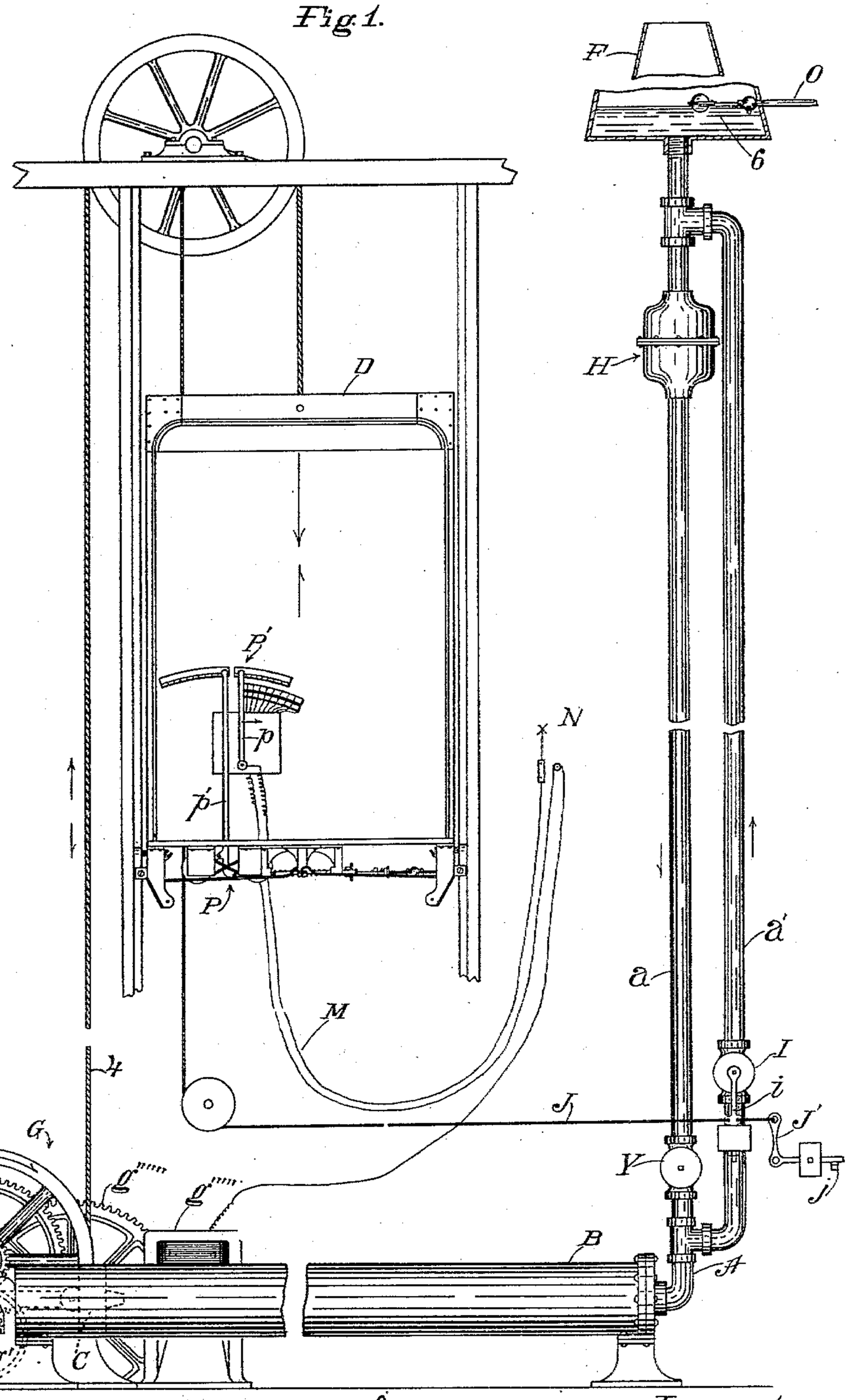
(No Model.) 5 Sheets—Sheet 1.

J. PARKINSON.

COMBINED ELECTRIC HYDRAULIC ELEVATOR.

No. 571,732. Patented Nov. 17, 1896.

Fig. 1.



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(No Model.) 5 Sheets—Sheet 2.

J. PARKINSON.

COMBINED ELECTRIC HYDRAULIC ELEVATOR.

No. 571,732. Patented Nov. 17, 1896.

Fig. 3.

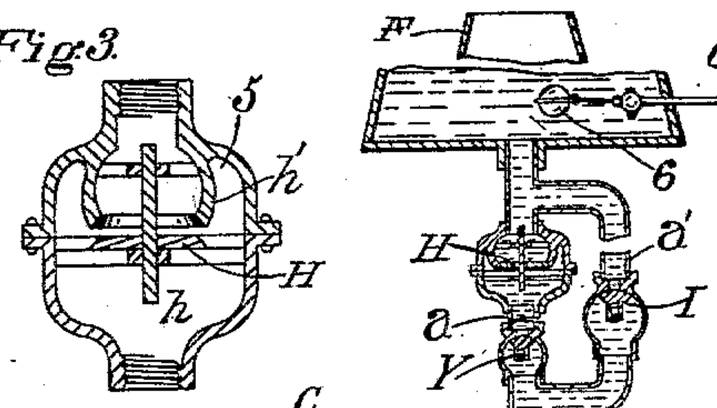


Fig. 2.

Fig. 4.

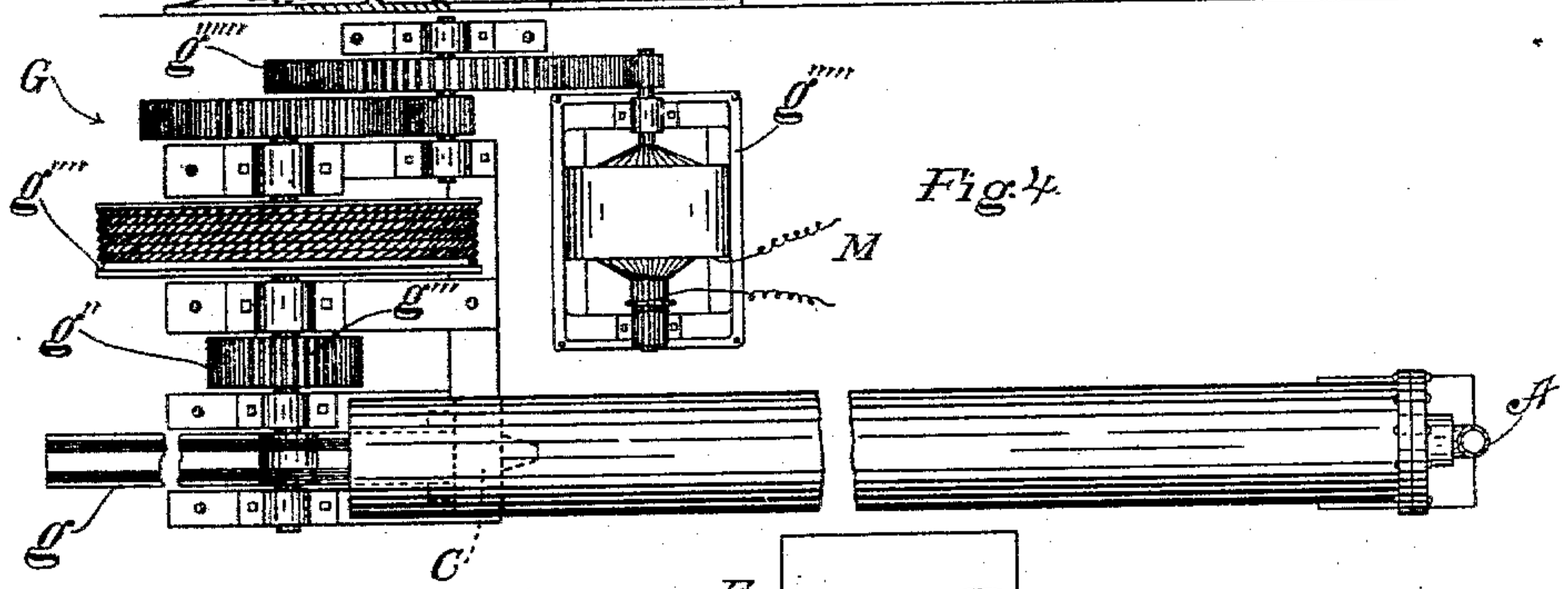


Fig. 5.

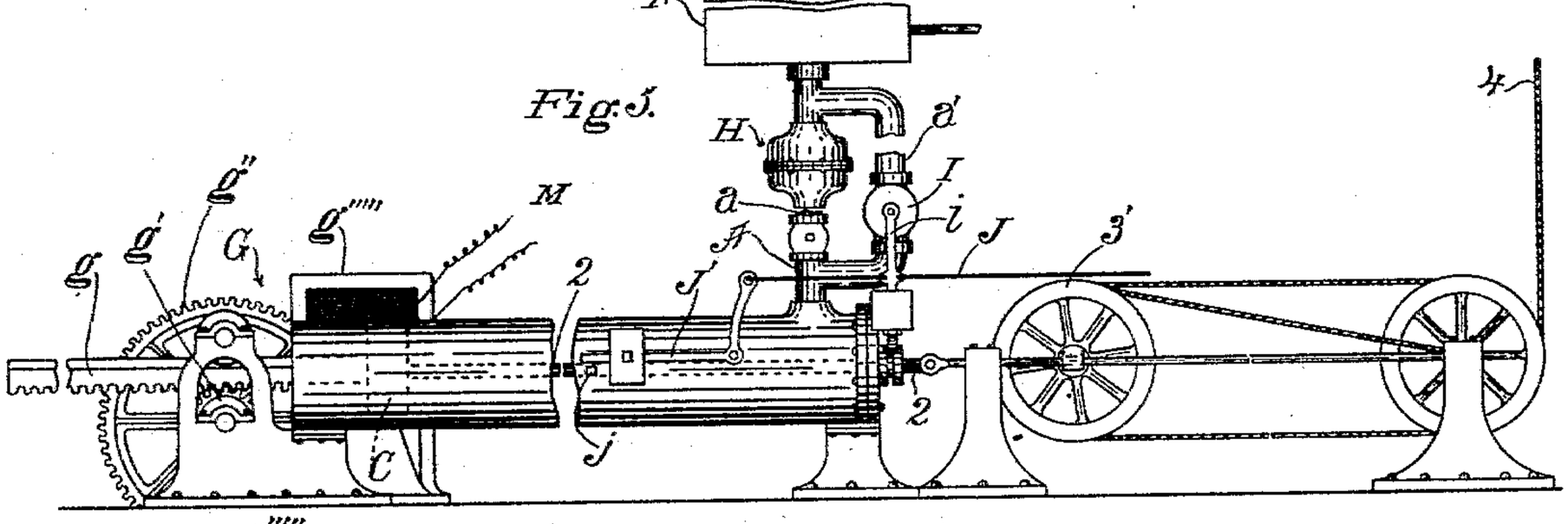
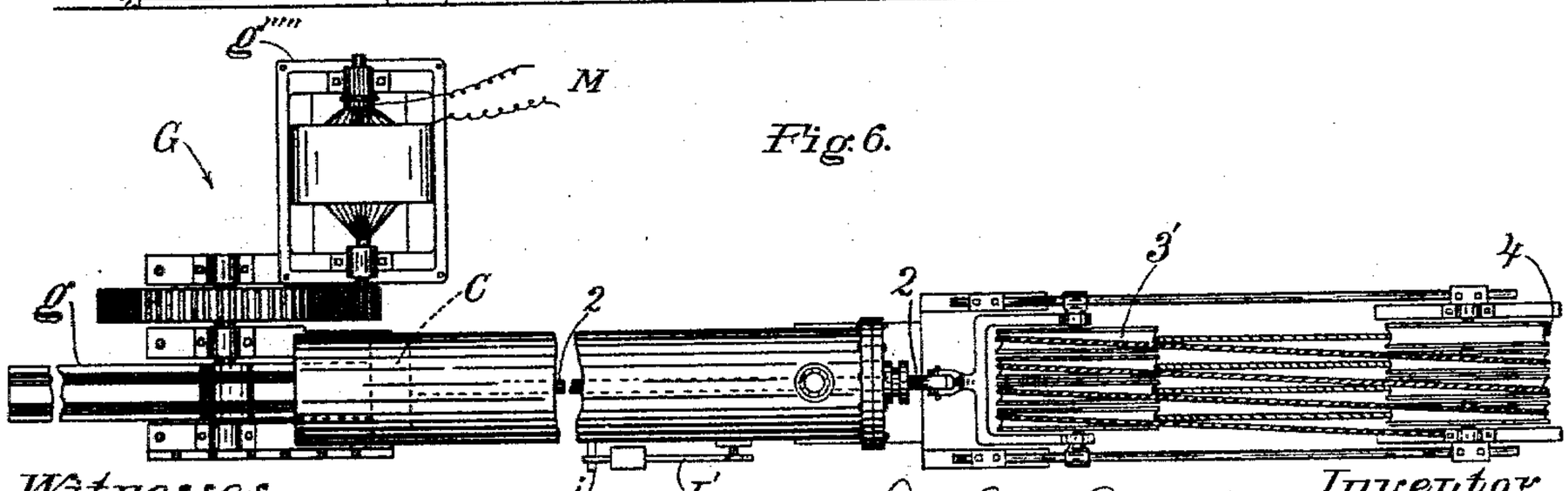


Fig. 6.



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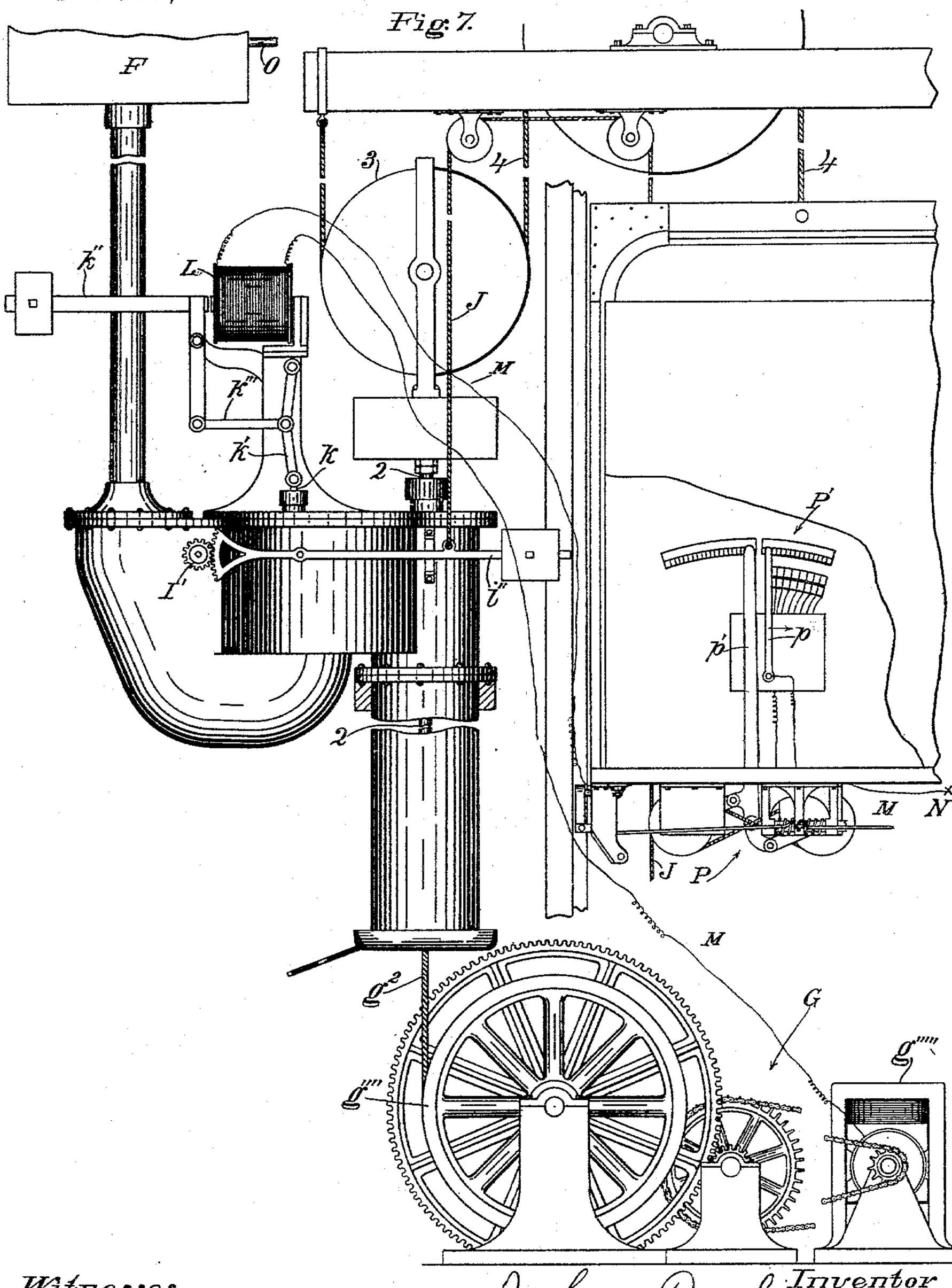
(No Model.) 5 Sheets—Sheet 3.

J. PARKINSON.

COMBINED ELECTRIC HYDRAULIC ELEVATOR.

No. 571,732. Patented Nov. 17, 1896.

Fig. 7.



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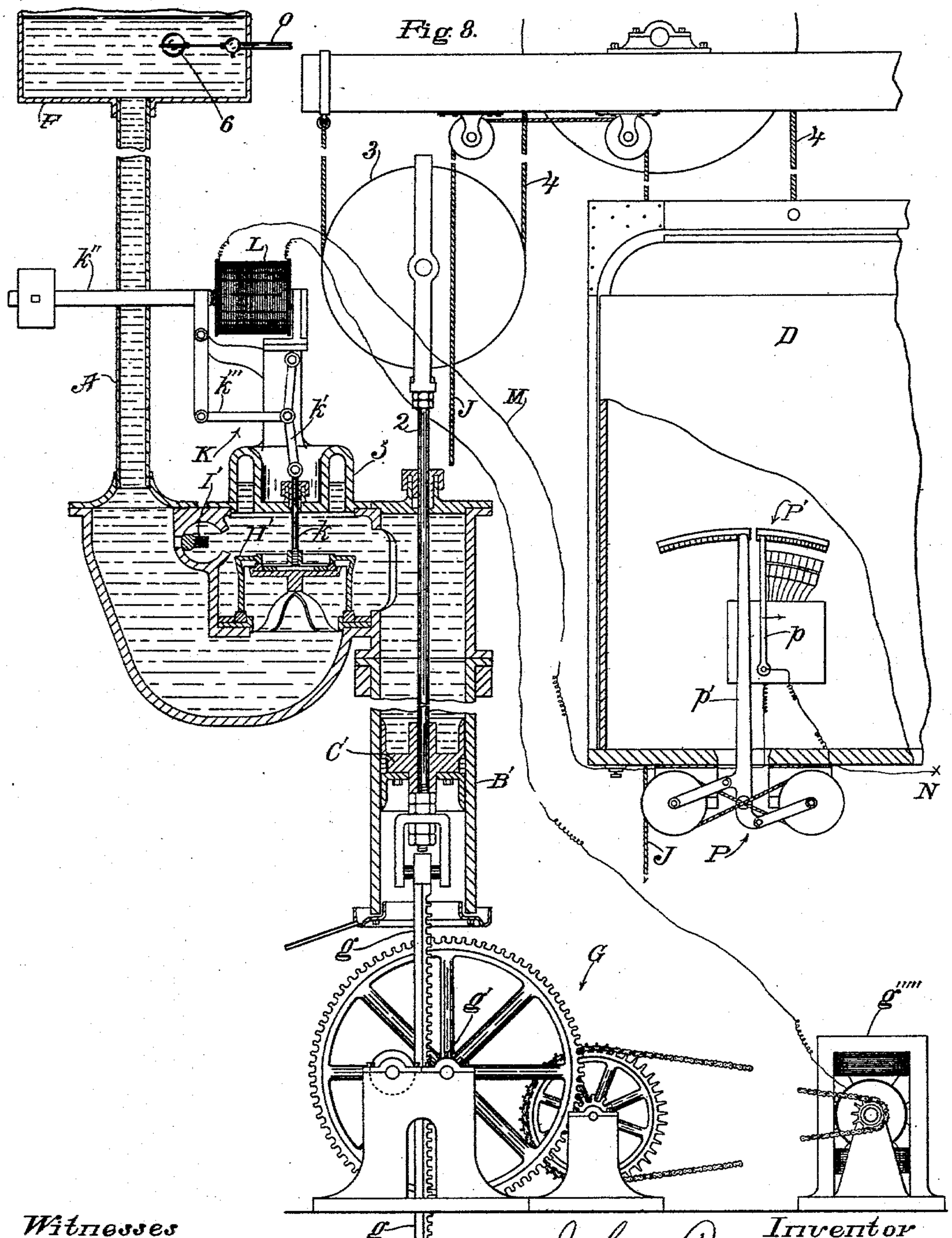
(No Model.) 5 Sheets—Sheet 4.

J. PARKINSON.

COMBINED ELECTRIC HYDRAULIC ELEVATOR.

No. 571,732. Patented Nov. 17, 1896.

Fig. 8.



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(No Model.) 5 Sheets—Sheet 5.

J. PARKINSON.

COMBINED ELECTRIC HYDRAULIC ELEVATOR.

No. 571,732. Patented Nov. 17, 1896.

Fig. 9.

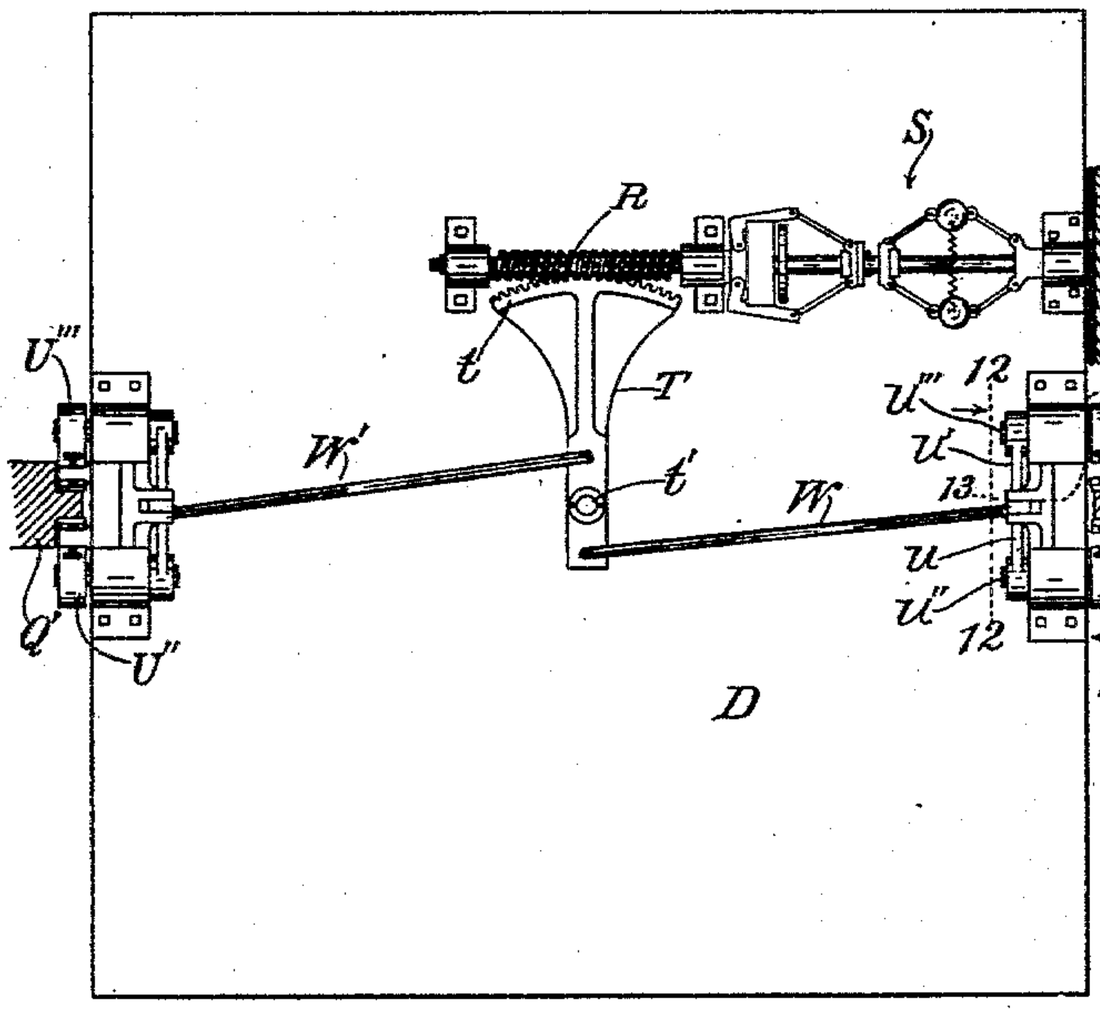


Fig. 11.

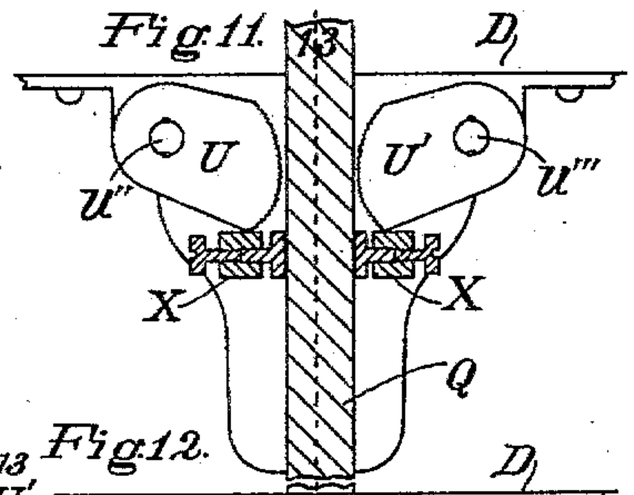


Fig. 12.

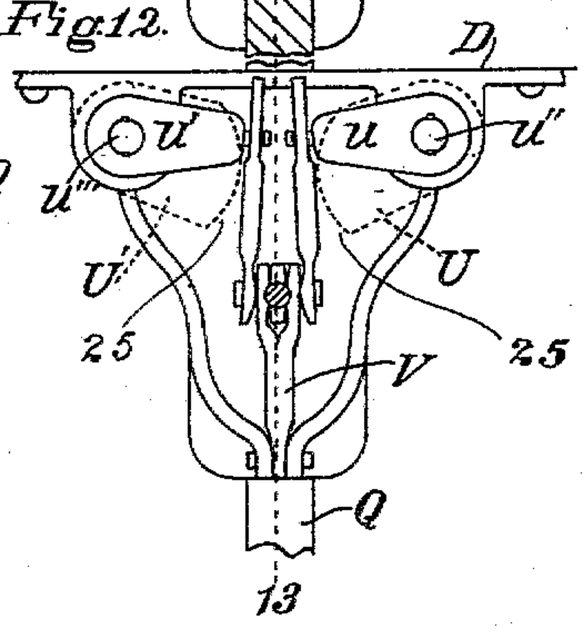


Fig. 10.

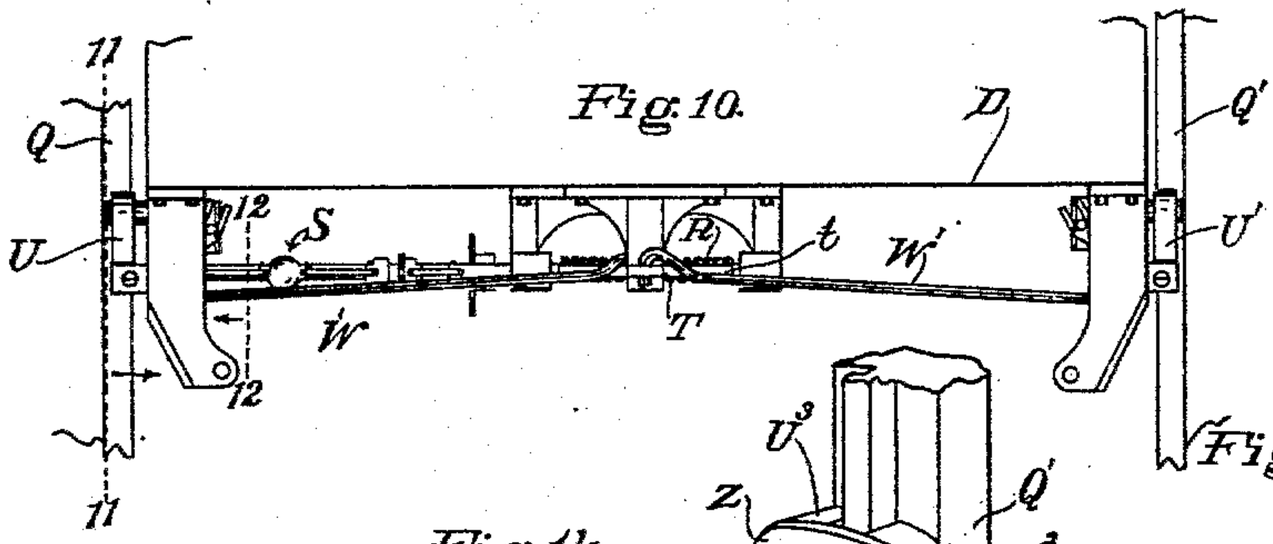


Fig. 14.

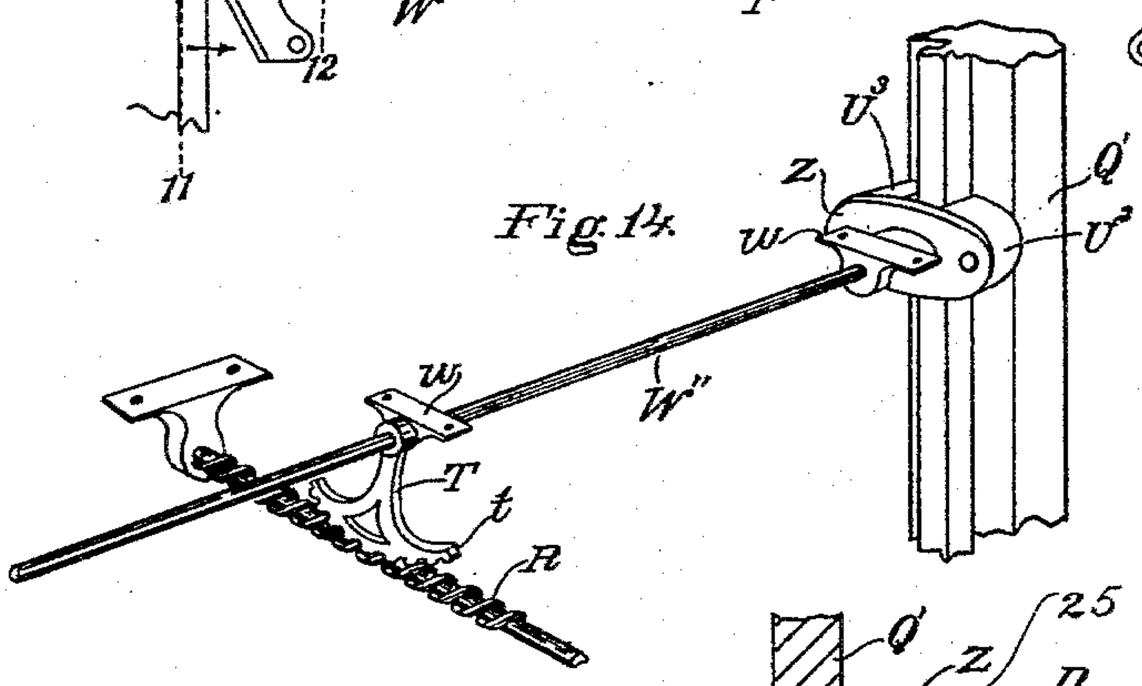


Fig. 13.

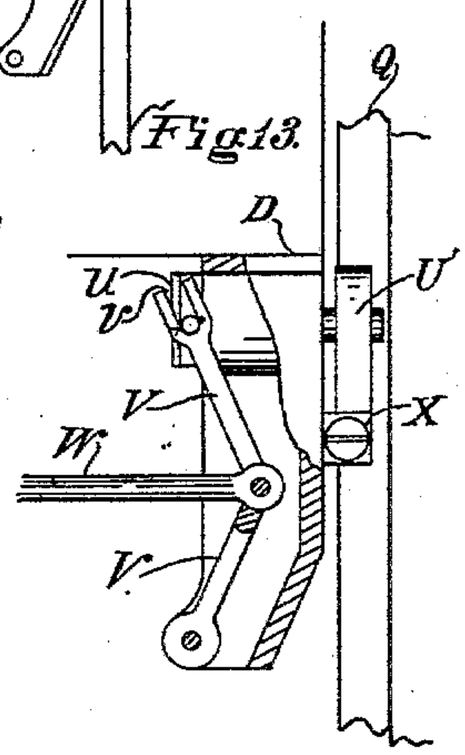
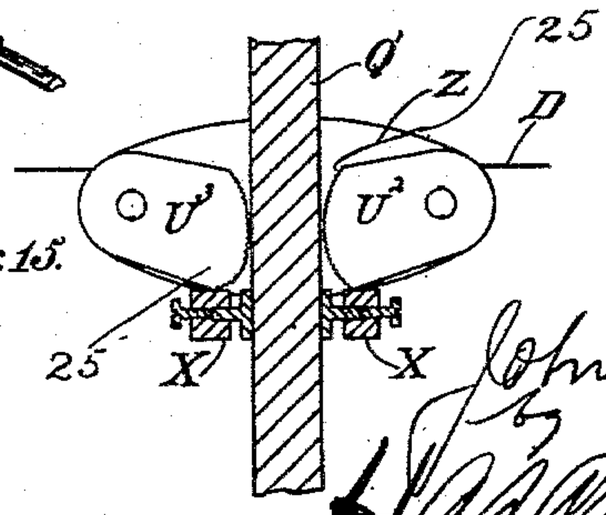


Fig. 15.



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UNITED STATES PATENT OFFICE.

JOHN PARKINSON, OF LOS ANGELES, CALIFORNIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE PARKINSON ELEVATOR COMPANY, OF SAME PLACE AND PHŒNIX, ARIZONA TERRITORY.

COMBINED ELECTRIC HYDRAULIC ELEVATOR.

SPECIFICATION forming part of Letters Patent No. 571,732, dated November 17, 1896.

Application filed December 3, 1895. Serial No. 570,875. (No model.)

To all whom it may concern:

Be it known that I, JOHN PARKINSON, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Combined Electric Hydrostatic Elevator, of which the following is a specification.

In my present invention I employ a principle of hydraulic control which is set forth in my applications for Letters Patent of the United States, Serial No. 536,198, filed January 25, 1895; Serial No. 545,175, filed April 10, 1895; Serial No. 553,959, filed June 25, 1895, and Serial No. 568,898, filed November 14, 1895, which consists, essentially, of controlling the downward movement of the elevator-car or other load by a body of liquid arranged to flow from one liquid-containing compartment to another through passages provided with valves which regulate the obstruction which the liquid may present to the operation of the piston, and providing for the return of the liquid by the opposite movement of the machinery. In said last-mentioned application I have shown a piston arranged in a cylinder, a reservoir arranged above the cylinder and communicating therewith, a body of liquid in the cylinder and reservoir, means to allow, to control, and to prevent the movement of the liquid from the cylinder into the reservoir, and vice versa, and driving mechanism for operating the piston. In said application the liquid in the reservoir serves to a limited extent as a counterbalance, it being primarily intended as a variable counterbalance for the car-suspending portion of the rope; but with said former invention the ordinary counterbalance-weights were required.

I employ an independent hoisting device which is independent of the liquid and which is operatively connected with the piston and with the car, so that when it is driven to raise the car it operates the piston. I drive this hoisting device by the electric motor.

In my present invention I supply the cylinder through a pipe from a reservoir arranged at a considerable height above the cylinder and into which the liquid will be forced by the movement of the piston in one direction. The height of the reservoir and the relative cross-sectional areas of the pipe and piston may be arranged to produce any desired pressure against the piston, the principle of hydrostatics being employed. In my present invention I am enabled to do away with any counterbalance which operates only as a counterbalance, and I greatly simplify the machine and make it easier to apply it in buildings.

My present invention differs from all my former inventions in that I connect the cylinder through a pipe with a reservoir sufficiently elevated to apply against one side of the piston in the cylinder a hydrostatic pressure sufficient to counterbalance the car and car-suspending ropes, or to more than counterbalance the same, or to less than counterbalance the same, as may be deemed expedient. I consider it most desirable to so adjust the counterbalance as to allow the car to descend of its own weight. A supplemental variable hydraulic counterbalance produced by a column of liquid in a vertical reservoir decreasing in cross-sectional area toward the top may be employed to counterbalance the car-suspending portions of the rope. That feature is set forth in my last-named application, and I do not herein broadly claim as an independent device such supplemental reservoir; but my present invention includes such reservoir when combined with the pipe and cylinder for applying a proportioned hydrostatic pressure on the piston.

It is to be understood that while preferable means for applying the pressure within the cylinder is an elevated reservoir connected with the cylinder by a pipe, my invention is broad enough to include the application of hydraulic pressure produced in the cylinder by any means (such, for instance, as a receptacle or reservoir provided with a a weighted or spring-pressed piston or with compressed air or other elastic fluid for forcing the liquid out of such reservoir into the cylinder) which will allow the piston when it moves inward to return the liquid against the force which produces the pressure.

It must be understood that I distinguish between my invention and the use of a body of liquid playing in a vertical column to counterbalance in whole or in part an elevator-car or suspending-ropes; and I also distinguish

between my invention and those machines in which, when the piston pushes into the cylinder, there is an exhaust either of the pressure-applying liquid or of any medium, such as steam or compressed air, which applies the force to produce the pressure on the piston. The principle of my present invention in relation to this particular is that I apply a practically constant and uniform pressure in a cylinder against a piston which is of greater area than the pipe which introduces the liquid into the cylinder, and arrange the machine so that the piston operates (instead of any separate pumping-plant) to return the liquid to the elevated source or against whatever force is used to give the desired pressure; and I am thereby enabled, by simple means and with a comparatively small weight of water, to produce a counterbalance sufficient to wholly counterbalance the car, and yet I avoid the necessity of stand-pipes of large capacity, either cross-sectional or vertical, and avoid the use of pumps or other machinery for supplying any exhaust, and am enabled to combine in one machine electric and hydrostatic power for operating and controlling the elevator, and I avoid all waste of energy and use the electric current only when the elevator is being driven by it; and I also apply the power directly to the work of driving the car and yet attain perfect safety.

With my invention, in the practical form which I have illustrated in the accompanying drawings, the stand-pipe will extend preferably from the top of the building to the basement where the driving mechanism is located, and a sufficient quantity of liquid is supplied to fill the stand-pipe and the cylinder when the piston is retracted; and I provide at the top of the pipe a storage-reservoir to receive the liquid which is forced upward out of the pipe when the piston is forced into the cylinder. The cross-sectional area of the reservoir should be in such proportion to the cross-sectional area of the cylinder that the liquid discharged by the movement of the piston will not raise the level of the liquid in the reservoir, except to the extent necessary to increase the pressure on the piston sufficiently and in proper ratio to counterbalance the increasing weight of the car-suspending rope as the car descends. The storage-reservoir may taper upwardly and in such relation to the area of the piston that the rise of the liquid in such reservoir, as the piston inserts into the cylinder, will be sufficient to increase the pressure upon the piston in such ratio as to exactly counterbalance the increasing load of the car-suspending rope, (that is, the rope between the car and the sustaining-pulley,) so that the necessity of any supplemental reservoir or of any other separate and independent means to counterbalance the variable weight will be dispensed with.

In my present invention it may be preferable to arrange the cylinder in horizontal position, but it can be arranged vertically. By arranging the cylinder horizontally there will be greater pressure exerted against the piston by water at a given level and the cylinder can be placed in the basement in the least valuable space, and the pipes which connect the cylinder with the reservoir on the top of the building can be carried up at any desirable place and will occupy no important space. I deem it preferable to arrange these pipes entirely outside of the elevator-shaft, so that with my invention the only appliances in connection with the shaft will be the car with its safety attachments and the necessary controlling devices and the rope and suspending-pulley by which the car is carried.

When my invention is applied with the vertical cylinder and rack, as shown in Figure 8 of the accompanying drawings, the rack depending from the piston operates as a counterbalancing weight and in this way compensates to a greater or less extent for the difference in vertical height of the supporting-column of water.

My present invention also includes a safety appliance for the car and various parts and combinations which I will hereinafter specify and claim.

The accompanying drawings illustrate my invention.

Fig. 1 is a fragmental elevation of an elevator embodying my invention as applied with pipes leading from the top of the building to produce hydrostatic pressure in the cylinder. The piston is retracted and the car is at the top of well. Double-barbed arrows indicate the movement of the liquid and parts of the elevator when the car descends, and single-barbed arrows indicate the return movement. Fig. 2 is a fragmental sectional elevation of the elevator, the section being taken through the axis of the cylinder and pipes and reservoir. The parts are shown in the position they are in when the car is near the bottom of the well. Fig. 3 is a detail of a check-valve for allowing a free flow of liquid down through the pipe to supply the hydrostatic pressure in the cylinder and to prevent the return of the liquid through such valve. The annular air-cushion above the valve is illustrated as applied with this form of valve. Fig. 4 is a plan of the cylinder and driving mechanism shown in Figs. 1 and 2. In this figure, as in Fig. 1, the piston is retracted, the car being at the top of the shaft. In Figs. 1, 2, and 4 the machine is of the winding-drum type. Fig. 5 is a fragmental elevation, and shows my invention applied in a multiple-sheave type of machine, with the cylinder between the driving mechanism and the car-operating rope. In my said last-mentioned application, Serial No. 568,898, I have claimed the application of the safety device between the driving mechanism and the car, and for this reason I make no claim thereto in this application. Fig. 6 is a plan of the machine shown in Fig. 5. Fig. 7 is a fragmental elevation showing my invention applied with a

vertical cylinder and a rope-winding drum driven by an electric motor. It also shows electrically-operated mechanism for the positive operation of the valve which allows and prevents the flow of liquid. Fig. 8 is a vertical mid-section showing my invention applied with a vertical cylinder and a depending rack for operating the piston and in which the rack assists as a counterweight. In this view the electrically-operated mechanism for the valve to prevent flow of liquid is shown. The annular air-cushion chamber above the valve is also shown as applied in this form of valve. Fig. 9 is a view of the under side of the car, showing the application thereto of the safety device. In this view the mechanism, which is shown in Figs. 1, 7, and 8, for operating the controlling valve and motor is omitted. Fig. 10 is an elevation of the safety mechanism shown in Fig. 9. In this view the car is in its upright position and the mechanism is seen from the side of the car which is at the bottom in Fig. 9. Fig. 11 is a sectional elevation on line 11 11, Fig. 9, looking to the left in the direction of the arrow. Fig. 12 is an elevation on line 12 12, Fig. 9, looking to the right in the direction of the arrow. Fig. 13 is an elevation, partly in section, on line 13 13, Figs. 9, 11, and 12. Fig. 14 shows a modification of mechanism for operating the eccentric dogs. Fig. 15 is an elevation, partly in section, looking from the guide toward such dogs.

Referring to the form of machine shown in Figs. 1, 2, and 4, it will be seen that hydrostatic pressure is applied through pipe A into cylinder B against a piston C to assist the movement of the car or other load D in one direction, and that since there is no provision for any exhaust the return of the car is compelled to cause the return of the liquid E against the force which produces the pressure against the piston, because there is no escape for such liquid except into the reservoir F, from which the pressure is applied.

The body of liquid is of sufficient volume so that when the piston is retracted and the car at the top of the shaft the liquid will fill the cylinder and the pipe, so that the liquid is pressed against the piston in the cylinder under a practically constant and uniform pressure throughout all the movement of the piston.

The piston C is operatively connected with operative mechanism of the elevator and arranged to be operated (in whole or in part) in one direction by the pressure of the liquid in the cylinder, and is arranged to return the liquid from the cylinder to the source of pressure and against the force which produces such pressure on the reverse movement of the piston. It is thus to be seen that the piston is so adapted and arranged that it may be operated indiscriminately by either the pressure of the liquid or by the electric or other motor, as occasion may require or make desirable, and that it is also adapted to be operated by the conjoined action of both the water-pressure and the motor to raise the car. By the preferred arrangement in the practical operation of the machine the piston is forced in one direction to raise the car by the conjoined action on the piston of the water and the motor. That is to say, although the water serves as a counterbalance for the car its force is applied directly to the piston to operate it, and this force may be wholly or only partially sufficient to move the piston and the load, and the water also holds the piston and governs its movement.

The combination shown admits of using the water-pressure as main motive power or as auxiliary power, as may be desired. Although in the arrangement at present preferred it acts as a counterbalance it also acts directly on the piston to move the same, and through that medium to operate the car. The motor-driven hoisting mechanism also acts directly on the piston to move it.

G indicates in a general manner the hoisting device or operative mechanism of the elevator.

g indicates a rack connected with the piston.

g', *g''*, and *g'''*, Figs. 1, 2, and 4, indicate a train of wheels by which the rack is connected with the rope-winding drum *g''''*, which is connected with the motor *g'''''* by the gearing *g''''''*.

I provide suitable means to allow, to control, and to prevent the movement of the liquid medium through which the pressure is applied to assist, to resist, or to prevent the movement of the piston.

H indicates a valve arranged to allow the free descent of the liquid from the reservoir F through the pipe A and into the cylinder B. This valve may be of the form shown in Figs. 1, 2, 3, and 5, or it may be of the form shown in Figs. 7 and 8, or of any other effective form. The valve H is arranged to control the main member *a* of the pipe which communicates between the reservoir and the cylinder, and a supplementary pipe *a'* communicates with the pipe *a* above and below the valve H and is provided with a wide-way control-valve I, which is operated from the car to control the flow of liquid from the cylinder to the reservoir when the car descends. The valve H is placed near the reservoir F, so that there will be but little pressure of liquid on top of such valve, and the valve is made to close upward to prevent the liquid from flowing through the pipe *a* when the piston moves inward in the cylinder.

i indicates a weighted lever to normally hold the valve I closed.

J indicates a rope leading to the car to operate the lever *i*. J' indicates a weighted lever arranged to pull against such rope to hold it taut. A stop *j* is arranged to stop such lever to prevent it from swinging too far. In this machine the cylinder is closed at one end, and the other end of the cylinder is open, and means for operating the piston (such as the rack *g* or rope g^2) plays freely

through the open end of the cylinder and is connected with the motor through suitable intermediate mechanism and is also connected with the car and is arranged to operate in conjunction with the car and at the same time to operate the piston, against one side of which the liquid is applied to press with a practically constant and uniform pressure. In Figs. 5, 6, 7, and 8 a piston-rod 2 is connected with the piston and plays through the closed end of the cylinder and is connected with a movable sheave 3′ 3 to operate the same. In the case of the movable-sheave machine the safety appliance provided by the cylinder and the valved pipes is between the driving mechanism G and the car-sustaining rope 4, thus affording absolute safety against accident through any breakage of the driving mechanism G. This feature is claimed in my said last application for patent, Serial No. 568,898.

The reservoir F serves as a pressure-equalizing reservoir arranged to store the liquid displaced and forced from the cylinder at the inward movement of the piston and to return the same to the cylinder when the piston is retracted. This reservoir, as shown in Fig. 1, is upwardly tapering, so that while the pressure against the piston is practically uniform, by reason of the height of the pipe in which the water always stands, there is produced, in connection with such pressure, an increased pressure as the car descends and the length of car-suspending rope increases.

The valve H is of larger area than the body of the pipe *a* and is arranged in such pipe near the top thereof to allow liquid to flow downward therethrough. By making the valve of larger area than the pipe it operates more certainly and more quickly cuts off and opens the passage through the pipe. In order to prevent jars upon the sudden closing of the valve, I provide an annular air-chamber into which the water can press when the valve closes. The valve is arranged in the chamber *h* to seat on the seat *h′*, which extends down into the chamber to provide the annular air-space 5 above the valve-seat in the chamber. The upward rush of water past the rim of the valve is gradually overcome by the air-cushion in the space 5, and the pressure is equal all around the edge of the valve. This construction is detailed as applied to the check shown in Fig. 3, and another application of an annular air-cushion above the valve is shown in Fig. 8.

In Fig. 8 I have detailed means by which the valve-leaf can be positively operated by the current of electricity which drives the motor g''''''.

K indicates in a general way means connected with the valve H′ to hold it normally closed. These means, as shown in Figs. 7 and 8, comprise a piston-rod *k*, a toggle *k′*, a weighted lever *k″*, and a connecting-rod *k‴*, connecting the lever *k″* with the toggle-joint. L indicates an electromagnet to operate such means to open the valve.

M is an electrical conductor which connects the source of electrical energy N with the motor and is connected between the motor and such source of electrical energy with the electromagnet and energizes the same. This it does to attract the lever *k″* when the current is turned on through the conductor M to operate the motor g''''.

O indicates a pipe or other source of liquid supply arranged to supply liquid to the reservoir F. 6 indicates a float-valve for such supply arranged near the bottom of the storage reservoir F, so that it will be operated to supply liquid to the reservoir only when the reservoir is nearly empty, so that loss by evaporation and leakage will be supplied only in such quantity and at such time as may be necessary to maintain the desired pressure in the cylinder. This valve will only be operated when the volume of liquid is below the minimum level the water should maintain when the piston is fully retracted.

In Fig. 2 I have shown means for gradually stopping the machinery when the car reaches the bottom of the well. *b* indicates a port in the end of the cylinder B to introduce liquid into the cylinder and to allow it to discharge. The piston C is provided with a tapering plug *c* to enter the port and gradually close the same when the piston approaches the end of its inward stroke, thus gradually stopping the piston.

In Fig. 8 a vertical cylinder B′ is shown, and the piston C′ plays vertically therein, and the liquid presses downward upon the piston. The load or car D is operatively connected with the piston to force it up as the load descends, and the rack *g* is fastened to and extends downward from the piston and is operated by the pinion *g′*, which is driven by the motor g''''' through suitable mechanism.

In Fig. 7 the operative means which are provided for pulling the piston down consist of a rope g^2, wound on the winding-drum g''''.

The valve I′ in Figs. 7 and 8 and the valve I in Fig. 1 are arranged respectively to allow a restricted flow of liquid from the cylinder into the reservoir F and prevent such flow. These valves I and I′ are substantially the same, and are both operated by a weighted lever, such as *i* or *i″*, and a rope J, connecting the same with suitable operating mechanism P, to be operated by the attendant in the car. The valve may be operated, however, by an electromagnet contrivance similar to that shown in Figs. 7 and 8 and hereinbefore described as applied to the check-valve. In that form of valve the valve-rod *k* is connected with the valve H′ and extends through the wall of the valve-chamber, and the toggle-joint is connected with the valve-rod to operate the valve mechanically to open and close the same. This form of valve may be applied in any other situation where it is desired to sud-

denly and positively stop the flow of liquid. 5 indicates an annular air-chamber around the valve-rod above the valve.

P′ indicates suitable means arranged in the car between the magnet and the source of electrical energy for cutting off the current.

I will now describe the safety mechanism carried by the car to prevent the same from falling in case of accident to the rope or other car-sustaining parts.

Q Q′ indicate the guides upon either side of the car.

R indicates a worm journaled to the car and carried thereby.

S indicates a governor device operated by the movement of the car and adapted to operate the worm. Any well-known suitable governor device may be employed for this purpose.

T indicates a lever fulcrumed to the car.

U U′ indicate two dogs, carried by the car and operatively connected with the lever T and respectively provided with eccentric curved faces 25, arranged to engage the opposite sides of the guide Q, respectively. Suitable means, such as the arc rack *t*, are provided for operatively connecting the lever with the worm to work the lever to bring the dogs into engagement with the car. The dogs may be operatively connected with the lever by any suitable mechanism.

In the form shown in Figs. 9, 10, 11, 12, and 13 a toggle-joint V is connected, through the cranks *u u′* and shafts *u″ u‴*, with the dogs to operate the same, and a rod W is arranged connecting the lever with the toggle-joint to operate such joint. The cranks and dogs are arranged so that the force of their gravity holds the dogs normally free from the guides. The crank where connected with the toggle plays in a slot *v*, so that after the dogs engage the guide the crank and dog can move upward after rod W has ceased to move. The rod W is pivotally connected with one arm of the lever T, and the rack *t* is arranged upon the other arm at a greater distance from the fulcrum than the point at which the rod W is pivoted. Another rod W′ is pivoted to the lever between its fulcrum *t′* and the rack *t* and at the same distance from the fulcrum as the pivot of the rod W, and the rod W′ is connected with a pair of guide-clamping dogs U″ U‴ by mechanism the duplicate of which has just been described as connecting the dogs U U′ with the rod W, so that the movement of the worm operates to cause the dogs to engage the guides, after which the further downward movement of the car will cause the dogs to clamp the guides and the reverse movement will unclamp them from the guides.

X indicates the guide-shoes, which form supports for the dogs when they are at rest.

In practical operation to raise the car the attendant in the car will throw the lever *p* of the controlling mechanism P P′ in the direction indicated by the arrow to turn the current on to the motor. In the form of machine shown in all the figures except Figs. 7 and 8 the operation of the motor will then immediately operate to raise the car, and the liquid will pass downward through the automatic check-valve II to fill the cylinder as the piston recedes and constantly apply the hydrostatic pressure to the piston to assist in raising the car. When the lever *p* is thrown in the opposite direction, it shuts off the current, and if the control valve I is shut the car will be held by the piston. If the lever *p′* is thrown to the left, it will operate the rope J to open the valve I and allow liquid to flow from the cylinder and rise in the reservoir E, thus allowing the piston to yield to the weight of the load in the car and allow the car to descend. The speed of descent is controlled by the valve, and the car can be stopped and held at any point by closing the valve. The weight of the car preferably overbalances the pressure against the piston sufficiently to cause the car to descend with the required speed when the control-valve is fully open. When the motor is operated to raise the car and retract the piston, the weight of the water in the vertical pipe causes the water to flow rapidly into the cylinder, so that the support for the piston is constant.

In the forms shown in Figs. 7 and 8 when the current is thrown on to operate the motor to raise the car it energizes the electromagnet L, thus to operate the lever *k″* and the toggle connected therewith to draw up the valve-rod *k* and valve H′, and the current operates the motor at practically the same time to pull down the piston and raise the car. When the current is turned off, the valve returns to its closed position and the descent of the car can be accomplished by opening valve I′.

Y indicates a cut-off valve at the bottom of the pipe *a*.

In the form shown in Figs. 14 and 15 the dogs U″ and U‴ are carried by a cross-head Z, which is fixed to the shaft W″, which is journaled in hangers *w w*, fastened to the car, which is not shown in Fig. 14. With this form when the shaft W″ is partially rotated the cross-head Z cants so as to bring the roughened cam edges of the dogs into contact with the guide, and they catch thereon and clamp the guide securely and prevent the car from further descent.

I do not claim as my invention a safety device for elevators comprising the combination of an elevator-cage, mechanism for operating said cage, safety mechanism separate from and independent of the operating mechanism, said safety mechanism consisting of a main pipe, a piston therein, said main pipe containing a pressure agent located thereon on one side of the piston, an auxiliary pipe extending from the main pipe, and a connection between the piston and the elevator-cage, said connection, as the elevator-cage descends, adapted to lift the piston and thereby carry the pressure-column into the supplemental

pipe, and when the elevator-cage ascends to permit the pressure-column by gravity to flow from the supplemental pipe back into the main pipe and against the piston to assist said piston in its return stroke.

My invention is to be distinguished from a mere safety device, as it is a combined electric hydrostatic elevator, and the piston is directly connected with and driven by the operating mechanism irrespective of whether the piston is directly or indirectly connected with the car; and, furthermore, I provide means for the control of the liquid during the descent of the car to thereby assist, resist, or prevent the movement of the piston.

Now having described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an elevator, the combination of a piston arranged to operate in a cylinder; a movable liquid medium adapted and arranged to apply a practically constant and uniform pressure against the piston to force it in one direction; and means to allow, to control, and to prevent the movement of the liquid in order to assist, resist or prevent the movement of the piston; the car; and a hoisting device independent of the liquid connected with the car and arranged to operate in conjunction therewith and also connected with the piston and arranged to operate the piston, substantially as set forth.

2. In an elevator, the combination of a cylinder closed at one end; a piston arranged to operate in the cylinder; an elevated reservoir; a pipe connecting the reservoir with the closed end of the cylinder between it and the piston; a body of liquid in the cylinder, pipe and reservoir of sufficient volume to maintain a practically uniform pressure in the cylinder against the piston; a valve in the pipe to allow, to control and to prevent the flow of liquid therethrough; the car; and a hoisting device independent of the liquid and connected with the car to operate in conjunction therewith, and also connected with the piston and arranged to operate the piston; the whole being arranged as set forth whereby the hydrostatic pressure assists the hoisting device to raise the car, and at the descent of the car the piston is operated against the pressure of the liquid in the cylinder to force the water up the pipe, to the reservoir.

3. The combination of the elevated reservoir; the cylinder; the piston in the cylinder; the pipe connecting the reservoir with the cylinder; the liquid on one side of the piston in the cylinder, pipe and reservoir; mechanical means independent of the liquid and connected with the piston to operate the piston; and means to allow, to control and to prevent the movement of the liquid.

4. In an elevator, the combination of the car; driving mechanism connected with the car; a cylinder closed at one end; a piston in the cylinder; mechanism operatively connecting the piston with the driving mechanism; a body of liquid; means for introducing the liquid under a practically constant and uniform pressure into the cylinder to press against one side of the piston; and means to allow, to control, and to prevent the flow of the liquid into and out of the cylinder.

5. In an elevator, the combination of the car; driving mechanism connected with the car; a rack operatively connected through a pinion with the driving mechanism to move in conjunction therewith; a cylinder closed at one end; a piston in the cylinder connected with the rack; a body of liquid; means for introducing the liquid under pressure into the cylinder to press against one side of the piston; and means to allow, to control, and to prevent the flow of liquid into or from the cylinder, substantially as set forth.

6. In an elevator, the combination of a cylinder; a piston; the car operatively connected with the piston to move it in one direction; a pipe connection extending from the cylinder to an elevated reservoir to give hydrostatic pressure in the cylinder against the piston to move it in the other direction; such reservoir of greater cross-sectional area than the cylinder; a body of liquid in the cylinder, pipe and reservoir, of sufficient volume to fill the cylinder and pipe when the piston is retracted, whereby a practically uniform pressure against one side of the piston will be maintained; and the driving mechanism connected with the piston to operate the same.

7. In an elevator, the combination of a cylinder; a piston; a pipe connection extending from the cylinder to an elevation great enough to give a practically constant hydrostatic pressure in the cylinder at all positions of the piston; a reservoir of greater sectional area than the cylinder arranged to supply liquid to the pipe and to receive the overflow therefrom when the piston rises; a body of liquid in the cylinder, pipe and reservoir of sufficient volume to fill the cylinder and pipe when the piston is retracted, whereby a practically uniform pressure against one side of the piston will be maintained; and the driving mechanism connected with the piston to operate the same to raise the car.

8. In an elevator, the combination of the driving mechanism; a rack arranged to be operated by the driving mechanism; a piston connected with the rack to move therewith; and a body of liquid arranged to exert a practically constant and uniform pressure against the piston, and arranged so that the liquid will be displaced at the movement of the piston; whereby the driving mechanism is assisted in one direction and controlled in the other, substantially as set forth.

9. In an elevator, the combination of the car; a piston; a body of liquid under a practically constant and uniform pressure arranged to press against the piston; and intermediate means between the piston and the car arranged to operate the car and to force the piston against the pressure of the liquid

when the car descends and a motor independent of the liquid, operatively connected with such intermediate means to drive the same.

10. In an elevator, the combination of a piston arranged in a cylinder and operatively connected with the driving mechanism; such mechanism; the motor, independent of the liquid, arranged to operate said driving mechanism; means for applying hydrostatic pressure to the piston; and a pressure-equalizing reservoir arranged to store the liquid forced from the cylinder at the inward movement of the piston and to return the same to the cylinder when the piston is retracted, substantially as set forth.

11. The combination of the cylinder; the piston in the cylinder; the elevated upwardly-tapering reservoir; the pipe connecting such reservoir with the cylinder to apply liquid to produce hydrostatic pressure against the piston; and a body of liquid in the cylinder, pipe and reservoir.

12. The combination of the cylinder; the piston in the cylinder; the elevated upwardly-tapering reservoir; the pipe connecting such reservoir with the cylinder to apply liquid to produce hydrostatic pressure against the piston; a body of liquid in the cylinder, pipe and reservoir; the car; and driving mechanism operatively connected with the car and with the piston.

13. In an elevator, the combination of the cylinder; an elevated reservoir; a pipe connecting the reservoir with the cylinder; a body of liquid in the cylinder, pipe and reservoir; a valve in the pipe to allow, to control and to prevent the movement of the liquid therethrough; and a piston arranged in such cylinder and operatively connected with the car through intermediate means, and adapted and arranged to force liquid from the cylinder into the pipe, substantially as and for the purpose set forth; and the motor operatively connected with such intermediate means to drive the same.

14. In an elevator, the combination of the cylinder; the piston arranged in the cylinder and operatively connected with the car through intermediate means; the elevated reservoir; the pipe connecting the reservoir with the cylinder; the valve in such pipe to allow the liquid to flow in one direction therethrough and to prevent its return; a supplementary pipe communicating with such connecting-pipe on opposite sides of said valve and provided with the valve to allow, to control and to prevent the movement of the liquid through such supplementary pipe; and a body of liquid in the cylinder, pipes and reservoir.

15. In an elevator, the combination of the cylinder; the piston arranged in the cylinder and operatively connected with the car through intermediate means; the pipe connecting the reservoir with the cylinder; a valve arranged in such pipe near the top thereof to allow liquid to flow downward therethrough and to prevent its return; a supplementary pipe communicating with the connecting-pipe on opposite sides of such valve; a valve arranged at the bottom of the supplementary pipe to allow, to control and to prevent the flow of liquid through the supplementary pipe; means for operating such valve and a body of liquid in the cylinder, pipes and reservoir.

16. In an elevator, the combination of the cylinder; the piston arranged in the cylinder and operatively connected with the car through intermediate means; the pipe connecting the reservoir with the cylinder; a valve of larger area than the body of the pipe, arranged in such pipe near the top thereof to allow liquid to flow downward therethrough and to prevent its return; a supplementary pipe communicating with the connecting-pipe on opposite sides of such valve; a valve arranged at the bottom of the supplementary pipe to allow, to control and to prevent the flow of liquid through the supplementary pipe; means for operating such valve, and a body of liquid in the cylinder, pipes and reservoir.

17. The combination with the cylinder, piston, elevated reservoir, the pipe connecting the cylinder and reservoir, and the body of liquid in such pipe; of a valve arranged in a chamber; such chamber in the pipe; a seat for the valve; and an annular air-space above the valve-seat in the chamber.

18. The combination of the cylinder; the piston in the cylinder; the car operatively connected with the piston through intermediate means; the elevated reservoir; the pipe connecting the reservoir with the cylinder; the body of liquid in the reservoir, pipe and cylinder; a valve arranged to allow, to control, and to prevent the movement of the liquid; means connected with the valve to hold it normally closed; an electromagnet to operate such means to open the valve; the motor; the source of electrical energy; and the electrical conductor connecting the source of electrical energy with the motor and connected between the motor and such source of electrical energy with the electromagnet to energize the same.

19. In an elevator, the combination of a cylinder; a piston in the cylinder; a pipe connected with the cylinder; a storage-reservoir for such pipe arranged to supply liquid thereto; means for operating the piston; a liquid supply for such storage-reservoir; and a float-valve for such supply having its float arranged near the bottom of the storage-reservoir with its path wholly below the normal level of the liquid in such reservoir when the piston is retracted, so that the valve will be operated to supply liquid to the reservoir only when the piston is retracted and the volume of the liquid in the cylinder, pipe and reservoir is below the normal; substantially as and for the purpose set forth.

20. The combination of the vertical cylinder; the piston therein; the liquid; means for introducing the liquid into the cylinder to press upon the piston; means to control the movement of liquid into and out of the cylinder; the load operatively connected with the piston to force it up as the load descends; a rack fastened to and extending downward from the piston; a pinion for operating the rack; and means for driving the pinion.

21. The combination of a vertical cylinder closed at its upper end; a piston within the cylinder; a motor; operative means connecting the motor with the piston to pull it down; the load; operative means connecting the load with the piston to pull it up; a reservoir arranged above the cylinder and communicating therewith above the path of the piston; a body of liquid in the reservoir and cylinder above the piston; a valve arranged to allow a free flow of liquid from the reservoir into the cylinder and to prevent such flow; a valve arranged to allow a restricted flow of liquid from the cylinder into the reservoir and prevent such flow; and means for operating such valve.

22. The combination of a vertical cylinder closed at its upper end; a piston within the cylinder; a motor; operative means connecting the motor with the piston to pull it down; the load; operative means connecting the load with the piston to pull it up; a reservoir arranged above the cylinder and communicating therewith above the path of the piston; a body of liquid in the reservoir and cylinder above the piston; a valve arranged to allow the free flow of liquid from the reservoir into the cylinder and to prevent such flow; a rod connected with such valve and extending through the wall of the valve-chamber; suitable means connected with the valve-rod to operate the valve mechanically to open and close the same; a valve arranged to allow the restricted flow of liquid from the cylinder into the reservoir and prevent such flow; and means for operating such valve.

23. The combination of a cylinder closed at one end; a piston within the cylinder; a motor; operative means connecting the motor with the piston to force it down; the load; operative means connecting the load with the piston to force it up; a reservoir extending above the cylinder and communicating therewith between the piston and the closed end of the cylinder; a body of liquid in the reservoir and cylinder above the piston; a valve arranged to allow the free flow of liquid from the reservoir into the cylinder and to prevent such flow; a rod connected with such valve and extending through the wall of the valve-chamber; a toggle connected with such valve to reciprocate the same; a lever arranged to operate the toggle; means arranged to operate the lever to straighten the toggle to close the valve; an electromagnet arranged to operate against such means to bend the toggle to lift the valve; the power-wire connecting the motor with the source of electrical energy and passing through the magnet to energize the same; and suitable means between the magnet and the source of electrical energy for cutting off and turning on the current.

24. The combination of the elevator-car; the guide; the worm journaled to the car and carried thereby; a governor device operated by the movement of the car and adapted to operate the worm; a lever fulcrumed to the car and operatively connected with the worm; two dogs carried by the car and operatively connected with the lever and respectively provided with an eccentric curved face arranged to engage the opposite sides of the guide respectively.

25. The combination of the elevator-car; the guide; the worm journaled to the car and carried thereby; a governor device operated by the movement of the car and adapted to operate the worm; a lever fulcrumed to the car and operatively connected with the worm; two dogs carried by the car and respectively provided with an eccentric curved face adapted and arranged to respectively engage the opposite sides of the guide; a toggle-joint connected with the dogs to operate the same; and a rod connecting the lever with the toggle-joint to operate such joint.

26. The combination of the elevator-car; the guide; the worm journaled to the car and carried thereby; a governor device operated by the movement of the car and adapted to operate the worm; two dogs carried by the car and respectively provided with an eccentric curved face adapted and arranged to engage the opposite sides of the guide respectively; a toggle-joint arranged to operate the dogs; a rod connected with the toggle-joint and arranged to operate the same; and the lever pivoted to the car and having on one arm a rack meshing with the worm to be driven thereby and the other arm connected with the rod to operate it.

27. The combination of the elevator-car; two guides; the worm journaled to the car and carried thereby; a governor device operated by the movement of the car and adapted to operate the worm; a lever fulcrumed to the car; two eccentric dogs carried by the car and adapted to engage the opposite sides of one of the guides; a toggle-joint arranged to operate such dogs; another lever fulcrumed to the car; two eccentric dogs carried by the car and adapted to engage the opposite sides of the other guide; a toggle-joint arranged to operate such other dogs; a lever fulcrumed to the car and operatively connected with the worm; a rod connecting one arm of such lever with one of the toggle-joints; and a rod connecting the other arm of such lever with the other toggle-joint.

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Witnesses:
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