

Feb. 1, 1944.

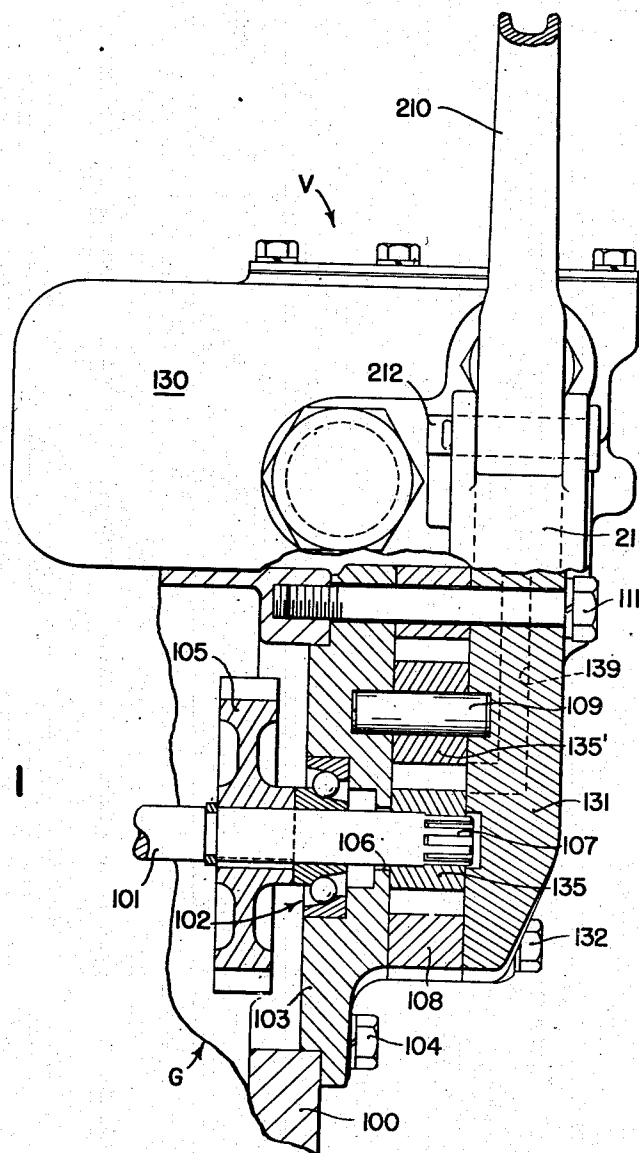
J. D. JOHNSON
HYDRAULIC MECHANISM

2,340,474

Filed June 18, 1941

3 Sheets-Sheet 1

FIG. 1



INVENTOR

Jay D. Johnson

BY

W. B. Parker
ATTORNEYS.

Feb. 1, 1944.

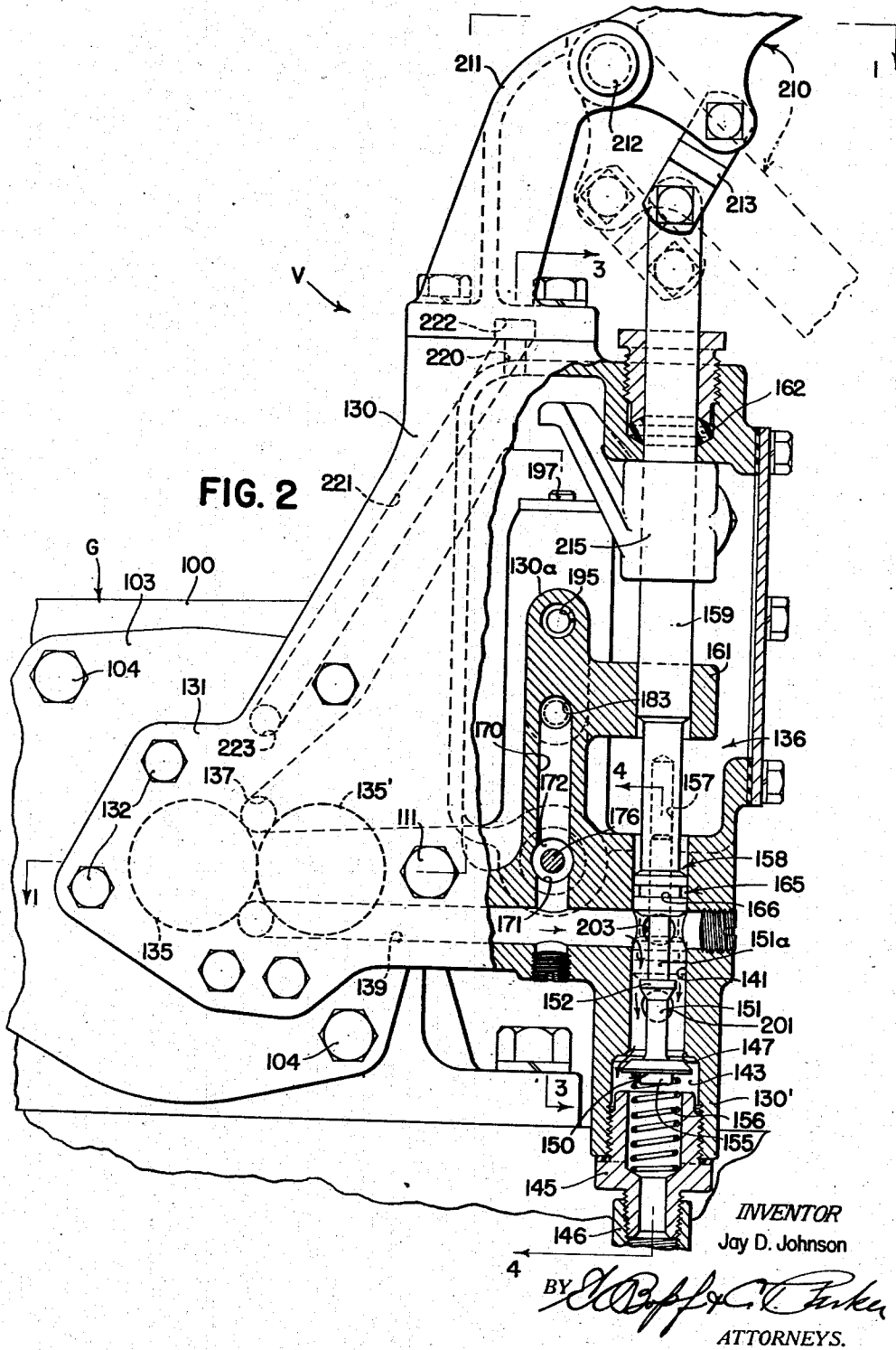
J. D. JOHNSON

2,340,474

HYDRAULIC MECHANISM

Filed June 18, 1941

3 Sheets-Sheet 2



Feb. 1, 1944.

J. D. JOHNSON
HYDRAULIC MECHANISM
Filed June 18, 1941

2,340,474

3 Sheets-Sheet 3

FIG. 3

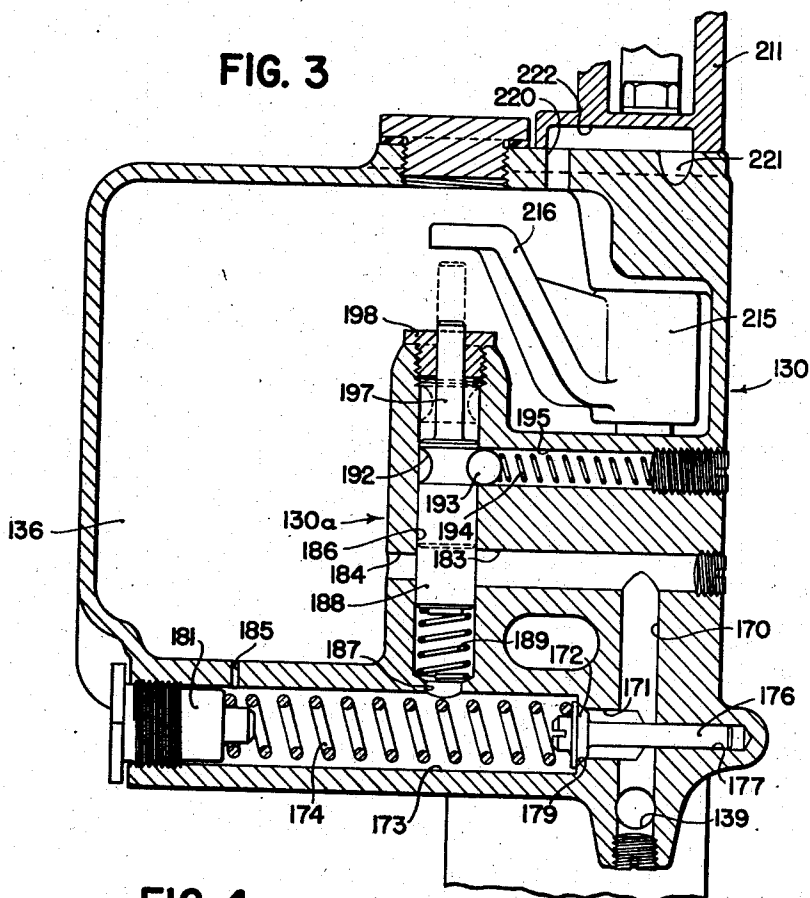
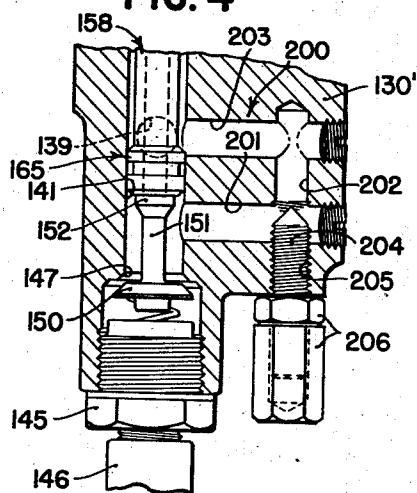


FIG. 4



INVENTOR

Jay D. Johnson

BY *J. D. Johnson*
ATTORNEYS.

UNITED STATES PATENT OFFICE

2,340,474

HYDRAULIC MECHANISM

Jay D. Johnson, Peoria, Ill., assignor to John Deere Tractor Company, Waterloo, Iowa, a corporation of Iowa

Application June 18, 1941, Serial No. 398,539

5 Claims. (Cl. 121-46.5)

The present application relates to hydraulic mechanisms of the type used for controlling the action of hydraulic lifting cylinders, such as are used on tractor power lifts, dump trucks, and the like. The principal object of my invention relates to the provision of a hydraulic control mechanism of a novel and improved design for controlling the flow of hydraulic fluid to a hydraulic power unit such as a piston and cylinder, for locking the piston and cylinder in any desired raised position, and for releasing the fluid from the cylinder to allow the piston to lower.

A more specific object of my invention is concerned with the provision of a novel and improved valve mechanism for directing the hydraulic fluid to the lifting cylinder or diverting the same to the reservoir, and also for releasing the fluid which is locked within the cylinder and permitting the same to flow to the reservoir to lower the piston. Still another object of my invention has to do with the provision of a control means for determining the rate of flow of the fluid from the lifting cylinder back to the reservoir. Another object of my invention relates to the provision of an improved mechanism for relieving the pressure in the supply duct when the power lift piston reaches the end of its stroke or otherwise becomes immovable.

A further object of my invention relates to means for venting the control valve casing to prevent leakage of oil to the outside of the casing. This is accomplished by providing a passage in the casing wall leading from the top of the reservoir and communicating with the gear case on the tractor which houses the mechanism that drives the hydraulic pump.

Still another object of my invention has to do with the provision of mounting the pump and valve housing on the governor housing of a tractor or other vehicle and driving the hydraulic pump from the governor shaft. Since the governor shaft usually runs at high speed, the size of the pump required is minimized.

These and other objects and advantages of my invention will be apparent to those skilled in the art after a consideration of the following description in which reference is had to the drawings appended hereto, in which

Figure 1 is a plan view, partly in section, taken along a line 1-1 in Figure 2, showing the means for mounting the pump and valve housing on the governor housing and for driving the hydraulic pump from the governor shaft.

Figure 2 is an elevational view partly in section of a hydraulic control mechanism embodying the principles of the present invention;

Figure 3 is an elevational view taken in section along a line 3-3 in Figure 2; and

Figure 4 is a fractional elevational view taken along a line 4-4 in Figure 2, and showing the

controlled by-pass for determining the rate of return of the hydraulic fluid from the power lift cylinder.

Referring now to the drawings, the governor of the tractor is indicated in its entirety by reference character G and includes a housing 100 within which a governor shaft 101 is rotatably supported in a ball bearing 102 carried in the end plate 103 of the housing. The end plate is secured to the housing 100 by bolts 104. The governor shaft 101 is driven through a gear 105, keyed to the shaft and adapted to mesh with a suitable engine driven drive gear (not shown). The governor shaft 101 is extended through an aperture 106 in the end plate 103 and has a splined outer end 107, on which is fixedly mounted a pump gear 135, and is enclosed in a pump housing block 108 with a second pump gear 135'. The latter is mounted on a shaft 109 and is disposed in mesh with the gear 135.

The valve mechanism, indicated generally by reference character V, includes a valve casing 130 having an extension 131, disposed in juxtaposition with the pump housing 108. Bolts 132 fixedly secure the casing extension 131, the pump housing 108 and the end plate 103 together, and other longer bolts 111 extend through these three parts and engage the governor housing 100. The valve housing 130 is formed with an inner chamber 136, which serves as a reservoir from which oil or other fluid serving as a hydraulic medium, passes through an opening 137 to the pump gears 135.

Since the governor shaft normally runs at a constant speed, the pump delivers oil at a substantially constant volume into a high pressure duct 139 which extends generally horizontally through the valve casing 130 and intersects a vertical bore 141. At its upper end, the bore 141 communicates with the reservoir 136, and at its lower end below the duct 139, it opens into a cylindrical valve chamber 143, formed in an extension 130' in the bottom of the casing 130. The lower end of the valve chamber 143 is tapped to receive a reducer 145, to which a delivery tube or conduit 146 is coupled in any suitable manner. The delivery conduit 146 is extended to any suitable power unit such as a piston and cylinder (not shown). A check valve 150 of the poppet type is adapted to close upwardly against a valve seat 147 for closing off communication between the delivery conduit 146 and the vertical bore 141. The check valve 150 is urged upwardly toward a closed position by means of a light spring 156 which seats in a bore in the reducer 145 and encircles a guide lug 155 on the check valve 150.

The stem 151 of the check valve 150 extends upwardly through the vertical bore 141 and is received within a socket 157 in the lower end of a manually controlled piston valve, indicated in its

entirety by the reference numeral 158. This manual valve comprises a plunger shaft 159 slidable in a bearing lug 161 secured to an internal wall 130a in the valve housing 130 and extends upwardly out of the casing 130 through a suitable packing gland 162. The lower end of the manually controlled plunger shaft 159 carries a cylindrical piston valve 165 in which an annular groove 166 is formed. The lower end of the piston valve 165 is arranged to engage a stop 152 in the form of a collar or flange rigidly fixed to the check valve stem 151, but the valve plunger 158 may move upwardly relative to the check valve 150, and the latter may in turn move downwardly relative to the manually controlled valve 158.

The valve plunger 158 is manually controlled by means of a hand lever 210 pivotally connected by means of a pin 212 to a standard 211 bolted to the top of the valve casing 130. The hand lever 210 is swingable vertically on the pivot pin 212 and is connected with the upper end of the valve plunger shaft 159 through a toggle link 213.

When the control lever 210 is raised to the position shown in solid lines in Figure 2, the piston valve 165 is held in the upper portion of the vertical bore 141 above the high pressure supply duct 139, thus preventing the oil from flowing upwardly into the reservoir 136, but providing a path for the oil to flow downwardly through the vertical bore 141. The pressure of the oil forces the check valve 150 to open downwardly against the yielding action of the spring 156 and the oil then flows downwardly through the reducer fitting 145 into the delivery conduit 146 leading to the lifting cylinder.

By moving the handle 210 downwardly, the piston valve 165 is moved downwardly in the vertical bore 141 into the lower portion of the latter below the supply duct 139. This opens the upper portion of the vertical bore 141 above the supply duct 139, and since the plunger shaft 159 is smaller in diameter than the diameter of the bore 141, the oil readily flows upwardly through the latter into the reservoir, thus relieving the pressure in the supply duct 139. This causes the spring 156 to close the check valve 150, locking the oil in the delivery conduit 146, but by forcing the plunger shaft 159 downwardly still further, the piston valve 165 engages the stop 152 on the check valve stem 151 and further downward movement of the handle 210 forces the check valve 150 open, thus allowing the trapped oil in the power lift cylinder and the delivery conduit 146 to escape upwardly past the check valve, but since the piston valve 165 in this position blocks the vertical bore 141, as best illustrated in Figure 4, the oil must follow a by-pass 200. The by-pass 200 comprises a horizontal duct 201 in the casing extension 130', communicating with the vertical bore 141 below the piston valve 165, a short vertical duct 202 which communicates with the duct 201 and with a second horizontal duct 203, which connects with the vertical bore 141 immediately above this position of the piston 165 and substantially on a level with the supply duct 139. The by-pass 200 is partially obstructed by means of an adjustable plug 204 which is threaded through a tapped opening 205 in register with the vertical passage 202. By turning the plug 204 the size of the passage can be adjusted to adjust the rate of flow of the return oil therethrough. This has the effect of cushioning the drop of the piston in the cylinder as the load is being lowered. The plug 204 can be locked in any desired position of adjustment by means of a pair of lock nuts 206.

When the piston in the main power cylinder (not shown) reaches the end of its lifting or power stroke, or is immovably blocked during the stroke, continued operation of the pump gears 135 will cause a sudden rise in pressure in the supply duct 139 and delivery conduit 146, which will result in damage to the mechanism unless this pressure is immediately relieved. The mechanism for automatically relieving the excess pressure in the supply duct 139 will now be described. A vertical passage 170 extends upwardly within the internal wall 130a in the valve casing 130 from the horizontal supply duct 139. A generally horizontal passage 171 intersects the vertical passage 170 above the supply duct 139 and extends into communication with a relief chamber 173. The passage 171 is normally obstructed by a relief valve 172, which is urged by means of a compression spring 174 against the seat 179. The compression spring 174 reacts against a plug 181 which is threaded into the outer end of the relief chamber 173 and is adjustable by turning the plug in its threads to adjust the pressure of the spring 174 against the valve 172. The spring 174 is sufficiently strong so that the pressure within the supply duct 139 must rise to an excessive value above the normal operating pressure before the valve 172 can be forced away from its seat 179. The valve 172 is supported on a valve stem 176 which is slidable in a socket 177 formed in the valve casing 130.

The upper end of the vertical passage 170 intersects a horizontal by-pass duct 183, which is connected in communication with the reservoir 136 through an outlet 184 of somewhat smaller diameter than the passage 183. The by-pass duct 183 is controlled by a piston valve 188 which is slidable within a vertical bore 186 formed in the internal wall 130a of the valve casing 130. The lower end of the vertical bore 186 has an opening 187 communicating with the relief chamber 173. Normally there is no hydraulic pressure within the relief chamber 173 since the latter is connected with the reservoir 136 by means of a hole 185 of small diameter, and the valve 172 is held closed against normal operating pressures by the spring 174. The piston valve 188 is normally held in closed position with respect to the by-pass duct 183 by means of a ball 193 engaging an annular groove 192 in the upper portion of the valve 188. The ball 193 is urged into engagement with the groove 192 by means of a coil spring 194 disposed in a horizontal bore 195 in the internal wall 130a of the casing 130.

As soon as the main power piston reaches the end of its lifting stroke, the hydraulic pressure in the supply duct 139 immediately rises, thereby forcing the relief valve 172 away from its seat 179 against the action of the spring 174, whereupon the pressure in the relief chamber 173 also rises, causing oil to flow into the vertical bore 186 through the opening 187, forcing the piston valve 188 upwardly and thus opening the by-pass duct 183 to the reservoir 136. The detent ball 193 readily yields to the oil pressure against the lower end of the piston valve 188, after which the movement of the piston 188 upwardly within the bore 186 is very rapid, since the oil pressure is assisted by a coil spring 189 which bears against the lower end of the piston 188 and reacts against the lower end of the bore 186 around the edge of the bore opening 187.

The piston valve 188 rises against a stop in the form of a bushing 198 which threads into the top of the vertical bore 186 and has an opening

therein for receiving a valve stem 197 extending upwardly from the upper end of the piston valve 188.

As soon as the valve 188 opens the by-pass duct 183 to the reservoir 136, the pressure against the relief valve 172 is relieved, thereby causing the latter to close under the action of the spring 174. The piston valve 188 is retained in raised position, however, by the spring 189 and also by a slight pressure in the by-pass duct 183 existing due to the fact that the outlet 184 is of smaller diameter.

The piston valve 188 is returned to closed position by an arm 216 supported on a collar 215 which is fixed to the valve plunger shaft 159. The arm 216 overlies the upper end of the valve stem 197, so that when the valve operating lever 210 is lowered the arm 216 engages the valve stem 197 and forces the valve back to the closed position shown in Figure 2.

The operation of the valve mechanism V, as described above, is substantially as follows: In Figures 1 and 2, the parts are shown in the positions they occupy when the pump 135 is forcing oil or other fluid through the delivery pipe 146 to the power cylinder, thus causing the latter to lift the load or otherwise move against the reaction of the load. At this time it will be noted that the manually operable handle 210 is in raised position, thus holding the piston valve 165 in the vertical bore 141 above the supply passage 139 and thus closing off the communication with the reservoir 136. The lifting movement can be interrupted at any time by lowering the control handle 210 and thus dropping the piston valve 165 into the portion of the bore 141 below the supply passage 139, thus opening the upper portion of the vertical bore 141 to the reservoir 136, relieving the pressure in the supply duct and thereby permitting the spring 156 to reseal the check valve 150, to hold the load in raised position. By forcing the handle 50 downwardly still further, the piston valve 165 engages the stop member 152 on the check valve stem 151 and opens the check valve 150, thereby allowing the fluid to escape upwardly past the check valve 150 and around the by-pass passage 200. The load can be raised to the limit of movement of the main piston by raising the control handle 210 and leaving the latter in raised position. As described in detail above, when the main power piston reaches the end of its power stroke, the pressure in the supply duct 139 rises abruptly, opening the relief valve 172 and then forcing the by-pass valve 188 upwardly to open the by-pass duct 183 to the reservoir. This relieves the pressure in the supply duct 139 and allows the relief valve 172 to close. To lower the load from the extreme raised position, the control handle 210 is lowered until the piston valve 45 engages the stop 152 on the check valve and opens the latter. This movement of the valve plunger shaft 159 causes the arm 216 to engage the valve stem 197, forcing the valve 188 back to its closed position, after which the output of the pump flows upwardly through the bore 141 from the supply duct 139 and into the reservoir 136.

If it were not for the groove 166 in the piston valve 165, the latter would block the high pressure duct 139 every time it was moved from lowering position to lifting position, and would thus cause the by-pass valve to open. This difficulty is

avoided by allowing the oil to flow through the groove 166 into the delivery duct 146 by way of the ducts 203, 202, 201 and through the check valve 150.

A vent hole 220 extends upwardly through the top of the reservoir and is connected in communication with a downwardly inclined duct 221 formed in a wall of the casing 130 by a recess 222 in the bottom of the control level supporting standard 211. The lower end of the passage 221 has an opening 223 disposed in register with an aperture in the side of the governor G. Thus any oil that escapes through the vent hole 220 because of foaming, splashing, or the like, is conducted to the governor gear case, with the result that the outside of the casing 130 is kept clean and dry.

I claim:

1. In hydraulic mechanism, a casing provided with a cylindrical bore communicating at one end with a reservoir, a delivery conduit disposed in communication with the other end of said bore, a supply duct connected in communication with the intermediate portion of said bore, a piston valve slidable in said bore to opposite sides of said supply duct, a check valve positioned to obstruct flow of fluid from said delivery conduit to said bore, means for engaging said piston valve with said check valve to open the latter when said piston valve is moved to a position between said supply duct and said delivery conduit, and a by-pass duct connected with said bore at opposite sides of said piston valve when the latter is in said position.

2. The combination set forth in claim 1, with the further provision of adjustable valve means in said by-pass duct for controlling the flow of fluid therein.

3. In hydraulic mechanism, a valve casing having a valve bore, and having a reservoir duct and a delivery duct communicating with said valve bore at opposite ends thereof, respectively, a high pressure supply duct connected in communication with said valve bore intermediate of the ends of the latter, a valve piston slidable through said bore to either side of said supply duct, said piston having a relief passage through which fluid from said supply duct can flow during the time said piston moves over the latter, and a by-pass duct in said casing disposed in register with said relief passage and connected in communication with said delivery duct for conducting fluid therebetween when said piston is in a position blocking said supply duct.

4. In hydraulic mechanism, a valve casing having a valve bore, and having a reservoir duct and a delivery duct communicating with said valve bore at opposite ends thereof, respectively, a high pressure supply duct connected in communication with said valve bore intermediate of the ends of the latter, a valve piston slidable through said bore to either side of said supply duct, and a by-pass passage in said casing interconnecting said delivery duct and said supply duct, for exhausting said delivery duct with said supply duct into said reservoir duct when said valve piston is in a position between said delivery duct and said supply duct.

5. The combination set forth in claim 4, with the further provision of adjustable valve means in said by-pass passage for controlling the flow out of said delivery duct.

JAY D. JOHNSON.