T. LARSSON.

PLUNGER ELEVATOR SYSTEM.

APPLICATION FILED APR. 3, 1905.

975,540.

Patented Nov. 15, 1910.

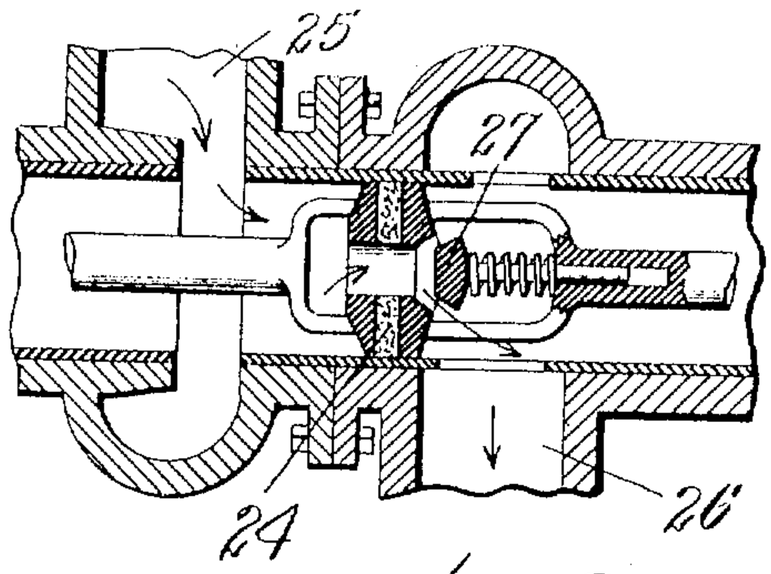


Fig. 2.

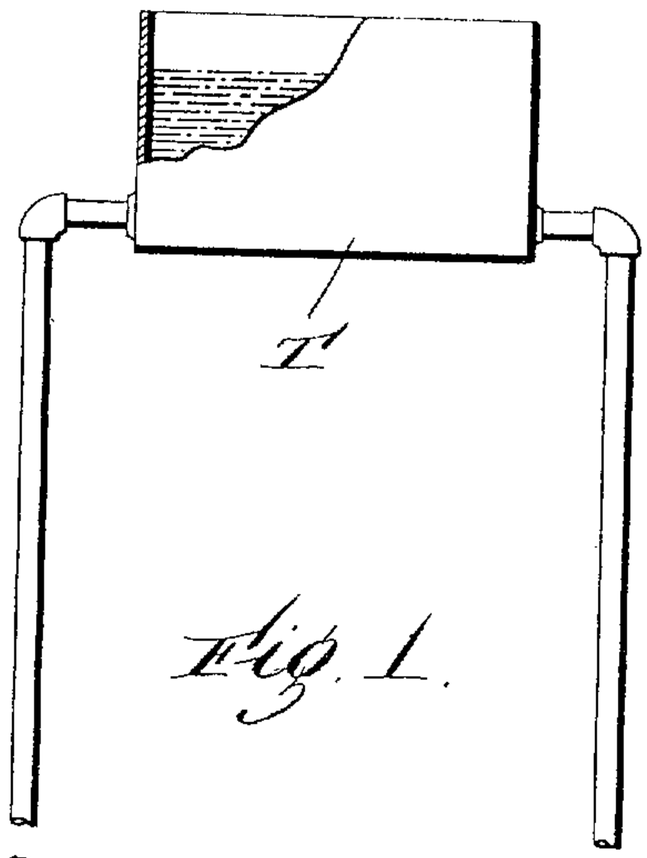
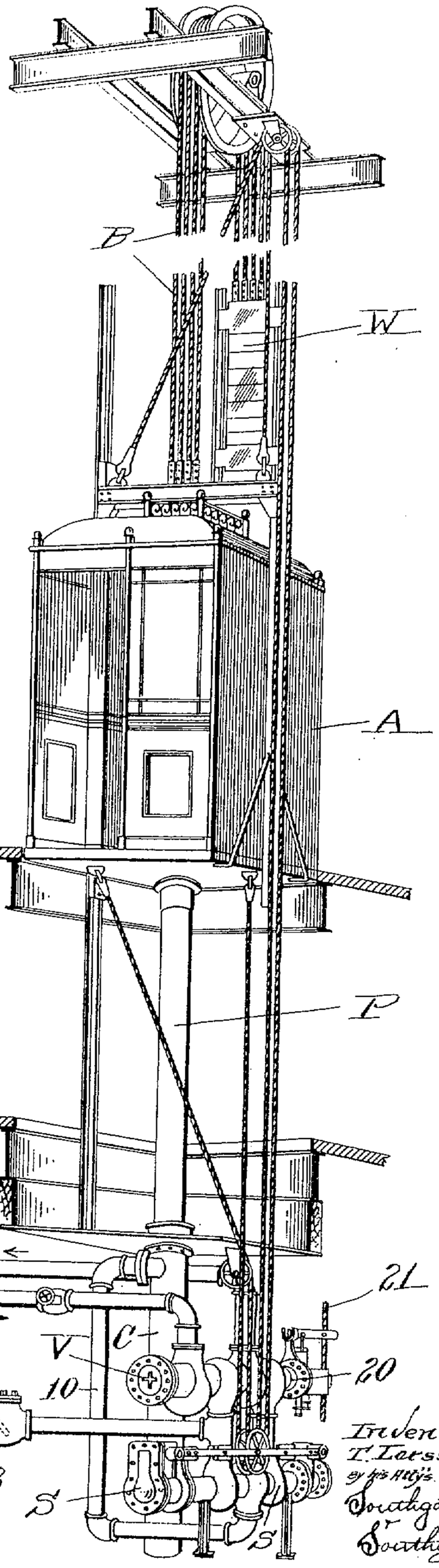


Fig. 1.



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UNITED STATES PATENT OFFICE.

THURE LARSSON, OF WORCESTER, MASSACHUSETTS, ASSIGNOR TO HIMSELF, WILLIAM E. D. STOKES, OF NEW YORK, N. Y., AND FRED A. JONES, OF WORCESTER, MASSACHUSETTS.

PLUNGER-ELEVATOR SYSTEM.

975,540. Specification of Letters Patent. **Patented Nov. 15, 1910.**

Application filed April 3, 1905. Serial No. 253,571.

To all whom it may concern:

Be it known that I, THURE LARSSON, a subject of the King of Sweden, residing at Worcester, in the county of Worcester and State of Massachusetts, have invented a new and useful Plunger-Elevator System, of which the following is a specification.

This invention relates to a hydraulic elevator of the direct plunger type.

The objects of this invention are to provide a plunger elevator system which can be used in high buildings and can be operated at high speeds with greater efficiency than other types of elevators which are now used.

To these ends, this invention consists of the plunger elevator and of the combinations of parts therewith as hereinafter described and more particularly pointed out in the claims at the end of this specification.

In the accompanying drawing, Figure 1 is a diagrammatic view partly in section of sufficient parts of the hydraulic elevator to illustrate the application of this invention thereto, and Fig. 2 is a detail view illustrating a modified form of construction.

The plunger elevator on account of its comparative simplicity and absolute safety has long been recognized as one of the most desirable and practical types of hydraulic elevators for comparatively short runs, or for use in situations where high speeds are not required.

In the larger and taller business blocks, some of which are from two to four hundred feet high, it has been thought that the plunger elevator could not be used to advantage, and particularly that it could not be operated at high speeds. In recent installations, however, plunger elevators are now being employed for runs of between two and three hundred feet. While these elevators can be installed at prices comparing favorably with elevators which cannot be operated with the same degree of safety, and while these long-run plunger elevators can be operated smoothly and can be readily controlled, yet it has been found in practice that the absolute efficiency of these long-run plunger elevators does not reach a very high percentage. This is due to the fact that in raising a long plunger and heavy car, heavy weights are set in motion. This in itself would not be objectionable if it were possible to counterweight the plunger and car to the full limit of weight less the amount required to start the unloaded car on its downward travel, which is the limit to which comparatively short-run low-speed elevators may be counterweighted.

The reason why it has not been thought desirable to use a heavy counterweight in a long-run high-speed elevator is that during the upward travel of the car the preponderance of the car and plunger over the counterweight must be sufficient to overcome the inertia of the moving parts. If a long-run high-speed direct plunger elevator is too heavily counterweighted, it has heretofore been thought impossible to accurately control the upward travel of the car, because in an over-counterweighted system of this kind the car will continue its upward travel after the controlling valve is shut, and where there was but a single source of water supply, this upward jump or uncontrolled motion of the car will draw air down through the stuffing-box, introducing an air-cushion inside the air cylinder, allowing the end of the plunger to leave the water, and producing what is known as "bounding."

In a prior application for patent filed by me July 29, 1904, Serial No. 218,661, I have shown an anti-bounding elevator system in which an independent source of water-supply is used which will provide water which will be drawn into the cylinder by the unrestrained upward travel of the plunger. In an anti-bounding elevator system of this type, not only is the plunger prevented from leaving the water so that the car after coming to rest cannot afterward settle, or be seriously jolted, but it also has the advantage that it can be operated with higher efficiency and with a considerable saving of power. This is due to the fact that the pump or other ordinary source of water supply may be shut off during the time that the elevator is being brought to rest. For example, if the comparative weights of an elevator system are proportioned so that the unweighted car when ascending at full speed can be stopped in a distance of fifteen feet, the main-valve of an anti-bounding elevator system can be shut off when the car is fifteen feet from the desired stopping place, and the last part of the run will be accomplished by inertia alone.

In my prior application for patent before referred to, the water required for anti-bounding action was furnished from an independent source, and the amount of water required to be furnished from such independent source would vary in accordance with the conditions under which the elevator was being operated. For example, in office building elevators, at the close of the day when most of the people are descending, the elevators will frequently run up light, and the anti-bounding provision will frequently be brought into use; while at other times in the day the same will be less frequently brought into use.

The especial object of my present invention is to provide a plunger elevator system of the anti-bounding type, in which all the water required either for ordinary operations, or anti-bounding operations will be obtained from a common tank or other source of supply.

A further object of my invention is to utilize in connection with an anti-bounding elevator the system of hydrostatic counterbalancing covered in a prior application for patent filed by me January 27, 1903, Serial No. 140,722.

Referring to the accompanying drawing and in detail for a description of a plunger elevator system constructed according to this invention, C designates the elevator-cylinder which extends down into the ground below the building a distance equal to the length of the elevator run. Working up and down in the cylinder C and extending through a stuffing-box in the upper end thereof, is a plunger P carrying the car A at its upper end. Connected to the car A are counterweight ropes B which connect to a counterweight W for counterweighting so much of the weight of the car A and plunger P as may be possible, while still leaving the required preponderance of plunger and car to start downward travel.

The weight of the cables or counterweighted ropes B and the counterweight are preferably proportioned so that the weight of the cables for a given length is substantially equal to one-half the buoyancy of a corresponding length of elevator plunger. This distribution of cable weights provides an offsetting counterbalance which automatically offsets the buoyancy of the plunger. For example, when the car is near the top of its run, substantially the entire weight of the counterweight rope B will be added to the weight of the counterweight W; while when the car is near the bottom of its run and the plunger has displaced an equal volume of water, and has, therefore, its greatest amount of buoyancy tending to raise the same, the weight of the counterweight rope B will oppose the action of the counterweight W.

Opening into the upper end of the cylinder is a to-and-from pipe 10 which connects through stop-valves S, and a main valve V either with the supply pipe 15 or with the exhaust pipe 16. The exhaust pipe 16 is extended upwardly to a storage tank T, and extending down from the storage tank T is the inlet pipe 17 of the ordinary pump 18 which maintains pressure in the pressure tank 19.

The stop valves S are shown as controlled by an arrangement of inclined running controlling ropes which need not be herein described at length, as the same is claimed in an application for patent filed by me July 5, 1904, Serial No. 215,266. The main valve V is controlled by a pilot valve 20 which may be operated from the car through a rope 21 by means of any of the ordinary controlling devices.

In the operation of the system as thus far described, the counterweight W will counterweight as much of the weight of the car and plunger as is thought desirable; the counterweight cables B are preferably, but not necessarily designed to compensate the buoyancy of the plunger; while the hydrostatic head of the overhead tank T will counterweight the whole, or a considerable part of the preponderance of the weight of the plunger and car over its counterweight which is required for bringing the elevator to rest.

In many of the high speed elevator plants, it has been thought necessary to maintain a preponderance of the elevator car and its plunger, frequently running as high as thirty-five hundred pounds, and this has heretofore ordinarily been a dead weight, which has been required to be overcome by the pump at each stroke of the elevator; while by the use of hydrostatic counterbalancing column considerable amount of this work can be taken off of the pump. In addition to this, the storage tank provides a convenient source of water supply which can be utilized to secure anti-bounding action. For this purpose a pipe 22 is connected to the exhaust pipe 16 and to the inlet side of the main valve V. In the pipe 22 is a check-valve 23 which is normally closed but which will open to admit a supply of water to provide anti-bounding action when required.

In some cases instead of providing an exterior check-valve for the anti-bounding water supply, one of the pistons of the main valve itself may be provided with a check-valve for this purpose.

As shown in Fig. 2, 24 designates a piston of the main valve V, normally separating a passage 25 connected with the tank T from a passage 26 leading to the stop valve S. Arranged in the piston 24 is a spring-pressed check-valve 27 which is normally

closed, but which will be drawn open when a supply of water for anti-bounding action is required. The passage 25 preferably communicates directly with the pipe 16, and the passage 26 with the right hand side, as shown in Fig. 1, of the valve S, the mechanism shown in Fig. 2 being inserted at this point.

In a complete plunger elevator system constructed according to this invention it will be seen that the parts are counterbalanced with the greatest possible efficiency; that the water required for anti-bounding action is furnished from the same source as for ordinary action; and that for high-speed operations a high degree of efficiency may be maintained because when the main valve is closed some distance below the desired stopping point, the additional supply of water required to follow up the plunger and prevent bounding will be furnished without the expenditure of power. This high degree of efficiency which results in a considerable saving of power is secured without in any way endangering the safety of operation, because the stop valves are adjusted to secure a differential and gradual stopping action which will have a retarding effect upon the car, commencing at any desired distance from the top of its run.

In the construction illustrated in Fig. 1, the water required for anti-bounding action has to pass through the stop valve which stops the upward movement at the top of the run; while in the construction illustrated in Fig. 2, the water for anti-bounding action is drawn into the main valve before it passes through said stop-valve; but in either case, the operating connections for the stop-valve are adjusted to have a comparatively gradual stopping action which will slow down and check the speed of the car some distance from the top of its run. That is to say, in a complete elevator system equipped according to this invention, while at intermediate points of its run, the ascending car when going up light will be permitted to move by its own inertia some distance after the main valve is closed, permitting the operation of the pump to be stopped sometime before the car reaches the desired landing; there will be no danger at the top of the run on account of the easy and gradual stopping of the car by the stop-valve.

I am aware that changes may be made in the construction of my plunger elevator system by those who are skilled in the art without departing from the scope of my invention as expressed in the claims. I do not wish, therefore, to be limited to the construction I have herein shown and described, but

What I do claim and desire to secure by Letters Patent of the United States is:—

1. In an elevator system, the combination of a cylinder, a plunger therefor, a car, a counter-balance for part of the weight of the car and plunger, a to-and-from connection opening into the cylinder, a storage tank connected thereto and located at such elevation that its static pressure assists in balancing the preponderance of weight of plunger and car over the counter-balance, a pressure tank, and means for admitting supply from the storage tank to the cylinder when anti-bounding action is required.

2. In a plunger elevator system, the combination of a cylinder, a plunger therefor, a counter-balance for a part of the weight of the plunger and elevator car, a to-and-from connection opening into the cylinder, a storage tank connected therewith and located at such elevation that its static pressure will assist in counter-balancing the preponderance in weight of plunger and car over the counter-balance, a pressure tank, a pump intermediate the pressure tank and storage tank, and means for admitting supply from the storage tank to the cylinder without passing through the pump when anti-bounding action is required.

3. In a direct plunger elevator system, the combination of a vertical cylinder, a plunger working therein, a car on the upper end of the plunger, a counterbalance for part of the weight of the car and plunger, a to-and-from pipe opening into the upper end of the cylinder, a storage tank connected thereto and located at such elevation that its static pressure will assist in balancing the preponderance in weight of plunger and car over the counterbalance, a pressure tank, a pump intermediate the storage tank and pressure tank, and means for admitting supply from the storage tank to the cylinder without passing through the pump when anti-bounding action is required.

4. In a plunger elevator system, the combination of a cylinder, a plunger therefor, a car, a counter-balance for part of the weight of the plunger and car, a to-and-from pipe connected with the cylinder, an elevated storage tank, an outlet pipe leading to the storage tank, a pressure tank, a pump between the pressure tank and storage tank, an inlet pipe from the pressure tank to the to-and-from pipe, a main valve for connecting the to-and-from pipe with the inlet pipe or outlet pipe as required, and means for admitting supply from the outlet pipe to the cylinder when the main valve is closed.

5. In a direct plunger elevator system, the combination of a vertical cylinder, a plunger working therein, a car on the upper end of the plunger, a counterbalance for the greater part of the weight of the car and plunger, a main valve, a to-and-from pipe opening into the upper end of the cylinder, a storage tank connected thereto and located at an elevation such that its static pressure will aid

in balancing the preponderance in weight of car and plunger over the counterbalance, a pressure tank, a pump intermediate the storage tank and pressure tank, and means for admitting supply from the storage tank to the cylinder for anti-bounding action.

In testimony whereof I have hereunto set my hand, in the presence of two subscribing witnesses.

THURE LARSSON.

Witnesses:
PHILIP W. SOUTHGATE,
MARY E. REGAN.