No. 612,722. Patented Oct. 18, 1898.

C. I. HALL.

ELEVATOR.

(Application filed Apr. 29, 1897.)

(No Model.) 2 Sheets—Sheet 1.

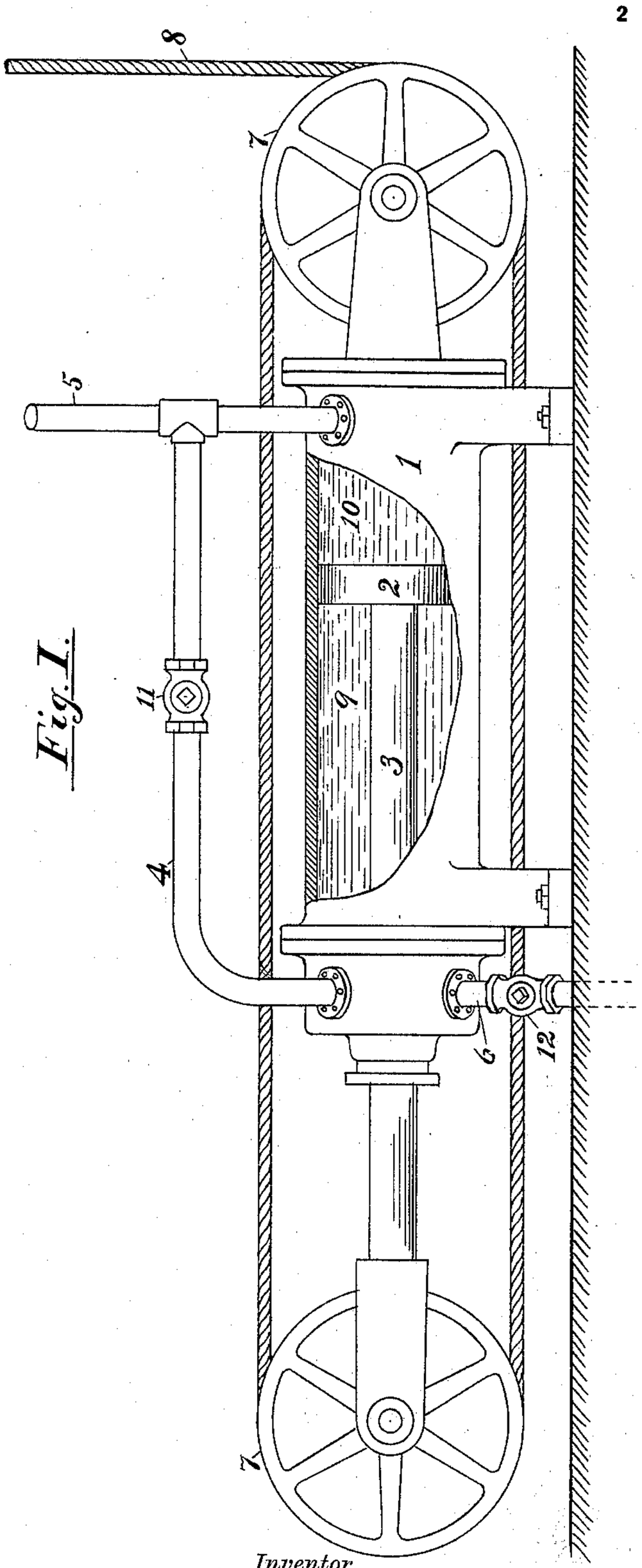

Fig. I.

Witnesses

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Fig. III.

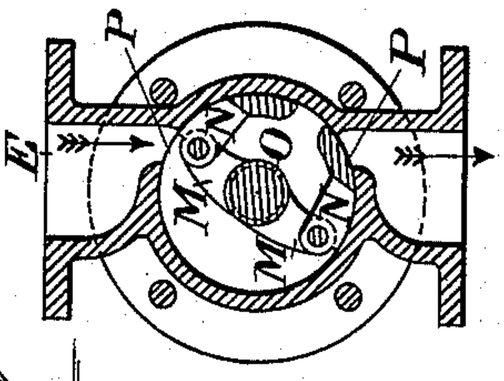


Fig. II.

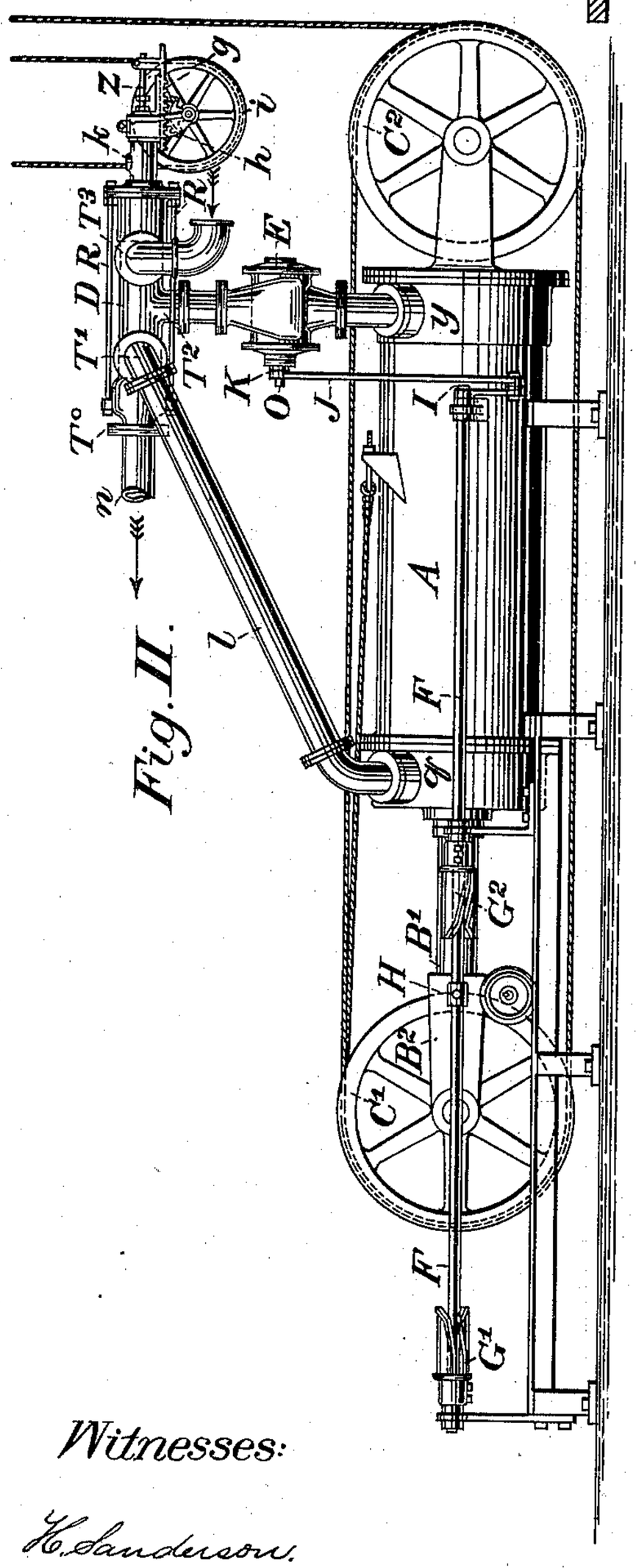
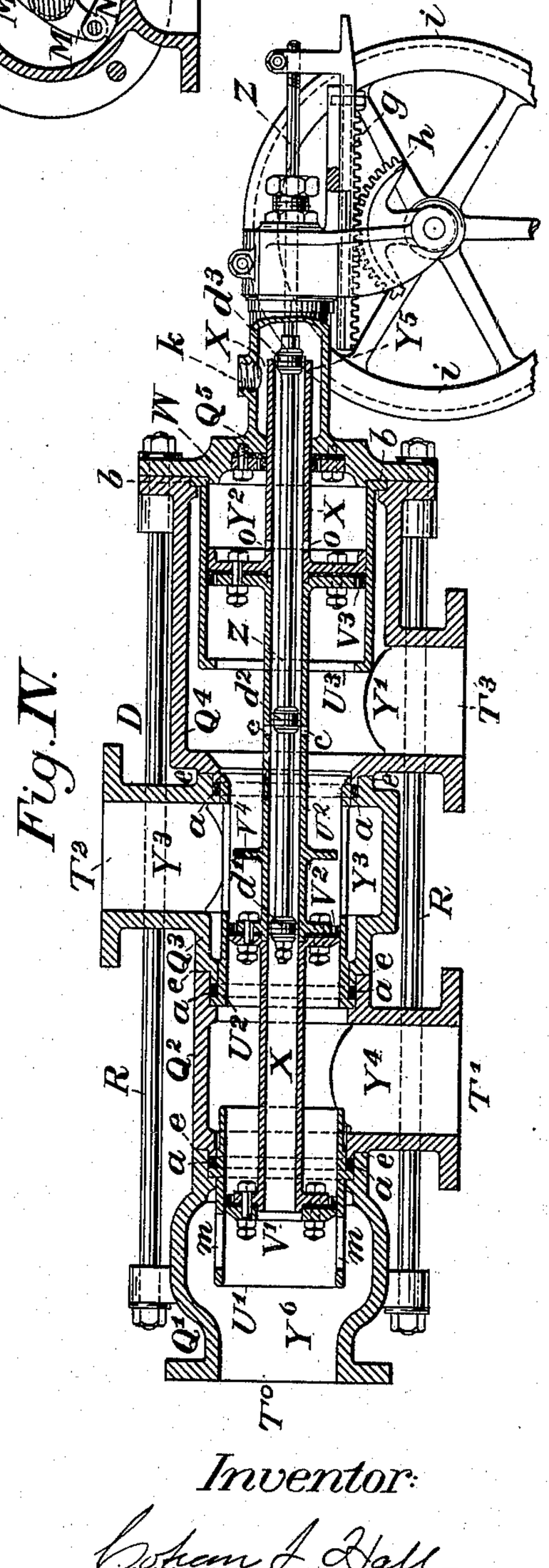


Fig. IV.



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UNITED STATES PATENT OFFICE.

COFRAN I. HALL, OF SAN FRANCISCO, CALIFORNIA, ASSIGNOR TO THE CAHILL & HALL ELEVATOR COMPANY, OF SAME PLACE.

ELEVATOR.

SPECIFICATION forming part of Letters Patent No. 612,722, dated October 18, 1898.

Application filed April 29, 1897. Serial No. 634,429. (No model.) Patented in England January 17, 1894, No. 1,040.

To all whom it may concern:

Be it known that I, COFRAN I. HALL, a citizen of the United States, residing at San Francisco, in the county of San Francisco and State of California, have invented certain new and useful Improvements in Elevators, (patented in Great Britain, No. 1,040, dated January 17, 1894;) and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to elevators for raising and lowering passengers and goods by means of hydraulic pressure acting on a piston and from thence by suitable gearing and connections to a cage to be raised or lowered at such relative speed, range, and force as the power of the actuating-piston and intervening mechanism may determine.

My invention consists of a main actuating hydraulic cylinder and a differential piston therein having different effective area on the sides thereof, constituting a counterbalance for some predetermined part of a load to be raised by the piston, and a four-way piston-valve or combination of valves connected and moving in one line and around one axis that distribute and control the water acting upon the main actuating-piston.

The objects of my invention are to dispense with the usual counterweights employed to balance in part the dead-weight of the cage, such dead-weight being the gravity of the cage and its accessories less the amount required to overcome friction of the machinery during descent; also, to control and distribute the impelling-water by a single valve and one motion. To attain compensation without the use of counterweights, I so construct the actuating-cylinder and its piston that the difference of effective area on the opposite sides of the piston multiplied by the operating pressure will equal a required counterweight, so that aside from so much of the gravity of the cage as is required to expel or circulate the impelling-fluid in the actuating-cylinder and permit the cage to descend the machinery is at all times in equilibrium. The methods I employ to attain this part of my invention are illustrated in the accompanying drawings, in which—

Figure I is a diagram to explain the method of operating the main piston. Fig. II is a side elevation of a hydraulic-elevator cylinder and connected apparatus constructed according to my invention. Fig. III is a section through the automatic stop-valve to arrest motion at each end of the cage's movement. Fig. IV is an enlarged longitudinal section through the axis of the distributing and controlling valves.

The same letters of reference apply in common to corresponding parts in Figs. II, III, and IV. The diagram Fig. I has independent references.

Referring first to the diagram Fig. I, 1 is the cylinder; 2, the piston; 3, the piston-rod; 4, a transfer or passover pipe connecting the two ends of the cylinder, and 5 a supply-pipe from the source of pressure; 6, a waste-pipe to empty one end of the cylinder 1. 7 are the usual multiplying-pulleys, and 8 a wire rope extending to the cage or load to be raised and lowered. Explaining by means of this diagram the action of the water in the impelling-cylinder it will be seen that the chamber 10 on one side of the piston 2 is constantly exposed to the static or working pressure of the water from the pipe 5, and when the cock 11 is open, to the chamber 9, both sides of the piston 2 are exposed to this same pressure, with the difference, however, that the area of the piston 2 is reduced in the chamber 9 by so much as the area of the cross-section of the piston-rod 3. Consequently there is an outward thrust on the piston-rod 3 equaling the area of its cross-section multiplied by the water-pressure employed. This force or the area of the piston-rod 3 is made enough to nearly balance the weight of the elevator cage or platform, exclusive of a load, leaving, however, enough surplus weight of the cage or platform to cause these to descend without a load, overhauling the ropes and moving the piston 2 inward. Supposing the cage or platform to be at the bottom and the piston 2 at

the end of its inward stroke and that a load is to be raised, then the cock 12 is opened and the water in the chamber 9 escapes through the pipe 6, relieving that side of the piston 2 from pressure. The cock 11 being closed, the whole area of the piston 2 in the chamber 10 is exposed to the pressure of the water passing through the pipe 5, so the piston 2 is forced outward, raising the load. In descending or during the inward stroke of the piston 2 the cock 12 is shut and the cock 11 is opened, so that the water in the chamber 10 is free to flow through the pipe 4 into the chamber 9; but as the capacity of this chamber is reduced by so much as the cubic contents of the piston-rod 3 within the cylinder a volume of water equal to this difference is forced back through the pipe 5 and that much of the water and energy are saved to be applied again in effective work. This action of the water in the impelling-cylinders is explained separately from the controlling and automatic valves and their gearing, and by means of two simple stop-cocks 11 and 12, so as to avoid the complication that would exist if control by a single valve were included at the same time.

Referring next to Figs. II, III, and IV, these include the devices for controlling the flow and action of the water and movements of the main hydraulic piston. Fig. II shows a hydraulic cylinder and apparatus made according to my invention. A is the main cylinder with a piston-rod B′, rope-sheaves C′ C², a main controlling-valve D, and an automatic stop-valve E, the latter operated by a rod F and the spiral tappets G′ G², these latter being turned right and left by the pin H, attached to the piston-rod B′ or its cross-head B². The tappet H enters the spiral slots, seen in the tappets G′ G², turning the rod F right and left, and by means of the crank I, link J, and crank K opening and closing the valve E positively and automatically at the extremes of the stroke of the piston independent of the main valve D at the extreme of the range of the elevator-cage. In order to understand the action and the functions of this automatic valve E, reference is made to Fig. III, which shows a central transverse section of the same. There is a central oscillating shaft O, on which are two opposite arms M M, and to these are attached the pivoted valve-flaps N N, adapted to cover, respectively, the ports or passages P P. It will be seen that when the shaft O is turned to close either of the ports P the other port will be open, the flow being closed in one direction only. If the flow is reversed, the closing-valve swings back, offering no obstruction to the fluid flowing through both valves in one direction. In this manner the flow of the fluid and the movement of the piston and elevator are stopped in one direction; but when reversed by action of the main controlling-valve D the stop-valve E offers no obstruction to the reversed flow of the fluid until the other extreme stroke is reached, when by action of the mechanism before described the valve again closes.

Referring next to the main controlling-valve D, (represented in enlarged section in Fig. IV,) the main shell or casing is composed of five sections Q′ Q² Q³ Q⁴ Q⁵. These sections are held together by means of rods or bolts R R, extending the whole length, as shown. The section Q′ is provided with a waste or discharge nozzle T⁰, the sections Q² Q³ with inlets or circulating-nozzles T′ T², and the section Q⁴ with a supply-nozzle T³, as shown in Figs. II and III, the nozzle T² being in the case of Fig. IV turned ninety degrees from the position in Fig. II to enable easier description. The sections Q′, Q², Q³, and Q⁴ fit together at the joints *e e e* with short telescoping nipples that bear upon and expand elastic packing-rings *a a a*. These packing-rings perform the double function of sealing the joints *e e e* and at the same time embracing and forming a close water-packing around the shells or barrels U′ U². The first or main internal shell or chamber U³ is secured by a rim or flange *b*, held under the cap W. V′, V², and V³ are leather-packed pistons of the usual kind, and V⁴ is an unpacked disk or flange, permitting water to pass slowly, as will be explained farther on. The four pistons V′ V² V³ V⁴ are all rigidly mounted on or may be formed integrally with the tube X. This tube, forming an axis of the pistons named, is open at each end, as shown, and has perforations *c* in the chamber Y′, admitting supply-water between the two small pistons *d′* and *d²*, also perforations *o* admitting supply-water to the chamber Y², as will be presently explained. The rod Z and pistons *d′*, *d²*, and *d³* are moved by the sliding rack *g*, the toothed segment *h*, and the wheel *i* by means of a rope or chain passing around the latter in the usual manner.

Referring next to the operation, the chamber Y′ is constantly filled and under pressure of the supply-water from the inlet-nozzle T³, and the piston V⁴ not being a close one the inner or opposite faces of the pistons V² and V³ are subjected to the same pressure, exerting a force each way in proportion to their areas; but as the piston V³ is much larger than the one V² there is a force to the right or outward that tends to move the tube X and all connected pistons in that direction; but the chamber Y² being filled with water this forms a stop, so no movement can take place until the rod Z is moved outward until the small piston *d³* passes out of the tube X, so that the water in the chamber Y² can pass through the small ports *o o* into the tube X and out at its end into the chamber Y⁵, from where it escapes by a wasteway *k*. This relieves the piston V³ from pressure in the chamber Y², and the tube X, with its attached pistons, moves to the right. It will be seen that this movement is progressive, the main pistons and the tube X follow-

ing the rod Z and the small piston d^3, which if overtaken by the tube X closes the end of this tube and locks the water contained in the chamber Y^2, so the movement of the main pistons and the tube X follows in exact relation the movements of the rod Z and the small pistons d', d^2, and d^3. The reverse movement of the tube X and its attached pistons is performed by moving the rod Z and the pistons d', d^2, and d^3 to the left or inward until the small piston d^2 passes beyond the ports *c c* and the piston d^3 closes the end of the tube X. This permits the supply-water from the chamber Y′ to rush into the tube X through the ports *c c*, out at the ports *o o*, filling the chamber Y^2 and putting the large piston V^3 into equilibrium, so the piston V^2 will move to the left and to the position shown in the drawings. In this position the water will pass from the supply-chamber Y′ past the loose-fitting disk or piston V^4 into the nozzle T^2 and through the valve E to the inner end *y* of the main cylinder A; but no movement of the main piston or piston-rod B′ can take place, because the other or outer end *q* of the main cylinder A is filled with entrapped water, forming an abutment. To finish the outward stroke of the piston B′ and raise the cage of the elevator, the rod Z is farther advanced, the tube X and its pistons following, until the piston V′ passes over the ports *m* in the shell U′. Then the entrapped water in the outer end *q* of the main cylinder A rushes up the pipe *l* through the nozzle T′ into the chamber Y^6 and out through the waste-pipe *n*. This constitutes the working stroke of the main piston B′ and raises the elevator-cage. When the downward stroke is to be made, the rod Z is moved to the right or outward, the tube X and the pistons thereon following, in the manner before explained, until the piston V^2 is so far advanced in the chamber Y^3 that water can pass from the nozzle T^2 to the nozzle T′ or circulate from the inner end *y* of the main cylinder A to the outer end *q*, putting the main piston (except as to the area of the piston rod or plunger B′) into equilibrium, and the cage will descend. The cubic capacity of the end *q* of the main cylinder A is reduced by so much as the contents of the immersed portion of the main piston-rod B′, as has been shown by means of the diagram Fig. I, and an equal volume of water cannot enter the chamber Y^4, but is forced back into the chamber Y′ and out at the nozzle T^3 against the supply-pressure.

The retarding or check piston V^4, which is made a little smaller than the bore in which it moves, is to prevent rapid backflow of the water from the chamber Y^3 to the chamber Y′ in case too heavy a load is placed on the elevator-cage greater than the supply-pressure will sustain or in case the supply-pressure should from any cause be diminished or fail. When in the position shown, it guards against a rush of water past this piston or disk, and consequently against rapid or dangerous descent of a cage or load.

Having thus explained the nature and objects of my improvements in hoisting and lowering machinery, I claim—

1. In a hydraulic elevator, a main impelling-piston sustaining constant pressure on one side and variable pressure on the other side, a passage leading to the constant-pressure side having therein an automatic stop-valve, means operated by the main impelling-piston for controlling said stop-valve and arresting or permitting the flow of water through the valve in either direction, a main controlling-valve having a constant-supply nozzle T^3, a nozzle T^2 connecting with the automatic stop-valve, a branch connection *l* to the variable-pressure side of the main piston, and a waste-outlet *n:* also pistons controlling waterways respectively between, first, the supply-nozzle T^3 and the passage T^2 to the stop-valve; second, between the passage T^2 and the branch connection *l;* and, third, between the branch connection *l* and the waste-pipe *n;* and a differential auxiliary valve with pistons controlling the movements of the pistons of the main controlling-valve, substantially as specified.

2. In a hydraulic elevator, a main impelling-piston sustaining constant pressure on one side and variable pressure on the other side; pipes and passages to conduct water from one side of the piston to the other, and in combination therewith a controlling main valve provided with inlets and outlets, four in number; and valve-pistons V′, V^2, V^3, and a restraining-valve V^4, all set in alinement, moving together by means of water-pressure, and controlled by auxiliary valves, d', d^2, d^3, moving in the axis of the main controlling-valve all operating dependently and by one movement, produced by an attendant, substantially as specified.

3. In a hydraulic elevator, a main impelling-piston, sustaining a constant pressure on one side proportionate to the piston area, said piston having a diminished area on the other side due to a piston-rod in the cylinder-chamber, giving a proportionally-diminished pressure, a supply-pipe on the constant-pressure side having an automatic stop-valve therein, a branch pipe on the diminished-pressure side of the main piston, and a waste-passage connecting with the said diminished-pressure side, in combination with a main controlling-valve, having a supply-nozzle, said main valve controlling the passage of liquid between, first, said supply-nozzle and the automatic stop-valve; second, between the said stop-valve and the said branch pipe, and, third, between the said branch pipe and the waste-passage respectively, substantially as specified.

4. In a hydraulic elevator, in combination

with a main impelling-piston sustaining a constant pressure on one side, and a variable pressure on the other side, a three-way main controlling-valve, having a constant-supply nozzle T^3, a passage T^2 to the constant-pressure side of the main impelling-piston, a passage T' to the variable-pressure side of the said main piston, a waste-outlet T^0, tubular piston-rod X, pistons V', V^2, V^3, loose piston V^4, inner pistons d', d^2, d^3, passages c and o, and piston-rod Z, all substantially as specified.

In testimony whereof I affix my signature in presence of two witnesses.

COFRAN I. HALL.

Witnesses:
H. J. LANG,
JOS. B. KEENAN.