K. E. O. JANSSON.

HYDRAULIC ELEVATOR.

APPLICATION FILED MAR. 22, 1907.. RENEWED SEPT. 9, 1914.

1,136,140. Patented Apr. 20, 1915.

FIG. 1

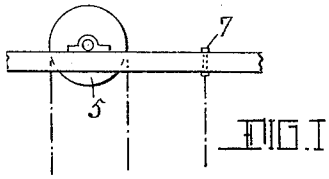


FIG. 2

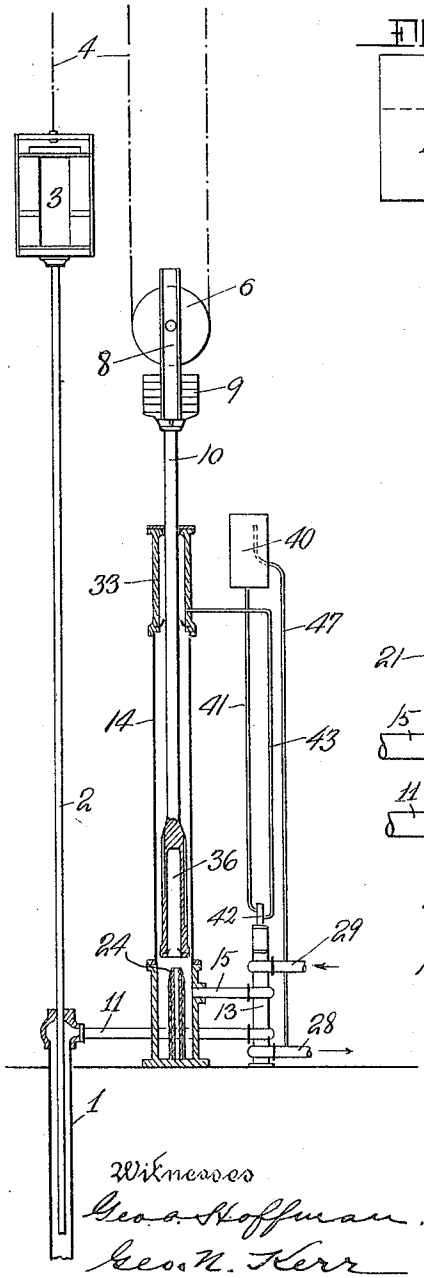
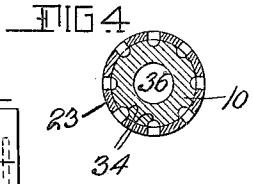


FIG. 4



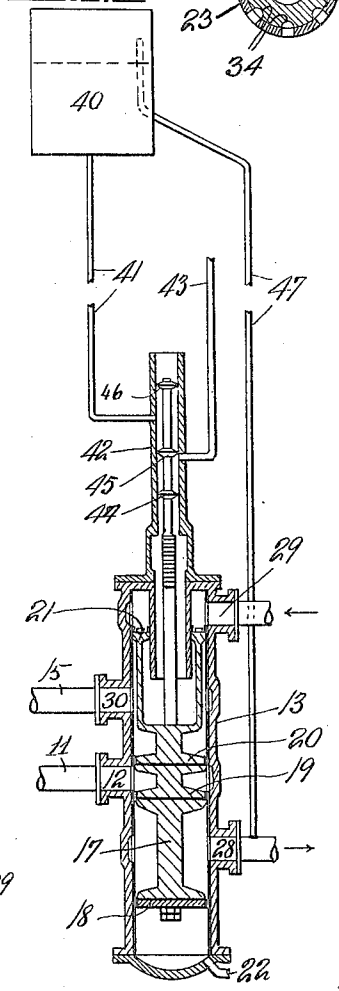
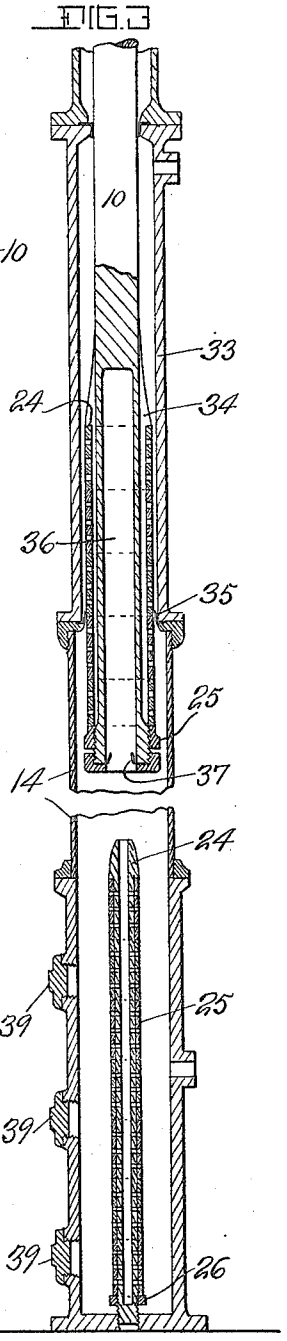


FIG. 3



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UNITED STATES PATENT OFFICE.

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HYDRAULIC ELEVATOR.

1,136,140. Specification of Letters Patent. Patented Apr. 20, 1915.

Application filed March 22, 1907, Serial No. 363,847. Renewed September 9, 1914. Serial No. 860,962.

To all whom it may concern:

Be it known that I, KARL E. O. JANSSON, a citizen of the United States, residing at Flushing, in the county of Queens and State of New York, have invented certain new and useful Improvements in Hydraulic Elevators, of which the following is a full, clear, and exact specification.

This invention relates to hydraulic elevators and has particular reference to improvements in elevator systems of the hydraulic plunger type whereby power may be economized, the rise and speed of operation increased, as well as greater facility of control and safety secured.

In the plunger elevator systems in common use, the car is usually underbalanced by the counterweight to a considerable degree, this difference being what is known as "dead load," as distinguished from the passengers and goods carried, known as "live load." In raising this dead load, power is necessarily wasted, and it has been impracticable to reduce this loss by close counterbalancing, by reason of the tendency of the main plunger at high speeds, to bound off the water, when the flow is suddenly cut off. At the present time this tendency is overcome in part by means of this unbalanced load.

According to this invention, the greater weight, exceeding by approximately one-half the maximum load, is on the counterbalance side, and to enable the car to be accurately controlled without bounding, means is provided for applying hydraulic power to the counterweight and opening the main cylinder to exhaust, when the car is to descend, whereby the car becomes temporarily unbalanced, so that it will descend by gravity at a speed determined by the main valve. To cause the car to ascend, power derived from the hydrostatic column in the counterweight cylinder, is applied to the main plunger, and a valve simultaneously connects the two cylinders to permit descent of the counterweight at the same time. Preferably the valve is constructed to temporarily remove the pull of the counterbalance in stopping, so that the car stops by its own weight without bounding. To accomplish these objects, a special form of valve is provided for simultaneously controlling both the main plunger cylinder and the counterweight cylinder. It will be understood, that the function of this valve broadly is to simultaneously control both cylinders, in such manner as to permit one plunger to ascend and the other to descend, which result may be accomplished in various ways, though I consider the valve herein described of particular advantage for this purpose.

A further feature of this invention, resides in an arrangement of parts whereby the counterweight cylinder is disposed above the top of the main cylinder, so that the hydrostatic column in the former can be used to lift the plunger in the latter cylinder, in combination with means preventing a variation in pressure in one cylinder by reason of a difference in the displacements of the two plungers for a given movement of the car. While theoretically it is possible to proportion the counterweight plunger so as to displace exactly the same volume of water for a given movement of the car, as the main plunger, in practice this theoretical result is not readily obtained. If the displacement of the main plunger, for a given movement be greater, a vacuum will be produced in the main cylinder, and air drawn in, which will be objectionable. If, on the other hand, the displacement of the counterweight plunger be greater, it will produce an excessive increase in pressure in the main cylinder and tend to buckle the main plunger, which is likewise objectionable. To overcome these objections, and also avoid the necessity of maintaining the theoretical displacements of the plungers exactly equal, the counterweight plunger is made to have a somewhat greater displacement, for a given movement of the car, than the main plunger, and automatic means provided for preventing increase of pressure in the main cylinder due to such greater displacement. This is ac-

complished by providing an auxiliary tank connected to be controlled by the main valve, into which the excess water displaced by the larger plunger can discharge without increasing the pressure in the other cylinder. It will be obvious that the same pressure equalizing mechanism would be necessary in case pistons were used instead of the rams or plungers herein shown, and a piston is to be considered the equivalent of a ram or plunger. Preferably, in combination with said equalizing means and with an automatic end stopping mechanism for the counterweight plunger at the top of its stroke, there is provided means for relieving or equalizing the pressure in the end stopping mechanism to permit a start in the opposite direction, at the normal speed.

A further object of the invention is to provide hydraulic automatic end retarding mechanism independent of the main cylinder, and controlled by the counterweight, and having means whereby the speed of stopping at the ends can be readily adjusted without necessitating disarrangement of the system, or prolonged shutting down.

The foregoing, and other objects and advantages, will be more fully explained in connection with the accompanying drawings, wherein—

Figure 1 is an elevation, of a system embodying the invention; Fig. 2 is a section of the controlling valve mechanism and the pressure relieving devices; Fig. 3 shows the hydraulic end stopping mechanism for the counterweight cylinder, and Fig. 4 is a section of the counterweight plunger.

1 represents a main cylinder having a plunger 2 therein, and 3 is a car mounted on the upper end of the plunger. Connected to the car is a counterweight cable 4 running over an overhead sheave 5, thence around a movable sheave 6 and attached at the other end to the building at 7. The movable sheave 6 is carried by a yoke 8, which may also carry additional weights 9, and depending from the yoke 8 is an auxiliary plunger 10. The sheave 6, yoke 8 and plunger 10 will together comprise the counterweight, and preferably, in practice, will exceed the weight of car 3 and plunger 2 by an amount equal to one-half the maximum load which the car is to carry, though it will be understood that the particular amount of excess weight on the counterbalance side, if any, will not necessarily be this amount, and in some cases it may be desirable to have the weights on opposite sides balance each other, more or less.

11 is a to-and-from pipe leading to cylinder 1, and connected by a suitable connection to a port 12 of the main controlling valve 13.

14 is an auxiliary cylinder in part or wholly above the main cylinder 1, so as to provide a head of water, or a water column for raising the plunger 2 and the car when the main valve is manipulated for this purpose.

By reason of the movable sheave 6, and the cable connection 4 therewith, it will be seen that the plunger 2 will move twice as fast as the plunger 10, and in order to avoid loss of pressure in the main cylinder and formation of a vacuum, the plunger 10 will have somewhat more than twice the cross section of plunger 2. Whenever the plunger 2 goes up, plunger 10 will go down, and accordingly, the main valve 13 is connected by a pipe 15 with the cylinder 14, and the pistons and ports are so arranged that opposite movements of the main valve permit such respective movements of the plungers to take place, in both directions, simultaneously. Inasmuch as the water column in cylinder 14 supplies lifting pressure for the car, the car will ascend whenever cylinders 1 and 14 are connected, as the pressure required to lift the live load will be more than sufficient by reason of overbalancing on the counterweight side, in the preferred arrangement, and if approximately balanced somewhat more pressure will of course be required, depending upon the degree of balancing, but not greater than the cylinder 14 can supply. By making the excess weight on the counterbalance side equal to one-half the maximum live load, an operation will result well suited for average operating conditions, without affecting the quickness of descent of the car. By reason of the overbalancing of the car, the cylinder 14 becomes in effect, a loaded accumulator, and any live load the car descends with, reduces to a corresponding degree the amount of power required to lift the counterweight plunger. Instead of the rams or plungers shown, pistons might be used instead.

The main valve comprises a stem 17 carrying pistons 18, 19, 20, 21, and has at one end a controlling passage 22 which is connected with a suitable pilot valve not shown. This pilot valve is operated by manual connections upon the car in a well known manner not necessary to be illustrated herein. When pressure is admitted to the lower side of piston 18 through pipe 22, the main valve stem 17 will move upward, thereby opening the main cylinder 1, through pipe 11, port 12, and port 28 of main valve 13 to the exhaust. Simultaneously, piston 21 connects supply port 29 of the main valve with port 30, and thence by pipe 15 to cylinder 14, thereby admitting pressure to cylinder 14. This operation causes the car and main plunger to descend and the counterweight plunger 10 to ascend. To cause the car to ascend, the pipe 22 of the main valve, is, by a proper

manipulation of the main valve by a downward movement opened to the exhaust, whereupon piston 20 will uncover port 12, and port 29 be closed, and thus establish a circulating passage between the cylinder 14 and the cylinder 1, causing the car to ascend by the hydrostatic pressure in cylinder 14 as before stated. In this connection, it should be stated that the main valve in moving automatically closes the pilot valve in the well understood manner.

A particular feature of this invention comprises the automatic retarding mechanism contained in the counterweight cylinder and acting to automatically effect a cushioned stop of the counterweight plunger at each end of its movement in cylinder 14, thereby stopping the car. If the counterweight cannot move at its lower limit, it is immaterial whether the pressure be under the main plunger or not as it cannot be sufficient to move the uncounterbalanced part farther upward. On the other hand, if the movement of the counterweight plunger be cushioned and retarded at the top of its path of travel, by positive means, the car cannot go farther down, even though the exhaust of the main cylinder be open and lifting pressure admitted to the counterweight cylinder. For cushioning the counterweight plunger 10 at the top, an auxiliary stopping or cushioning cylinder 33 is provided, and the lower end of plunger 10 is provided with an enlarged grooved portion 34 which will pass through a packing 35, so that the water trapped above packing 35 will be forced out through the grooves 34.

To regulate the cushioning effect, the grooves are surrounded by a number of movable perforated rings 23, the perforations of which can be adjusted to register more or less with the grooves in the end of the plunger and thus control the quantity of water which can flow through the grooves and holes from one side of the packing 35 to the other. These rings are mounted between a shoulder, and a lock nut 25, which latter holds them in adjusted position. To provide an automatic top retarding for the car, the counterweight plunger has the lower end hollow, as at 36, and a packing 37. At the lower end of cylinder 14 is an upright perforated casing or tube 24, carrying a second set of perforated rings 25, the perforations of which can be made to register more or less with those in the tube 24, and thereby regulate the descent of the plunger 10 by restricting the escape of the water trapped in the hollow end 36 of plunger 10. These rings are also held between a shoulder and a lock nut 26, in adjusted position, in the manner before described. This forms a very effective end retarding device, because the lifting power on the car is never sufficient to lift it unless the counterweight can fall correspondingly. It should be here noted that the effective area of the plunger 10 is not diminished by the tube 24, since the area outside the tube, and at all times subject to lifting pressure will ordinarily exceed the cross section of the plunger, so that it will not be retarded by having to pass over the tube. These cushioning devices, depending upon the linear movement of plunger 10 will be more effective, because the main plunger is moving at twice the linear speed of plunger 10 and no unusual stresses are put on the main plunger in stopping, except those naturally due to the live load. For adjusting both sets of rings, hand holes and removable covers 39 are provided.

The means heretofore referred to, for preventing variation of pressure between the two cylinders, by reason of the unequal displacement of the two plungers will now be described, in connection with the means of admitting a supply of water under pressure above packing 35 to balance that below, when the plunger 10 is to descend and the car to ascend. By doing this the start of the plunger is not retarded by requiring the water to pass through the throttled grooves 34 into the auxiliary cylinder 33 to replace the enlarged plunger end. This same mechanism also takes up the surplus water displaced by the plunger 10 in its descent, so that no excess pressure can be applied to the main plunger by reason of the greater volume of water displaced by the counterweight plunger. When the counterweight plunger is being raised and the main plunger and car lowered, the same conditions do not occur, since the two cylinders are not opened to the same body of water.

40 represents an auxiliary tank disposed at the level of cylinder 14, and of a capacity greater than the total excess volume of plunger 10 over plunger 2. Leading from tank 40, is a pipe 41 connected to an auxiliary valve casing 42 in main valve 13.

43 is a pipe leading from the casing 13 to cylinder 33. Mounted on the main valve stem 17, are three packings 44, 45, 46, so disposed as to connect pipes 41, and 43, during the opening and closing of the main valve when the car is to be lifted. By this means, the head of water in pipe 41 is immediately applied above packing 35 in starting the counterweight plunger downward, so that the throttled passages 34 are only effective in slowing the plunger 10 when approaching its upper limit and cannot act to retard it in starting downward, as would be the case if the water to fill cylinder 33 had to pass backward through the rings 23 and passages 34 in the descent of plunger 10. Also it will appear that the excess water due to the larger displacement of plunger 10 will be

forced upward into tank 40 during the descent of this plunger, and from there, will overflow into the exhaust through a pipe 47, thus equalizing the pressures in the two cylinders and preventing increase of pressure. As before stated, the same condition does not obtain for movement in the opposite direction, as when the main valve moves upward from its central position, so during this movement, piston 45 does not move far enough to connect pipes 41 and 43. It will thus be seen that unequal displacement of the plungers can be automatically compensated for, and thereby injurious strains on the main plunger, and variations of pressure by uneven displacement avoided. This result can be secured in other ways, without departing from the invention.

In the description thus far given of the operation, the design of the ports has not been particularly described, but it will be understood that the main valve ports will be so designed as to at times cause the main plunger to move quicker than the counterweight plunger and vice versa, which results can be accomplished by a proper design of the ports so as to throttle the water supply at certain portions of the main valve stem. For instance, in stopping the car going up, the escape of water from cylinder 14 should be throttled so as to retard the descent of the counterweight plunger 10, thereby removing the pull of the counterweight plunger on the car and permitting the car to stop quickly by reason of being underbalanced. In descending, if the admission of supply pressure to the cylinder 14 be throttled, the counterweight plunger 10 will be retarded, thereby putting a pull on the car and retarding it without increasing the strain on its plunger. Also the exhaust from cylinder 1 can be throttled at the same time, if not made so great as to buckle the main plunger.

From the foregoing description, the nature and advantages of the invention will be fully understood, and it will be seen that a hydraulic elevator system is provided in which an economy of power will result, and also a material reduction in the compressing strains to which the plungers of underbalanced hydraulic systems are now subject. Furthermore, it will be seen that the car can be readily controlled in either direction without straining the main plunger. By the use of the automatic end retarding mechanism described in connection with the adjustments and relief means the safety of the car will be insured without involving any strains on its plunger, and the car started with normal speed in the opposite direction.

Inasmuch as the invention is susceptible of various modifications and changes in the form, proportions, design and arrangement of parts, it is not to be restricted to the precise form and arrangement herein shown and particularly described.

Having thus described my invention, I declare that what I claim as new and desire to secure by Letters Patent, is,—

1. The combination with a hydraulic elevator system embodying a car, two connected cylinders and having connected plungers moving oppositely, one of said plungers displacing a greater volume of water than the other in proportion to a given movement, of means preventing variations of the pressure in said cylinders when connected by reason of the difference in displacement of said plungers.

2. The combination with a hydraulic elevator system embodying a car, two cylinders adapted to be connected, and having connected plungers moving simultaneously, one of said plungers displacing a greater volume of water than the other in proportion to a given movement, of means for connecting said cylinders to move the car in one direction, and means for preventing excess of pressure by reason of the excess of water displaced by one of said plungers when said cylinders are connected.

3. The combination with a hydraulic elevator system embodying a car, two cylinders adapted to be connected, and having plungers moving simultaneously, one of said plungers displacing a greater volume of water in proportion to a given movement than the other, of means for automatically preventing the difference in displacement of said plungers, when said cylinders are connected, from increasing the pressure.

4. The combination with a hydraulic elevator system embodying a car, two cylinders adapted to be connected, and having plungers moving simultaneously, one of said plungers carrying the car, and the other a counterweight connected to the car, and one plunger having a greater displacement in proportion to a given movement than the other, of means for connecting said cylinders to move the car in one direction, and means for preventing increase of pressure by reason of said difference in displacement of said plungers when said cylinders are connected.

5. The combination with a hydraulic elevator system embodying a car, two cylinders adapted to be connected and having plungers moving simultaneously in opposite directions, one of said plungers carrying the car and the other a counterweight, one plunger having a greater displacement than the other, of means for preventing increase of pressure in one cylinder by reason of the greater displacement of the plunger in the other cylinder for a given travel of the car.

6. The combination with a hydraulic elevator system embodying two cylinders

adapted to be connected and having plungers moving simultaneously at different speeds, one of said plungers carrying the car and the other the counterweight, and the counterweight plunger having a greater displacement for a given movement than the other, of means for receiving the excess water displaced by the counterweight plunger when moving into the cylinder.

7. The combination of two cylinders containing connected plungers or pistons, the piston of one being operated by pressure from the other when the cylinders are connected, and one piston or plunger displacing a greater volume of water than the other, of means compensating for the difference in the volume of water displaced by the larger plunger when the cylinders are connected, and means controlling the connection of said cylinders.

8. The combination with two cylinders containing each a plunger, one cylinder supplying actuating pressure for the plunger of the other, said plungers having different speeds and total displacements, of means for connecting the cylinders and preventing variation of pressure by reason of such difference in displacement.

9. The combination with two cylinders containing each a plunger one plunger being connected to the other, one cylinder supplying actuating pressure for the plunger of the other, said plungers having total different displacements, of means preventing variation of pressure by reason of such difference in displacement, and means for connecting the cylinders to cause said plungers to move simultaneously.

10. The combination with two cylinders containing each a plunger, one cylinder supplying actuating pressure for the other to move its plunger in one direction, means connecting the plungers whereby they move simultaneously in opposite directions, controlling means for connecting said cylinders, and means whereby any difference in the displacements of said two plungers is prevented from producing a variation in pressure when the cylinders are connected.

11. The combination with two cylinders containing each a plunger, one cylinder supplying actuating pressure for the other, means connecting the plungers whereby they move simultaneously in opposite directions, controlling means for connecting said cylinders, and means whereby any difference in the displacements of said two plungers is prevented from producing a variation in pressure, said means being thrown into and out of operation by the cylinder controlling means, substantially as described.

12. The combination with two cylinders containing each a plunger, one cylinder supplying actuating pressure for the other to move the plungers in one direction, a valve for connecting said cylinders, and means controlled by said valve for preventing variation of pressure by reason of a difference in the displacements of said plungers, substantially as described.

13. In an elevator system, the combination with a hydraulic plunger carrying a car, of a counterweight comprising a second plunger, automatic end retarding mechanism for both ends controlled by said second plunger, and means for adjusting said mechanism, substantially as described.

14. In an elevator system, the combination with a hydraulic plunger carrying a car, of a counterweight, a hydraulic automatic end retarding mechanism for both ends independent of the said plunger and controlled by said counterweight, and means for regulating the retarding effect of said mechanism, substantially as described.

15. In an elevator system, the combination with a hydraulic plunger carrying a car, of a counterweight connected therewith and carrying a plunger, said plungers having unequal displacements, automatic hydraulic end retarding means controlled by said counterweight plunger, cylinders containing said plungers, means for connecting the cylinders, and a connection between said end retarding means and a source of water pressure to equalize the difference in displacements of said plungers.

16. In an elevator system, the combination with a hydraulic plunger carrying a car, of a counterweight carrying a plunger, said counterweight and plunger being heavier than the car and plunger, automatic end retarding means for both ends controlled by said counterweight plunger, and means for varying the retarding effect of said means, substantially as described.

17. In a hydraulic elevator system, the combination with a main hydraulic plunger and car, of a counterweight and plunger opposing the car and main plunger, and adjustable means for cushioning the counterweight plunger at the opposite ends of its travel and thereby automatically stopping the car, substantially as described.

18. The combination with a cylinder having a water chamber at each end, of a plunger having means for forcing water from said chambers through restricted passages for slowing the movement of the plunger at the ends, and adjustable means for varying the areas of said passages.

19. The combination with two cylinders each containing a plunger, and one cylinder supplying power to actuate the plunger of the other in one direction, said plungers having unequal total displacements, hydraulic means for automatically checking one of said plungers at one end of its movement, and means whereby the excess water displaced by the larger plunger is stored to

supply equalizing pressure when said plungers are to move in the opposite direction, substantially as described.

20. The combination with a cylinder having a water chamber at each end, of a plunger working through one end of said cylinder and having its free end adapted to force water from said chambers through restricted passages for slowing the movement of the plunger at the ends, and means for adjusting the areas of said passages.

In testimony whereof I affix my signature, in presence of two witnesses.

KARL E. OSSIAN JANSSON.

Witnesses:
JULIAN S. WOOSTER,
GEO. A. HOFFMAN.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C"