July 2, 1957 W. STELZER 2,797,550

HYDRAULIC ELEVATORS

Filed May 5, 1954 3 Sheets-Sheet 1

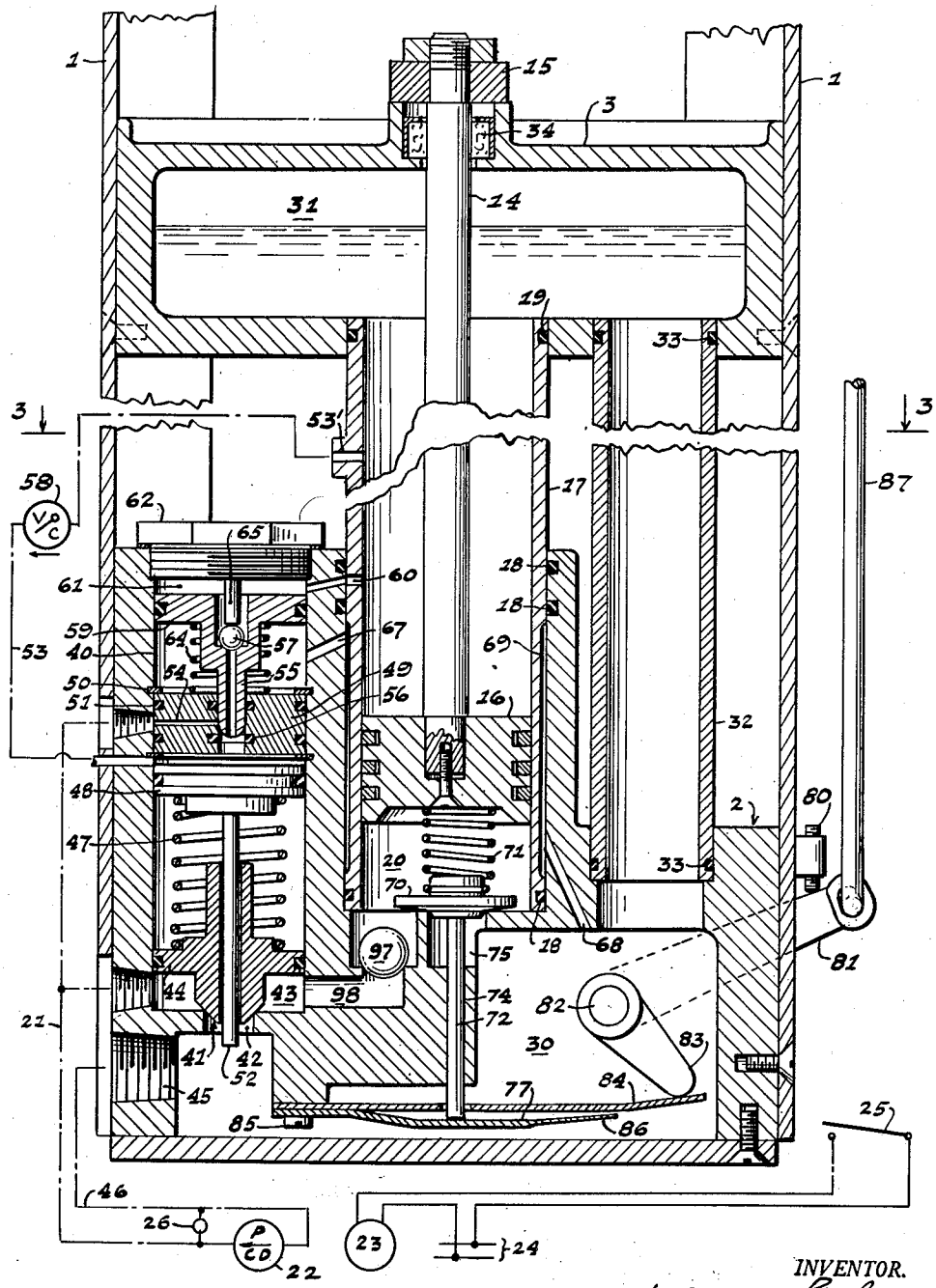


Fig. 1

INVENTOR.

William Stelzer

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Filed May 5, 1954 3 Sheets-Sheet 2

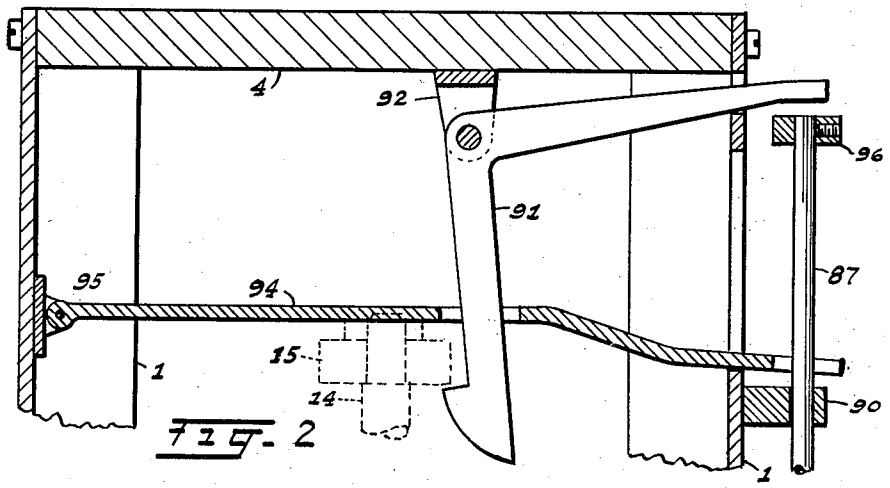
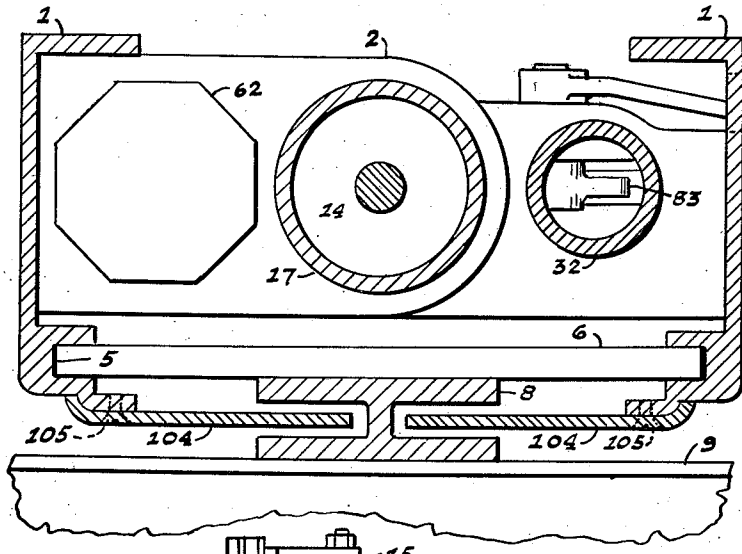


Fig. 2



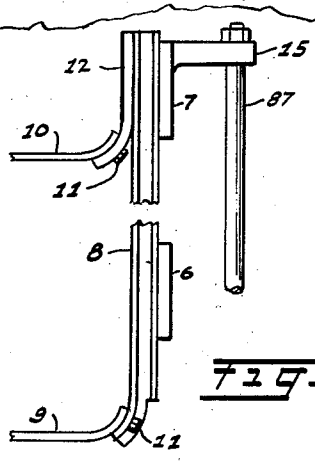


Fig. 3

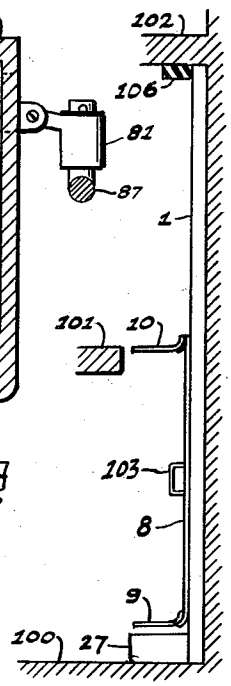


Fig. 4

Fig. 5

INVENTOR.

William Stelzer

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HYDRAULIC ELEVATORS

Filed May 5, 1954 3 Sheets-Sheet 3

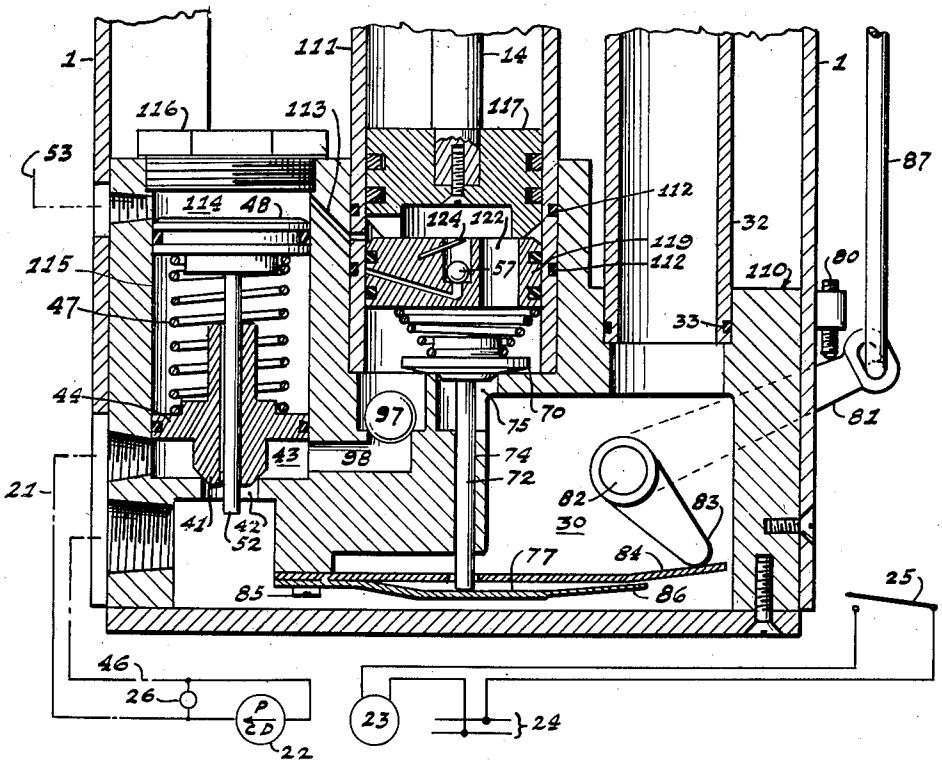


Fig. 6

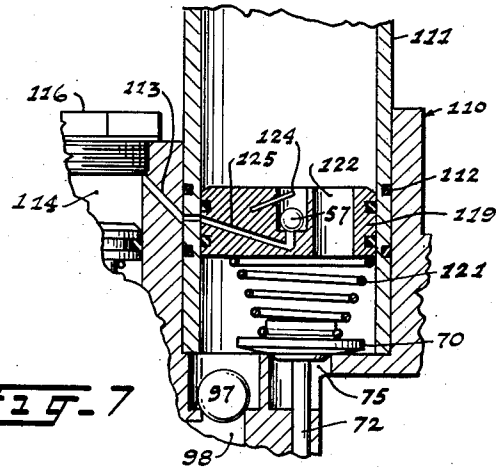


Fig. 7

INVENTOR.

William Stelzer

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2,797,550

HYDRAULIC ELEVATORS

William Stelzer, Summit, N. J.

Application May 5, 1954, Serial No. 427,753

10 Claims. (Cl. 60—52)

The invention relates to hydraulic elevators and more particularly to a short stroke hydraulic elevator incorporating a safety device limiting the hydraulic power to that required to lift a given load and to yield when certain additional resistance is encountered.

The object of the invention is to produce an inexpensive elevator for home use, particularly adapted for mass production through the elimination of safety and interlocking devices dependent on structural details of the building where the elevator is installed.

Another object is to obtain inherent safety by automatically limiting the lifting power of the elevator to be only sufficient to lift the load, regardless of what the latter is.

Another object is a general simplification in design making a self-contained compact unit possible to reduce installation work to a minimum.

Other objects and advantages of this invention will be apparent from the following description considered in connection with the accompanying drawings submitted for the purpose of illustration and not to define the scope of the invention, reference being had for that purpose to the subjoined claims. In the drawings, wherein similar reference characters refer to similar parts throughout the several views:

Fig. 1 is a fragmentary cross-sectional front elevation of the lower portion of an elevator embodying my invention, some parts being shown diagrammatically;

Fig. 2, a fragmentary cross-sectional front elevation, showing the upper or topmost part of the elevator mechanism, thus being a continuation of Fig. 1;

Fig. 3, a section taken on lines 3—3 of Fig. 1;

Fig. 4, a side elevation of the elevator on a smaller scale, where the building is shown in section;

Fig. 5, a fragmentary side elevation of the carriage or spider comprising the load carrying platform;

Fig. 6, a fragmentary cross-sectional front elevation similar to Fig. 1 but showing a modified form of the invention; and

Fig. 7, a fragmentary view similar to Fig. 6 showing the lower end of the lifting cylinder after the piston is raised.

Before explaining the present invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of elements illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practised or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not limitation.

The structural frame within which which the lifting mechanism is housed consists of a pair of opposite channels 1 held spaced from each other by a base 2, a reservoir 3, and a top brace 4. The channels are of a special shape as shown in Fig. 3 and have tracks 5 in which slide runners 6 and 7 secured to H-beam 8 to which platforms 9 and 10 are attached, as with screws 11. For platform 10, an adaptor plate 12 is interposed. The curved portion of the latter, and the curved portion of the lower

end of H-beam 8 conforming to the curvature of the platform afford adjustability of the platforms where the latter may be at an angle relative to H-beam 8, so that if the channels 1 are inclined, the platforms may be set level. H-beam 8, runners 6 and 7, and platforms 9 and 10 form a spider or carriage adapted to slide up and down, guided by the tracks 5 and carrying the passenger or other load. The carriage is lifted by a piston rod or push rod 14 secured to a bracket 15 extending from upper runner 7. The lower end of rod 14 is attached to a piston 16 sliding in a power cylinder 17 extending from base 2 to reservoir 3, the external ends being sealed with packings 18 and 19 to provide tight connections with base 2 and reservoir 3. Thus the carriage, rod 14, and piston 16 form a rigid assembly moving up or down as a single unit. The motive force for the upward travel of the carriage is furnished through the medium of hydraulic fluid transmitted under pressure to chamber 20 via line 21 from a constant delivery pump 22 driven by an electric motor 23 energized by power from line 24 and controlled by a switch 25. A by-pass safety valve 26 protects the pump against delivering a too high pressure. The motor and pump and their connections are shown diagrammatically, since they may be of conventional design and located at any convenient place. As shown in the general view of Fig. 4, they may be arranged within box 27 at the foot of the elevator. Base 2 has a sump 30 in communication with reservoir chamber 31 of reservoir 3 through a pipe 32 whose external ends are sealed by packing rings 33. Sump 30, the space above piston 16 in cylinder 17, and part of reservoir chamber 31 are filled with hydraulic fluid. Due to the displacement of rod 14 a certain amount of breathing of air to and from chamber 31 takes place. To prevent any dirt from entering, a porous seal 34 in the upper wall of reservoir 3 surrounds rod 14. This seal lets air through as piston 16 moves. Reservoir chamber 31 and seal 34 may be considerably larger than shown, the illustration shown being drawn out of proportion in order not to encumber the drawing.

A bore 40 in base 2 houses the controlling mechanism regulating the pressure of the cylinder fluid to be proportioned to the load or slightly higher than required to lift the elevator carriage. At the lower end of bore 40 is a pressure relief valve 41 closing off passage 42 between chamber 43 and sump 30 and having a piston 44 sliding in bore 40 so that the hydraulic pressure in chamber 43 tends to unseat the relief valve to by-pass the fluid from the pressure line 21 to sump 30, from where the fluid may return to the intake of the pump via port 45 and line 46. A spring 47 normally free is seated on top of piston 44 to urge valve 41 in a seated position when control piston 48 is subjected to hydraulic pressure from line 21. This control piston slides in bore 40 intermediate piston 44 and a separator 49 held by retaining rings 50 and sealed by packings 51. It has a stem 52 passing through a central splined hole in relief valve 41, whereby the clearance around stem 52 provides communication between sump 30 and the chamber where spring 47 is housed so that the pressure in the latter chamber is always relieved. The space between piston 48 and separator 49 is normally in communication with pressure line 21 through a restricted passage 54. This passage may be shut off by a valve 55 when the latter touches lower seal 56, whereby the fluid in the chamber intermediate piston 48 and separator 49 becomes locked, except for the action of a check valve 57 located in the stem of valve 55 permitting a relief of pressure under certain conditions. The upper part of valve 55 has a flange 59 serving as a piston slideable in bore 40 and subject to the pressure in cylinder 17 communicated through passage or port 60 to chamber 61, a plug 62 closing off bore 40 and forming one wall of chamber 61. Normally check valve 57 is held closed

by the action of a spring 64 pushing valve 55 upwardly where ball 57 abuts against pin 65 extending downwardly from plug 62. The space intermediate separator 49 and piston 59 is always open to the sump through passages 67, 68 and clearance space 69 around cylinder 17. A hydraulic line 53 leads from the chamber above piston 48 to a port 53' near the top of cylinder 17. This port is positioned so that cylinder 16 is above it when the elevator carriage is at the upper station. A check valve 58 is interposed allowing flow of fluid from port 53' to the chamber above piston 48 but not vice versa.

No power is required for the descent of the carriage. Instead, the hydraulic fluid in chamber 20 is permitted to bleed back to the sump past speed control valve 70, whereby the degree of opening determines the speed of descent of piston 16 and the elevator carriage. In the position shown, valve 70 is closed due to spring 71 whose main purpose is to cushion the stop when piston 16 reached the bottom position. The cushioning effect is obtained when spring 71 gradually closes valve 70 prior to bracket 15 seating on the top of reservoir 3. Spring 71 has its lowest coil securely seated in a circular groove in valve 70 so that it cannot accidentally fall off when piston 16 has ascended. A central stem 72 of valve 70 slides in a bore 74 and guides the valve to be concentric with passage 75. The lower end of stem 72 is engaged by a leaf spring 77 subordinate to spring 71 but of sufficient strength to lift valve 70 against maximum pressure permissible by safety valve 26. The proper rate, force, and movement of this spring are important to obtain the desired speed of flow past the valve when the elevator descends. The face of the valve which seats is slightly tapered from the seat toward the outer periphery of the valve whose outer diameter is considerably larger than that of the valve seat. As shown in Fig. 1, the angle is somewhat exaggerated for purposes of illustration; but the angle must be sufficient to assure that the valve seat is restricted to the edge of opening 75 and not the entire area of the valve disc. The object is to obtain automatic regulation of the flow of fluid from chamber 20 to sump 30 during descent of piston 16 through the interplay of the forces of suction under valve disc 70 and the hydraulic pressure in chamber 20 on the one hand, and the force of spring 77 on the other. The suction forces under valve disc 70 are increased with the speed of fluid flow, thereby tending to reduce the opening of valve 70 when the pressure in chamber 20 is higher. Spring 77 must have a sufficiently high rate of increase of force so that the valve is not completely shut in response to an increased pressure in chamber 20. Some means of adjustment for spring 77 is provided by adjusting screw 80 serving as a stop for a manually operated lever 81 secured to a shaft 82 turning in a sealed bearing in the back wall of base 2 and carrying a cam 83 engaging a leaf spring 84 secured to base 2 with screws 85. Spring 77 has a weakened extension 86 the outer extremity of which may be engaged by leaf spring 84. Thus by adjustment of screw 80, cam 83 comes to rest in a different position to change the force of spring 77. Lever 81 is actuated by a manually operable rod 87 pivoted in a slot in lever 81 and guided near the top by a bearing 90 secured to the right hand rail 1, as shown in Fig. 2. The upper end of rod 87 serves to trip a catch or pawl 91 pivotally supported from brace 4 by a bracket 92, the pawl being adapted to arrest the elevator carriage after reaching the upper station, by engaging bracket 15 of the carriage. In Fig. 2 the top position of bracket 15 is indicated in dotted lines. The normally open electric switch 25 is positioned to be closed when rod 87 and lever 81 are depressed, and opened when lever 81 and rod 87 are raised.

The latter operation is performed automatically when the top position is reached by rod 14 to lift a lever 94 pivoted at 95 and arranged to lift rod 87 by means of adjustable collar 96 secured to rod 87. By lifting the latter, switch 25 is opened and the motor deenergized. Lever 94 is also intended to operate rod 87 to cause cam 83 to release spring 77 to open valve 70 to bring the carriage to a stop even if the motor and pump are still running due to their inertia. In order to prevent by-passing of fluid past valve 41 when piston 16 descends, a check valve 97 closes off passage 98, but permits flow of fluid from chamber 43 to 20 when piston 16 is ascending.

While the construction shown is adapted for travel between two end stations without intermediate stops, it nevertheless may provide transportation between a plurality of floors. Thus a passenger could travel on platform 9 from floor 100 to 101, and after descent of the elevator carriage, on platform 10 to floor 102, provided there is an opening. Where travel between two floors only is desired, the upper platform merely serves to close the opening when the carriage has descended. Numeral 103 indicates a grip or strap for the passenger. The runners of the carriage, as well as all the lifting mechanism, are completely enclosed within channels 1, a pair of shields 104 extending vertically the entire length of the channels being secured to the latter with screws 105 to leave only a narrow slot accommodating the web of H-beam 8. A bumper 106 at the top of channels 2 prevents overtravel of the elevator carriage when ascending and after motor 23 is deenergized.

Referring now to the modification shown in Figs. 6 and 7, the construction is similar to that shown in Fig. 1, except that in place of piston 59 which shuts off valve 55 by hydraulic power, in the modified form the equivalent of valve 55 is operated mechanically by an element which moves in unison with the elevator carriage. The base, which is only slightly modified, is indicated in its entirety by numeral 110. A power cylinder 111 fits into base 110 and is sealed with a pair of packings 112 between which is a port 113 communicating with a chamber 114 above control piston 48 sliding in a bore 115 closed by a plug 116. Within cylinder 111 slides a power piston 117 secured to piston rod 14. Below piston 117 is a valve plunger 119 sliding in the bore of cylinder 111 and having seals to prevent leakage. It is pressed upwardly against piston 117 by a spring 121 secured to valve 70 in the same fashion as spring 71 in Fig. 1. A hole 122 in valve 119 serves as a passage for the fluid transmitted from chamber 43 to lift piston 117. Centrally of the valve plunger is the check valve 57 retained by a pin 124 and being seated at the end of a passage 125 which communicates with port 113 when piston 117 is not in the bottom position, as shown in Fig. 7 where spring 121 is expanded to its free height. When piston 117 is descended, port 113 is open to the space below piston 117.

Describing now the operation of the elevator shown in Figs. 1–5, the drawings show the elevator in the bottom position and at rest, where the power is shut off. Assuming that a passenger steps on platform 9 and depresses rod 87 to ascend, cam 83 depresses springs 84 and 77 so that no force exists that would urge valve 70 to open. When lever 81 closes switch 25, motor 23 is energized to drive pump 22 which transmits fluid to chamber 43 and also to the space between separator 49 and piston 48, causing the latter to descend. Due to the restricted passage the action is rather slow so that the fluid in chamber 43 lifts piston 44 and valve 41 to by-pass fluid through the sump 30. This provides a no-load start and allows motor 23 to accelerate during the first instant. After piston 48 has compressed spring 47, valve 41 is closed and the fluid is pumped through passage 98 past check valve 97 into chamber 20 to lift piston 16 and the elevator carriage. The hydraulic pressure in chamber 20 represents the total load. This same pressure also exists in the chamber intermediate piston 48 and separator 49 so that the force exerted by spring 47 against piston 44 is greater than the upward force of the fluid in chamber 43, the difference being equal to the hydraulic unit pressure in chamber 43 times the area of passage 42. This difference

is enough to prevent leakage past valve 41. The hydraulic pressure above piston 16 is negligible, so that piston 59 remains in the position shown, valve 57 being closed so that the pressure existing in passage 54 cannot be transmitted to chamber 61. However, after piston 16 has passed port 60, the hydraulic pressure from the expanding chamber 20 is transmitted to chamber 61 to depress piston 59 and valve 55, shutting off passage 54 so that piston 48 becomes hydraulically locked, and relief valve 41 is set to yield when the hydraulic pressure exceeds a predetermined pressure above the hydraulic pressure transmitted by the pump during the first increment of movement of the power piston. After the end of valve plunger 55 has passed seal 56 below passage 54 so that passage 54 is shut off, piston 59 may descend a very short distance further before being seated on separator 49, whereby a very small amount of fluid is displaced by valve plunger 55 tending to slightly increase the pressure in the chamber above piston 48. However, any such increased pressure is immediately relieved through check valve 57 to chamber 20, whereby the hydraulic pressure in the chamber above piston 48 can never be higher than in chamber 20 after piston 16 has passed port 60. Thus an increase in hydraulic pressure in chamber 20 after piston 16 has passed port 60 does not increase the compression of spring 47, whereby an obstacle introduced during the ascent in addition to the load carried, causing increased hydraulic pressure in chambers 20 and 43, would cause valve 41 to lift, limiting the hydraulic pressure in chamber 43 to be only slightly higher than before the obstacle was encountered. The unit pressure in chamber 20 would be the same as in chamber 43 as long as piston 16 is ascending. During the upward movement of piston 16 the unit pressure in cylinder 17 due to the obstacle would be limited to the area of bore 40 times the initial or minimum unit pressure in chamber 43 divided by the effective area of piston 44. The latter is the difference between the area of bore 40 and that of passage 42. It follows that no accident due to the power of the elevator would be possible, and that a person could arrest the elevator in any position simply by resisting it. Assuming that the passenger would jump off the platform during the ascent, the hydraulic pressure below piston 16 would consequently be reduced. As a result, hydraulic pressure would be relieved from above piston 48 through check valve 57 and passage 60 to be the same as the pressure below piston 16 when the latter is above port 60, so that the force of spring 47 would be reduced to provide an adjusted setting for the reduced load. When the elevator nears the top position, the top of rod 14 lifts lever 94 which picks up collar 96 and rod 87 to open switch 25 and subsequently release springs 84 and 77 through the return of cam 83, spring 77 opening valve 70. After valve 70 has opened, the elevator carriage comes to a stop and sinks back until pawl 91 catches bracket 15. It is also possible that the elevator carriage comes to a stop before valve 70 is opened, in which case the speed of downward movement before pawl 91 is engaged depends entirely on the leakage past piston 16.

To cause descension of the elevator carriage it is necessary to lift up rod 87 to release pawl 91; whereby the weight of the carriage plus whatever load is on it forces the fluid in chamber 20 past valve 70 into sump 30 and through pipe 32 into reservoir 31. If there is only a small load or no load on the carriage as it descends, the pressure in chamber 20 is consequently low and the hydraulic force tending to close valve 70 small, so that spring 77 is able to lift the valve higher. If there is a heavy load on the carriage, the hydraulic pressure in chamber 20 is higher and the force tending to close valve 70 greater, so that spring 77 is able to lift the valve only a very short distance. Thus in the first case a larger amount of fluid passes at low speed and in the second case a small amount of fluid passes the valve at high speed, the result being that the rate of flow from chamber 20 to sump 30 is constant with different loads carried. An additional controlling factor is obtained by the oversize disc or valve 70, where an increase in fluid velocity underneath valve 70 tends to close the latter. According, if the elevator has a tendency to descend faster at high speeds than at low speeds, it could be corrected by increasing the diameter of the disc of valve 70. If the opposite is true, the diameter should be decreased. Adjustment of spring 77 to obtain the proper speed of descent can be obtained by pre-loading extension 86 of spring 77 by adjusting screw 80 downwardly, the descent of the elevator carriage is slowed up. When piston 16 nears the bottom position and starts to compress spring 71, the opening of valve 70 is decreased and the descent of piston 16 slowed down, until near full compression of the spring, valve 70 is entirely closed and piston 16 arrested, preferably prior to bracket 15 abutting on top of reservoir 3.

In the operation of the modified construction shown in Figs. 6 and 7, depression of rod 87 and starting motor 23 causes fluid to flow past check valve 97, through hole 122 and port 113 into chamber 114 to depress control piston 48 and compress spring 47 which then closes relief valve 41 so that pressure is built up to lift piston 117 and with it the elevator carriage. As piston 117 moves upwardly, valve 119 follows for a short distance until spring 121 has expanded. Passage 125 then registers with port 113 and chamber 114 is shut off, except that its pressure may be relieved if the pressure below piston 117 is subsequently reduced. Since the hydraulic pressure below piston 117 is somewhat increased at the start during acceleration of the ascending elements, and drops slightly after full speed is reached, the hydraulic pressure in chamber 114 is relieved through check valve 57 to be the same as exists below piston 117. On the other hand, if the pressure, below piston 117 is increased as when an obstacle is accidentally encountered, the excessive pressure below piston 117 is relieved past valve 41 into the sump, causing the elevator carriage to stop. The relieved hydraulic pressure acting on piston 117 then being reduced to be only slightly higher than existed at the start of the ascension, the pressure depending on the area of passage 42 relative to the area of bore 115. Stopping at the upper station, and descent are the same for both constructions and need not again be described. It is also apparent that the ascent may be stopped at any time by simply lifting rod 87 slightly to open switch 25, and the upward travel can be continued by depressing rod 87 again to close switch 25. If rod 87 is lifted fully during ascent to cause the elevator to descend, the hydraulic pressure in chamber 114 remains the same, and if rod 87 is depressed again for upward travel, the elevator will ascend again. When descent is started from the upper station, it is also possible to stop the elevator and reverse it to ascend again. This is made possible by line 53 and check valve 58 (Fig. 1) because at the start of the descent, the hydraulic pressure below piston 16 or 117 is communicated to chamber 114 or the space above piston 48 through port 53'. Thus in ascending from an intermediate position the safety feature is maintained.

Having thus described my invention, I claim:

1. In a hydraulic elevator having a load carrying platform guided to move up and down, a power cylinder, a power piston slideable in said power cylinder and operatively connected with the platform to move the latter, a source of hydraulic fluid under pressure, means to transmit hydraulic fluid from said source to said cylinder to move said piston in a direction to raise the platform, a pressure relief valve connected to reduce the hydraulic pressure transmitted from said source when a certain pressure is exceeded, said pressure relief valve including yieldable means urging to keep said pressure relief valve closed,

and means responsive to the hydraulic pressure transmitted during the first increment of movement of said power piston to set said yieldable means of said pressure relief valve to yield and thereby cause to relieve the hydraulic pressure when the latter is increased due to an increased load during the ascent of the platform so as not to exceed a predetermined pressure above the hydraulic pressure transmitted during said first increment of movement of said power piston.

2. The construction as claimed in claim 1, and automatic means responsive to a reduction in the hydraulic pressure required to lift the platform to change the setting of said pressure relief valve to limit the hydraulic pressure after a predetermined increase over the minimum pressure required to lift the platform.

3. In a hydraulic elevator having a load carrying platform guided to move up and down, a power cylinder, a power piston slideable in said power cylinder, means to transmit movement from said piston to the platform, a power driven constant delivery pump connected to said power cylinder to transmit hydraulic fluid under pressure to said power cylinder to lift said piston, a pressure relief valve connected to relieve the hydraulic pressure transmitted by said pump, said pressure relief valve including resilient means to bias said pressure relief valve to oppose relief of pressure until a certain pressure is exceeded, and means responsive to the hydraulic pressure existing during the first incremental movement of said power piston to set said resilient means of said relief valve so that said relief valve yields to relieve the excessive hydraulic pressure transmitted by said pump when said hydraulic pressure exceeds a higher pressure that is in a predetermined proportion to the hydraulic pressure existing during the first incremental movement of said power piston.

4. In a hydraulic elevator having a load carrying platform, a power cylinder, a power piston slideable in said cylinder, means to transmit movement from said power piston to the platform, a source of hydraulic fluid under pressure, fluid pressure transmitting means to transmit fluid from said source to said cylinder to act on said piston to raise the latter, relief valve means connected to limit the pressure of said fluid transmitted to said cylinder, first means responsive to the hydraulic pressure transmitted from said source to urge said relief valve means to relieve the hydraulic pressure of the fluid transmitted, resilient means arranged to oppose said first means responsive to the hydraulic pressure, second means responsive to the hydraulic pressure transmitted to said cylinder movably arranged to increase the force of said resilient means to oppose said first means, and means to arrest said second means after said piston has risen a certain distance.

5. In a hydraulic elevator having a load carrying platform, a power cylinder, a power piston slideable in said power cylinder and operatively connected with the platform to move the latter, a constant delivery pump, power means to drive said pump, fluid pressure transmitting means to transmit hydraulic fluid from said pump to said cylinder, a pressure relief valve fluidly connected to by-pass hydraulic fluid transmitted from said pump and return it to the intake of said pump to thereby reduce the hydraulic pressure of the hydraulic fluid transmitted from said pump, first means responsive to the hydraulic pressure transmitted from said pump urging to open said relief valve, a spring acting on said relief valve urging to close it, second means responsive to the hydraulic pressure transmitted from said pump during the first increment of movement of said power piston at the start of its travel to load and adjust said spring and thereby urge to keep said relief valve in a closed position with a force proportional to said initial hydraulic pressure, so that said relief valve remains closed during the stroke of said piston unless the hydraulic pressure delivered from said pump is increased beyond a predetermined amount above said initial pressure, and means to arrest said second means to maintain said spring in the adjusted position during the ascent of the platform.

6. The construction as claimed in claim 5, where said "means to arrest said second means" includes a valve arranged to trap the hydraulic fluid acting on said second means, and valve operating means connected to operate said valve, said valve operating means being energized subject to the travel of a certain distance of said power piston to close said valve after said power piston has travelled a certain distance, the closure of said valve effecting the arrest of said second means.

7. The construction as claimed in claim 5, where said "means to arrest said second means" includes a valve arranged to trap the hydraulic fluid acting on said second means, and a fluid pressure operated expansible chamber motor operatively connected with said valve to operate the latter, a port located in said cylinder near its lower end to come into communication with the hydraulic pressure transmitted from said pump after said power piston has risen a short distance, and a passage to transmit fluid from said port to said fluid pressure operated expansible motor to close said valve.

8. The construction according to claim 7, and a check valve to facilitate the flow of fluid trapped by said valve to said power cylinder below said piston if the fluid transmitted under pressure from said pump is reduced due to a change in load on said platform.

9. In a hydraulic elevator having a load carrying platform, a power cylinder, a power piston slideable in said power cylinder and operatively connected with the platform to move the latter, a constant delivery pump, power means to drive said pump, fluid pressure transmitting means to transmit hydraulic fluid from said pump to said cylinder, a pressure relief valve fluidly connected to by-pass hydraulic fluid transmitted from said pump and return it to the intake of said pump to thereby reduce the hydraulic pressure of the hydraulic fluid transmitted from said pump, first means responsive to the hydraulic pressure transmitted from said pump urging to open said relief valve, a spring acting on said relief valve urging to close it, second hydraulic pressure sensitive means arranged to load said spring to thereby tend to keep said relief valve in a closed position, a port near the top of said power cylinder and positioned to be below said power piston when the latter is in the top position, fluid pressure transmitting means to transmit hydraulic fluid from said port to act on said second hydraulic pressure sensitive means, a check valve in said fluid pressure transmitting means to check the flow of fluid from said second hydraulic pressure sensitive means to said port, manually operable means to control said power means, a manually controllable discharge valve to discharge the hydraulic fluid in said cylinder under said power piston, and a check valve to facilitate the flow of fluid from said second hydraulic pressure sensitive means to said cylinder near the lower end of the latter but checking the flow in the opposite direction.

10. The construction as claimed in claim 5, and a check valve in said fluid pressure transmitting means intermediate said relief valve and said cylinder to check the flow of fluid from said cylinder to said relief valve, a discharge valve arranged to discharge hydraulic fluid at a constant rate of flow from said power cylinder below said piston to control the descent of said power piston, and manually operable means to open or close said discharge valve.

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