Feb. 13, 1934. P. S. SHIELD 1,946,715

HYDRAULIC OPERATOR

Filed Feb. 5, 1931 4 Sheets-Sheet 1

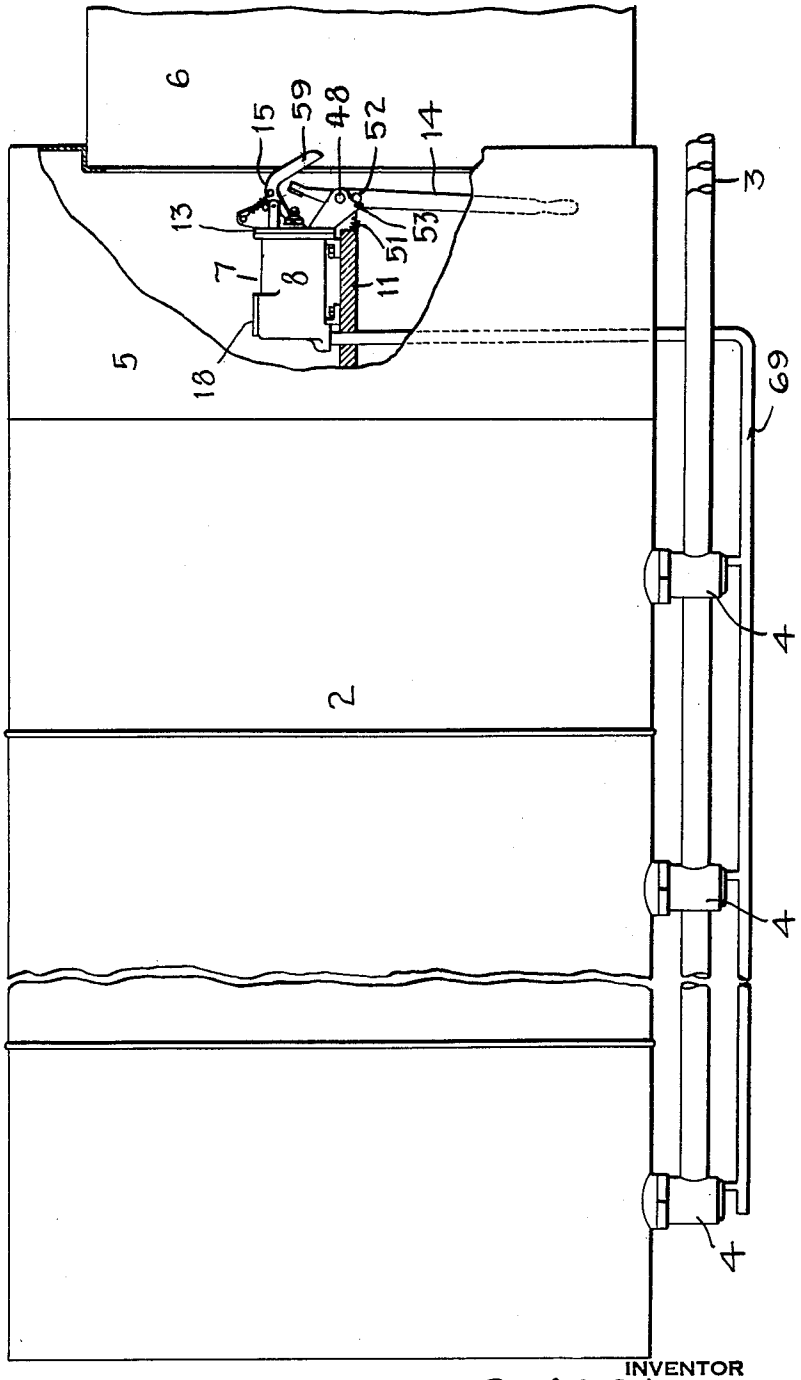


Fig. 1.

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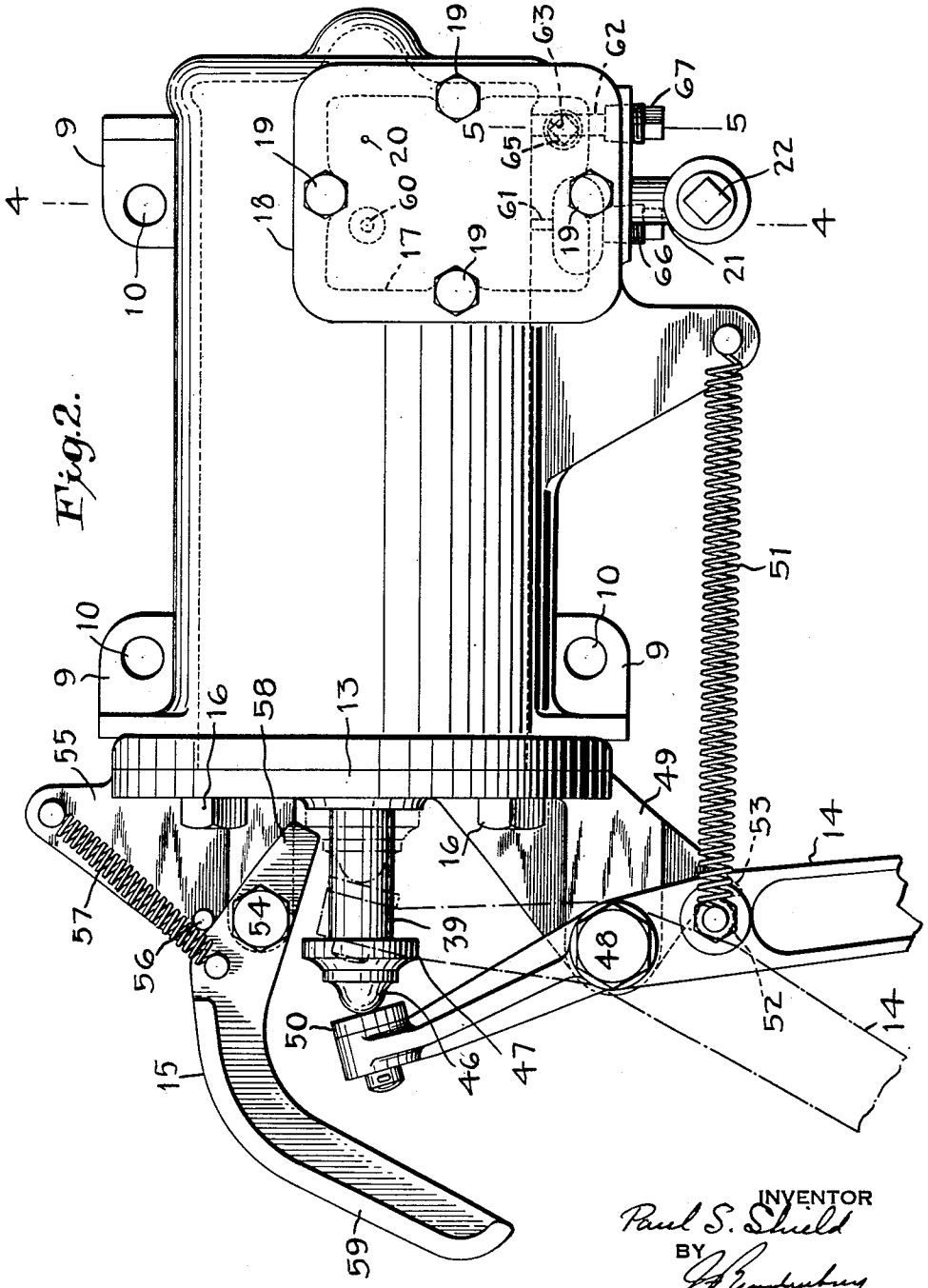


Fig.2.

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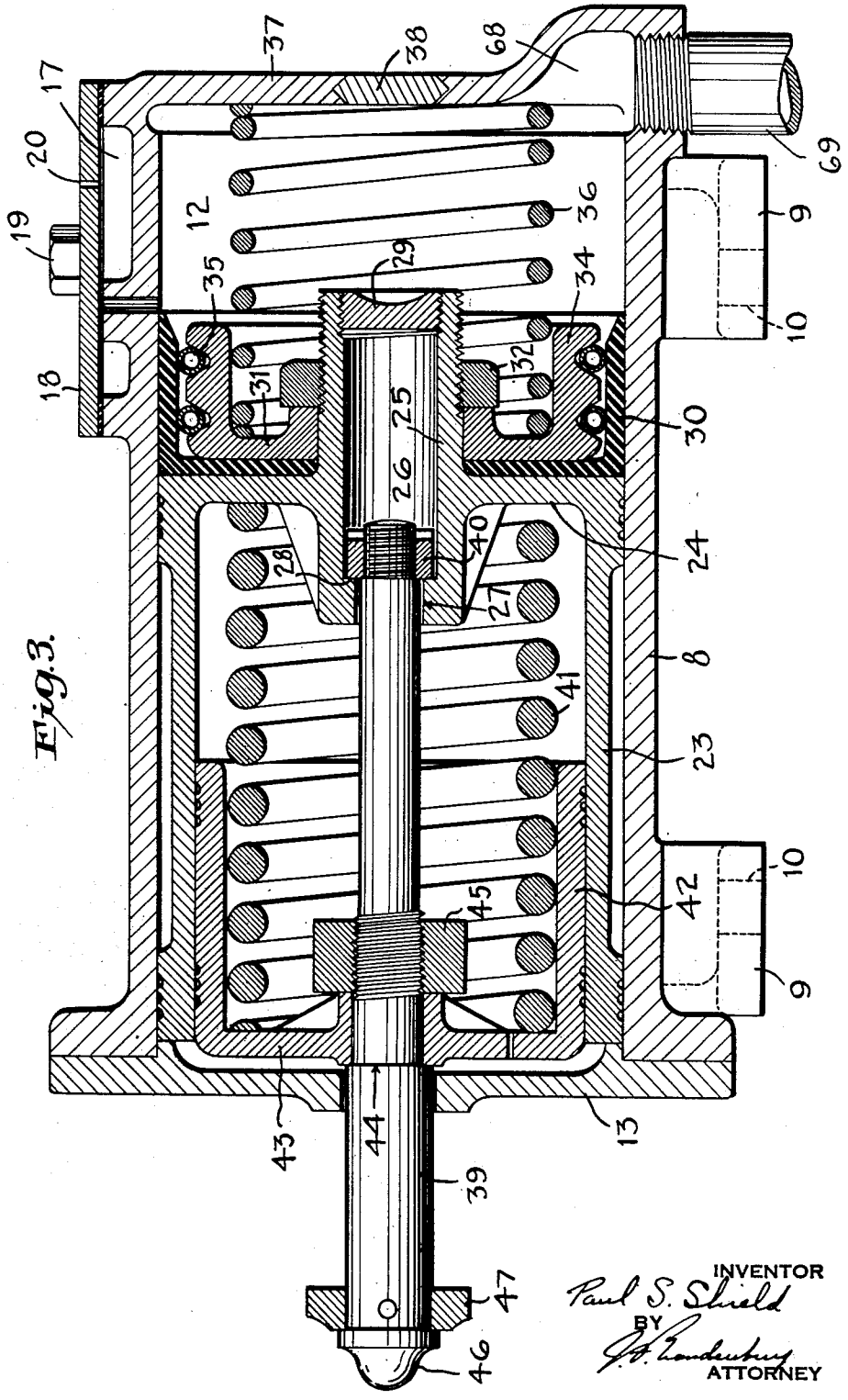


Fig. 3.

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Fig. 4.

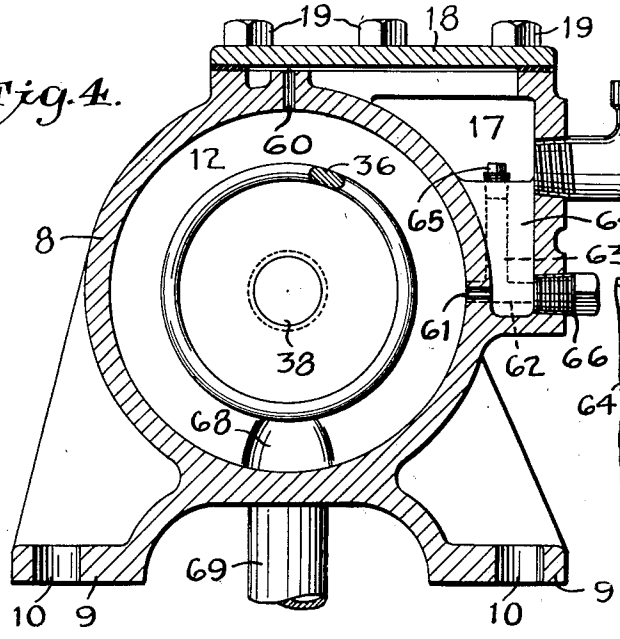


Fig. 5.

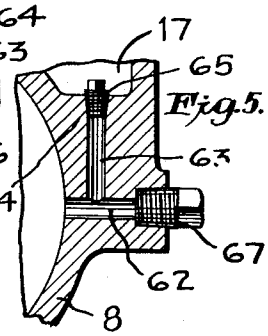
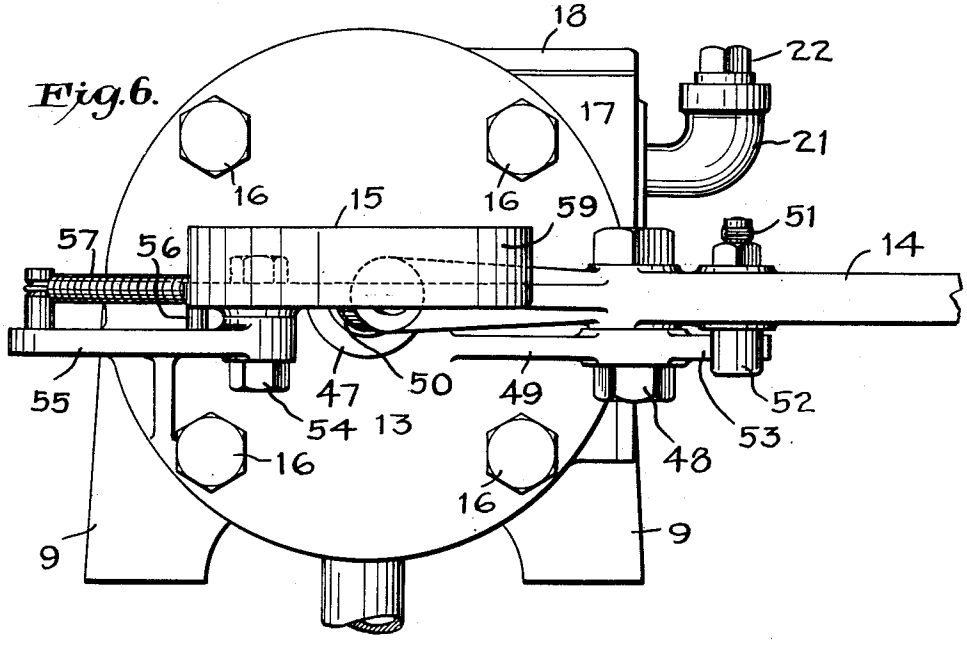


Fig. 6.



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UNITED STATES PATENT OFFICE

1,946,715

HYDRAULIC OPERATOR

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5 Claims. (Cl. 60—54.6)

This invention relates to piston and cylinder devices for forcing liquid through ducts to hydraulically operated valves, or other hydraulically operated agencies, when the piston is advanced, the amount of liquid thus displaced being returned to the cylinder when the piston is returned to its normal position.

Objects of the invention are simplicity of construction, manufacturing facility, durability, compactness, ease of operation, and the provision of long, broad bearings to insure against cocking and sticking. Another object is to incorporate a provision which limits to a safe maximum the amount of pressure that can be transmitted through the liquid, which enables a standard operator to operate varying numbers of subject devices, and which permits the operating rod to be latched always at the same point irrespective of the extent of travel of the working piston.

In the preferred embodiment of the invention there is a telescoping arrangement of two pistons one within the other, one of these being a long working piston guided in the cylinder and the other being a spring-abutment piston which is guided inside the working piston and which is connected with an operating rod. Reacting between and enclosed within these pistons there is a spring confined under compression. The operating rod is preferably utilized to limit the expansive effect of this spring.

A further object of the invention is to provide a simple latch for locking the operating rod in its forward position. Still another object is to cause this latch to serve as an interlock between the operator and the door of a box in which the operator may be disposed. Another object is to provide the working chamber of the cylinder with a plurality of passages communicating with a reservoir to insure the venting of air and replenishment of the system with liquid, and to facilitate filling.

Other objects, features and advantages of the invention will be apparent to those skilled in the art from a consideration of the accompanying drawings and the following description.

In the said drawings, illustrating the preferred embodiment of the invention:

Fig. 1 is a side elevation of a multiple-compartment truck tank equipped with bottom valves which are operated hydraulically. The hydraulic operator is shown inside a box, the wall of which is partly broken away and the door of which is open. A portion of the tank intermediate its ends is broken out.

Fig. 2 is a plan view of the operator, the operating lever and the operating rod being shown in normal positions in full lines and in actuated positions in dot and dash lines;

Fig. 3 is a vertical, longitudinal section through the operator;

Fig. 4 is a cross-section taken on the line 4—4 of Fig. 2;

Fig. 5 is a fragmentary section taken on the line 5—5 of Fig. 2; and

Fig. 6 is a rear elevation of the operator.

In Figs. 2 and 6, the operating lever and the latch are disposed in a horizontal plane instead of in a vertical plane as in Fig. 1.

Fig. 1 illustrates a multiple-compartment truck tank 2. Each compartment of the tank has a bottom outlet communicating with one of the delivery pipes 3, and each outlet is guarded by a normally-closed valve. The internal arrangements of the valves are not illustrated, since they form no part of the invention, but they are sufficiently represented by the outlet bodies 4. The valves will be understood as being hydraulically operated, by means of small piston and cylinder devices, or by metal bellows devices, associated with the several valves. In the case of metal bellows devices, particularly, it is desirable to limit the pressure that can be applied to the devices, and that is provided for in the manner described hereinafter.

The tank is shown provided with a box 5, which may be at the rear end of the tank and which has a door 6. Such a box may serve for carrying buckets or other equipment and when present is also utilized to house the operator 7.

The operator is designed to be mounted with its cylinder 8 in a horizontal position, and for this purpose the under part of the cylinder casting is formed with feet 9 having bolt-holes 10, by means of which it can be fastened to a shell 11 or other support.

The working chamber 12 is located in the forward part of the cylinder. Fastened to the rear end of the cylinder is a head 13 carrying an operating lever 14 and a latch 15. The screws 16 securing this head to the cylinder are so arranged that the head can be fastened in either of two positions representing an angular displacement of 90°. This enables the handle to be disposed either vertically, as in Fig. 1, or horizontally as in Figs. 2 and 5.

A make-up reservoir 17 extends partly over the top of the cylinder and downward at one side, at the region of the working chamber. The top of the reservoir is closed by a plate 18 secured by screws 19, this cover being provided with a small air vent 20. An elbow 21 screwed

into the side of the reservoir and provided with a removable plug 22 serves for filling.

Guided on the inside of the cylinder is a long trunk piston 23, the rear end of which normally abuts a stop on the head 13. The body of this piston is more than half the length of the cylinder, giving a very long and broad bearing which prevents any possible cocking of the piston and contributes materially to ease and certainty of operation.

Formed integral with the end wall 24 of this working piston is a central, hollow boss 25, which extends both forwardly and rearwardly from said wall. The chamber 26 inside this boss has an opening 27 at the rear end, with a shoulder 28 formed by the difference in the diameters between the chamber and the opening. The forward end of said chamber is tightly closed by a plug 29, which keeps oil, which is the liquid used in the system, from escaping by this route from the working chamber to the space in the back part of the operator, and also prevents passage of air in the reverse direction.

A cup leather 30 is applied against the front of the piston 23, around the forward projection of the boss 25, and a cup-leather retainer 31 is slipped over the boss and is held by a nut 32, which is screwed onto threads 33 formed on the outside of the boss. The cup-leather retainer is of angular section, and its circumferential portion 34 extends forward inside the cup-leather for the purpose of sustaining the latter. Grooves are formed in said circumferential portion to retain springs 35 which exert a gentle outward pressure against the cup-leather to aid in holding the packing tight against the wall of the cylinder. This is of advantage more particularly in connection with the rearward stroke of the piston, since it insures against any air finding its way past the packing into the working chamber at that time. The said springs are helical springs of such length that when they are curved in a circle, with the two ends of each spring abutting, the outside diameter of the springs tends to be larger than the inside diameter of the cup-leather.

A spring 36 in the working chamber, reacting between the closed end 37 of said chamber and the cup-leather retainer 30, serves to return the piston, though the piston may be forced back by the oil expelled from the servo-motor devices of the valves 4 by the usual springs provided for closing said valves (such springs not being shown since they are part of the standard practice in connection with tank valves).

In the wall of the working chamber there is a fusible plug 38 to release the fluid pressure in event of a fire occurring when the valves are open. This is a feature already known. An operating rod 39 passes loosely through an opening in the back head 13 and extends forward into the chamber 26, where its end is threaded and carries a nut 40 to abut the shoulder 28. The length of the chamber 26 is such as to permit the rod and its nut to execute a free movement relative to the piston, if the latter should remain stationary, which permissible movement is as great as the maximum movement of the working piston that can be produced by the thrust of the rod transmitted through a spring 41.

The said spring 41 is confined under considerable initial compression between the front end of the working piston 23 and an abutment formed by the rear end of an inner piston 42. Said inner piston has a cylindrical wall which extends forward and is guided in the long cylindrical wall of the working piston. The rear end 43 of the inner piston has a central opening enabling it to be assembled over the rod 39, and said end is clamped between a shoulder 44 on the rod and a nut 45 screwed on the rod.

The expansive force of the spring 41 seeks to force the two pistons apart, and this expansion is limited by the nut 40 on the forward end of the operating rod abutting the shoulder 28, the operating rod thus serving as a tension connection, which in cooperation with the spring 41, keeps the pistons in a definite normal relation to each other. The spring 41 is comparatively powerful, and unless excessive resistance is encountered, acts as a full thrust connection, causing the pistons to move as a unit. If, however, the valves should fail to open for any reason, the spring 41 will yield, and since the pistons can not bottom on each other or the rod against the working piston, the pressure that can be placed on the operating liquid and through it transmitted to the fluid-pressure devices of the valves, will be limited to a safe value determined by the maximum compression of the spring that can be produced. This same spring also enables a standard operator to be used with any number of valves ranging from one to six, for example. With a lesser number of valves to be operated simultaneously, the amount of oil to be displaced from the working chamber will be less than for the maximum number. Consequently the working piston 23 will be advanced for only part of its maximum stroke, and when the piston has moved as far as it should go, the increased resistance will result in yielding of the spring 41, after which the inner piston 42 and the rod 39 will move relatively to the now stationary working piston. The safe limit of pressure to be imposed on the working fluid is intended in this instance to be twenty-five pounds, that being given by way of example.

The rear end of the rod 39 has a rounded knob 46 and fixed to the rod just in front of this knob is a latch-collar 47. This collar also serves as a stop to abut the rear head 13 and limit the distance through which the rod can be pushed in.

The operating lever 14 previously referred to is pivoted on a bolt 48 which is held in a bracket 49 extending from the head 13. The lever is not fastened to the operating rod 39, but the end of its short arm has a button 50 to bear against the knob 46. After the lever has been operated to push the operating rod in and the rod has been caught in this position by the latch 15, the operator releases the lever, which is then drawn away from the rod by a spring 51. Naturally the force of gravity may be utilized in place of this spring. The movement of the lever under the action of this spring is limited by a stop pin 52 on the lever coming to rest against an abutment 53 on the bracket 49.

The fact that the operating lever is unfastened to the operating rod and that the latter is latched independently of the lever is important, since it safeguards the attendant from injury, and also guards against the handle striking violently against anything in the box when the latch is released and the piston assembly and operating rod are returned by the spring 36, or also by the spring 41 if the latter has been compressed beyond its initial compression. When the rod 39 flies back, the lever is away from it and is not moved.

The latch 15 is pivoted on a bolt 54 held in another bracket 55 on the head 13. This latch is

normally held against a stop 56 by a spring 57. In this position the nose 58 of the latch is in proper relation to be cammed out of the way by the collar 47 on the forward stroke of the rod 39, and after the collar passes it to fall behind the collar and block any return movement of the rod. The latch has a curved tail or handle 59 by which the latch can be disengaged from the collar when it is desired that the operating rod and piston assembly shall return.

This latch is also utilized to insure closing of the tank valves before the tank vehicle is driven away after making a delivery. The driver can be relied on to close the door 6 of the box 5 before starting his vehicle, and accordingly the operator is so positioned in the box and the tail of the latch is so formed and proportioned that when the latch is in position locking the operator in its actuated condition, which is the valve-open condition, the tail will project out through the door opening into the path of the closing movement of the door. Consequently, either the driver is obliged to push the latch out of the way, releasing the piston assembly, before closing the door, or else,—and this amounts to the same things,—the door in closing will move the latch to produce the same result. When the latch is released the valves are automatically closed.

Door interlocks are known in connection with tank valve controls, but as far as I am aware a latch of this character for a hydraulic operator has not been employed for that purpose.

An air vent opening 60 is made through the top of the wall of the cylinder in the zone which lies just in front of the working piston, or to be more precise its cup-leather 30. This vent opens into the air space in the top of the reservoir 17, the liquid level in which is determined by the top of the elbow 21. This vent allows all air to escape from the working chamber 12 when the system is filled with oil, and during the use of the operator continues to vent any air which may enter the chamber, thereby insuring that the chamber will remain full of oil.

Any gradual wastage of liquid from the system is automatically replaced from the reservoir 17. For this purpose a hole 61 is formed through the wall of the cylinder at approximately the horizontal diameter. This hole lies in the same zone as the vent hole 60 and communicates with the lower pocket of the reservoir.

The hole 61 could serve for the filling of the working chamber from the reservoir at the intial filling, or in event of refilling, but it is desirable that the holes 60 and 61 be rather small in order to minimize the initial idle portion of the forward stroke of the piston, that is to say the movement required for the packing to cover these holes. This would make filling of the working chamber through the hole 61 slow, and it has accordingly been deemed desirable to drill a large filling opening 62 into the working chamber, and to connect this hole with a large vertical passage 63 in a boss 64 which juts onto the lower part of the reservoir. The upper end of this vertical passage opens into the reservoir, and is open when the system is filled, and after filling is closed by a plug 65.

For practical reasons the holes 61 and 62 have to be drilled from the outside of the reservoir, and these openings through the side wall of the reservoir are permanently closed by plugs 66 and 67.

The working chamber of the cylinder has a suitable outlet 68 at its front end, and a pipe 69 is shown connected with this outlet, this pipe representing the duct or ducts which lead to the pressure chambers of the valves or other devices to be operated. In Fig. 1 the pipe 69 is shown branched to the several valves 4.

The operation of the illustrated embodiment of the invention will now be briefly described. It will be assumed that the working chamber 12, the piping 69 and the fluid-pressure chambers of the several valves have all been filled with liquid to the exclusion of air, and that the reservoir 17 is also approximately full of oil, an air space being preferably left however in the top of this reservoir. In the normal condition of the apparatus, the piston and operating rod assembly of the operator are in the rearward position, and the subject valves are closed. To open a valve or valves the attendant grasps the handle 14 and pulls it so as to force the rod 39 forward. Unless more than the ordinary resistance is encountered, the spring 41 will not yield and the two pistons 23 and 42 will be advanced as if they were rigidly connected together. If at the start of the movement, or during the movement, the pressure on the operating liquid should exceed the initial compression of the spring 41, this spring will yield and the piston 42 and the rod 39 will move relatively to the working piston 23. The maximum pressure that can be applied to the liquid is represented by the amount of compression of the spring 41 that would result if the working piston should have failed to move at all by the time the operating rod and the inner piston 42 were advanced as far as they can go, this being limited by the collar 47 acting as a positive stop.

When the rod 39 is pushed all the way in, it is caught by the latch 15, and the piston assembly is consequently held in a forward position. This keeps the liquid expelled from the working chamber from returning to said chamber, and the valve or valves which were opened therefore remain open. In order to close the valves, the attendant releases the latch 15, or closes the door 6 and thereby displaces the latch, whereupon the piston and rod assembly automatically return to the original position.

The purpose and functioning of various features of the device have been explained in connection with the description of the construction, and it is thought unnecessary to repeat them.

While a preferred form of the invention has been described in sufficient detail for a clear understanding of one concrete embodiment, it will be understood that various changes may be made without departing from the scope of the invention more particularly pointed out in the claims

I claim:

1. A hydraulic operator comprising a cylinder, a piston therein, a spring for returning the piston, an operating rod having operative connection with said piston, a collar on the rear portion of said rod, an automatic latch to engage with said collar when the rod is pushed in, an operating lever arranged to act on the rear end of said rod, said lever being unfastened to said rod, and a spring urging said lever away from said rod.

2. A hydraulic operator comprising a cylinder, a piston therein, an operating rod extending through the end of the cylinder and having a yielding operative connection with said piston, a collar on the rear portion of said rod, an automatic latch to engage with said collar when the

rod is pushed in, and an operating lever unfastened to said rod and arranged to exert a thrust thereon.

3. A hydraulic operator comprising a horizontal cylinder, a reservoir, and a working piston in said cylinder, said cylinder having two openings through its wall, both openings being located in front of the piston when the latter is in its rearmost position, one of said openings being an air vent located at the top of the cylinder wall, and the other opening being at a lower level so that liquid passes through this opening between the working chamber of the cylinder and the reservoir.

4. A hydraulic operator comprising a horizontal cylinder, a working piston therein, a reservoir formed outside of said cylinder and extending downward at one side thereof, and a cover for said reservoir, said cylinder having two openings through its wall in the zone which lies just front of the piston when the latter is in its rearmost position, one of said openings being an air vent located at the top beneath the cover of said reservoir, and the other opening being at a lower level so that liquid passes through this opening between the working chamber of the cylinder and the reservoir.

5. A hydraulic operator comprising a horizontal cylinder, a working piston therein, a reservoir formed outside of said cylinder and extending downward at one side thereof, and a cover for said reservoir, said cylinder having two openings through its wall in the zone which lies just front of the piston when the latter is in its rearmost position, one of said openings being an air vent located at the top beneath the cover of said reservoir, and the other opening being at a lower level so that liquid passes through this opening between the working chamber of the cylinder and the reservoir, there being an additional passage of relatively large size adapted to form a filling communication between the working chamber and the reservoir, and a plug closing said passage.

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