally therefrom primarily in the provision of a combined check and counterbalance valve. Inlet ports **240** and **241** are adapted to be selectively connected by a directional control valve to either a source of supply fluid or a reservoir. The combined holding and check valves **256** and **257** are identical so that the description thereof will be referenced only to valve **256**.

The holding valve **256** includes a stepped bore **260** in valve plate **221** with a valve seat **261** at one end thereof. A valve member **265** is slidably mounted in the bore **260**. Valve member **265** includes a valve surface **266** adapted to engage the valve seat **261** in the bore. Pistons **267** and **268** are formed integrally with the valve member **265** and define a differential piston device. The differential piston is supplied fluid through restricted passage **269** which connects the port **241** to the valve bore **260** between the pistons. Valve member **265** has a counterbored spring seat **270** which receives compression spring **280**. The valving end of member **265** has intersecting passages **281** and **282** therein with passage **281** opening to the forward end of the valve member and defining a valve seat **284** therein. Passage **282** communicates with the interior of bore **260**.

A check valve assembly **285** is provided for permitting inlet fluid flow from port **240** to one side of the associated hydraulic motor but preventing reverse flow. Check valve **285** includes a ball valve member **286** which engages the valve seat **284** to close passage **281**. The ball **286** is resiliently biased against seat **284** by spring **287** which reacts against a plug **288** threaded into bore **289**.

When port **240** is pressurized fluid flows through passage **290**, passage **282**, passage **281**, opening check valve **285**, which permits flow into bore **289**, and through passage **291** which is connected to one side of the associated hydraulic motor by suitable fittings (not shown). With port **240** pressurized, port **241** is at tank pressure so that the fluid-actuated differential piston on valve **256** is not pressurized and the valve remains closed with the valve surface **266** engaging valve seat **261**. At this time valve **257** is open due to the actuation of its associated differential piston device permitting discharge flow from the other side of the hydraulic cylinder out through passage **297** and port **241**. When port **241** is pressurized, the movable valve member **265** opens valve surfaces **261** and **266** permitting discharge flow from one end of the cylinder through passage **291**, over valve surface **266** through passage **290** and out port **240**. At the same time, motive fluid is supplied to the other end of the hydraulic cylinder through passage **295**, through check valve assembly **296** and passage **297** which is adapted to be connected through suitable fittings to the other side of the hydraulic cylinder. When fluid flow in ports **240** and **241** is blocked by the directional control valve (not shown) the holding valves **256** and **257** including check valves **285** and **296** prevent flow from the hydraulic cylinder through passages **291** and **297**, respectively.

In FIG. 8, another form of the check or bypass valve is shown designated by the numeral **385**. Valve member **365** is identical to valve member **265** in FIG. 7. Axial passage **381** opens to the forward end of the valve and defines a check valve seat **384**. Axial passage **386** together with passage **381** provide a through bore in valve member **365**. The check valve **385** includes an elongated valve stem **392** slidably received in bore **386** with an enlarged conical head at one end thereof defining a conical valving surface **393** adapted to selectively engage valve seat **384**. The other end of stem **392** projects into bore **394** in valve member **365**. A spring assembly **396** is provided for biasing the valve stem **392** to the left into the valve member as shown in FIG. 8. When passage **390** is pressurized fluid flow in passage **381** acts against valve surface **393** urging the stem **392** to the right opening the valve against the opposing force of spring **396**. When passage **390** is at low pressure, the check valve closes preventing flow from passage **391** to passage **381**.

The valve assembly **413** shown in FIG. 9 is similar to that shown in FIG. 2 except that it is a separate assembly unconnected to the hydraulic cylinder except by suitable hosing. For this purpose outlet ports **414** and **415** are pro-

vided to which the hosing and fittings are connected from both sides of the associated hydraulic cylinder. The counterbalance holding valves **456** and **457** are similar to the FIG. 2 holding valves except for certain features. Inlet port **440** communicates with poppet valve **446** through passage **471**, in a similar manner to the FIG. 2 holding valves. Inlet port **441** on the other hand communicates with poppet valve **454** through bore **460**, passage **470** in valve member **465'** and chamber **472** in bore **460**. Bypass passages **475** and **476** permit high pressure flow through the poppet valves **446** and **454**, respectively, to the respective sides of the associated hydraulic cylinder. Discharge passages **477** and **478** are provided for permitting flow from the hydraulic cylinder when the respective holding valves are open. The operation of holding valve assembly **413** is otherwise identical to that described with reference to FIG. 2.

Having described our invention as related to the embodiments shown in the accompanying drawings it is our intention that the invention be not limited by any of the details of description, unless otherwise specified, but rather be construed broadly within its spirit and scope as set out in the accompanying claims.

We claim:

1. A holding valve assembly adapted for use with a hydraulic load, comprising: a valve housing member, a discharge passage in said housing member adapted to receive discharge flow from the hydraulic load, a valve seat in said passage, a movable valve member in said passage, resilient means for maintaining said valve member in a closed position in opposition to the force provided by fluid tending to discharge through said passage, said valve seat limiting movement of said valve member beyond said closed position, fluid operable means for selectively opening said valve and permitting discharge flow through said passage, and bypass passage means in parallel with said valve member communicating with said discharge passage for supplying fluid under pressure to said discharge passage and said hydraulic load.

2. A holding valve assembly adapted for use with a reciprocating hydraulic piston and cylinder device having an inlet port and a discharge port, comprising: a valve housing member, a discharge passage in said housing adapted to be connected to the cylinder device discharge port to receive discharge fluid from the device, a valve seat in said passage, a valve member in said passage positioned to close in opposition to the pressure of the discharge fluid so that discharge fluid tends to open said valve member, a low pressure return passage in said valve housing selectively connectable with said discharge passage through said valve member, resilient means for biasing said valve member to a closed position, said resilient means being of sufficient strength to maintain said valve member closed against the pressure of the discharge fluid in said discharge passage, said valve seat limiting movement of said valve member beyond said closed position, control means for selectively opening said valve member and permitting discharge flow from said discharge passage to said return passage including fluid actuated means separate from said discharge passage connected to open said valve member whereby discharge fluid leakage is minimized and bypass passage means in parallel with said valve member communicating with said low pressure return passage and said discharge passage for supplying fluid under pressure to the discharge port of the device.

3. A holding valve as defined in claim **2** and further including inlet passage means in said housing adapted to be connected to the cylinder device inlet port, said control means including a piston means on said movable valve member adapted to open said valve in opposition to said resilient means, passage means connecting said inlet passage means and said piston so that fluid flow through said inlet passage actuates the piston means and opens the valve member.

4. A holding valve as defined in claim **3** wherein said piston means includes a piston formed integrally with said movable valve member.

5. A holding valve as defined in claim **2** and further including a valve seat in said valve housing separating said discharge passage and said return passage, said valve member having a valve surface movable within and engaging said valve seat in the closed position, said resilient means maintaining tight engagement between said valve seat and said valve surface, said fluid actuated means being connected to said valve member at the end thereof opposite said valve surface whereby the discharge passage is separated from said fluid actuated means by the valve surface and valve seat to prevent fluid leakage from the discharge passage.

6. A holding valve as defined in claim **3** and further including a valve bore intersecting said discharge passage, a valve seat in one end of said bore adjacent said discharge passage, said return passage means intersecting said valve bore adjacent the side of said valve seat opposite said discharge passage, said valve member being slidable in said bore and having a reduced portion at one end thereof adjacent said return passage, a conical valve surface on said one end of the valve member selectively engageable within said valve seat, said piston means including a differential piston on the other end of said valve member, said passage means connecting inlet passage to said piston means having a restricted portion for metering fluid to said differential piston to open said valve member, said resilient means including a compression spring in said bore engaging the end of the differential piston, and means for adjusting said spring to vary the valve closing force.

7. A counterbalance holding valve assembly for a hydraulic motor having two selectively operable ports for conveying fluid to drive the motor in two directions, comprising: a valve housing member, two first passage means in said housing adapted to selectively communicate with a source of supply fluid and a return means, two second passage means in said housing adapted to be connected respectively to convey and return fluid to and from the hydraulic motor, check valve means interconnecting each pair of first and second passages permitting flow from said first passage to said second passage but preventing reverse flow, discharge passage means in said housing by-passing each of said check valve means, a holding valve associated with each discharge passage for selectively preventing return flow from the hydraulic motor including a valve seat in such of said discharge passage means, movable valve members each selectively engageable with one of said seats, resilient means for biasing each of said valve members into said valve seats and being of sufficient strength to maintain said valve engagement against the force of fluid in said discharge passages, and fluid actuated means associated with each of said valve members responsive to fluid pressure in the first passage associated with the other valve member for opening said valve members and permitting discharge flow through the associated discharge passage means, said fluid actuated means being separated from said discharge passage means to prevent fluid leakage therefrom.

8. A counterbalance holding valve as defined in claim **7** and further including two valve bores each intersecting one of said discharge passage means and one of said first passages, said valve seats being disposed in said bores between said discharge passage means and said first passages, said valve members being slidably disposed in said bores and having conical valve surfaces engageable with said seats, said fluid actuated means including differential pistons on each of said valve members, restricted passage means connecting each of said first passages with the respective differential pistons to render the piston responsive to a predetermined fluid pressure therein.

9. A counterbalance holding valve as defined in claim **7** wherein said valves are oppositely disposed so that the fluid actuated means associated with each valve is ad-

jacent the valving surface end of the other valve, oppositely extending bores in said housing member for receiving said valve members, said bores communicating with the associated first passage means and discharge passage means, and restricted passages connecting each of said bores between the fluid actuated means and the first passage means.

10. A counterbalance holding valve assembly for a reciprocating hydraulic motor having inlet and discharge ports, comprising: a valve housing, first passage means in said housing adapted to be selectively connected to a source of fluid supply and a reservoir, second passage means in said housing adapted to be connected to one of said hydraulic motor ports, a counterbalance valve for porting fluid between said first and second passage means including a valve bore interconnecting said first and second passage means, a valve seat in said bore, a valve member slidable in said bore and having a valve surface selectively engageable within said valve seat, said passage means in said valve member continuously communicating with said first passage means and opening to said second passage means, check valve means in said second passage means engaging said valve member for selectively closing said valve member passage means, said check valve permitting flow through said valve member passage from said first passage to said second passage but preventing reverse flow, resilient means engaging said valve member for biasing the valve surface against the valve seat, said resilient means being of sufficient strength to maintain said valve member closed under the opposing fluid pressure in the second passage, said valve seat limiting movement of said valve member beyond the closed position, and fluid actuated means separate from said second passage for opening said valve member to permit fluid flow from said second passage to said first passage.

11. A counterbalance holding valve assembly as defined in claim **10** wherein said bore is a stepped bore, said fluid actuated means including first and second pistons on one end of said valve member defining a differential piston, passage means in said housing for metering fluid to said differential piston, said resilient means including a compression spring in said bore engaging one of said pistons.

12. A counterbalance holding valve assembly as defined in claim **10** wherein said check valve means includes a ball member in said second passage engaging said valve member passage, and spring means in said second passage engaging and biasing said ball member.

13. A counterbalance holding valve assembly as defined in claim **10** wherein said valve passage includes an axially extending passage completely through said valve member, said check valve means including an elongated valve stem slidably received in said valve passage, a conical check valve surface on one end of said valve stem projecting from one end of said valve passage adjacent said second passage, said valve stem projecting from the valve member at the other end thereof, and spring means engaging the projecting stem portion for urging the conical check valve surface to its closed position in engagement with the valve member passage.

14. A hydraulic cylinder assembly, comprising, a hydraulic actuator including a cylinder and a piston slidable in the cylinder, port means in said actuator for supplying and discharging fluid in said cylinder relative to one side of said piston, a holding valve assembly for selectively preventing discharge flow from said one side of said cylinder including valve housing means, a discharge passage in said housing means connected to said port means to receive discharge flow therefrom, a movable valve member in said passage, resilient means for maintaining said valve member closed in opposition to the force provided by fluid tending to discharge through said passage, means for selectively opening said valve and permitting discharge flow through said passage, and bypass passage means in parallel with said valve member communicating with said discharge passage for supplying fluid under pressure to said port means and said one side of said piston.

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