United States Patent

[11] 3,593,824

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[21] Appl. No. 814,671
[22] Filed Apr. 9, 1969
[45] Patented July 20, 1971

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[54] VALVE CIRCUIT FOR CONTROLLING THE MOTION OF A DECK EDGE ELEVATOR
8 Claims, 3 Drawing Figs.

[52] U.S. Cl. 187/26, 254/189, 60/51
[51] Int. Cl. B66b 11/04
[50] Field of Search 60/51; 187/26; 254/189

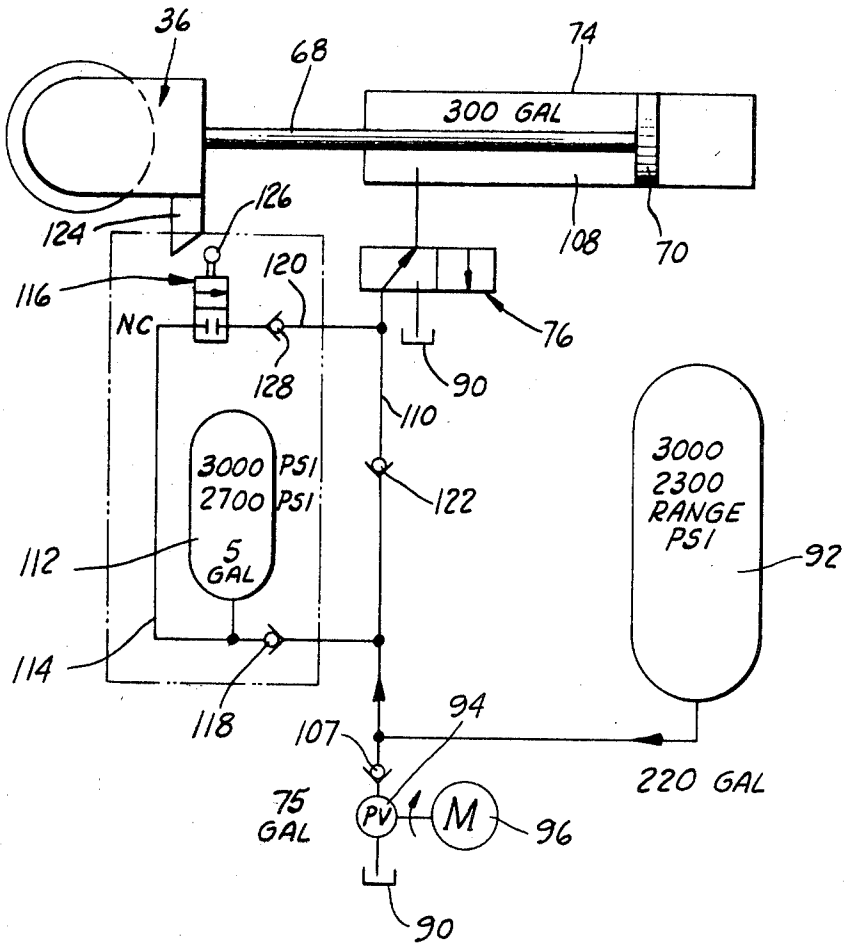
[56] References Cited

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2,595,248	5/1952	Greer	60/51
2,892,310	6/1959	Mercier	60/51
2,977,763	4/1961	Mercier	60/51
3,347,525	10/1967	Gregory	187/26

Primary Examiner—Harvey C. Hornsby
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ABSTRACT: A pressure intensifier valve circuit for controlling the motion of a deck edge elevator on a marine vessel, the elevator including a cable and pulley system for raising and lowering the elevator assembly and a hydrostatic engine for actuating the cable system, a valve mechanism in the circuit controlling pressure distribution to the hydrostatic engine wherein provision is made for instantaneously intensifying the working pressure of the hydrostatic engine when the elevator assembly has reached its uppermost limiting position thus providing an increased peak pressure for stabilizing the platform in a raised, clamping position, the intensified pressure being substantially in excess of the maximum operating pressure normally available during operation of the elevator assembly.



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SHEET 1 OF 3

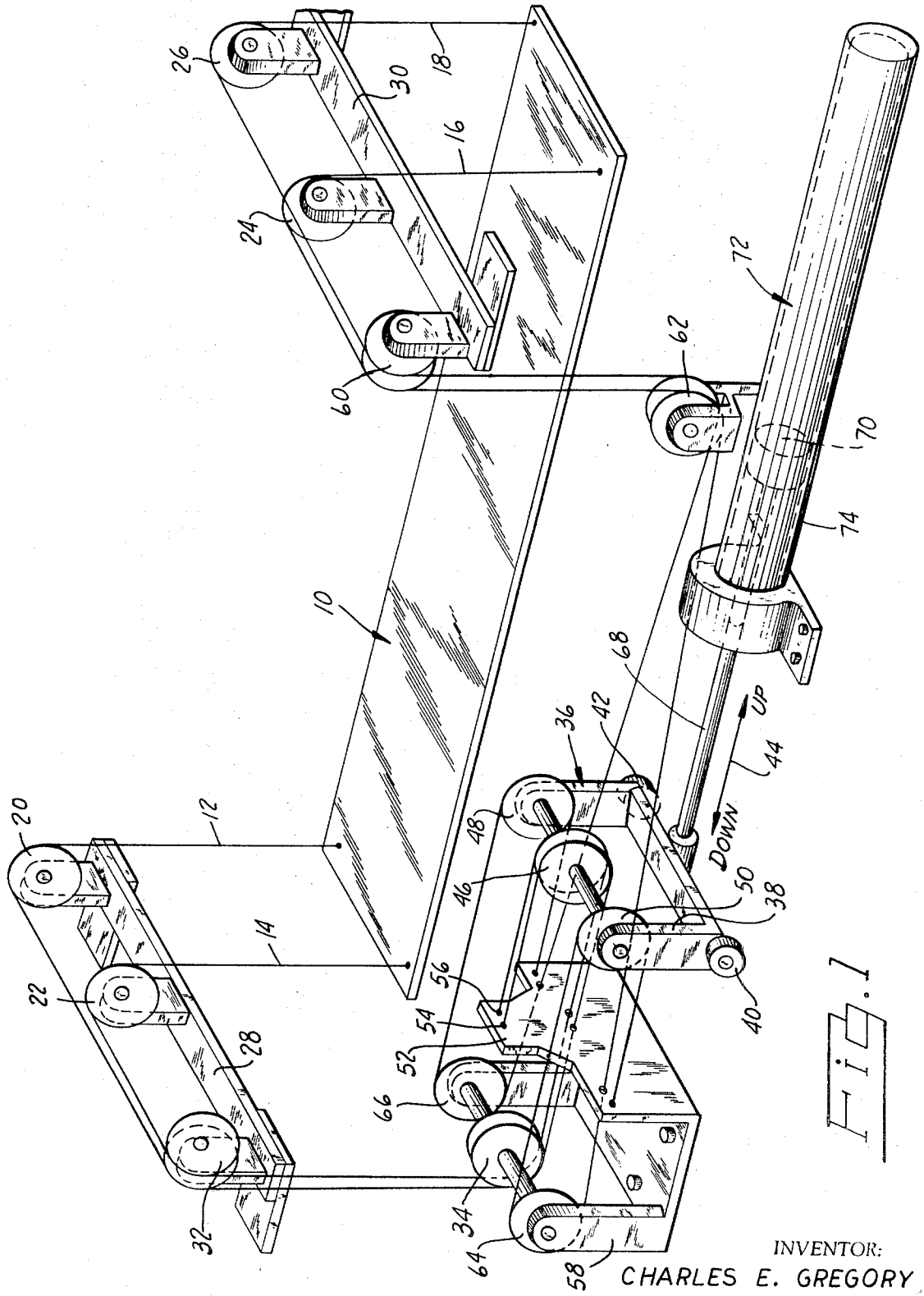


Fig. 1

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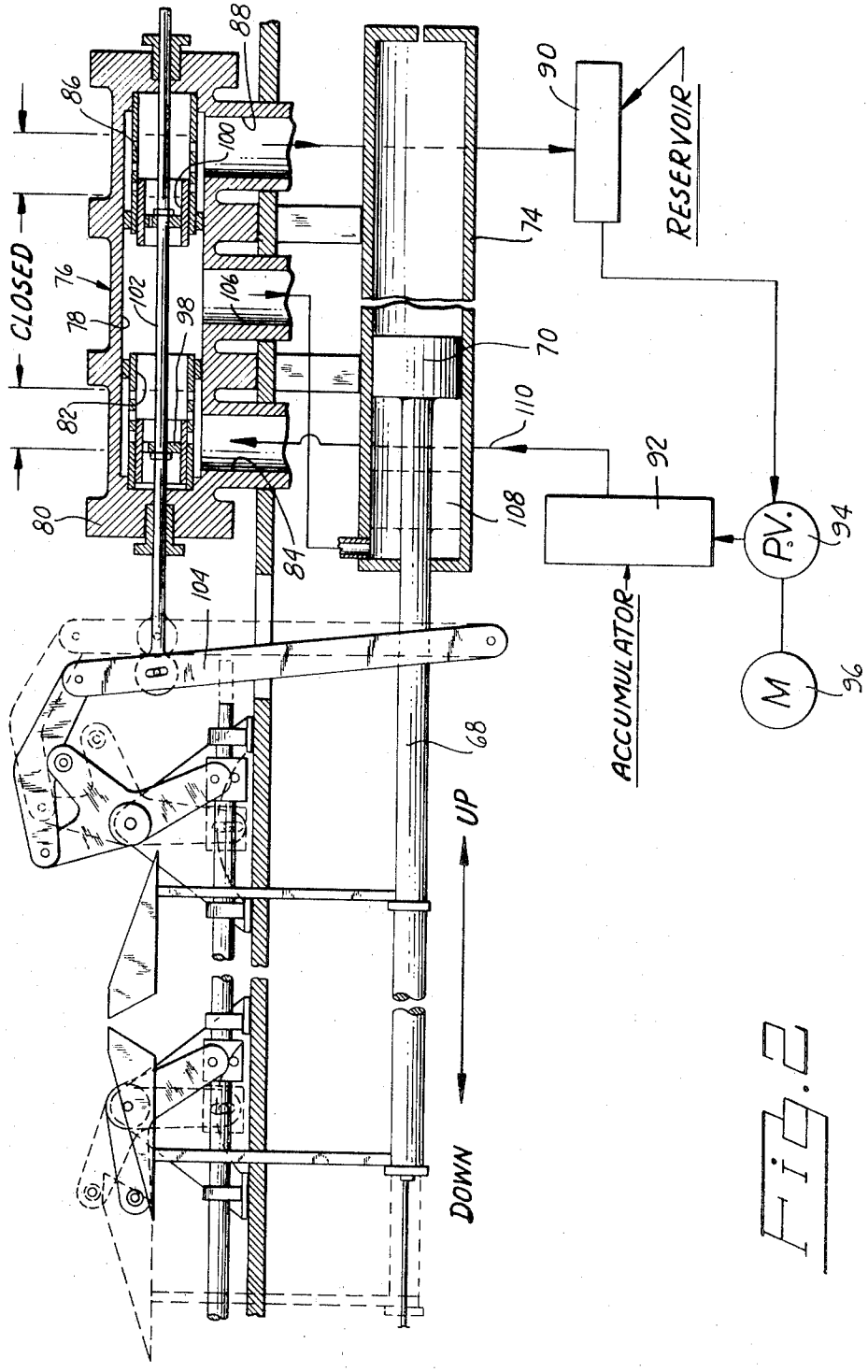


Fig. 2

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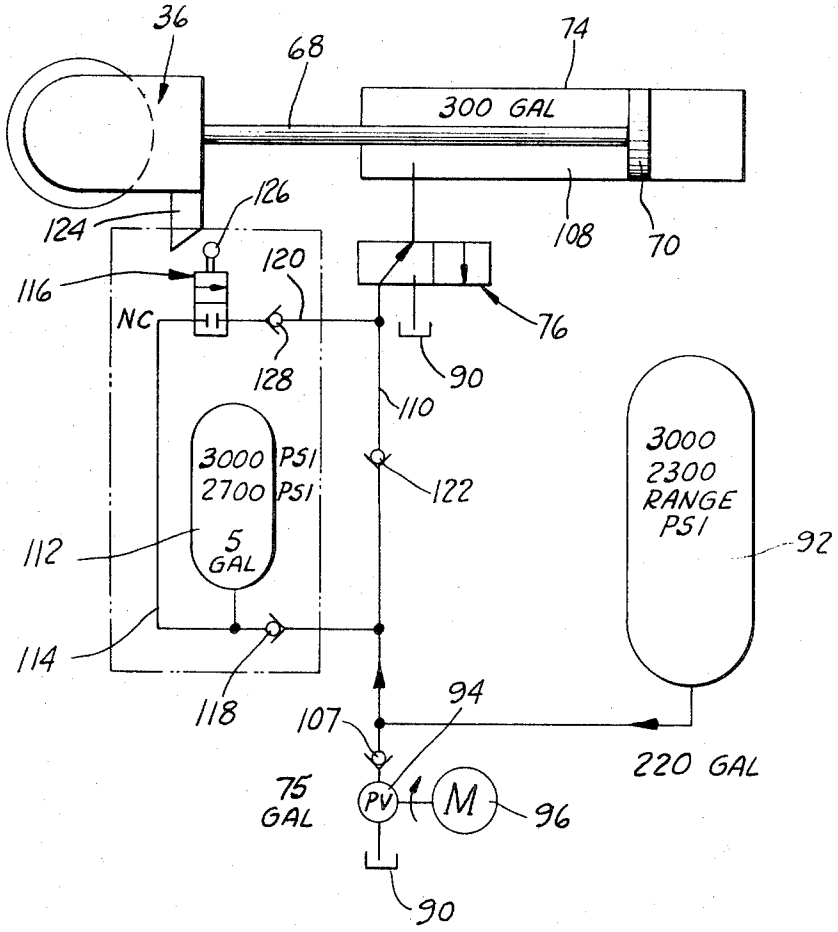


Fig. 3

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VALVE CIRCUIT FOR CONTROLLING THE MOTION OF A DECK EDGE ELEVATOR

GENERAL DESCRIPTION OF THE INVENTION

My invention relates to improvements in elevator engine assemblies of the type described in U.S. Pat. No. 3,347,525. The structure shown in that patent includes an aircraft elevator assembly located on one side of a naval aircraft carrier. It is adapted to move between a lower hangar deck level and an upper flight deck level as plane and cargo are transported from one level to the other. The elevator assembly is powered by a hydrostatic engine located at a lower deck station, and a pulley and cable mechanism operatively connects the pressure actuated member of the hydrostatic engine and the elevator assembly.

The operating pressure for the hydrostatic engine should be sufficiently high to permit the engine to produce a cable force that will permit added stressing of the cable after the elevator platform has reached its uppermost position, thereby permitting the assembly to be locked in its upper location. For example, the platform portion of the elevator assembly, when the elevator assembly reaches its uppermost position, should be on substantially the same plane as the upper deck in order to permit transfer of cargo between the elevator platform and the deck. The elevator platform may include rails that must register with rails formed on the upper deck. The rails themselves should be brought into registry in order to provide a continuous trackway for transfer of cargo.

In order to permit the necessary clamping force to be applied to the elevator assembly it has been necessary heretofore to increase the size of the hydrostatic engine beyond that which normally would be necessary for actuating the elevator between the two limiting positions. In the alternative, if the size of the hydrostatic engine itself were to remain the same, the operating pressure of the pressure valve system and the circuit for the hydrostatic engine must be increased. This, in turn, makes it necessary to provide a pump of higher horsepower than would be necessary for normal operation of the elevator assembly.

In my improved structure, it is possible to employ a hydrostatic engine and elevator assembly of this type without overdesigning it to increase the force transmitting capacity of the engine and without the necessity for a pump horsepower penalty normally associated with high-pressure circuits. I achieve this result by providing an intensifier valve system in the circuit which will permit an intensification in the working pressure for the hydrostatic engine during the final phase of the lifting cycle. After the elevator assembly has reached its limiting position this intensified pressure would not be required. The intensification would not impose a horsepower penalty on the hydrostatic pumps during normal operation of the elevator assembly.

BRIEF DESCRIPTION OF THE FIGURES IN THE DRAWINGS

FIG. 1 shows in schematic form an elevator assembly in combination with a hydrostatic engine and pulley system.

FIG. 2 is a schematic diagram showing a portion of the valve circuit used for controlling pressure distribution between the hydrostatic engine of FIG. 1 and a fluid pump.

FIG. 3 shows in schematic form a pressure intensifier circuit used in combination with the valve system of FIG. 2.

PARTICULAR DESCRIPTION OF THE INVENTION

In FIG. 1 reference character 10 shows an elevator platform in schematic form. It is supported at each of its four corners by cables 12, 14, 16 and 18. Each of these cables is trained over a separate one of a series of fixed pulleys 20, 22, 24 and 26, respectively. Pulleys 20 and 22 are supported by platform 28 and pulleys 24 and 26 are supported by a platform 30, each platform being situated at a location higher than the upper deck.

Cables 12 and 14 pass over an idler pulley 32 supported by the platform 28. Cables 12 and 14 then extend downwardly and are trained over stationary sheave 34. A sliding sheave assembly 36 comprises a carriage 38 having supporting wheels 40 and 42. These wheels are adapted to engage trackways, not shown, to permit movement of the sheave assembly 36 in the direction of the arrow 44.

Sheave 46 is journaled rotatably on the carrier 38 together with a pair of companion sheaves 48 and 50. The sheaves 46, 48 and 50 rotate about a common axis. Cables 12 and 14 are trained over the sheave 46 and are anchored at their ends to an anchor plate 52 as seen at 54 and 56, respectively.

Sheave 34 is journaled for rotation about a fixed axis. It is supported by a carrier 58 which is connected to a stationary portion of the sheave structure.

Cables 16 and 18 are trained over an idler sheave 60 supported by the platform 30. These cables then are extended in a downward direction and passed over idler sheaves 62 located at a lower deck level. Sheave 62 rotates about a fixed axis. The cables 16 and 18 extend over idler sheaves 64 and 66. Cable 16 then extends rearwardly and passes around idler sheave 50. The end of the cable 16 is anchored to the anchor plate 52. In a similar fashion cable 18 passes over the sheave 66 and is returned rearwardly. It then passes over sheave 48. The end of the cable 18 is anchored also to the anchor plate 52.

Sheaves 46, 48 and 50 move in unison as the movable sheave assembly 36 moves in the direction of the arrow 44. Movement of the assembly 36 is effected by a ram rod 68 connected to piston 70. This piston forms a part of a hydrostatic engine 72 which includes cylinder 74 and piston 70. As the piston 70 is moved to the right, as viewed in FIG. 1, the movable sheave assembly causes the platform 10 to be moved upwardly. When the piston 70 is moved in the opposite direction, the movable sheave assembly, together with the cable arrangement, causes the platform 10 to be lowered.

In FIG. 2, the cylinder 74 is in fluid communication with a control valve assembly 76. This includes a valve chamber 78 located in valve body 80. Positioned in the chamber 78 is an apertured valve sleeve 82 located directly adjacent pressure inlet port 84 formed in the body 80. Similarly, an apertured valve sleeve 86 is located in the chamber 78 adjacent pressure outlet port 88 formed in the body 80. Port 88 is in fluid communication with a lower pressure reservoir 90 and port 84 is in fluid communication with a pressure accumulator 92. The accumulator is supplied with fluid pressure from a pump 94, which in turn is driven by a motor 96.

A valve element in the form of a piston 98 is slidably received within the sleeve 82. It is joined directly to a similar valve piston 100 slidably situated within the valve sleeve 86. The valve pistons are joined by rod 102. The rod 102 is actuated by a control linkage shown in part at 104.

The region of the chamber 78 intermediate the valve pistons is in communication with the port 106 which in turn communicates directly with the pressure chamber 108 defined by the piston 70 and the cylinder 74. When fluid is applied under pressure to this chamber 108, piston 70 is moved in a right-hand direction which corresponds to upward motion of the platform 10. When fluid pressure is exhausted from the chamber 108, the platform 10 moves downwardly under its own weight and under the weight of the load on the platform, thereby causing the piston 70 to return in a left-hand direction, and at the same time displacing fluid within the chamber 108 through the port 106. This occurs as the port 106 is brought into fluid communication with the port 88 as the valve pistons and rod 102 are moved in a right-hand direction.

When the valve rod 102 and the valve pistons move in a right-hand direction, as explained above, the valve openings in the sleeve 82 are closed by the valve piston 98, thereby restricting or interrupting communication between the port 84 and the port 106. At the same time, ports in the sleeve 86 become uncovered by the piston 100, thereby establishing or increasing communication between port 106 and port 88. If the valve pistons are moved in the opposite direction, the

ports in the sleeve 82 establish communication between ports 106 and 84, and the ports in the sleeve 86 interrupt communication between ports 88 and 106.

In FIG. 3, I have shown a schematic diagram of a pressure intensifier circuit. The accumulator 92 shown in FIG. 3 is pressured by the pump 94 to a normal pressure range of 2,300 p.s.i. to 3,000 p.s.i. It has a capacity of approximately 220 gallons. The one-way check valve 107 is located between the pump 94 and the accumulator 92 to permit transfer of the fluid from the pump but which will prevent backflow of pressure from the accumulator to the outlet port for the pump 94.

The valve 76 is schematically illustrated in FIG. 3. Its mode of operation was described with reference to FIG. 2. It is a two-position valve, and the two positions are illustrated in block diagram form. In the position shown in FIG. 3, the valve 76 establishes communication between passage 110 and the working chamber 108.

When the valve 76 assumes a left-hand position, working chamber 108 communicates directly with reservoir 90 through the valve 76. In the position shown in FIG. 3, the valve 76 will establish upward movement of the platform which is accompanied by movement of the piston 70 in a right-hand direction.

An auxiliary accumulator circuit is arranged in parallel disposition with the circuit for the accumulator 92. The auxiliary accumulator circuit includes an accumulator 112 having a capacity of about 5 gallons. It normally is pressurized with a pressure with a pressure ranging between 2,700 p.s.i. and 3,000 p.s.i. Pressure passage 114 extends from the accumulator 112 to an intensifier control valve 116. Passage 114 communicates with passage 110 across one-way check valve 118, which prevents transfer of fluid from the accumulator 112 to the accumulator passage 110 but which will permit transfer of pressure in the opposite direction.

Valve 116 establishes communication between the passage 114 and passage 120. This passage is separated from the accumulator 92 by check valve 122. Thus any fluid under pressure in passage 120 will not be transferred to the accumulator 92 when the latter is under low pressure, although the valve 122 will permit transfer of pressurized fluid from the accumulator 92 to the passage 120.

The movable sheave assembly 36 carries a cam 124 adapted to engage valve actuator 126 which is in the form of a cam follower. Actuator 126 is adapted to adjust valve 116 from one position to another. Each position of the valve 116 is indicated in block diagram form in FIG. 3. When the valve 116 is positioned as shown in FIG. 3, communication between the passage 114 and the passage 120 is interrupted. On the other hand, when the movable sheave assembly 36 moves to its extreme right-hand position, cam 126 will actuate the valve 116, thereby causing it to assume its other position and establishing communication between passages 114 and 120.

During normal operation of the elevator from a lower position to the uppermost position, the pressure in the accumulator 92 is used for actuating the piston 70. As the piston 70 moves in a right-hand direction, the pressure available in the accumulator 92 falls to its lower limiting value. After the extreme upper position of the elevator is reached, it is necessary to exert an auxiliary pressure on the cables to stretch them, thereby causing the elevator to assume a position that will permit locking of the elevator platform in its uppermost position. This occurs as the movable sheave assembly 36 moves to the extreme right-hand position at which time the cam 126 will actuate the valve 116, thereby establishing communication between the auxiliary accumulator 112 and working chamber 108. The pressure that is available at that instant is higher than the residual pressure in the main accumulator 92, the latter pressure having been lowered because of the energy that was dissipated during the hoisting of the elevator to its uppermost position. Upon moving the valve 116, an instantaneous intensification in the working pressure in chamber 108 takes place. This intensification, however, is not reflected in a change in pressure in accumulator 92 because of the action of the check valves 122 and 118, and also because of the auxiliary check valve 128 which establishes one-way fluid communication between valve 116 and passage 120. After the elevator is locked in position, the pump 94 can proceed in the usual way to pressurize the accumulator 92 in preparation for the next operating cycle.

There is no necessity for maintaining in the accumulator 92 an excess of pressure to permit the so-called locking of the platform in its uppermost position. The horsepower requirements for the pump 94 and the motor 96 thus are reduced to a substantially lower level than what otherwise would be required without the presence of an auxiliary accumulator circuit. The pressure intensification that is available by reason of auxiliary accumulator circuit makes unnecessary an increase in the size of the hydrostatic motor. The motor itself can be designed for those forces necessary to operate the elevator throughout a normal cycle. The excess force needed to establish a locking condition can be obtained by the intensification made available by the auxiliary accumulator circuit without the necessity for increasing the size of the hydrostatic engine in itself.

Having thus described a preferred form of my invention, what I claim and desire to secure by U.S. Letters Patent is:

1. An elevator assembly for raising a load from one position to a higher position comprising a platform and a cable and sheave assembly including cables connected to said platform, a hydrostatic engine having a pressure movable member connected to said sheave assembly, said cable and sheave assembly moving said platform to an upper position as said pressure movable member is moved in one direction, said platform being lowered upon movement of said piston in the opposite direction, a pressure source, a main accumulator in communication with said pressure source whereby said accumulator is charged with fluid pressure, a motor feed circuit interconnecting said accumulator and said hydrostatic motor for accommodating distribution of working pressure to one side of said movable member thereby creating a pressure force actuating said movable member in said one direction, said circuit including a control valve for selectively establishing pressure distribution to said hydrostatic engine and for exhausting pressure therefrom, an auxiliary accumulator circuit comprising an auxiliary accumulator, valve control passage means connecting said pressure source and said auxiliary accumulator whereby the latter is charged with working pressure, an intensifier pressure passage extending from said auxiliary accumulator to said working chamber, valve control means in said intensifier pressure passage for interrupting and establishing communication between said auxiliary accumulator and said working chamber, and means including parts carried by movable portions of said elevator assembly for actuating said valve control means upon movement of said sheave assembly to a position proximate to its limiting position corresponding to the uppermost position of said platform, thereby establishing a pressure intensification in said hydrostatic engine following movement of said platform to its uppermost position.

2. The combination set forth in claim 1, wherein said control valve means comprises a movable valve element having two operating positions, said valve element interrupting communication between said working chamber and said auxiliary accumulator when it assumes one position and establishing such communication when it assumes another position, a mechanical cam means connected to portions of said sheave assembly and adapted to engage cam follower portions of said valve element whereby said valve element is moved to said one position following movement of said sheave assembly to a position corresponding to the uppermost position of said platform.

3. The combination set forth in claim 1, wherein said main accumulator is substantially greater in fluid capacity than the fluid capacity of said auxiliary accumulator.

4. The combination set forth in claim 2, wherein said main accumulator is substantially greater in fluid capacity than the fluid capacity of said auxiliary accumulator.

5. The combination set forth in claim 3, wherein said auxiliary accumulator and said main accumulator are in parallel relationship with common passages connecting them, each accumulator being connected to a common inlet and a common outlet, and one-way check valve means semi-isolating said accumulators from each other whereby pressurized fluid in said auxiliary accumulator is prevented from passing into said main accumulator.

6. The combination set forth in claim 4, wherein said auxiliary accumulator and said main accumulator are in parallel relationship with common passages connecting them, each accumulator being connected to a common inlet and a common outlet, and one-way check valve means semi-isolating said accumulators from each other whereby pressurized fluid in said auxiliary accumulator is prevented from passing into said main accumulator.

7. The combination set forth in claim 5, wherein said common inlet for said accumulators is connected to a common pump for pressurizing each accumulator, and motor means for driving said pump.

8. The combination set forth in claim 6, wherein said common inlet for said accumulators is connected to a common pump for pressurizing each accumulator, and motor means for driving said pump.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,593,824 Dated July 20, 1971

Inventor(s) CHARLES E. GREGORY

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the Title page, the line directly above the ABSTRACT, "Attorney Mentage" should be -- Attorney Mentag --.

Column 3, line 29, delete "with a pressure". Column 3, line 37, after "passage" second occurrence, insert -- 120 -- .

Signed and sealed this 14th day of December 1971.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Acting Commissioner of Patents

FORM PO-1050 (10-69)

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