

C. G. ARMSTRONG.

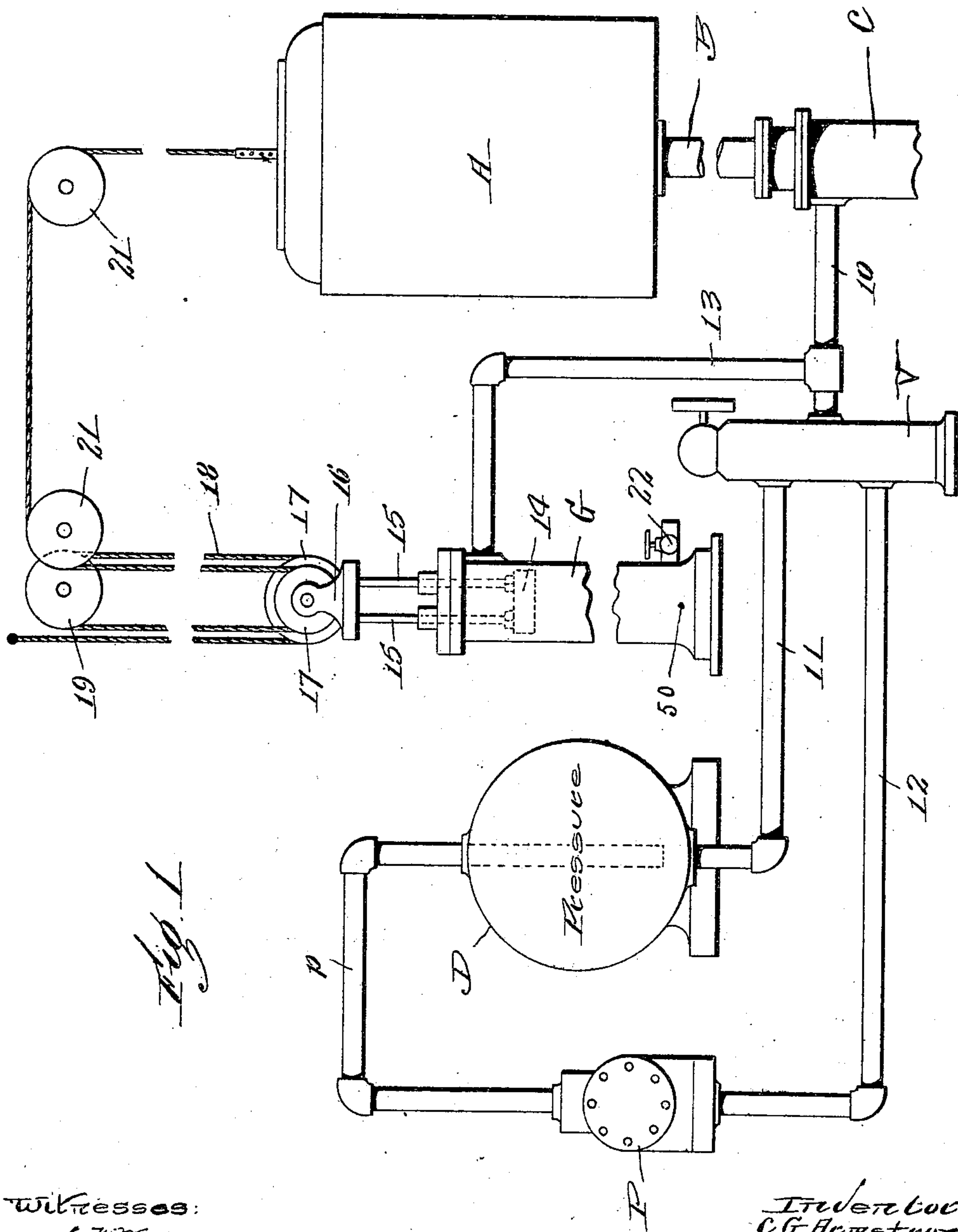
ELEVATOR.

APPLICATION FILED NOV. 2, 1905.

968,634.

Patented Aug. 30, 1910.

2 SHEETS—SHEET 1.



*Fig. 1*

Witnesses:  
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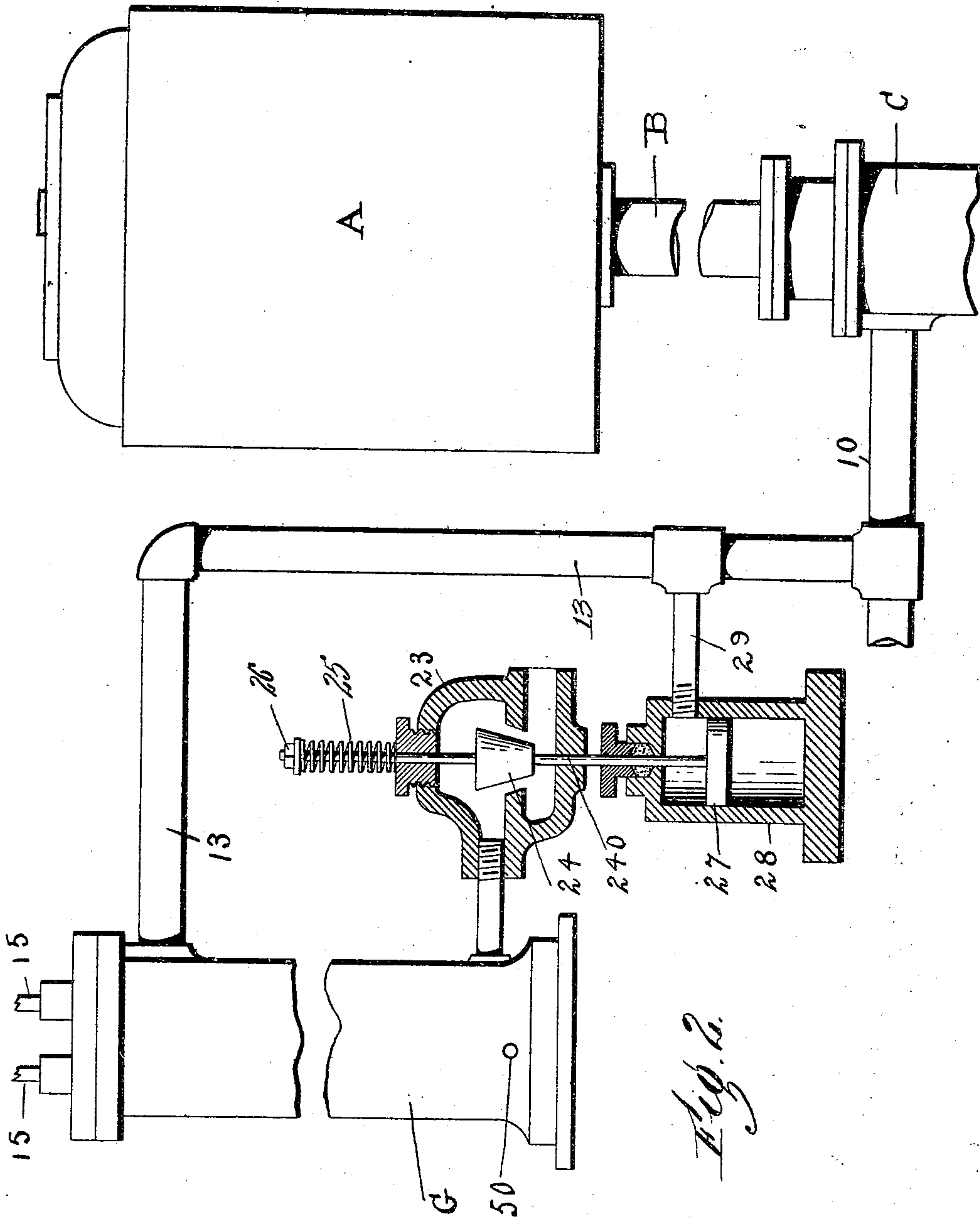


Fig. 2.

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# UNITED STATES PATENT OFFICE.

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## ELEVATOR.

968,634.

Specification of Letters Patent. Patented Aug. 30, 1910.

Application filed November 2, 1905. Serial No. 235,507.

### *To all whom it may concern:*

Be it known that I, CHARLES G. ARMSTRONG, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented a new and useful Elevator, of which the following is a specification.

The object of this invention is to improve that class of hydraulic elevators which are known as direct-acting or plunger elevators. In this class of elevators a car is raised by a long plunger which works in a cylinder set in the ground. This class of elevators has come into extensive use owing to its safety of operation, but difficulties are encountered when this style of elevator is adapted to long runs, principal among which are, that the plunger weighs a great deal and has to be counter-weighted which adds greatly to the mass of the moving parts, and also that in long runs a varying pressure will be given to the plunger as it rises, owing to its length, which difference in pressure is known as the loss of the hydrostatic head or the flotation of the plunger. This last difficulty is overcome in some instances by using very heavy cables between the car and counter-weights, and allowing the change in position of the cables, due to the movement of the car, to counterbalance the loss of pressure, but this remedy also adds to the mass of moving parts. The mass of moving parts necessarily interferes with the rapid running of the elevator, and particularly with the stopping and starting thereof, owing to the great inertia.

The aim of this present invention is to overcome these difficulties. To this end, I combine with a hydraulic plunger elevator, hydraulic means arranged so that the hydrostatic head therein works with the hydrostatic head in the plunger cylinder both assisting in moving the car in the same direction whereby the changes in the two heads may be made to compensate for each other at all positions of the parts for the reason that the head in the main cylinder decreases as that in the auxiliary cylinder increases, and vice versa, so that the hydrostatic head is substantially a constant throughout the entire movement of the car. This hydraulic means preferably consists of an auxiliary cylinder having a piston or plunger working

therein connected by cables or other suitable means with the car. A convenient way to arrange this auxiliary cylinder is to place the same vertically in the well or parallel with the run of the elevator, and to connect the same by cables turned over multiplying sheaves to the top of the car.

The auxiliary cylinder is made of such diameter that the movement of the piston therein will require substantially as much water as the movement of the plunger, but this size is varied a little as will be explained hereinafter so that the changing weight of the cables between the overhead sheaves and the car will compensate for it. Therefore, it will not be necessary to use very heavy cables above the car to counterbalance the loss of pressure as there will be no such loss. In other words, the combined heads acting on the plunger to push the car up and on the piston to pull the car up, will be substantially constant. Then by connecting this auxiliary cylinder to the to-and-fro pipe of the direct-acting plunger system, an ideal system is provided, as counter-weights are eliminated and the loss of the hydrostatic head of the plunger is taken care of. The auxiliary cylinder and piston also may be arranged to act as a safety device, as hereinafter described.

The invention is shown in the accompanying two sheets of drawings.

Referring to the drawings, Figure 1 is a diagram illustrating one way the invention may be practiced, and Fig. 2 illustrates a modified form of valve that may be used to attain the safety effect hereinafter described.

Referring to the drawings and in detail, A designates the car, B the plunger which works in a plunger-cylinder C, V the main valve, D the pressure tank, and P the pump of a plunger hydraulic elevator. The pump is connected by a pipe *p* to the pressure-tank. The main valve V is connected to the plunger cylinder C by an ordinary to-and-fro pipe 10. The pressure tank D is connected to the main valve by pipe 11 and the main valve V is connected to the pump by a pipe 12. These parts are so arranged that when the main valve is moved in one direction, pressure will be admitted to the plunger cylinder C to raise the car, and so that when the



main valve is moved in the opposite direction, the water in the cylinder C will be pumped back into the pressure-tank to lower the car.

5 G designates an auxiliary cylinder. This auxiliary cylinder may be arranged in any desired location, and preferably is placed vertically in the well in which the elevator system is arranged. The to-and-fro pipe 10  
10 of the elevator system is connected to the top of the cylinder G by a pipe 13. Fitting to run in the cylinder G is a piston 14, and extending therefrom through stuffing-boxes, are one or more piston-rods 15—15 which  
15 connect to a traveler 16 which carries multiplying sheaves 17—17. A cable or cables 18 is connected to a stationary point at the top of the system, passes around one of the pulleys 17, then up and over an overhead  
20 stationary sheave 19, down around the other sheave 17, and then up over overhead sheaves 21—21 and connects to the car or cage A. In the specific illustration shown and described, this arrangement of sheaves  
25 and cables will multiply the motion of the piston by four. When this arrangement is used, the piston 14 is made approximately twice the diameter of the plunger B, so that the area of the piston will be as many  
30 times the area of the plunger as said connections multiply, and preferably a little smaller than this, which is taken care of by the shift of weight of the cables. By this arrangement it will be seen that the work  
35 of raising the car is divided between the plunger B and the piston 14 and that one-half of the water passing under pressure through the main valve will go into the plunger-cylinder C and the other half into  
40 the auxiliary-cylinder G.

As the hydrostatic head in the plunger cylinder C decreases as the car ascends, the hydrostatic head in the auxiliary cylinder G increases, and this change of the hydro-  
45 static head in one cylinder will be equivalent to the change in the other. By this arrangement, this feature may be eliminated or neglected in designing the elevator system. It will also be seen that by this system  
50 counterweights are dispensed with, whereby the car can be much more easily controlled as the moving parts are much less in weight. By connecting the auxiliary cylinder G to the to-and-fro pipe between the main valve  
55 and the plunger-cylinder, means is provided whereby the combined pressure in the two cylinders will always be the same, whereby the push and the pull on the car will be practically equal throughout the entire  
60 travel of the car. On the downward movements of the car the water will flow equally from the two cylinders. The auxiliary cylinder G also may be arranged to act as a safety device by providing the same with  
65 an air escape or valve 22 at its bottom. The

principal danger in a plunger elevator as now arranged, is the breaking of the plunger which will relieve the car of a heavy weight and allow the same to be pulled violently upward by the counterweights. If the  
70 plunger should break in the apparatus shown under discussion, and all the water should flow into cylinder G, the piston 14 therein cannot acquire an unusual speed as the air under the piston can only pass at a  
75 certain rate out through the air-valve and when the piston reaches the bottom of its movement, it will be cushioned by passing the air outlet, whereby the car will be prevented from being pulled violently up  
80 against the overhead work and the parts will be gradually stopped. If, on the other hand, the auxiliary cylinder G and its connections should become broken or deranged, the car will be prevented from falling by the  
85 plunger B.

In Fig. 2 I have shown a modified arrangement of air-valve. In this arrangement an air valve casing 23 is connected to the bottom of the auxiliary cylinder G. A  
90 conical valve 24 is arranged therein on a rod 240 which has a spring 25 thereon, the tension of which may be adjusted by a nut 26. A piston 27 is arranged on the end of the rod 240 and the same works in a cylinder 28  
95 which is connected by a pipe 29 to the pipe 13. With this arrangement, if the plunger should break, the pressure on the piston 27 will force the valve 24 to close the air escape from the cylinder G, preventing a  
100 rapid descent of the piston 14 and a rapid upward movement of the detached car. I usually provide the auxiliary cylinder with a small drain opening 50, as indicated in the drawings, for any water leaking past  
105 the piston to escape, so as not to interfere with the action of the air valve or outlet.

The details and arrangements herein shown and described may be greatly varied by a skilled mechanic without departing  
110 from the scope of my invention as expressed in the claims.

Having thus fully described my invention, what I claim and desire to secure by Letters Patent is:—  
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1. In a hydraulic elevator, the combination of the car, a plunger for raising the same, a cylinder for the plunger, an auxiliary cylinder, a piston therein, connections therefrom to the car, and means whereby the  
120 sums of the hydrostatic heads acting in the two cylinders are rendered substantially constant during the entire travel of the car.

2. In a hydraulic elevator, the combination of the car, a plunger for raising the  
125 same, a cylinder for the plunger, an auxiliary cylinder, a piston therein, connections therefrom to the car, and connections between said cylinders constituting means whereby the combined hydrostatic heads act-  
130



ing on the plunger and piston are substantially constant during the entire travel of the car.

3. In a hydraulic elevator, the combination of the car, a vertically acting plunger connected thereto, a cylinder for the plunger, a vertically arranged auxiliary cylinder, a piston therein connected to the car, and hydraulic connections to the cylinders arranged so that the piston will be forced down and the plunger up to raise the car.

4. In a hydraulic elevator, the combination of the car, a plunger for raising the same, a cylinder for the plunger, an auxiliary cylinder, a piston therein, multiplying connections therefrom to the car, and connections between said cylinders constituting means whereby the sums of the hydrostatic heads acting on the plunger and piston are rendered substantially constant during the entire travel of the car.

5. In a hydraulic elevator, the combination of the car, a plunger for raising the same, a cylinder for the plunger, an auxiliary cylinder, a piston therein, and multiplying connections therefrom to the car, the piston being substantially as many times in area relatively to the plunger as said connections multiply.

6. In a hydraulic elevator, the combination of the car, a plunger for raising the same, a cylinder for the plunger, an auxiliary cylinder, a piston therein connected by cables to the car, and connections between said cylinders constituting means whereby the sums of the hydrostatic heads acting on the plunger and piston are rendered substantially constant during the entire travel of the car, and so that the piston is also taken care of and compensated for by the weight of the cables.

7. In a hydraulic elevator, the combination of the car, a plunger for raising the same, a cylinder for the plunger, a main valve connected by a to-and-fro pipe to the plunger-cylinder, an auxiliary cylinder, a piston therein, connections therefrom to the car, and a connection from the to-and-fro pipe to the top of said auxiliary cylinder.

8. In a hydraulic elevator, the combination of the car, a plunger for raising the same, a cylinder for the plunger, an auxiliary cylinder, a piston therein, connections therefrom to the car, and an air outlet in the bottom of the auxiliary cylinder.

9. In a hydraulic elevator, the combination of the car, a plunger for raising the same, a cylinder for the plunger, an auxiliary cylinder, a piston therein, connections therefrom to the car, an air valve in the bottom of the auxiliary cylinder, and means whereby the air valve is controlled by the pressure in the plunger-cylinder.

10. In a hydraulic elevator, the combination of the car, a plunger for raising the

same, a cylinder for the plunger, a main valve connected by a to-and-fro pipe to the plunger-cylinder, an auxiliary cylinder, a piston therein, connections therefrom to the car, a connection from the to-and-fro pipe to the top of the cylinder, an air vent at the bottom of the auxiliary cylinder, a valve controlling the same, a spring-actuated piston for controlling said valve, and connections whereby the pressure in the plunger cylinder will act on said piston.

11. In a hydraulic elevator, the combination of the car, a plunger for raising the same, a cylinder for the plunger, an auxiliary cylinder, a piston therein, connections therefrom to the car, an air outlet in the auxiliary cylinder, and a drain-opening therein.

12. In a hydraulic plunger elevator system, the combination with a car, a plunger for raising the car, a cylinder for said plunger connected with a source of hydraulic pressure, and a main valve for directly controlling the admission of water to, and the discharge of water from, said cylinder through said main valve, of independent uncounter-weighted means outside said cylinder, connected with the same source of hydraulic pressure, and controlled directly by said main valve for keeping the entire hydrostatic head for moving the car substantially constant during the entire travel of said car.

13. In a hydraulic plunger elevator system, the combination with a car, a plunger for raising the car, a cylinder for said plunger, and a main valve for directly controlling the admission of water to, and the discharge of water from, said cylinder through said main valve, of purely hydraulic means independent of said cylinder and plunger and controlled directly by said main valve for keeping the entire hydrostatic head for moving the car substantially constant during the entire travel of said car in the same way and at the same time that said plunger cylinder is controlled thereby.

14. In a hydraulic elevator system, the combination with the car and cables extending upwardly therefrom, of hydraulic means for raising the car, said hydraulic means comprising a plunger under the car and connections for operating the cables and keeping the entire hydrostatic head for moving the car substantially constant during the entire travel thereof, but continually and gradually varying the head slightly so that the shifting weight of the cables compensates for the varying head.

15. In a hydraulic plunger elevator system, the combination with the car and cables extending upwardly therefrom, a plunger for raising the car, a cylinder for said plunger, and a main valve for controlling the admission of water to and the discharge of



water from said cylinder, of means controlled by said main valve and connected with the cables for keeping the entire hydrostatic head for moving the car substantially constant during the entire travel of said car, said means acting continually and gradually to vary the hydrostatic head for moving the car slightly during the travel of the car, whereby the shifting weight of the cables compensates for the variation of the head.

16. In a hydraulic plunger elevator system, the combination with the car and cables extending upwardly therefrom, a plunger for raising the car, and a cylinder for said plunger, of hydraulic means connected with said cables to operate them independently of said plunger for keeping the entire hydrostatic head for moving the car substantially constant during the entire travel of the car, said means acting to vary the hydrostatic head for moving the car slightly during the travel of the car, whereby the shifting weight of the cables compensates for the variation of the head.

17. In a plunger elevator, the combination with a car of a plunger for pushing the car up, a piston for pulling the car up, and means for keeping the sum of the hydraulic heads acting on the plunger and piston substantially constant during the entire travel of the car.

18. In a hydraulic elevator the combination with a car plunger and cylinder, of means for controlling the movement of the car, a hydraulic auxiliary cylinder connected directly to said first named cylinder, a piston movable in said auxiliary cylinder, and a rope-multiplying device connected between said piston and the car.

19. In a hydraulic elevator, the combination with a car, plunger, and receiving cylinder for said plunger, of means for controlling the movement of the car and plunger, a substantially vertical auxiliary cylinder, a conduit establishing communication between said plunger cylinder and said auxiliary cylinder, a piston and piston rod movable in said auxiliary cylinder, and a rope-

multiplying device connected between the car and the piston rod to reduce the path of travel of the piston.

20. In a hydraulic elevator, the combination with a car, a plunger connected thereto, and a plunger cylinder, of means for controlling the movement of the car and plunger, an auxiliary cylinder connected to the plunger cylinder, a piston and piston rod movable in said auxiliary cylinder, a vertically arranged multiplying device connected to said piston rod, and a rope or cable connecting the car to said multiplying device.

21. In a hydraulic elevator, the combination with a car, plunger, plunger cylinder and operating means, of a vertically arranged auxiliary cylinder connected directly to said plunger cylinder, a piston and piston rod movable in said auxiliary cylinder, a vertically arranged multiplying device connected to said piston rod and a cable connecting the car to said multiplying device.

22. In a hydraulic elevator, the combination with a car, a plunger movable with the car, a cylinder, and means for controlling the movement of the car, of an auxiliary cylinder, means for maintaining the pressure in the two cylinders substantially equal, a piston movable in the auxiliary cylinder, and means between the car and piston for reducing the speed of the latter.

23. In a hydraulic elevator, the combination with a car, a plunger, a cylinder, and valve apparatus for controlling the supply of fluid pressure to the cylinder, of an auxiliary cylinder, a duct connecting the two cylinders, independently of the valve apparatus, a piston movable in said auxiliary cylinder, and means between the car and piston for reducing the speed of the latter.

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

CHARLES G. ARMSTRONG.

Witnesses:

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H. P. CHURCHILL.