(No Model.) 4 Sheets—Sheet 1.

J. PARKINSON.

COMBINED ELECTRIC HYDRAULIC SCREW CONTROLLED ELEVATOR ENGINE.

No. 571,731. Patented Nov. 17, 1896.

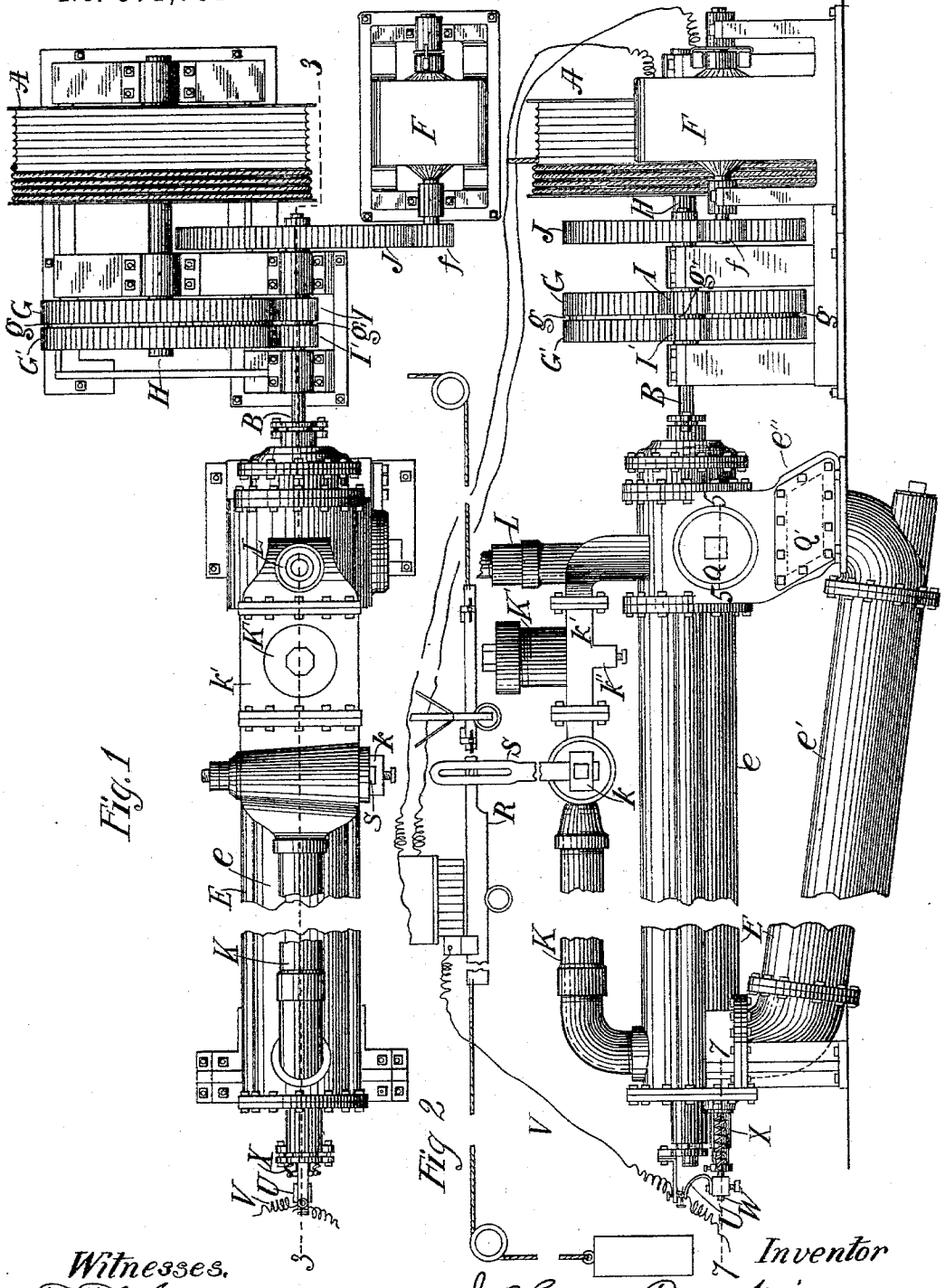

Fig. 1

Fig. 2

Witnesses.
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(No Model.) 4 Sheets—Sheet 2.

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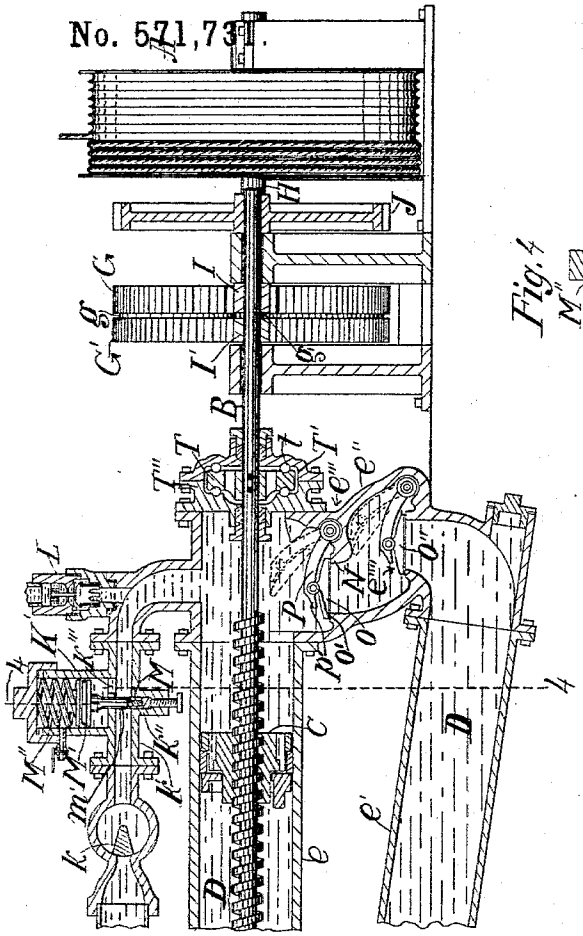

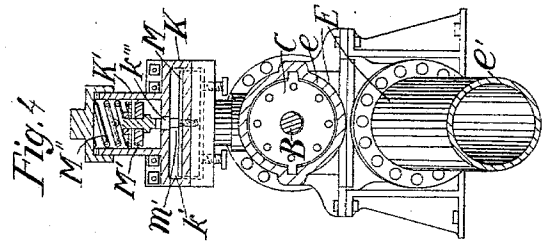

Fig. 4

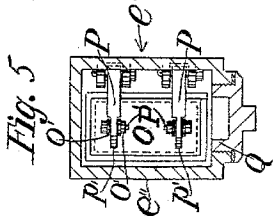

Fig. 5

Fig. 6

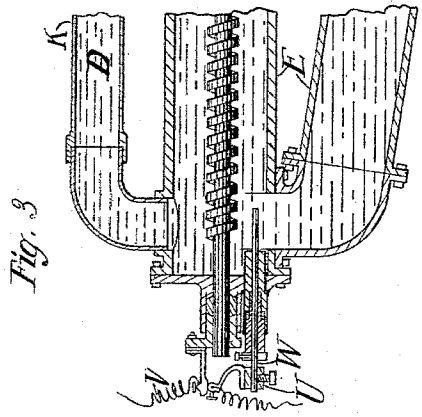

Fig. 3

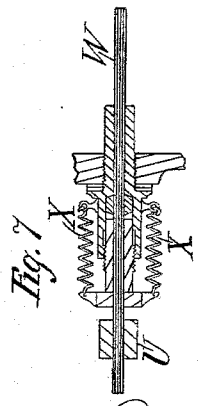

Fig. 7

Witnesses
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(No Model.) 4 Sheets—Sheet 3.

J. PARKINSON.

COMBINED ELECTRIC HYDRAULIC SCREW CONTROLLED ELEVATOR ENGINE.

No. 671,731. Patented Nov. 17, 1896.

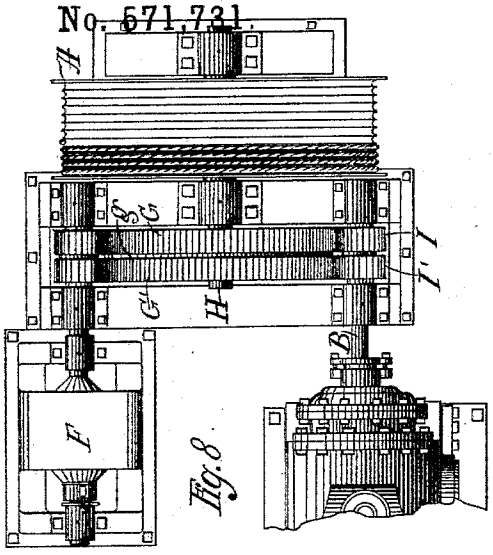

Fig. 8

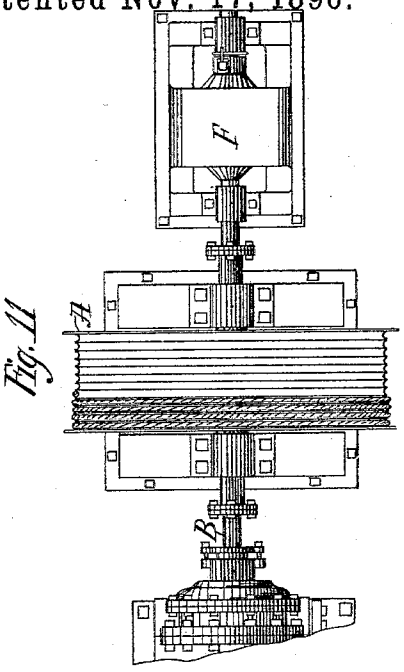

Fig. 11

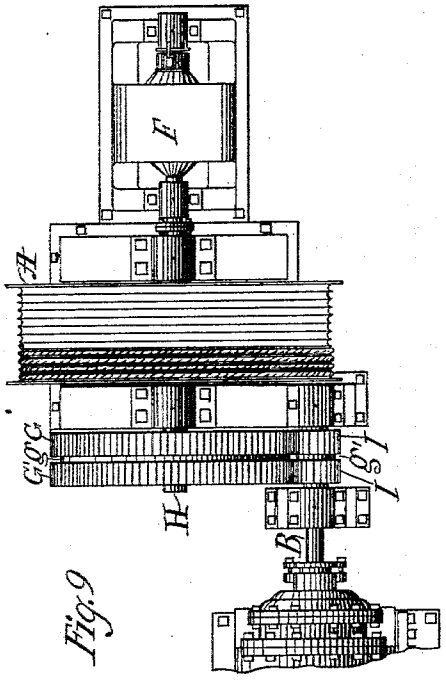

Fig. 9

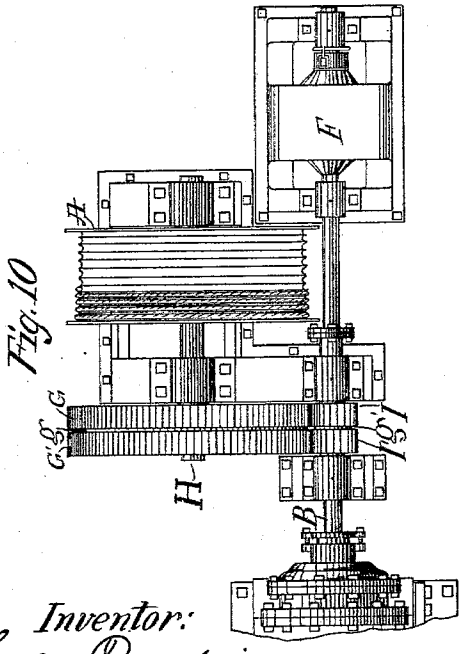

Fig. 10

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Inventor:
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his attys

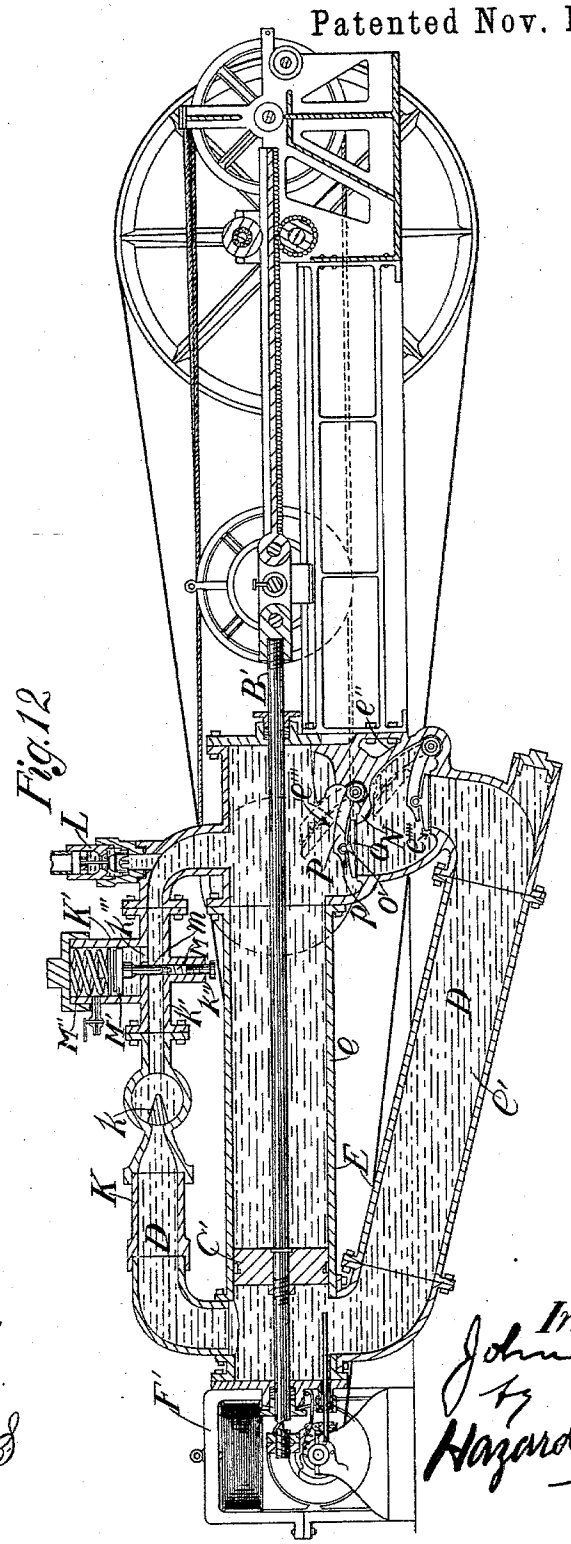
(No Model.) 4 Sheets—Sheet 4.

J. PARKINSON.

COMBINED ELECTRIC HYDRAULIC SCREW CONTROLLED ELEVATOR ENGINE.

No. 571,731. Patented Nov. 17, 1896.

Fig. 12



Witnesses:
F. T. Johnson.
F. M. Townsend

Inventor:
John Parkinson
by Hazard & Townsend
his Attys.

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 SCREW-CONTROLLED ELEVATOR-ENGINE.

SPECIFICATION forming part of Letters Patent No. 571,731, dated November 17, 1896.

Application filed June 25, 1895. Serial No. 553,959. (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 Hydraulic Screw-Controlled Elevator-Engine, of which the following is a specification.

One object of my invention is to provide an electric hydraulic elevator-engine which will require less room than any elevator-engine heretofore operated by electricity and controlled by hydraulic force.

Another object of my invention is to provide for supporting the car while descending and at stops by a nut threaded on a screw-shaft and held by a body of liquid under compression; also, to provide a hydraulic substitute for a ratchet.

While my invention is more especially designed for electrically-operated elevators, still it is adapted for use with other power.

Another object of my invention is to provide for an elevator a support which will offer the least resistance to the power applied while raising and which will safely and entirely support the car in its descent and during its stops. In this respect my invention comprises the combination of a cylinder, a piston in the cylinder, a body of liquid in the cylinder on both sides of the piston, means to allow the unobstructed flow of liquid from one end of the cylinder to the other when the piston moves in one direction, and means to restrict and control the flow of the liquid from end to end of the cylinder.

My invention is different from all screw elevator-engines heretofore made in that with all such former engines the power for driving the elevator-rope is applied through the screw which affords the desired safety, while with my engine the power for driving the elevator-rope is not applied through the safety-screw, and the safety-screw is an adjunct to the raising mechanism proper. By this feature of my invention I avoid the great friction and waste of power resulting in such other engines from the sliding operation by which the screw operates to turn the gear, an object in this connection being to provide an elevator-engine having all the advantages of the former screw elevator-engines and devoid of the friction and loss of power characteristic of such other machines.

I have heretofore invented a safety device employing a screw and adapted for attachment to an elevator-car, and in such safety device a piston-head provided with openings therethrough was arranged upon a screw within a hydraulic cylinder, and the screw operated to drive the piston-head to and fro within the cylinder, valves being arranged to control the openings through the head, so as to allow the liquid to flow through the head more or less freely in one direction and with more or less restriction in the other direction as the car raised or lowered. Said former invention is shown and claimed in my application for United States patent, Serial No. 536,198, filed January 25, 1895. My present invention differs from such an appliance in that I use a solid nut instead of the piston-head provided with openings, and said nut is arranged to move to and fro within a straight member of a tubular loop, which loop is provided with check-valves to allow free flow of the liquid through the loop in one direction and to prevent any flow of liquid in the other direction. This loop with its valves, the screw and nut and the hoisting-rope, and connections between such rope and the screw are all arranged so that when the rope is operated to lift the car the liquid will flow freely through the loop past the check-valves. Provision for return of the liquid in the other direction is made through a conduit connecting the ends of the straight member and suitably controlled by a valve.

In this connection it is an object of my invention to provide means whereby a screw-operated nut arranged as a piston (or any other form of piston) will be enabled to operate to force the body of liquid from its one face to the other in one direction with a minimum resistance, and in which the liquid when forced in the other direction will be subject to perfect control by a suitable valve.

Incidentally an object of my invention is to provide for properly sustaining the thrust of the nut during the descent or stoppage of the car and to avoid objectionable friction, which otherwise would result.

An object of my invention is to provide for direct connection between the elevator-rope-winding sheave and the electric motor with a gear, and yet provide absolute safety and at the same time entirely relieve the motor from any work during the descent of the car and cut off the current, thus preventing waste of power.

An object of my invention is to provide a very simple automatic governor or descent-speed-controlling appliance operated by the compression of the liquid during descent of the car and to so construct the same that it will resist the flow of liquid in proportion to the speed with which the car descends, thus diminishing the speed of descent.

Another object of my invention is to provide a device operated by a hydraulic piston for cutting off the electric current when the car reaches its upward limit of movement. In my present machine the connection only remains broken when the car is above its normal limit of travel, and the connection is re-established as soon as the car again enters the path of its normal travel.

In my application for Letters Patent of the United States, Serial No. 568,898, filed November 14, 1895, I have broadly and generically claimed the invention underlying this appliance, and which invention consists, essentially, of controlling the downward movement of the elevator-car 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. The new type of elevator which I have invented and which is claimed in said application includes, broadly, the combination, with an electric motor, of a piston operated thereby and operatively connected with the car to drive the same, and suitable means or appliances arranged to allow the free movement of the piston when the car ascends and to afford perfect control of the movement of the piston at the descent of the car. The said invention comprises an electric lifting apparatus and a hydraulic supporting and lowering apparatus so arranged in combination that the strain is taken off of the electric motor at all times except when the motor is in operation to raise a load. It comprises a cylinder, a piston arranged in such cylinder, means connected with the piston to move it in one direction, a receptacle or reservoir, a body of liquid in the cylinder and receptacle, a passage being provided between the receptacle and cylinder, a valve arranged to allow the liquid to flow freely through such passage from the receptacle into the cylinder and prevent its return, a passage being provided to allow liquid to flow from the cylinder into the receptacle, a valve arranged to control and to prevent the flow of liquid through such passage, and means for operating such valve.

No claim is herein made broadly and generically to said invention, because the same is broadly claimed in said application, Serial No. 568,898.

The accompanying drawings illustrate my invention.

Figure 1 is a plan of my new elevator-engine. Fig. 2 is a side elevation of the same. Fig. 3 is a vertical longitudinal mid-section on line 3 3, Fig. 1, except that the screw, the check-valves, and the automatic governor mechanism are shown intact. Fig. 4 is a vertical transverse section on the irregular line 4 4, Fig. 3, looking toward the left. The liquid is not shown in this view. Fig. 5 is a plan section on line 5 5, Fig. 2. Fig. 6 is an elevation of the valve-arm. Fig. 7 is a horizontal section on line 7 7, Fig. 2. Figs. 8, 9, 10, and 11 show different modifications for simplifying my engine by the use of powerful low-speed motors. Fig. 12 illustrates the use of the loop with a piston fixed to a reciprocating piston-rod.

My new elevator-engine comprises the combination of the rope-winding sheave A, a screw-shaft B connected thereto and arranged to rotate therewith, a nut C, screwed upon said screw-shaft and arranged to be driven to and fro along the screw-shaft as the screw-shaft rotates, suitable means for preventing the rotation of the nut, and suitable means for controlling the travel of the nut along the screw-shaft. By this means the rotation of the rope-winding sheave is under the control of the nut, and by controlling the travel of the nut the rope-winding sheave can be made to travel slowly or can be entirely stopped. The means which I use for controlling the travel of the nut is a confined body of liquid D, arranged to be moved by the nut as it travels along the screw. The means for confining the liquid consists of a hydraulic loop E, composed of a straight member e and a return member e', which connects the ends of the straight member. This return member is provided with a vertical portion e'', in which are two check-valves e''' e'''', arranged to allow the flow of liquid in one way upward through the vertical portion and to prevent its flow in the other direction, so that the liquid can flow freely from one face of the nut to the other through the return member of the loop, but cannot flow back through such member. The rope-winding sheave, the screw-shaft, and nut are arranged with such relation to each other and to the check-valves that when the sheave is winding the rope thereupon the nut will operate to force the liquid through the return member past the check-valves, which open to allow the flow of the liquid in that direction. The straight member of the hydraulic loop has a longitudinal groove at each side and forms a guide for the nut to allow it to travel along the screw-shaft. The nut has side lugs c, which fit into the grooves of the straight member, as shown in Fig. 4, and prevent the nut from rotating.

My invention comprises the combination of

the parts above mentioned and an electric motor F, the screw-shaft being connected with the motor to rotate therewith. By the operation of the motor the screw-shaft is rotated, the nut being driven along the straight member, and at the same time the rope-winding sheave is rotated to wind the rope thereupon. The nut is constantly held by the compression of the liquid to prevent the rope-winding sheave from turning in the other direction in case the current of the motor is turned off, so that when the current is turned off the weight is immediately sustained by the nut and the liquid.

G indicates a cog-wheel connected with the rope-winding sheave A by a shaft H, upon which the cog-wheel and the rope-winding sheave are fixed. I indicates a pinion meshing with such cogwheel and fixed upon the screw-shaft. The screw-shaft and rope-winding sheave are thus connected to each other to rotate together.

J indicates a driven cog-wheel fixed upon the screw-shaft to drive the same, and the motor is provided with a pinion *f*, meshing with the driven cog-wheel J to rotate the screw-shaft, so that the motor is thus connected by a gear with the rope-winding sheave and with the screw-shaft. This construction is designed for a high-speed motor. A low-speed motor of greater power could be geared directly with the cog-wheel G, as shown in Fig. 8, or the armature of the motor could be coupled with the shaft H, as shown in Fig. 9, or with the screw-shaft B, as shown in Fig. 10, but with such construction a much stronger and slower motor would be required; or with a very powerful motor the motor can be coupled directly with the screw-shaft and the rope-winding sheave be fixed thereupon, as shown in Fig. 11. This form is the simplest form of elevator which I have devised. The ends of the straight part of the loop are connected by the valve-restricted return-conduit K and the body of liquid fills the loop and the return-conduit.

L indicates a valved stand-pipe for keeping the loop constantly filled. This structure is shown and claimed in my application for Letters Patent, filed January 25, 1895, Serial No. 536,198.

k indicates a balance-valve for controlling the movement of the liquid through the restricted return-conduit. The return-conduit is provided with a widened and flattened portion *k'* and with a gate-socket *k''* in the floor thereof. A gate M is arranged in such socket and adapted to play across the passage to obstruct the same. K' is a piston-chamber arranged above such passage and communicating therewith through the opening *k'''*. A piston M', having an area greater than the upper face of the gate, is arranged in the chamber, and the rod *m'* connects such gate with the piston. Suitable means, such as the spring M'', is provided for normally holding the piston depressed. By this contrivance when the compression of the liquid caused by the return of the nut along the straight member exceeds the predetermined pressure the liquid pressing against the bottom of the piston will force the piston up, and thus draw the gate up to contract the passage through the conduit. As the piston M' and the gate M rise the resistance of the spring increases, so that when the movement of the nut reaches the normal speed the piston M' will be balanced and allow the nut to travel at said normal speed.

The speed of flow of the liquid through the restricted conduit depends upon the load upon the car during descent, and as the load is diminished the compression of the spring M'' will be reduced, thus allowing the liquid to flow more rapidly through the return-conduit. By this simple device the pressure of the liquid is made to directly control the movement of the car in descent.

The screw is so arranged with relation to the nut, the hydraulic loop, and the rope-winding sheave that when the motor is operated to wind the rope upon the drum and thus raise the elevator-car (not shown) the nut will be drawn away from the motor, and upon the reverse movement the nut will be made to travel toward the motor. When the nut moves from the motor during the ascent of the car, it is desirable that the liquid flow through the loop with as little obstruction as possible, and for this reason it is necessary to make large check-valves to allow the liquid to pass freely in one direction, and such check-valves must be very strong to bear the pressure applied when the car is descending. In order to provide for this, I employ a check-valve which, while moving freely to allow the passage of a large volume of liquid, will be positive and quick in its return action to close the valve. This valve comprises the combination of the valve-seat N, the valve-leaf O, arranged to seat upon such valve-seat, the arm P, hinged by one end to the valve-seat and hinged at the other end to the valve-leaf on the upper side thereof and provided with a projection *p'* extending beyond the valve-leaf hinge to prevent too free movement of the valve-leaf upon this hinge.

o' indicates the valve-leaf hinge-lugs provided on the upper face of the valve-leaf.

The arm P is provided with a pintle-hole *p*, and a removable pintle *p'* is passed through the hinge-lugs and the pintle-hole in the arm, thus forming the valve-leaf hinge and allowing the valve-leaf to be detached from the valve-arm P, so that it can be removed readily through the hand-hole Q (or Q') in the vertical portion of the return member *e'* of the loop.

In order to provide for greater security against leakage and breakage, I provide two valves *e''' e''''* in the vertical portion of the return member of the loop. The valves are identical in construction, and the description

of one will serve for both. Preferably each valve-leaf is provided with two arms, as shown in the plan in Fig. 5.

Suitable rheostat mechanism R is provided to control the current of electricity, and this is connected with the elevator-car for suitable operation. The means for operation are not shown in the drawings for the reason that various means can be devised therefor. The appliance which I have indicated is the same as that shown in my said application for patent, Serial No. 545,175, filed April 10, 1895. This rheostat-operating mechanism is connected with a valve-operating arm S, arranged to operate the valve *k*, so that the valve and the rheostat will operate in conjunction with each other to simultaneously cut off the flow of liquid through the return-conduit and cut off the current to the motor, so that at the moment when the current is cut off the passage through the conduit will be entirely closed by the valve *k*. The valve *k* is arranged to open in both directions, so that when the current has been cut off a further movement of the valve-arm S will again open the valve in the other direction, thus allowing the liquid to again flow through the conduit. Then the rheostat mechanism R can be operated while opening and closing the valve without turning on the current of electricity. Then when it is desired to turn on the current of electricity the mechanism will be thrown to accomplish that object. At the moment the current is turned on the flow of liquid will be stopped by the valve *k*, and then, by a further movement, the valve will be opened in the other direction, thus allowing the liquid to again pass through the conduit. In this way the return-conduit connects in both directions, and thus allows greater freedom for the return of the liquid from end to end of the straight member during the descent of the car. The capacity for returning the liquid when the car ascends being fully equal to the area of the cylinder *e* or straight member of the loop, the flow of the liquid from one end to the other of the cylinder *e* is unobstructed when the piston moves during the ascent of the car or other load.

The hydraulic loop is adapted for use with a piston C′, driven by a reciprocating piston-rod B′, (shown in Fig. 12,) instead of by the screw, as shown in Fig. 3, &c., and my invention includes the combination of the valved loop and the piston, whether the piston be a nut on a screw or be fixed to and driven by a rod. The screw extends through the end of the straight member of the loop and is packed to prevent the escape of the liquid, and if a piston-rod were used it would be packed. The thrust of the nut against the liquid during the descent of the car is sustained by the tension of the screw-shaft, and this is liable to shift the shaft endwise in its bearings. To provide against this, a collar T is fixed upon the screw-shaft, and ball-bearings *t* are arranged upon the opposite sides of the collar to sustain the thrust thereof. T′ T″ indicate seats for the balls of the ball-bearing. The seats and collars are shown both provided with grooves for the balls of the bearing.

The form of elevator which I have shown in Figs. 1, 2, and 3 of the drawings is designed for a freight or passenger elevator of a speed of about one hundred feet per minute, with a motor F, making five hundred revolutions per minute. The speed of the elevator can be increased by increasing the diameter of the armature-pinion *f*, or by increasing the revolutions of the motor, or by increasing the size of the sheave, or changing the gear between the sheave and the screw-shaft.

It is to be observed that the speed of this engine is only limited by the horse-power of the motor, and that this machine differs from other worm-gear elevators notably in that any speed can be attained with a low-speed motor, and this cannot be done with other types of screw elevators.

In this type of machine the power applied by the pinion of the screw-shaft to the spur-wheel of the sheave-shaft is very great, and I have devised special means for transmitting this power without danger of breakage. This means consists of two or more spur-wheels G G′, fixed upon the sheave-shaft with their cogs arranged to break joints with each other, and two or more pinions I I′, fixed upon the screw-shaft with their cogs arranged to break joints and meshed in the spur-wheels. This contrivance is arranged, in combination with the other parts hereinbefore described, so that the power applied through the armature-pinion *f* and the driven spur-wheel J will be applied through the shaft B to the sheave A without danger of breakage.

By arranging the cogs on the spur-wheels to break joints with each other, as shown, and meshing with such spur-wheels two or more pinions, the cogs of which also are arranged to break joints with each other, cogs are always in engagement with each other to bear the load to an advantage, and with this kind of gear the danger of breakage is greatly eliminated.

In the drawings the two cog-wheels are shown separated by a plate *g*, interposed between such cog-wheels, and the pinions are likewise set at a distance from each other.

In order to provide for cutting off the current when the car has reached the upward limit of its travel, I provide an electrical contact U for connecting and disconnecting the electrical conductor V, and I provide a rod W, carrying such contact and arranged extending through the end wall of the loop into the path of the nut and arranged to be moved by the nut to break the electrical circuit in the conductor. A spring X is arranged for normally holding the electrical contact rod or carrier W extending into the path of the nut

when the contact is made and the circuit unbroken. This spring normally holds the contact unbroken.

In practice when the piston or nut C is operated to drive the liquid through the return member e' of the loop it will travel until it comes into contact with the rod W, and then will move the rod W, so as to break the electrical current, thus stopping the operation of the motor and allowing the car to come to a standstill at the top of the shaft. Upon the reverse movement of the piston or nut C the rod will be returned by the springs X and the current will again be turned upon the motor.

The large return member of the loop and the large check-valve shown were invented subsequent to the filing of said applications, Serial Nos. 536,198 and 545,175, and I believe the same to be preferable for connecting the separate compartments of the cylinders shown in said applications for the reason that the larger flow of liquid thus provided for is desirable in a practical machine. I wish my claims to cover the liquid-return device herein shown, whether the same be used in connection with the other mechanism shown herein or with the said former inventions or in any other situation in which it may be applied.

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 cylinder; a piston in the cylinder; a body of liquid in the cylinder on both sides of the piston; means to allow the unobstructed flow of liquid from one end of the cylinder to the other when the piston moves in one direction; and means to restrict and control the flow of the liquid from end to end of the cylinder.

2. In an elevator, the combination of the cylinder; the piston therein; the body of liquid in the cylinder on both sides of the piston; means to allow the unobstructed flow of the liquid from one end of the cylinder to the other when the piston is actuated in one direction; means for preventing the return of the liquid; and controlling means for allowing the return of the liquid when the piston is moved in the other direction.

3. In an elevator-engine, the combination of the loop provided with the straight member; the piston arranged to travel to and fro in such straight member; means for moving the piston arranged in the straight member and extending through the end thereof; a return-conduit connecting the ends of the straight member; a check-valve to allow the flow of liquid in one direction only through the loop; the body of liquid in the loop and return-conduit; and a valve to control the flow of liquid through the return-conduit.

4. In an elevator-engine, the combination of a rope-winding sheave fixed on a shaft; such shaft journaled to rotate; a cog-wheel fixed on such shaft; a screw-shaft provided with a pinion geared in such cog-wheel; a driven cog-wheel fixed on such screw-shaft; a motor provided with a pinion fixed on its armature and geared into such driven cog-wheel; a nut screwed on the screw-shaft; a guide to prevent the rotation of the nut and allow it to travel along the screw-shaft; and means to control the travel of the nut along the screw-shaft.

5. In an elevator-engine, the combination of a hollow loop for confining a body of liquid and composed of a straight member and a return member connecting the ends of the straight member; a nut fitted into the straight member and arranged to travel therein; a screw-shaft arranged in the straight member, screwed through the nut and journaled in the ends of the straight member and projecting beyond one of such ends; a restricted return-conduit connecting the ends of the straight member; a body of liquid in the loop and conduit; check-valves in the return member of the loop to allow the liquid to flow therethrough in one direction only; and a valve in the return-conduit to control the flow of liquid therethrough.

6. The combination of the loop composed of a straight member and a return member connecting the ends of the straight member; a nut fitted into the straight member and arranged to travel therein; means to prevent the rotation of the nut; a screw-shaft arranged in the straight member and projecting beyond one of its ends; a restricted return-conduit connecting the ends of the straight member; a body of liquid in the loop and conduit; a check-valve in the return member of the loop to allow the liquid to flow therethrough in one direction only; and a valve in the return-conduit to control the flow of the liquid therethrough.

7. In an elevator-engine, the combination of the loop provided with the straight member; the nut arranged to travel to and fro in such straight member; means for preventing the rotation of the nut; a return-conduit connecting the ends of the straight member; a check-valve to allow the flow of liquid in one direction only through the loop; the screw-shaft journaled in the ends of the loop and screwed through the nut; the body of liquid in the loop and return-conduit; a valve to control the flow of liquid through the return-conduit; the rope-winding sheave connected with the screw-shaft to rotate therewith; a collar fixed upon the screw-shaft; and ball-bearings arranged upon the opposite sides of the collar to sustain the thrust thereof.

8. In an elevator-engine, the combination of the rope-winding sheave mounted on a shaft; such shaft; spur-wheels fixed on such shaft with their cogs arranged to break joints with each other; the screw-shaft and means for controlling the rotation of the screw-shaft; pinions fixed upon the screw-shaft with their cogs arranged to break joints and meshed in

the spur-wheels; a driven spur-wheel fixed upon the screw-shaft; a motor provided with a pinion; and such pinion meshing with such driven spur-wheel.

9. The combination of the conduit provided with a widened portion and with a gate-socket in the floor thereof; a gate arranged in such socket and adapted to play across the passage to obstruct the same; a piston-chamber arranged above such passage and communicating therewith; a piston arranged in such chamber and having an area greater than the upper face of the gate; a rod connecting such gate with the piston; and suitable means for normally holding the piston depressed.

10. The combination of the hydraulic loop provided with the straight member and the check-valve-controlled return member; the return-conduit connecting the ends of the straight member and provided in its floor with the gate-socket; a gate arranged in such socket and adapted to play across the passage to obstruct the same; a piston-chamber arranged above such passage and communicating therewith; a piston arranged in such chamber and having an area greater than the upper face of the gate; a rod connecting such gate with the piston; the spring for normally holding the piston depressed; the screw-shaft connected to the rope-winding sheave to rotate therewith and journaled in the ends of the hydraulic loop; a nut fitted in the straight member of the loop and screwed upon the screw-shaft; means to prevent the rotation of the nut; and the body of liquid in the loop and return-conduit.

11. In an elevator-engine, the combination of the loop composed of a straight member and of a return member which connects the ends of the straight member and has at one end a vertical portion provided with a valve-seat; a valve arranged to seat upon such valve-seat; the valved return-conduit connecting the ends of the straight member; the body of liquid in the loop and return-conduit; and a piston operating in the loop.

12. In an elevator-engine, the combination of the loop composed of a straight member and of a return member which connects the ends of the straight member and has at one end a vertical portion provided with two valve-seats arranged one above the other in such vertical portion; two valves arranged respectively to seat in such valve-seats; two arms respectively hinged at one end to the valve-seats respectively and at the other end to the valves respectively; and a piston operating in the loop.

13. In an elevator-engine, the combination of the hydraulic loop provided with a straight member and the return member and a body of liquid therein; a nut arranged to travel to and fro in the straight member; a screw arranged to drive such nut; an electrical conductor; an electrical contact for connecting and disconnecting such conductor; a rod carrying such conductor and arranged extending through the end wall of the loop into the path of the nut and arranged to be moved by the nut to break the electric circuit.

14. The combination of the hydraulic loop having the straight member, and check-valves in the return member to allow the liquid to flow in one direction only, in such return member; a screw-shaft journaled in the ends of the loop and extending from outside the loop into the straight member; a nut fitted in the straight member and screwed upon the screw-shaft; means for preventing the rotation of the nut; a valved conduit connecting the opposite ends of the straight member, and a body of liquid in the loop and return-conduit.

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Witnesses:
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