

Dec. 19, 1933.

R. V. PROCTOR

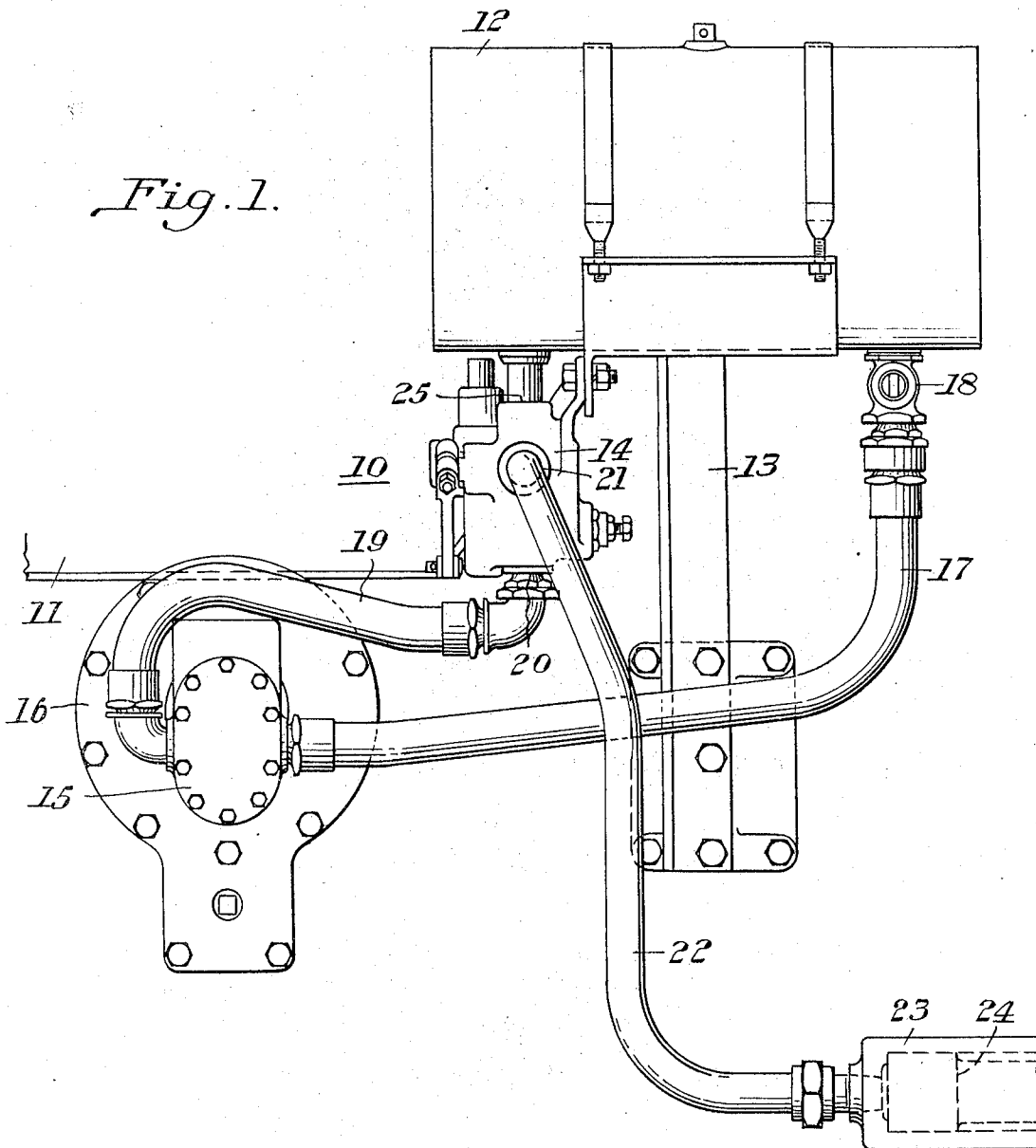
1,940,508

HYDRAULIC SYSTEM

Filed Oct. 6, 1930

3 Sheets-Sheet 1

Fig. 1.



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Fig. 4.

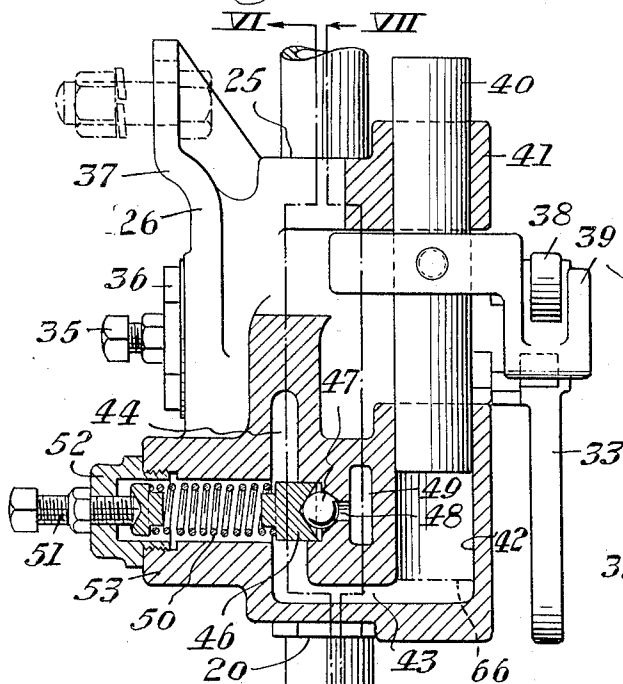


Fig. 5.

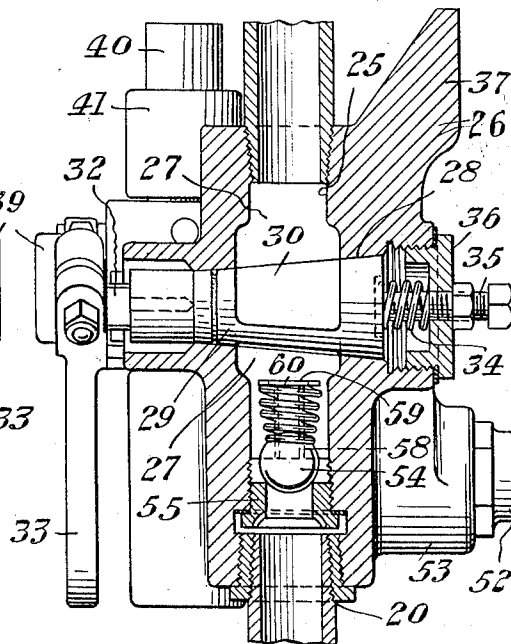


Fig. 2.

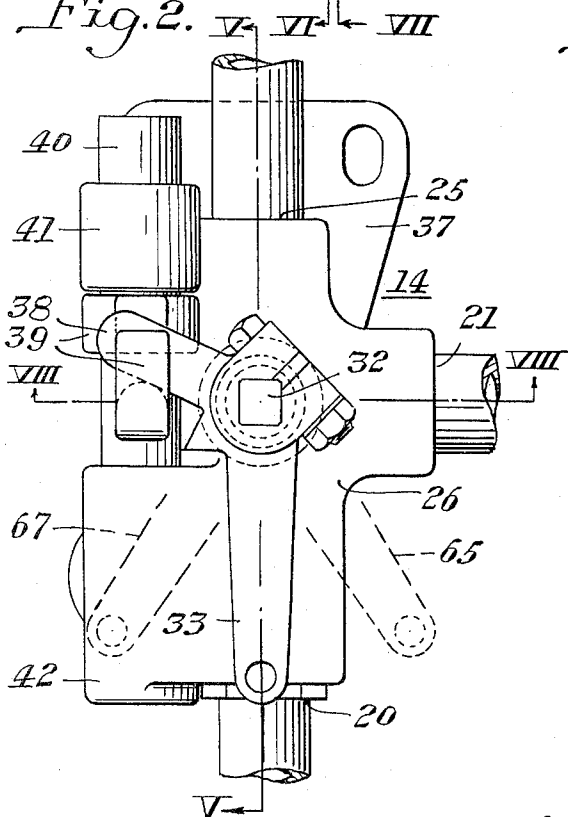
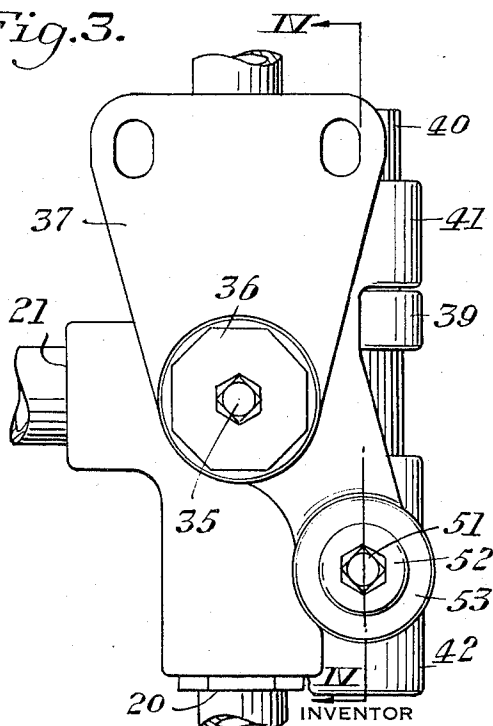


Fig. 3.



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Fig. 6.

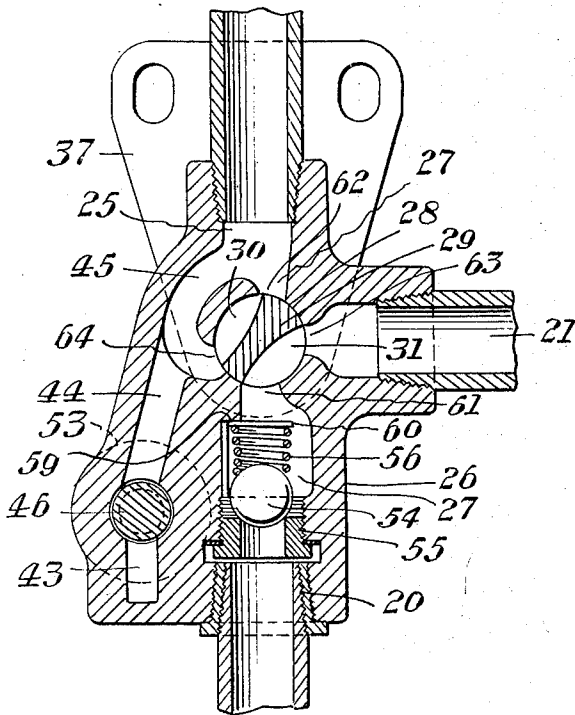


Fig. 7.

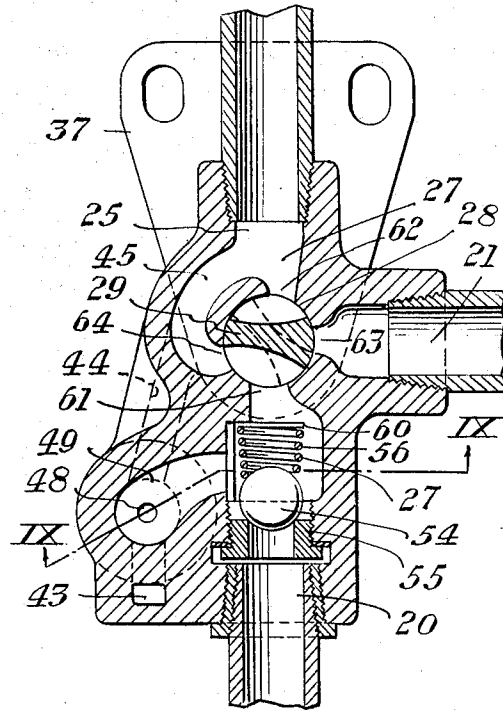


Fig. 10.

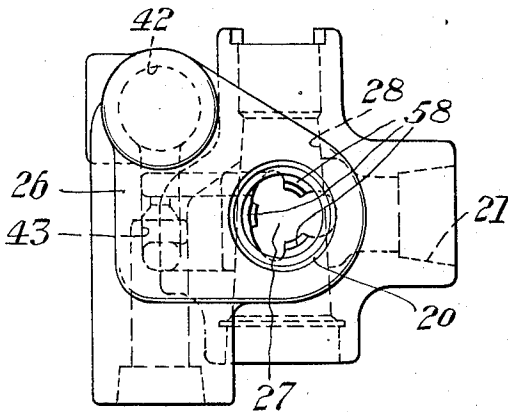


Fig. 8.

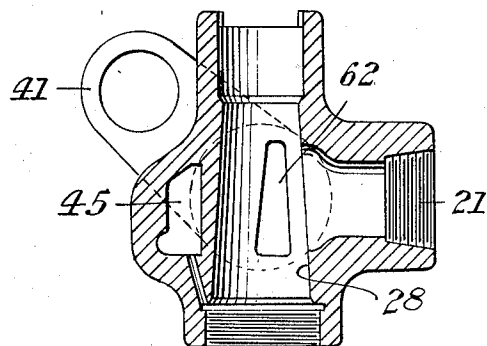
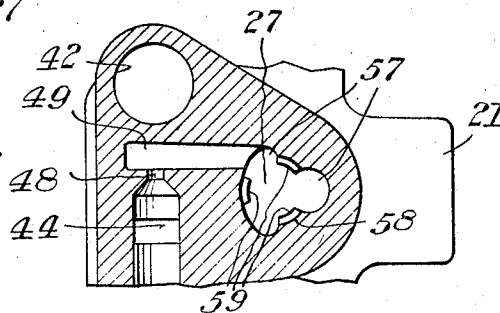


Fig. 9.



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UNITED STATES PATENT OFFICE

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HYDRAULIC SYSTEM

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Application October 6, 1930. Serial No. 486,607

3 Claims. (Cl. 138—16)

My invention relates, in general, to translating systems in which the working element is a fluid, such as oil. In particular, the invention contemplates an automatically operating system which, after being set initially, shall be effective to control subsequent operations in accordance with conditions as they arise.

The invention will be described with reference to a specific embodiment thereof, namely, a tractor adapted to draw and partially support a trailer unit having devices thereon, such as dumping bodies, adapted to be actuated by hydraulic pressure. The invention is also useful for controlling bulldozers or scrapers mounted on the tractor itself.

I am aware that it has been proposed heretofore to provide automatic valve-actuating means for installations of the character mentioned, such as the hydraulic lifting jack of a dumping body carried on a motor truck. In all such devices with which I am familiar, however, there are numerous objectionable features. In one example, the automatic actuation of the valve is effected by contact of the main actuating piston with a valve-operating lever. Devices of this character are unsatisfactory in operation because of their unreliability, which results from the possibility of failure of operation or accidental operation. Since they are entirely mechanical, furthermore, they are not suitable for use with a tractor and trailer combination, since it would be practically impossible to devise a satisfactory mechanical connection between a body on a trailer and the valve mechanism on the tractor.

I have invented an improved device for automatically controlling a hydraulic system which is simpler, more effective and more reliable than those previously known. According to the invention, I employ a valve for controlling a hydraulic system which may be manually shifted to a position such that fluid under pressure is supplied to a cylinder to cause a working stroke of a piston reciprocating therein. I also provide an auxiliary valve-operating piston for shifting the valve when the working stroke of the main piston has been completed, so that fluid pressure will no longer be applied thereto, but the cylinder will be closed to maintain the piston in its extended position. Thereafter, the valve may again be manually shifted to release the fluid in the cylinder. I preferably employ a continuously operating pump for circulating the working fluid and, in order to avoid excessive pressures, I provide suitable by-passes for the

fluid after the working stroke of the main piston has been effected.

In order to control the valve-actuating piston, I employ a pressure relief valve which is responsive directly to the pressure applied to the main working piston.

For a complete understanding of the invention, reference is made to the accompanying drawings illustrating the present preferred embodiment thereof. As previously stated, this embodiment is adapted for application to a tractor, although the invention is in no wise limited to such application since it may be used with equal satisfaction in vehicles of other types for performing almost any desired operation, as well as in stationary installations.

In the drawings,

Figure 1 is a front elevational view of the assembled parts of the system with parts of the apparatus shown in diagram;

Figure 2 is a side elevation of the valve;

Figure 3 is a side elevation of the valve showing the side opposite to that shown in Figure 2;

Figure 4 is a sectional view substantially along the line IV—IV of Figure 3;

Figure 5 is a sectional view along the line V—V of Figure 2;

Figure 6 is a sectional view along the line VI—VI of Figure 4;

Figure 7 is a sectional view along the line VII—VII of Figure 4;

Figure 8 is a sectional view along the line VIII—VIII of Figure 2, with parts removed for the sake of clearness;

Figure 9 is a sectional view along the line IX—IX of Figure 7, with certain parts being omitted; and

Figure 10 is a bottom plan view of the valve body with the working parts omitted therefrom.

Referring in detail to the drawings, a hydraulic system 10 is adapted to be mounted on a vehicle, such as a tractor, a portion of the framework which is indicated at 11. The system comprises a reservoir 12 supported from the vehicle frame on a bracket 13, a valve 14 and a pump 15. The pump 15 is preferably a gear type pump and is carried on an adapter plate 16 bolted to the transmission housing of the vehicle 11 so as to be driven thereby from any suitable power take-off mechanism. A low pressure connection 17 extends from the reservoir 12 to the pump 15 and includes a manually operable valve 18. A high pressure connection 19 extends from the outlet of the pump 15 to an inlet port 20 in the valve 14. The latter is also provided with an

outlet port 21 having a connection 22 to a main working cylinder 23. A piston 24 is reciprocable in the cylinder 23 for effecting a working stroke. The valve 14 also has an outlet port 25 connecting directly to the reservoir 12.

Referring now particularly to Figures 2 through 10, the valve 14 comprises a body portion 26 which has a cored longitudinal cavity 27 into which the ports 20, 21 and 25 lead and a transverse tapered bore 28 for receiving a gate member in the form of a valve plug 29 suitably recessed at 30 and 31 for connecting the various ports and passages in a manner to be described in greater detail later.

The valve plug 29 has a squared extension 32 adapted to receive a valve-operating lever 33. The valve plug is forced into tight engagement with its tapered bore by a spring 34 surrounding a bolt 35 and compressed between the enlarged end of the plug and a cap 36 received within a threaded enlargement of the bore 28. A bracket 37 is formed integrally with the valve body for supporting the structure from any desired hanger.

The valve operating lever 33 is provided with an angularly disposed extension 38 adapted to be received within a yoke 39 pinned to a plunger 40. The plunger 40 is reciprocable, being slidably carried in a guide 41 and a cylinder 42 formed integral with the valve body. The plunger 40 thus constitutes means for actuating the valve plug on the occurrence of certain conditions to be described later.

The cylinder 42 is connected to the discharge port 25 through a passage 43 connecting with a pipe 44 leading through a by-passing chamber 45 to the discharge port 25. The passage 44 is controlled by a valve plug 46 seated on a ball 47. The ball 47 closes a port 48 connecting the passage 44 to the passage 49 leading to the lower part of the chamber 27. The valve plug 46 is preferably seated on the ball 47 by means of a compression spring 50. An adjusting screw 51 for the spring 50 is seated in a bushing 52 threaded into a boss 53 on the valve body 26.

The inlet port 20 of the valve 14 communicates with the cavity 27 through a ball check valve 54. The ball 54 seats against a bushing 55 threaded into the inlet port and is forced against the bushing by a spring 56. As is shown more clearly in Figures 9 and 10, the cavity 27 above the ball 54 is cut away as at 57 to facilitate free passage of oil therethrough. Three lugs 58 projecting between the cutaway portions 57 have lips 59 overhanging the periphery of the inlet port 20. These lips provide a seat for a washer 60 against which the spring 56 bears. The lower portion of the cavity 27 communicates with the bore 28 through a port 61. The upper portion of cavity 27 similarly communicates with the bore 28 through a port 62. The outlet port 21 of the valve 14 communicates with the bore 28 through a port 63. A port 64 connects the by-passing passage 45 to the bore 28.

The operation of the system will now be described, assuming initially that the piston 24 in the cylinder 23 is retracted, that the valve lever 33 is in the position illustrated in Figure 2, in which case the valve plug 29 has the position illustrated in dotted lines in Figure 7. It will also be assumed that the pump 15 is running continuously, being connected directly to the tractor transmission gearing or through a suitable clutch. Under these conditions, oil is drawn from the reservoir 12 through the valve 18, which

is always open except when the system is shut down for repair, and the connection 17. Fluid is delivered from the pump through the connection 19 to the inlet port 20 of the valve. The ball check valve 54 is seated against the bushing 55 with only a comparatively light spring pressure, so that the ball is readily lifted from its seat by the fluid supplied by the pump. When the pump has developed pressure sufficient to raise the ball 54, the fluid flows into the lower portion of the cavity 27 and thence through the passage 49 to the port 48. The ball 47, however, is seated against the port 48 with considerable pressure, and the ball 47 is not shifted from its port until a corresponding pressure is exerted thereagainst. Since the valve plug 29 is in the position shown in solid lines in Figure 7, a clear path is open for the passage of the fluid through the valve and out the port 25. This path includes the port 61, the cutaway portion 31 of the valve plug 29, and the by-passing passage 45 which communicates directly with the port 25. From the port 25, the oil passes directly to the reservoir 12. This circulation of fluid is maintained as long as the pump 15 operates and the valve is maintained in the position shown in solid lines in Figure 7. It will be seen that a continuous circuit for the fluid is provided and that the only pressure applied to the fluid is that necessary to effect the opening of the valve 54.

When it is desired to supply fluid to the cylinder 23 to cause a working stroke of the piston to raise a tilting body or operate a bulldozer or scraper, depending upon the particular application, the valve plug 29 is shifted to the position shown in Figure 6 by moving the lever 33 to the dotted position 65 shown in Figure 2. The plunger 40 is thereby lowered to the dotted line position 66 shown in Figure 4. The cutout portion 31 of the valve plug 29 thus connects the port 61 and port 63, as shown in Figure 6, so that the fluid, after passing the check valve 54, passes through the port 21 and, through the connection 22, to the cylinder 23. At this time, the fluid exerts a pressure against the ball 47, but because of the adjustment of the spring 50, the ball is not moved from its seat. The circulating fluid is thus diverted to the cylinder 23 and, with continued operation of the pump, the pressure on the fluid builds up until the piston 24 is extended to perform the desired operation.

When the piston 24 has been extended to the limit of its movement, it is obvious that further operation of the pump 15 will cause a further increase in the pressure on the fluid. The spring 50 is preferably adjusted so that when the piston 24 has reached the limit of its stroke, the pressure on the fluid will be almost sufficient to raise the ball 47. A slight increase in the pressure, therefore, causes the displacement of the ball 47 from its seat 48.

When the ball 47 is shifted from its seat 48, fluid under pressure flows against the valve plug 46 and, because of the larger area of the latter compared to that of the port 48, the plug 46 is moved positively to the left, as viewed in Figure 4. The first result of this movement is to cut off the passage 44 from the passage 43, as soon as the left-hand end of the plug 46 reaches the wall of the passage 44. All connection to the outlet port 25 through the passages 44 and 45 is thus cut off. On further movement of the plug 46, the lower portion of the right-hand edge thereof passes away from the wall of the passage 43 to permit fluid under pressure to flow through

the latter against the end of the plunger 40. At this time, the passage 44 is still cut off from the high pressure source by means of the upper portion of the plug 46. It will be observed in Figure 4 that the lower portion of the plug 46 uncovers an opening from the port 43 into the passage 43 before the upper portion of the plug passes away from the wall of the passage 44.

As soon as oil under pressure is supplied to the cylinder 42, the plunger 40 is raised to shift the valve lever back to the solid line position of Figure 2, so that the valve plug 29 resumes the position shown in solid lines in Figure 7. As previously stated, when the valve plug is in this position, a by-passing circuit for the fluid delivered by the pump is afforded through the passage 45. The movement of the valve, therefore, relieves the pressure on the fluid in the lower part of the cavity 27 and permits the valve to resume its closed position. In this position, an open path is provided for the oil in the cylinder 42 through the passages 43, 44 and 45 to the outlet port 25, so that when the valve lever is further shifted, the oil in the cylinder 42 can escape through the low pressure outlet.

In addition to relieving the pressure on the fluid, the movement of the valve effected by the piston 40 closes the port 63 to prevent outflow of the fluid in the cylinder 23. Release of the load is thus prevented and all working parts are maintained in operating position until further movement of the valve is effected. When it is desired to release the fluid trapped in the cylinder 23, the valve lever is shifted to the dotted line position 67 shown in Figure 2. When the valve lever is moved to this position, the arm 38 thereof leaves the yoke 39 and the valve plug 29 assumes the position shown in dotted lines in Figure 7. It will be apparent from Figure 7 that in this position the valve permits the fluid in the cylinder 23 to flow through the outlet port 25, and at the same time the by-passing circuit through the passage 45 is not interrupted. Assuming the load operated by the piston 24 to be a tilting vehicle body, the lowering of the body causes the fluid trapped in the cylinder to be discharged therefrom into the outlet port 25, from which it flows into the reservoir 12. Restoration of the lever 33 to the raising position (shown at 65 in Figure 2), resets the piston 40. Any suitable operating mechanism, such as links and levers, can be provided, facilitating control of the valve 14 by the operator of the tractor or other vehicle. This is desirable, especially in the case of vehicular installations in which the valve would generally be positioned adjacent the transmission gearing in a somewhat inaccessible position.

After the cylinder 23 has been emptied, it is not necessary for the valve to be further shifted, unless it is desired to effect another working stroke of the piston 24. In other words, in both the holding position of the valve shown in solid lines in Figure 7 and the lowering position shown in dotted lines in the same figure, the by-passing circuit for the fluid is maintained open.

It will be apparent that the invention described is characterized by numerous advantages over anything known to the prior art. In the first place, the operation of the valve from the raising to the holding position is entirely automatic, depending on the pressure developed in the rais-

ing operation. The movement of the valve member is positively effected by the same fluid pressure which raises the load. Simplicity and ease of adjustment also characterize the structure described. There is no possibility of accidental movement of the valve by the automatic control mechanism, and, because of the positive actuation of the valve, failures thereof are practically eliminated. Another advantage is that if automatic shifting of the valve is prevented for some reason, such as by the operator holding the lever 33 or if the latter is jammed, increasing pressure in the valve body will cause the valve plug 46 to move back sufficiently to open the passage 43 to the low pressure path including the passage 44 and the by-pass 45.

Although I have described but one present preferred embodiment of the invention, it is obvious that constructions other than that described may be resorted to without sacrificing the advantages mentioned. For this reason, the invention is not to be limited to the specific embodiment disclosed, since any changes therein may be made without departing from the scope of the appended claims.

I claim:

1. In a valve, a valve body having a tapered bore, a plug with segmental recesses rotatable in said bore, inlet, outlet and exhaust ports for fluid communicating with said bore, said plug having a delivery position in which one of said recesses connects said inlet and outlet ports, a holding position in which said outlet port is closed and said inlet and exhaust ports connected, and an exhaust position in which said recess connects the inlet and outlet to the exhaust, and means responsive to the pressure in the body for shifting the valve plug from its first position to its second position, comprising a piston free of but engageable with said plug.

2. In a hydraulic system, the combination with a pump, a tank for supplying fluid to the pump, and a hydraulic jack adapted to be actuated by fluid delivered by the pump, of a valve for controlling the flow of fluid from the pump to the jack, said valve having ports connected to the pump, jack, and tank, and a movable member controlling the connection of said ports to each other, and means responsive to the increased pressure built up by the pump on the completion of the jack movement, for shifting said member to close the jack port of the valve and connect the pump and tank ports.

3. In a hydraulic system, the combination with a pump, a tank for supplying fluid to the pump, and a hydraulic jack adapted to be actuated by fluid delivered by the pump, of a valve for controlling the flow of fluid from the pump to the jack, said valve having ports connected to the pump, jack, and tank, and a movable member controlling the connection of said ports to each other, means responsive to the increased pressure built up by the pump on the completion of the jack movement, for shifting said member to close the jack port of the valve and connect the pump and tank ports, said means comprising a piston and cylinder, and a relief valve subject to the pressure at the pump port for admitting fluid to the cylinder.

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