A. L. SCHULLER.

PLUNGER ELEVATOR RETARDING MECHANISM.

APPLICATION FILED AUG. 24, 1905.

965,542. **Patented July 26, 1910.**

Fig. 1,

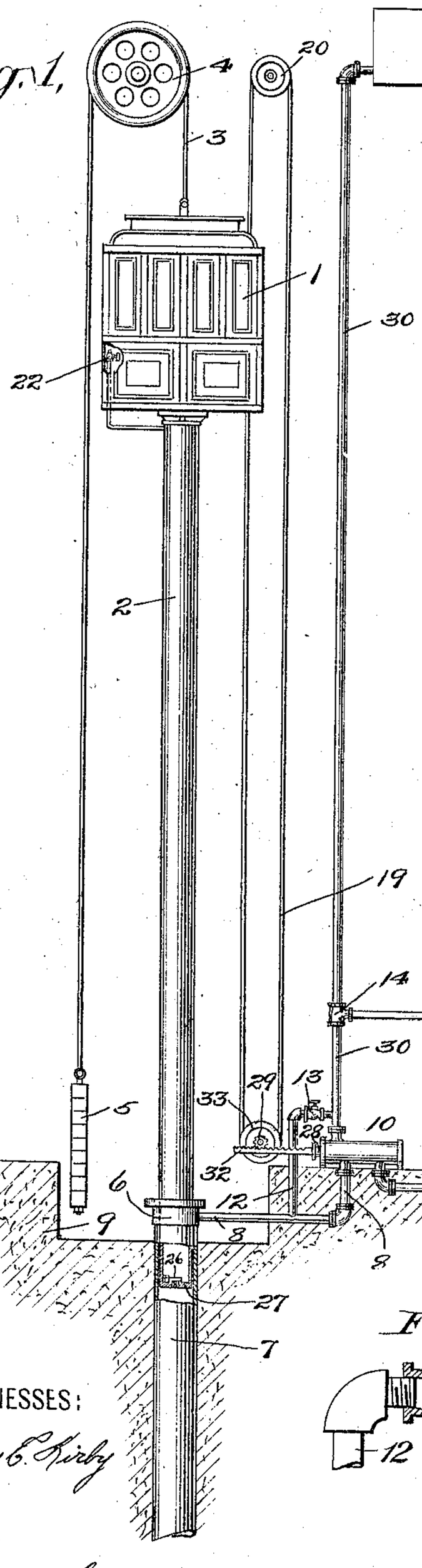


Fig. 2,

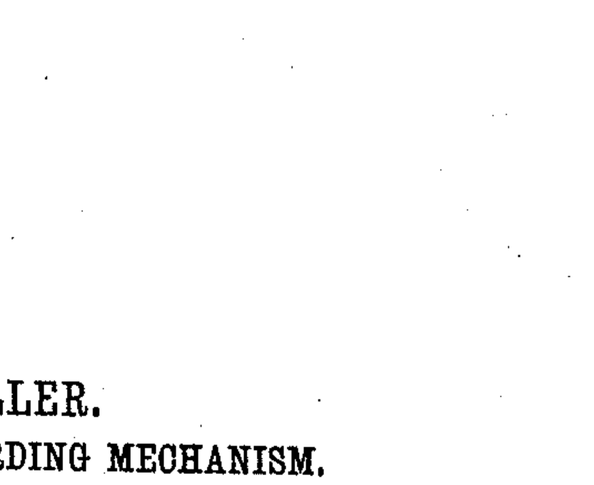


Fig. 3,

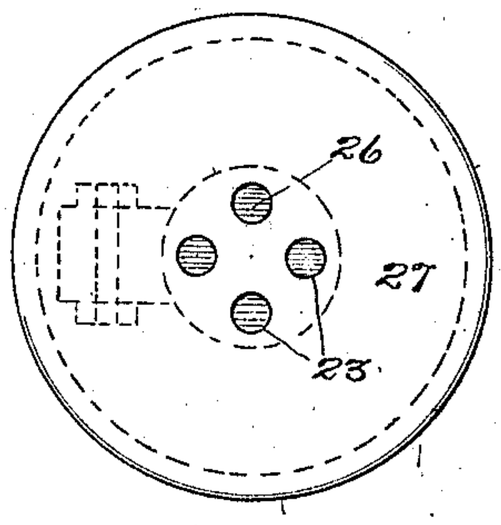
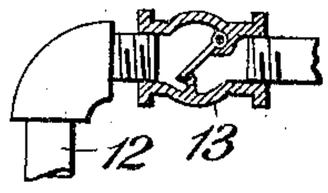


Fig. 4.



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PLUNGER-ELEVATOR-RETARDING MECHANISM.

965,542. Specification of Letters Patent. Patented July 26, 1910.

Application filed August 24, 1905. Serial No. 275,532.

To all whom it may concern:

Be it known that I, ALFRED L. SCHULLER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Plunger-Elevator-Retarding Mechanism, of which the following is a specification.

My invention relates to plunger elevators and has for its principal object the provision of simple and efficient means for retarding the motion of the car after the supply pressure is cut off or reduced.

Other objects of the invention will appear hereinafter, the novel combinations of elements being pointed out in the claims hereto appended.

Referring to the drawings, Figure 1 represents a plunger elevator system with my invention applied thereto; Figs. 2 and 3 are detail views of the check valve at the lower end of the plunger; and Fig. 4 is a detail view in section of the check valve 13 in the filling-in pipe 12.

1 designates the elevator car to the lower side of which is secured the plunger 2 and to the upper side of which is fastened the cable 3, this cable passing around the overhead sheave 4 to the counterweight 5.

7 designates the cylinder for receiving the plunger 2. This cylinder is buried in the ground 9 and has a stuffing box 6 for the plunger 2 and communicates at its upper end by means of a pipe 8 with the change valve 10, preferably a balanced three-way valve. This pipe is connected by the pipe 11 with the pressure tank 16 which in turn is connected with a suitable pump 18 by means of a pipe 17.

The valve stem 28 has a rack 32 which meshes with a pinion 29 on the flier sheave or shipper sheave 33. An endless operating rope or shipper rope 19 passes around the flier sheave 33, through the car 1 and around the overhead sheave 20. Also connected with the valve 10 is a discharge pipe 30 leading upwardly to the discharge tank 15 which is placed a little above the upper limit of travel of the elevator car. At the point 14 a suction pipe 31 is connected to the discharge pipe 30 and leads to the pump 18. A filling-in pipe 12 affords communication between the discharge pipe 30 and the cylinder supply pipe 8 but has a check valve 13 in it so that the water or other motive fluid can flow only in one direction, viz., from the discharge pipe 30 to the pipe 8.

As illustrated in Figs. 1 and 2, the plunger 2 is made hollow but has openings 23 in its bottom 27. These openings may be of any desired size or number or arrangement. The pressure is communicated through these openings to the fluid in the plunger and acts at the bottom of the car to lift the same. A valve 22 is provided for the upper end of plunger 2 which valve is operable from inside of the car to allow any air that may accumulate in the upper end of the plunger to escape. Such a valve in the car for the plunger is necessary as otherwise the car would tend to jump up and down while coming to rest on account of the elastic air cushion in the upper end of the plunger.

When the car is traveling upwardly and the rope 19 is actuated from the car to move the valve 10 to closed position the car has a tendency to run away from the motor fluid and then to fall back again with a thud. To prevent this water hammer, as it is called, the check valve 13 opens automatically and allows water to flow from the discharge pipe 30 at the proper rate of speed to prevent the formation of any vacuum or to fill up any vacuum in the plunger or cylinder. In order to secure the necessary head to keep the plunger full of water at all times and particularly when the car is at the upper limit of its travel, the discharge tank must be placed adjacent such upper limit. This is for the reason that the valve 26 hereinafter described may not entirely close the holes 23 in the bottom 27 of the plunger either when desired or at other times. For instance, if the valve 26 leaks, a vacuum will form in the plunger at the bottom of the car as well as at the bottom of the plunger, and the car after stopping in its upward travel will fall back onto the water in the plunger with a shock. A check valve in combination with the requisite head for the prevention of the formation of a vacuum in a plunger is disclosed in a patent to Crane, 661,575, November 13, 1900, hydraulic elevator.

It is a well known fact that the efficiency of the plunger elevator machine is considerably lessened, on high speed work particu-

larly, by reason of the necessity for leaving unbalanced a weight in amount sufficient to insure the plunger not running away from the water in the cylinder when the supply is cut off by the regular operation of the change valve.

It is the especial object of this invention to provide means for lessening or eliminating the tendency of the plunger to run away from the water in the cylinder and yet permit the stopping distance to be kept within reasonable limits, thus admitting of a closer counterbalancing and increasing the efficiency. In order to accomplish this result, I not only make the plunger hollow and permit the water to enter the interior of the plunger and have its pressure act directly under the platform of the car, but I also close the bottom end of the plunger by a head 27 provided with holes 23 and a check valve 26. If the holes are sufficiently reduced in size the check valve may be omitted. The head 27 may be integral with the plunger 2, welded thereto or otherwise tightly secured in place. On the inside of this head is a lug or projection 24 to which is pivoted the check valve 26. This check valve is fitted on a finished metal seat, preferably of some non-corrosive metal and opens inwardly. The holes 23 are of such size, number and arrangement that the water may easily enter the interior of the plunger and properly transmit its pressure.

It is to be understood that the head of water in the plunger is always maintained by the pressure back of it, but should this pressure become less than that due to the head in the plunger the check valve will instantly close, preventing its escape. Should any water leak out through the check valve 26 the plunger will of course tend to settle but the head of the water from the discharge tank will prevent this so that at all times the plunger is filled with water.

The object of the check valve 26 and the keeping of the plunger filled with water may be illustrated by assuming an unbalanced car ascending light and at approximately six hundred feet a minute. Let the supply be cut off at the speed at which the change valve ordinarily operates. With the ordinary closed plunger the result would be that the car would coast and the plunger run away from the water and then fall back with considerable shock. Under the conditions noted above, however, the instant the supply pressure is cut off or sufficiently reduced, the head of water in the plunger would be unsupported and consequently the check valve 26 would close to trap or lock the water in the hollow plunger and the total weight in the plunger would act as a retarding force to stop the car. The filling-in pipe 12 which contains the check valve 13 would take care of the vacuum tending to form when the main supply is cut off and the valve 26 closes the openings 23, this vacuum tending to form under the head 27 in this instance, but if the valve does not entirely close the holes 23 then also in the top portion of the plunger under the car. This filling-in pipe 12 and check valve 13 may be so regulated that the water would flow through the same at such a speed as to just keep pace with the vacuum, when the car ascends, care being taken that the water through the filling-in pipe shall not produce any pressure on the bottom of the plunger and thereby neutralize the retarding force due to its unsupported weight.

The loss of pressure at the bottom of the car inside the plunger as the plunger is lifted is compensated for by the increased counterweighting due to counterweight cable 3 run over to the other side of the overhead sheave 4. The pump 18 will work from a suction pressure equal to the discharge head and deliver at a corresponding higher pressure to the pressure tank 16 which is partly filled with air to equalize the pressure in the plunger in a well-known manner.

If the discharge tank 15 is raised to any height H the pressure on the bottom of the plunger is raised .434 H X A (the area of the plunger) and equilibrium is destroyed by this amount. To reëstablish equilibrium either the counterweight must be reduced this amount, or weight be added to the plunger to this amount, or a combination of both. No loss of power is occasioned by raising the discharge tank since the increased height is utilized as suction head on the pump. It is evident that if such increased weight is placed in the plunger it makes no difference what its material may be. Now, while this addition of weight in the plunger, (or equivalent reduction of the balance weight,) is compensated by the elevation of the discharge tank, and therefore the static conditions are unchanged, the dynamic conditions are changed, for, when an up motion stop is made, and the change valve is closed sufficiently to reduce the pressure in the cylinder by an amount equal to the elevation of the discharge tank, the added weight is at once unbalanced and acts to retard the moving masses. Hence it is seen that elevating the discharge tank aids in stopping while leaving static conditions unchanged, and if the increased head is used as suction head on the pump, increased economy is attained, but that the nature of the weight used to offset the elevation of the tank is immaterial, and there is the same advantage in filling the plunger with water that is gained by weighting it to an equivalent amount.

The placing of the water in the interior of the plunger has the further advantage of putting the plunger, in most cases, in tension instead of in compression. If the plunger

is hollow and empty and the end capped the walls of the plunger must sustain the entire water pressure on the bottom of the plunger. But if the end is open and the plunger full of water to the top, the pressure is conveyed through the water to the bottom of the car, and the only compression on the metal of the plunger is that due to the water pressure on the bottom area of the metal itself. Taking the ordinary six and one-half inch plunger, say one-quarter inch thick, the total area is about thirty-three square inches, and the annular area of the metal but about five square inches. Therefore when the plunger is filled with water the compression on the metal is but five thirty-thirds of what it is in the ordinary case. This undoubtedly is a gain, and the plunger is still further stiffened by the tension due to the internal radial pressure and to the weight of the water in the plunger on the bottom 27.

Having thus described my invention and without limiting myself to the precise construction of details or arrangement of parts, what I claim and desire to have protected by Letters Patent of the United States is:

1. The combination with a car, of a hollow plunger, means permitting the plunger to be filled with the motor fluid, and means for locking said fluid in the said hollow plunger at all times.

2. The combination with a car, of a hollow plunger arranged to be filled with the motor fluid, means for controlling the flow of the motor fluid, and means for trapping the fluid in said plunger under all conditions.

3. The combination with a car, of a hollow plunger, means for controlling the fluid pressure to move said plunger and car, and means for confining the fluid in said plunger and maintaining the latter filled irrespective of its position when the supply pressure is reduced or entirely cut off.

4. The combination with a car, of a hollow plunger arranged to be filled with the motor fluid, means for controlling the flow of the motor fluid to said plunger, means permitting the pressure to be communicated to the fluid within the plunger, and means for preventing the flow of fluid from said plunger at all times.

5. The combination with a car, of a hollow plunger, means permitting said plunger to be filled with fluid, means for controlling the transmission of pressure to the fluid within the plunger, and means for preventing the fluid from draining from said plunger when the latter is at its lower limit of travel.

6. The combination of a car, a hollow plunger movable therewith, means permitting the plunger to be filled with fluid, means for controlling the pressure communicated to the interior of said plunger, and means operable during the upward travel of the car and plunger and independently of the position of the plunger for automatically trapping or confining the fluid in the plunger upon reducing the supply pressure or upon entirely cutting off the same.

7. The combination with a car, of a hollow plunger secured thereto, a cylinder for receiving said plunger, valve mechanism, means for operating said valve mechanism to control the fluid pressure, and means for confining the fluid within said plunger during its entire travel in either direction.

8. The combination with a car, of a hollow plunger fixed thereto, a cylinder for receiving said plunger, valve mechanism for controlling the application of fluid pressure at the upper end of said plunger, and means for trapping the fluid in the plunger to retard the motion of the car and plunger when the supply pressure is reduced and to prevent said fluid from draining from said plunger in any other position thereof.

9. The combination with a car, of a hollow plunger, means for controlling the application of fluid pressure at the upper end of the plunger near the bottom of the car, and means for checking the flow of fluid from said plunger when the supply pressure is reduced and the car is traveling upwardly and when the plunger is in any other position.

10. The combination with a car, of a hollow plunger for said car, means for controlling the transmission of pressure to the fluid within said plunger, and a check valve for said plunger to trap the fluid within the plunger when the supply pressure is reduced and to hold the fluid in said plunger at all other positions of the latter.

11. A hollow plunger for an elevator closed at its upper end, and having a bottom at its lower end provided with apertures therethrough, and a check valve wholly within the plunger, opening inwardly and resting on said apertures.

12. A hollow plunger for an elevator, closed at its upper end and having a bottom at its lower end provided with two or more apertures therethrough and a check valve wholly within the plunger operated by difference of fluid pressure within and without the plunger to close or open said apertures.

13. The combination with a car, of a hollow plunger therefor arranged to be filled with the motor-fluid, means for controlling the movements of the car and plunger, and means for confining the fluid in the plunger to retard the motion of the car when the supply pressure is reduced and to trap the fluid within the plunger when the car is at the lower limit of its travel.

14. The combination with a car, of a hollow plunger therefor, a cylinder for said plunger, means for controlling the motor-

fluid to and from said cylinder, and a check valve at the bottom of said plunger and wholly within the latter.

15. The combination with a car, of a hollow plunger with one or more openings therein, means for controlling the transmission of pressure to fluid within the plunger through said opening or openings, and means dependent entirely upon difference of fluid pressure for closing said opening or openings at any position of the car.

16. The combination with a car, of a hollow plunger connected thereto and having its lower end perforated, means for controlling the fluid pressure to the interior and exterior of said plunger, and means for maintaining said plunger filled with fluid during its upward travel irrespective of its position.

17. The combination with a car, of a hollow plunger provided with perforations, means for controlling the supply of fluid pressure to said plunger, and a valve for automatically closing said perforations upon the supply pressure being reduced and maintaining said perforations closed for any stationary position of the car.

18. The combination with a car, of a hollow plunger provided with perforations at its lower end, means for controlling the transmission of fluid pressure to fluid within said plunger through said perforations, and a valve for automatically closing said perforations when the supply pressure is cut off and the car is traveling upwardly and maintaining said perforations closed for any stationary position of the car.

19. The combination with a car, of a hollow plunger provided with one or more openings, means for closing said opening or openings, fluid-pressure-supplying means for said plunger, means for controlling the fluid pressure applied to said plunger, and a discharge tank adjacent the upper limit of the travel of the car.

20. The combination with a car and a hollow plunger, of means for controlling transmission of fluid pressure to the interior of said plunger, fluid pressure supplying-means, a discharge tank adjacent the upper limit of travel of said car, and connections between said tank and said controlling means, said connections comprising a check valve.

21. The combination with a car and a hollow plunger, of a cylinder for said plunger, means comprising a change valve for controlling transmission of fluid pressure to the interior of said plunger, fluid pressure-supplying means, a discharge tank, a pipe connecting said controlling valve to said discharge tank, an additional pipe connecting said last-named pipe with the cylinder, and a check valve in said additional pipe.

22. The combination with a car, of a hollow plunger secured at its upper end to the car and provided with a bottom having apertures therethrough, means for controlling the supply of fluid to the plunger, and a discharge tank located at about the upper limit of travel of the car and having connection with the plunger.

23. The combination with a car, of a hollow plunger secured at its upper end to the car and provided with a bottom having one or more apertures therethrough, means for controlling the supply of fluid to the plunger, a valve for said aperture or apertures, and a discharge tank at or near the upper limit of travel of the car and having connection with the plunger.

24. The combination with a car, of a hollow plunger secured to the car and having a perforated bottom, means for controlling the supply of fluid to the plunger, a discharge tank, means co-acting with said controlling-means for establishing communication between said discharge tank and said plunger, and a check valve in said communicating means.

25. The combination with a car, of a hollow plunger secured at its upper end to the car and having apertures in its bottom, an inwardly opening valve for closing said apertures, fluid pressure-controlling valve mechanism for said plunger, a discharge tank at or near the upper limit of travel of the car, a discharge pipe connecting said discharge tank to said controlling means, a branch pipe around said controlling valve mechanism, and a check valve in said branch pipe.

26. The combination with a car, of a hollow plunger secured at its upper end to the car and having its bottom provided with apertures, a check valve for automatically closing said apertures, a cylinder for said plunger, a change valve for controlling the flow of fluid to and from said cylinder, a discharge tank adjacent the upper limit of travel of the car, a discharge pipe connecting said discharge tank to said change valve, a by-pass pipe from the discharge pipe and passing around said change valve to said cylinder, and a check valve in said by-pass pipe and opening toward said cylinder.

27. The combination with a car, of a hollow plunger provided with openings in its bottom, a valve opening inwardly for closing said openings, a cylinder for the plunger, fluid pressure-supplying means comprising a pump and pressure tank for transmitting pressure through the fluid in the plunger to the top of the plunger at or near the bottom of the car, controlling valve mechanism between the cylinder and said pressure tank, a discharge tank adjacent the upper limit of travel of said car, a discharge pipe connecting the exhaust port of said valve

mecnanism to said discharge tank, a suction pipe between said discharge pipe and said pump, a filling-in pipe between said discharge pipe and the plunger cylinder, and a check valve in said filling-in-pipe and opening toward the cylinder.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

ALFRED L. SCHULLER.

Witnesses:
G. M. McCAULL,
WM. H. DUNN.