

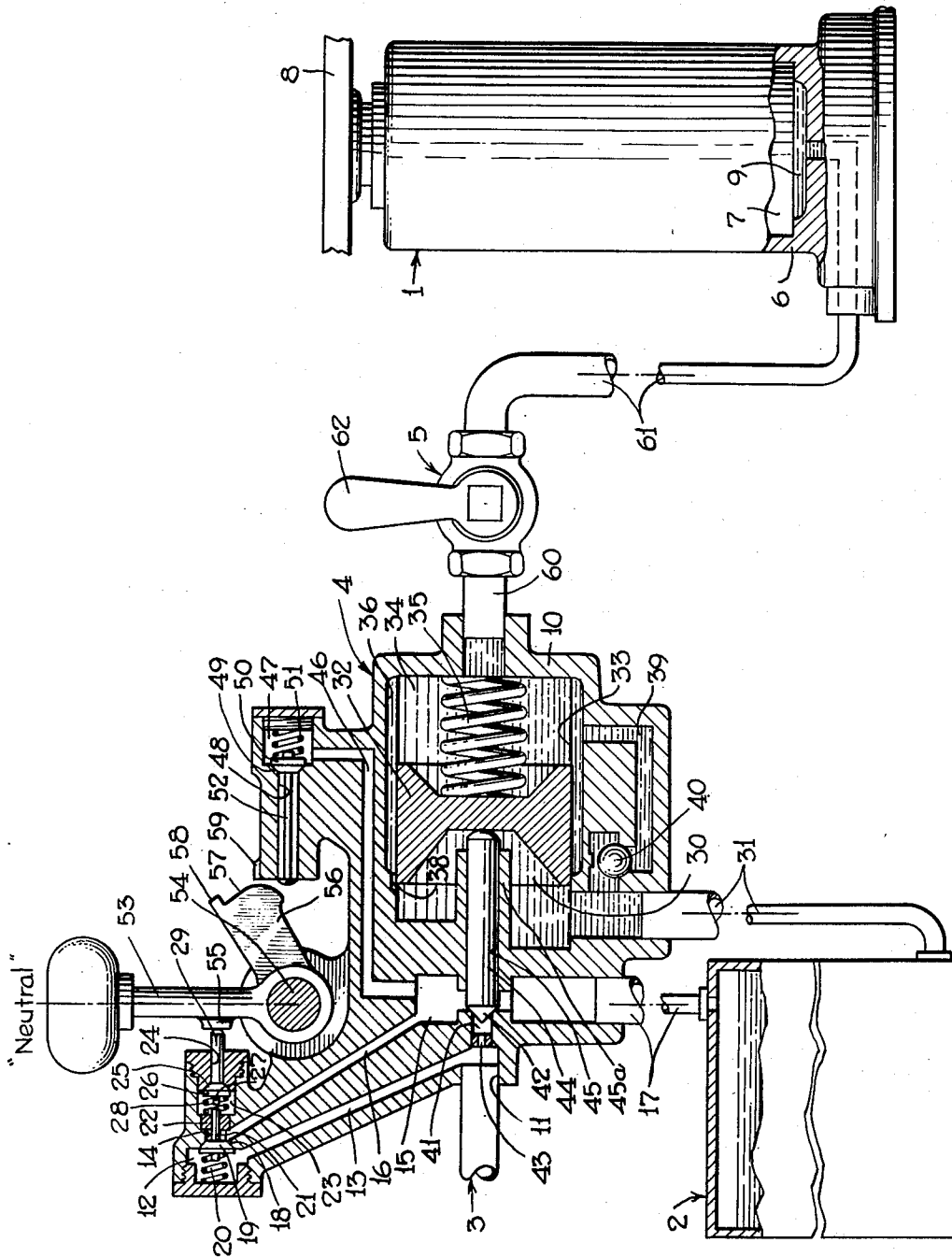
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FLUID PRESSURE CONTROL APPARATUS

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FLUID PRESSURE CONTROL APPARATUS

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This invention relates to fluid pressure operated control apparatus, and more particularly to hydro-pneumatic control apparatus adapted for use with hydraulic hoists, elevators and the like.

The principal object of my invention is to provide an improved control apparatus of the above type, which is relatively simple in construction, economical in the use of compressed air and which minimizes the time required of an operator for controlling its operation.

Other objects and advantages will become apparent from the following more detailed description of the invention, taken in connection with the accompanying drawing in which the single figure is a side elevation view, partly in section and partly in outline, of a control apparatus embodying my invention, shown for sake of illustration in association with a hoisting apparatus.

Description

Referring to the drawing, the improved control apparatus for controlling operation of such as a hydraulic hoist 1 comprises a reservoir 2 containing hydraulic fluid for operating said hoist; a source of compressed air, such as a supply pipe 3, for pressurizing the hydraulic fluid in reservoir 2; an operator's control valve device 4 for controlling admittance of compressed air from the pipe 3 to the reservoir 2 for displacement of pressurized hydraulic fluid from the reservoir 2 to the hoist 1; and an operator's safety control valve device 5 interposed between the valve device 4 and hoist 1 for closing communication of hydraulic fluid between the valve device 4 and the hoist 1, for safety and other reasons which will be hereinafter stated.

The hoist 1 may be of well-known construction comprising a vertically disposed cylindrical casing 6 within which is slidably mounted the usual cylindrical piston 7. A platform 8 for supporting an automotive vehicle or other object to be elevated is operably attached to the upper face of the piston 7, while the lower face of said piston is subjected to pressure of hydraulic fluid in a chamber 9, displacement of which fluid controls elevation and descent of the platform 8 in the well-known manner.

The operator's control valve device 4 comprises a casing 10 having a suitable opening 11 formed therein to threadably accommodate the supply pipe 3 for constant supply of compressed air to a supply chamber 12 by way of an internal passage 13 provided in said casing. A central longitudinal opening 14 is formed in one portion of

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the casing 10 to establish communication between the chamber 12 and a chamber 15 by way of a passage 16, the chamber 15 being in constant communication with the upper end of the hydraulic fluid reservoir 2 by way of a pipe 17.

The supply chamber end of opening 14 is tapered outwardly to form a tapered seat 18 to accommodate seating engagement of a tapered supply valve 19 which is disposed in the supply chamber 12 for controlling communication between said chamber 12 and opening 14. A compression spring 20 is suitably arranged in the chamber 12 to urge movement of the valve 19 into engagement with its seat 18 to close off chamber 12 from opening 14. A stem 21 of substantially smaller diameter than the opening 14 and centrally disposed therein is attached at its one end to the valve 19 to serve as a means for unseating said valve to open the chamber 12 to opening 14. The other end of stem 21 is slidably guided within, and preferably extends exteriorly through a central bore in a bushing 22 closing the opposite end of opening 14. A chamber 23 is provided on the side of bushing 22 opposite the opening 14, and at the opposite end of said chamber 23 is a longitudinal opening 24 coaxially aligned with the stem 21 and extending through the casing 10 to the exterior thereof. The interior end of opening 24 tapers outwardly into the chamber 23 to form a tapered seat 25 to accommodate seating engagement of a sealing valve 26 to prevent fluid under pressure in opening 14 from escaping to atmosphere by leakage between the stem 21 and the bore of bushing 22; the valves 19 and 26 being coaxially aligned and seatable in the same direction. A tit 27, coaxially aligned with the stem 21 and adapted at one end for operative abutting engagement therewith, is operably attached at its other end to the valve 26. A compression spring 28 is suitably arranged in the chamber 23 in encirclement of the tit 27 to urge movement of the valve 26 into seating engagement with its seat 25. An operating stem 29, slidably guided within the untapered part of opening 24, is operably attached at its one end to the valve 26, while its opposite end projects exteriorly of the casing 10 to permit actuation of said stem and hence of said valve 26 and the valve 19, the latter valve being operable by the former through the medium of the tit 27 and stem 21, as will be hereinafter described in detail.

The reservoir 2, which may be of any well-known construction, is partially filled with hydraulic fluid to provide clearance volume at its

upper end to receive compressed air deliverable thereto from the chamber 15 via the pipe 17 to pressurize said hydraulic fluid and cause same to flow to a chamber 30 provided in the casing 10 of valve device 4, by way of a pipe 31 connecting chamber 30 with the bottom of said reservoir.

A piston valve 32 for effecting operation of a compressed air by-pass valve 42, is slidably mounted in a bore 33 formed within the casing 10 and separates the chamber 30 at its one side from a chamber 34 at its opposite side; both of said chambers being filled with hydraulic fluid from reservoir 2 as will hereinafter be brought out in detail. The piston valve 32 is thus subject opposingly to hydraulic fluid in the chambers 30 and 34 and is also subject to action of a compression spring 35 suitably arranged in the chamber 34 to urge movement of said piston valve toward the chamber 30. Grooves 36 are formed longitudinally in the circumferential wall of bore 33 to permit communication of hydraulic fluid between the chamber 30 and the chamber 34; said grooves extend from the chamber 34 end of bore 33 toward the chamber 30 end of said bore for such a distance that when the piston valve 32, under action of spring 35, assumes a left-hand limit position, in which it is shown in the drawing, the periphery of said piston valve seals off such communication between chambers 30 and 34 via said grooves, whereas such communication is effective when said piston valve is moved out of its said limit position and toward the chamber 34. A leak port 38 provided in the circumferential wall of the bore 33 is so disposed that when the piston valve 32 is in its previously mentioned limit position, restricted communication is established between one of the grooves 36 and the chamber 30, for purposes hereinafter to be described. A hydraulic fluid by-pass 39 connects the chamber 34 with the chamber 30 and is provided with a ball check valve 40 suitably disposed to prevent flow of fluid from chamber 30 to chamber 34 via said by-pass 39 but to allow for flow through said by-pass in the reverse direction for reasons which will become apparent from subsequent description of operation.

An air by-pass opening 41, coaxially aligned with the piston valve 32, is formed in the casing 10 to establish communication between the chamber 15 and passage 13 in proximity to the opening 11 to permit compressed air to flow from supply pipe 3 directly into chamber 15 in by-pass of the chamber 12, valve 19 and passage 16, for reasons to be explained subsequently. A conical air by-pass valve 42 is disposed in chamber 15 and adapted for seating engagement against the wall of the opening 41 to seal said opening. A choke 43 is provided at the passage 13 end of opening 41 to restrict the flow of compressed air therethrough and yet permit sufficient pressure to be built up within the unchoked portion of opening 41 to unseat the valve 42 in the manner hereinafter to be described.

The valve 42 is operably attached to one end of a cylindrical stem 44 which is slidably and suitably accommodated within an opening 45 formed in casing 10 in coaxial alignment with the opening 41 and piston valve 32. The opening 45 extends through a wall separating chambers 15 and 30 and through a boss 45a formed integrally with said wall and projecting centrally into chamber 30 in the direction of piston valve 32 to provide proper guidance and support of the stem 44 without unnecessary thickness of the

aforementioned separating wall. The adjacent face of piston valve 32 is recessed to accommodate the boss 45a when said piston valve is in its left-hand limit position. The stem 44 extends exteriorly of the opening 45 into abutment with the recessed portion of piston valve 32 and is of such length that the valve 42 will be seated by action of spring 35 on the piston valve 32, when said piston valve is in its previously mentioned limit position.

An internal passage 46 formed in casing 10 connects chamber 15 with an exhaust chamber 47. A suitable longitudinal opening 48 is provided in casing 10 to establish communication between chamber 47 and the atmosphere. The exhaust chamber end of opening 48 tapers outwardly into the exhaust chamber 47 to form a tapered seat 49 to accommodate seating engagement of a tapered exhaust valve 50, which is urged into its normal seated position by action of a compression spring 51 suitably arranged in chamber 47. The exhaust valve 50 is operably attached to one end of a fluted cylindrical stem 52 slidably accommodated within the untapered portion of the opening 48, while said stem at its opposite end projects exteriorly of the casing 10 to enable actuation of said stem, and hence of said valve, in the manner hereinafter to be described.

The valve device 4 is provided with an operator's control lever 53 disposed intermediate and normally spaced from the projecting ends of valve stems 29 and 52. The lever 53 is pivotally mounted at one end about a pin 54 supported within an appropriate bore in the casing 10. The axis of pin 54 extends in a direction at right angles to the parallel, but not necessarily coaxially aligned axes of both stems 29 and 52 and to the axis of symmetry of the lever 53 so that lever 53 is pivotally movable toward and away from the projecting ends of said stems to serve as a means for actuating said stems. An operating lug 55, formed on one side of lever 53 and intermediate its ends, is disposed for operative abutting engagement with the valve stem 29.

A cam 56 for actuating the exhaust valve 50 is operably connected to the pivot end of said lever and projects outwardly therefrom at an acute angle relative to said lever. The lever 53 has a "Neutral" position, in which it is shown in the drawing, in which position the lug 55 may abut, but exert no force on the stem 29 so that the valve 26 is therefore seated, while the cam 56 is out of contact with stem 52 and the exhaust valve 50 is therefore also seated. The cam 56 has a curved operating surface 57 at its projecting end. The cam operating surface 57 is adapted for slidable transverse contact with the valve stem 52 during turning movement of lever 53 in a clockwise direction out of its "Neutral" position for displacement of said stem interiorly of the casing 10 against action of spring 51 to unseat valve 50. A stop finger 58 projecting transversely of surface 57 at its upper end is provided for contact with a stop surface 59 formed in the casing 10 to define a limit position of movement of cam 56 and thereby of handle 53, in which position the exhaust valve 50 is held off its seat through the medium of stem 52 in engagement with said cam.

The operator's safety control valve 5 may be of any well-known construction, such as a plug cock, connected at a supply side to chamber 34 of valve device 4 by way of a nipple 60 and connected at a delivery side to the chamber 9 of hoist 1 by

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way of a pipe 61. The valve 5 is actuatable by a handle 62 movable to an open position, in which it is shown in the drawing, to establish communication of hydraulic fluid under pressure between the nipple 60 and pipe 61, and is movable 90° in a clockwise direction to a closed position in which such communication is terminated.

Operation

In operation, assume that the lever 53 is in its previously defined "Neutral" position; that the handle 62 of the operator's safety control valve 5 is in its previously described open position; and that the chamber 15 and upper end of reservoir 2 are devoid of fluid under pressure.

Assume further that the reservoir 2 contains sufficient hydraulic fluid to operate the hoist 1 and that the hydraulic system from said reservoir to said hoist contains hydraulic fluid and has been properly bled of air.

As a consequence of these assumed conditions, the hoisting apparatus will be in the position in which it is shown in the drawing. In such position, the piston 7 of hoist 1, and hence platform 8, will be in their lowermost positions, and unpressurized hydraulic fluid will fill the chamber 9 of hoist 1, the pipe 61, the open valve 5, and nipple 60; and in the valve device 4, the chambers 34 and 30, the hydraulic fluid by-pass 39 and pipe 31 will be similarly filled with unpressurized hydraulic fluid, and such fluid will be at its highest level within the reservoir 2.

In valve device 4, the supply valve 19 will be seated under action of spring 20; the valve 26 will likewise be seated under action of spring 28, and the stem 29 will consequently project in its outermost position from the casing 10 and may merely abut lug 55 of lever 53. The exhaust valve 50 will also be seated by spring 51, and stem 52 will project in its outermost position relative to the casing 10 but said stem will be out of contact with the cam 56. Due to action of spring 35 the piston valve 32 will be in its previously described left-hand limit position, and consequently the valve 42 will be held in its seated position by said piston valve, whereby sealing off opening 41 and thus preventing flow of compressed air into chamber 15 via said opening. Further assume that pipe 3 and thereby chamber 12 are supplied with compressed air from any suitable source.

Assume now that it is desired to elevate the platform 8 to its uppermost position. The operator moves lever 53 of valve device 4 in a counter-clockwise direction, as viewed in the drawing, from its previously defined "Neutral" position. This movement of lever 53 causes the operating lug 55 to move the valve stem 29 interiorly of the casing 10, thereby unseating valve 26 and causing the tit 27 attached to valve 26 to successively abut and then advance stem 21 to unseat the supply valve 19 against action of spring 20. With supply valve 19 unseated, compressed air flows from the chamber 12 into passage 16 and chamber 15, and thence via pipe 17 to the upper end of the reservoir 2, causing pressurization of the air in said reservoir and consequently of the hydraulic fluid therein.

Pressurization of hydraulic fluid in the reservoir 2 is transmitted to the chamber 9 of hoist 1, through the medium of the solid column of hydraulic fluid contained within the pipe 31 and chamber 30, which acts upon the piston valve 32 and causes said piston valve to transmit such pressurization to the solid column of hydraulic

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fluid within chamber 34, the nipple 60, the open valve 5, pipe 51, and chamber 9 of said hoist. Such pressure of hydraulic fluid in chambers 34 and 9 will be less than that in chamber 30, however, due to the action of spring 35 on piston valve 32 opposing pressure of fluid in chamber 30. When the force exerted by compressed air on the hydraulic fluid in the reservoir 2, and transmitted by such fluid to the hoist 1, becomes sufficient to overcome the resisting force of the spring 35, the inertia of the fluid, and the load on platform 8, the aforementioned column of hydraulic fluid will be displaced in the direction of chamber 9 of hoist 1.

According to the invention, immediately upon initial displacement of hydraulic fluid into chamber 9 in the hoist 1 to initiate operation of same as above described, the piston valve 32 will be carried along with the hydraulic fluid displaced through bore 33 en route to said chamber 9 against the opposing force of spring 35 and said piston valve will thus be caused to leave its previously defined limit position and assume a position in the direction of chamber 34 in which the grooves 36 are uncovered to chamber 30. During subsequent continued displacement of hydraulic fluid from reservoir 2 to the chamber 9 in hoist 1 via device 4, hydraulic fluid will flow from chamber 30 to chamber 34 by way of the grooves 36 which so restrict such flow as to cause a sufficiently greater pressure of fluid to be obtained in chamber 30 than in chamber 34 to maintain said piston valve in its "groove uncovering" position in opposition to the action of spring 35, so long as such continued displacement persists.

As the piston valve 32 moves from its previously defined limit position to its "groove uncovering" position as just described, the pressure of the compressed air in opening 41 acting on the valve 42 will cause the stem 44 to follow such movement of said piston valve and thereby unseat said valve 42 and establish a communication between supply pipe 3 and reservoir 2 via choke 43, chamber 15 and pipe 17, in by-pass of the previously described communication established by the unseated manually operated valve 19.

When the operator observes that the platform 8 has started to rise as a result of initial pressurization of reservoir 2 via the unseated supply valve 19, he will know that the valve 42 has opened as just described and may then release the handle 53, thereby allowing the springs 20 and 28 to return supply valve 19 to its seated position and to return said handle to its "Neutral" position by movement of stem 29 to its outermost position in which the sealing valve 26 is closed. Upon seating of supply valve 19, supply of compressed air from supply pipe 3 to reservoir 2 to effect continued displacement of hydraulic fluid to chamber 9 in hoist 1 will be maintained at a controlled safe rate via the restricted communication established by the unseated by-pass valve 42.

Thus, according to one feature of the invention, it will be appreciated from the foregoing, that by manipulation of the handle 53, supply of compressed air to the reservoir 2 is effected to cause displacement of hydraulic fluid for initiating operation of the hoist 1, after which, due to the automatic opening of by-pass valve 42, the operator may leave his station at the site of valve device 4 to perform other duties, while displacement of fluid to the hoist 1 for fully raising platform 8 continues at a desirable controlled rate by virtue of continued flow of compressed

air to reservoir 2 via choke 43 and the by-pass valve 42; the latter having been unseated automatically upon initiating operation of the hoist 1.

The piston valve 32 will remain in its "groove uncovering" position as long as displacement of fluid to the hoist 1 continues. At the instant that such displacement terminates, due, for example, to the hoist piston 7 having attained its uppermost limit of travel, the pressure differential creating flow between chambers 30 and 34 via grooves 36 consequently will also terminate and the spring 35 will move the piston valve 32 in the direction of chamber 30 to cause, through actuation of stem 44, the by-pass valve 42 to reseat and close off communication between supply pipe 3 and reservoir 2 via opening 41. Thus, according to another feature of the invention, supply of compressed air to the reservoir 2 for displacement of hydraulic fluid to the hoist 1 is automatically terminated when the hoist attains its uppermost position.

It should be pointed out that return of piston valve 32 from a "groove uncovering" position to its previously defined limit position, upon termination of displacement of hydraulic fluid to the hoist 1, is permitted by virtue of a local displacement of fluid from chamber 30 to chamber 34 by said piston valve during such return, first by way of grooves 36, and subsequently, after the piston valve 32 closes off the ends of said grooves to the chamber 30, by way of leak port 38 and the respective one of said grooves open to said port.

With the platform 8 in its uppermost position, the handle 62 of the operator's safety control valve 5 may be moved in a clockwise direction into its closed position, if desired, to trap the fluid in chamber 9 and pipe 61 to prevent descent of said platform in event of leakage in the reservoir 2, valve device 4 or connections therebetween.

Assume now that it is desired to lower the platform 8. The operator moves the handle 62 of the safety control valve 5 in a counterclockwise direction to its aforementioned open position, if not already therein, to reestablish communication of hydraulic fluid therethrough. The operator also moves lever 53 of the valve device 4 in a clockwise direction into a vent position, which will be assumed when the stop finger 58 of cam 56 contacts the stop surface 59 in casing 10. In such position, operative abutting engagement of the cam surface 57 with the fluted valve stem 52 depresses said stem and holds the exhaust valve 50 in an unseated position against resistance of the spring 51, thereby venting compressed air from chamber 47, passage 48, chamber 15 and the upper end of reservoir 2. The handle 53 will remain in its aforesaid vent position until manually returned to its previously described "Neutral" position, since the reactive force of spring 51 tending to move said lever is relatively small. As compressed air is thus vented from the reservoir 2, the resultant reduction in force exerted by such air on the hydraulic fluid allows such fluid to be displaced by piston 7 from chamber 9 of hoist 1, through pipe 61, and thence through the operator's safety control valve 5 and nipple 60 into the chamber 34 of valve device 4. In valve device 4, this hydraulic fluid flows from chamber 34 into the by-pass 39, whence it unseats the ball check valve 40 and then flows back to the reservoir 2 via chamber 30 and pipe 31. During this entire venting operation, the piston valve 32 will remain in its previously defined limit position, which was assumed when elevation of the hoist 1 ceased; hence, throughout venting, the air by-pass valve

42 will be held in its seated position by said piston valve and the supply valve 19 will be held seated by action of spring 20.

Since the operator may occasionally desire to elevate or lower the platform 8 to some position intermediate its uppermost and lowermost positions, these operations will now be described.

If, during elevation, it is desired to stop the platform 8 at some intermediate position, the procedure previously described for full operation is initially followed. When the platform has been raised to substantially the desired elevation, however, the handle 62 of the valve 5 will be moved into its previously described closed position to terminate flow of hydraulic fluid to the chamber 9 of hoist 1 and lock said hoist in the desired intermediate position. Upon cessation of hydraulic flow, the air by-pass valve 42 will again be seated automatically by action of piston valve 32 to shut off the air supply in the manner previously described in detail.

If from this intermediate position it is desired to lower the platform to its lowermost position, the operator will return valve device 5 to its open position and position handle 53 of device 4 to effect venting of compressed air from the reservoir 2 in exactly the same manner as previously described in detail relative to venting from the uppermost position. If, however, it is desired to lower the platform 8, but not to its lowermost position, the operator may, after moving the handle 62 of valve 5 into its open position, control the descent of said platform by easing the lever 53 towards its vent position to effect engagement between the cam 56 and the valve stem 52, supervising the extent of venting until the desired position is reached; the handle 62 of valve 5 may then be returned to its closed position to positively retain the desired amount of fluid in hoist chamber 9.

If the operator desires to raise the platform 8 from an intermediate position, he will move the handle 62 of valve 5 into its open position and then actuate the lever 53 of valve device 4 in the manner already described for full elevation. If only a higher intermediate position is desired, however, the operator will move handle 62 of the valve 5 into its closed position when the desired elevation has been reached, in the manner previously described.

Summary

It will now be seen that the invention provides a relatively simple and economical fluid pressure control apparatus, particularly adapted for use with hydro-pneumatic operated hydraulic hoists, elevators and the like, which preferably operate primarily between given upper and lower limit positions of travel. In this improved control apparatus, after momentary actuation of the lever 53 to effect an initial surge of compressed air to the reservoir 2, the operator may release said lever and devote his attention to other things while the air by-pass valve 42 automatically supplies air to said reservoir until the platform 8 has reached its uppermost position, at which time the valve 42 automatically is seated to terminate further supply of compressed air and thereby prevent wasteful over-pressurization of said reservoir. Thus the reservoir 2 will be pressurized only to the extent actually necessary to elevate the particular load on the platform 8.

The improved control apparatus will also remain in its vent position upon being moved into such position by the operator; this feature not

only saves time of the operator but also prevents the possibility of serious injury which might otherwise occur if compressed air were not sufficiently vented from the reservoir. For example, if compressed air were not completely vented from the reservoir, it is quite possible that the load on the hoist, when the hoist obtained its lowermost position would have caused the hydraulic fluid to compress the air above said fluid in the reservoir, so that, when the load was removed, the pressure of the unvented compressed air in the reservoir would cause the hoist to move unexpectedly upward; but as above mentioned, this is avoided according to the invention.

The improved control apparatus also includes an operator's safety control valve 5 which not only traps hydraulic fluid in the hoist, when it is in an elevated position, to prevent descent of the platform in event of leakage in the reservoir 2, valve device 4 or connections therebetween, but which also is capable of use to hydraulically lock the hoist in any desired intermediate position.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a fluid pressure control apparatus for controlling operation of a device actuable by hydraulic fluid displaced from a reservoir, the combination of means operable to effect initial displacement of hydraulic fluid from said reservoir, valve means operable in response to said initial displacement to effect continued displacement of said fluid from said reservoir, and means operable upon cessation of displacement of fluid from said reservoir to terminate operation of said valve means.

2. In a fluid pressure control apparatus for controlling operation of a device actuable by hydraulic fluid displaced from a reservoir, the combination of means operable to effect initial displacement of hydraulic fluid from said reservoir by pressurization of fluid therein, valve means responsive to said initial displacement to effect, independently of said first mentioned means, continued displacement of said fluid from said reservoir by pressurization of said fluid therein, and means operative by a pressure condition arising upon cessation of displacement of said fluid from said reservoir to terminate such independent pressurization.

3. In a fluid pressure control apparatus for controlling operation of a device actuable by hydraulic fluid displaced from a reservoir by supply of fluid under pressure thereto, the combination with said reservoir of valve means for supplying fluid under pressure to said reservoir to effect displacement of said hydraulic fluid by pressurization thereof, and means controlled by displacement of fluid from said reservoir and operative in response to cessation of such displacement to effect operation of said valve means to cut off the supply of fluid under pressure to said reservoir.

4. In a fluid pressure control apparatus for controlling operation of a device actuable by hydraulic fluid displaced from a reservoir by supply of compressed air thereto, the combination with said reservoir, of valve means for supplying compressed air to said reservoir to pressurize said hydraulic fluid therein, a piston operable by flow of hydraulic fluid from and to said reservoir, and means operable upon cessation of said flow from said reservoir to effect operation of said piston for actuating said valve means to cut off supply of compressed air to said reservoir.

5. In a fluid pressure control apparatus for controlling operation of a device actuable by hydraulic fluid displaced from a reservoir by compressed air supplied to said reservoir, the combination with said reservoir, of valve means operable to supply compressed air to said reservoir, a device comprising a casing having a piston bore through which hydraulic fluid displaced from said reservoir flows, a piston slidably mounted in said bore subject on one side to and movable from a limit position by hydraulic fluid displaced from said reservoir, a communication for connecting opposite sides of said piston closed in said limit position thereof and opened upon said movement of said piston out of said limit position to permit flow of displaced fluid from one side to the opposite side of said piston, and spring means opposing movement of said piston out of its said limit position and operable upon cessation of such displacement to move said piston to said limit position and through attainment of said position operate said valve means to cut off supply of compressed air to said reservoir.

6. In a hydro-pneumatic control apparatus for controlling operation of a device actuable by hydraulic fluid displaced from a reservoir, the combination with said reservoir, of manually operable valve means for supplying compressed air to said reservoir to effect initial pressurization and displacement of hydraulic fluid from said reservoir to said device, by-pass valve means automatically opened by said initial displacement for continuing supply of compressed air to said reservoir, after termination of supply thereto by said manually operable valve means, for continued pressurization and displacement of said fluid to said device, and means operable upon cessation of such displacement to close said by-pass valve means to automatically terminate further pressurization of said fluid in said reservoir.

7. Apparatus for controlling displacement of hydraulic fluid from a reservoir to a hydraulically actuable device, and apparatus comprising in combination, a supply conduit charged with fluid under pressure, first valve means operable by application of manual effort to establish a first communication for conveying fluid under pressure from said conduit to said reservoir to effect pressurization thereof for effecting initial displacement of said hydraulic fluid, and second valve means responsive to said initial displacement to establish a by-pass communication for conveying fluid under pressure from said conduit to said reservoir to continue pressurization thereof independently of said first communication.

8. The combination as set forth in claim 7, including means responsive to relaxation of said manual effort to cause said first valve means to disestablish said first communication.

8. The combination as set forth in claim 7, including choke means in said by-pass communication.

10. The combination as set forth in claim 7, including means operable upon cessation of said displacement to cause said second valve means to disestablish said by-pass communication.

11. In a hydro-pneumatic control apparatus for controlling operation of a device actuable by hydraulic fluid displaced from a reservoir, the combination with said reservoir, of a piston slidable in a bore and subject, respectively, on opposite sides to hydraulic fluid in said reservoir and in said device and movable from a limit position by displacement of fluid from said reser-

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voir, a groove in the wall of said bore for communication of said fluid between opposite sides of said piston only when said piston is moved out of its said limit position, means to move said piston into its said limit position upon cessation of such displacement, a supply conduit chargeable with compressed air, an air by-pass valve responsive to movement of said piston and being automatically unseated by force of compressed air in said conduit upon movement of said piston out of its said limit position to effect pressurization of hydraulic fluid in and displacement thereof from said reservoir and being automatically seated to terminate such pressurization upon cessation of such displacement by movement of said piston into its said limit position.

12. The combination as set forth in claim 11, including a leak port at the reservoir end of said groove to establish restricted communication of hydraulic fluid past said piston toward said device to assure full return of said piston to its said limit position.

13. The combination as set forth in claim 11, including means to effect initial displacement of hydraulic fluid from said reservoir.

14. The combination as set forth in claim 11, including a by-pass communication providing for flow of hydraulic fluid in the direction of said reservoir in circumvention of said piston, and a check valve in said by-pass to prevent flow of such fluid in the direction of said device.

15. The combination as set forth in claim 11, including an operator's safety control valve device interposed in the hydraulic fluid communication between said piston and said device manually operable to close said communication.

16. In a hydro-pneumatic control apparatus for controlling operation of a hydraulic hoist, the combination with said reservoir, of a supply conduit chargeable with compressed air, valve means unseatable into said conduit and unseatable to atmosphere, being operable to effect pressurization and depressurization respectively of hydraulic fluid in said reservoir to control displacement of said fluid from said reservoir to said hoist and vice versa, a pivotally mounted lever having a neutral position in which hydraulic fluid is neither pressurized nor depressurized and manually movable into a supply position out of its said neutral position for actuating said valve means to effect said pressurization and manually movable into a vent position out of its said neutral position for actuating said valve means to effect said depressurization, spring means to move said lever to its said neutral position upon relaxation of manual effort when said lever is in its said supply position, and stop means to maintain said lever in its said vent position until manually moved therefrom.

17. An apparatus for controlling hydraulic actuation of a load lifting piston comprising, a reservoir containing hydraulic fluid, conveying means for conveying hydraulic fluid from said reservoir to said piston, manually operable valve means for supplying compressed air to said reservoir for forcing hydraulic fluid therefrom to said

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piston, other valve means for also supplying compressed air to said reservoir, movable abutment means operable by flow of hydraulic fluid through said conveying means to effect operation of said other valve means, and means operable upon cessation of flow of hydraulic fluid through said conveying means to actuate said other valve means to cut off its supply of compressed air to said reservoir.

18. An apparatus for controlling hydraulic actuation of a load lifting piston comprising, a reservoir containing hydraulic fluid, conveying means for conveying hydraulic fluid from said reservoir to said piston, manually operable valve means for supplying compressed air to said reservoir for forcing hydraulic fluid therefrom to said piston, other valve means for also supplying compressed air to said reservoir, movable abutment means operable by flow of hydraulic fluid through said conveying means to effect operation of said other valve means, means operable upon cessation of flow of hydraulic fluid through said conveying means to actuate said other valve means to cut off its supply of compressed air to said reservoir, means for releasing compressed air from said reservoir, a by-pass communication around said abutment means for releasing hydraulic fluid from said piston to said reservoir, and a check valve in said communication for closing same against flow therethrough in the reverse direction.

19. An apparatus for controlling hydraulic actuation of a load-lifting piston comprising, a reservoir containing hydraulic fluid, a supply conduit chargeable with fluid under pressure, conveying means for conveying hydraulic fluid from said reservoir to said piston, said conveying means including a device comprising a casing having a bore open at opposite ends to said reservoir and piston, respectively, and through which hydraulic fluid flows therebetween, a piston valve slidably mounted in said bore and having a position adjacent the end of said bore open to said reservoir for closing communication from said reservoir to said piston and movable out of said position by displacement of hydraulic fluid from said reservoir to open a communication from said reservoir to said piston, manually operable valve means for effecting supply of fluid under pressure from said conduit to said reservoir for forcing hydraulic fluid therefrom through said conveying means to said piston, a by-pass valve closable by said piston valve in its said position and responsive to movement of said piston valve from its said position to supply fluid under pressure from said conduit to said reservoir independently of said manually operable valve means, and spring means acting on said piston valve to move same to said position in response to cessation of flow of hydraulic fluid from said reservoir to said piston to terminate supply of fluid under pressure to said reservoir by said by-pass valve.

No references cited.