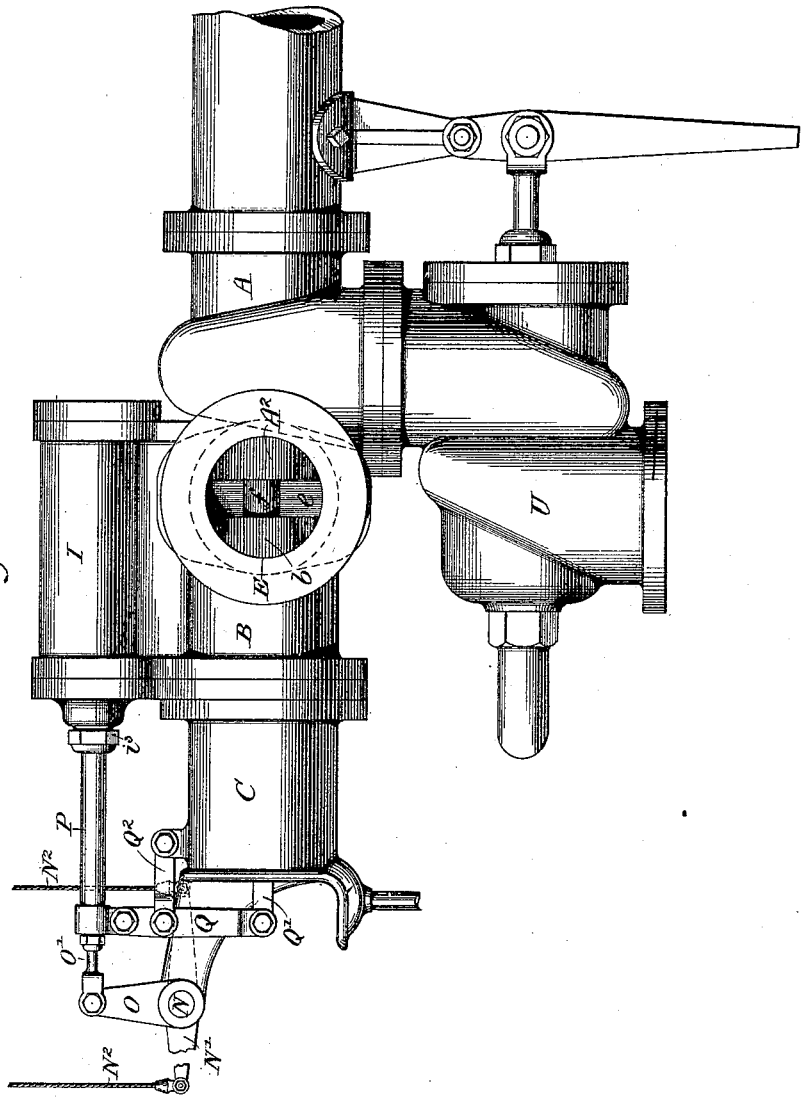
(No Model.) 5 Sheets—Sheet 1.

W. H. HULTGREN.

VALVE FOR HYDRAULIC ELEVATORS.

No. 420,801. Patented Feb. 4, 1890.

Fig. 1.



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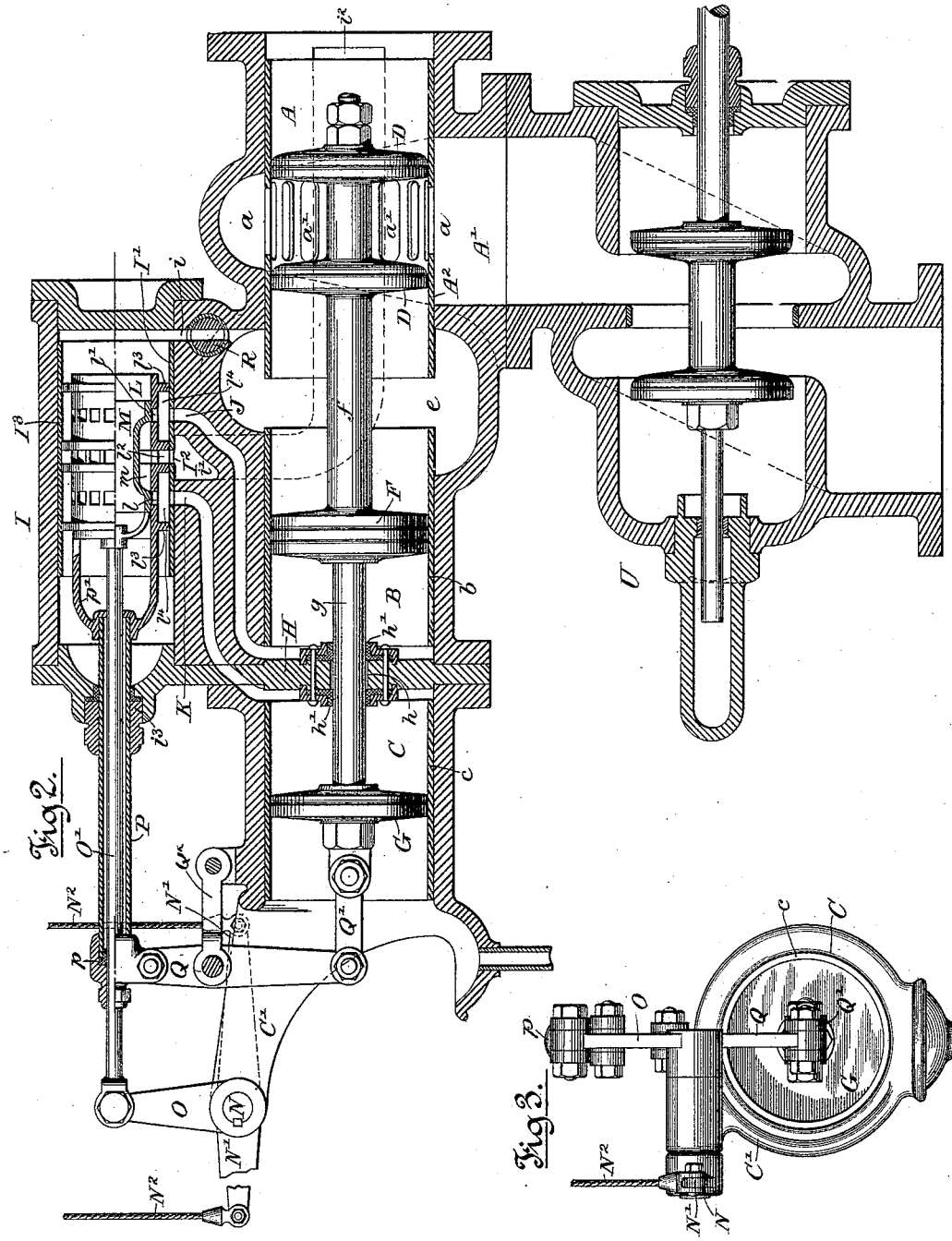

Fig 2.

Fig 3.

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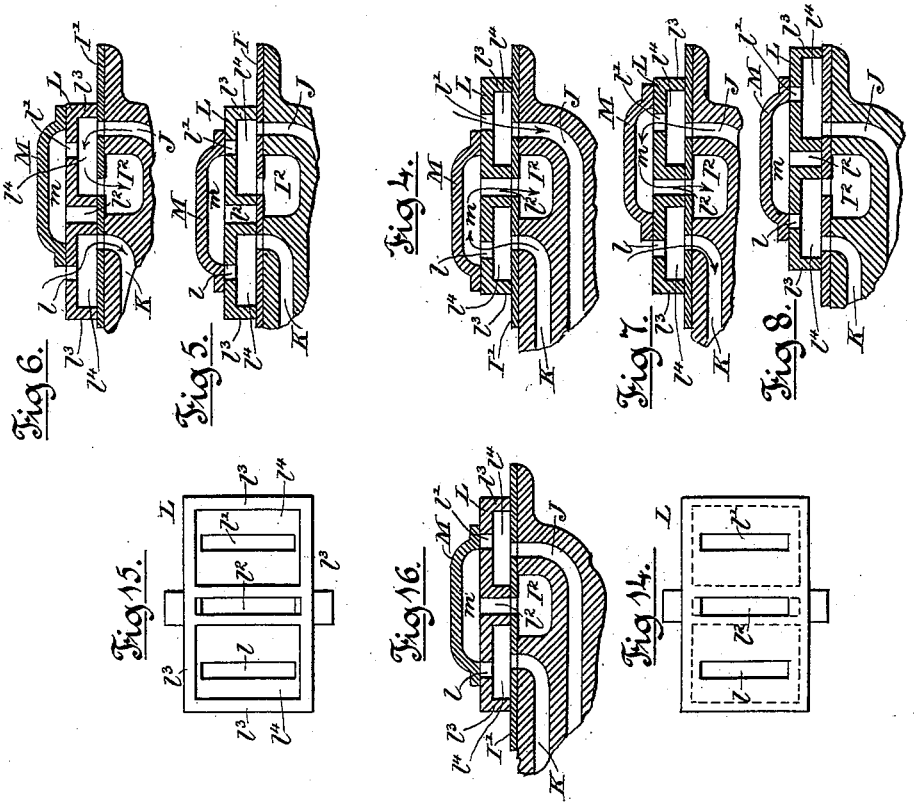

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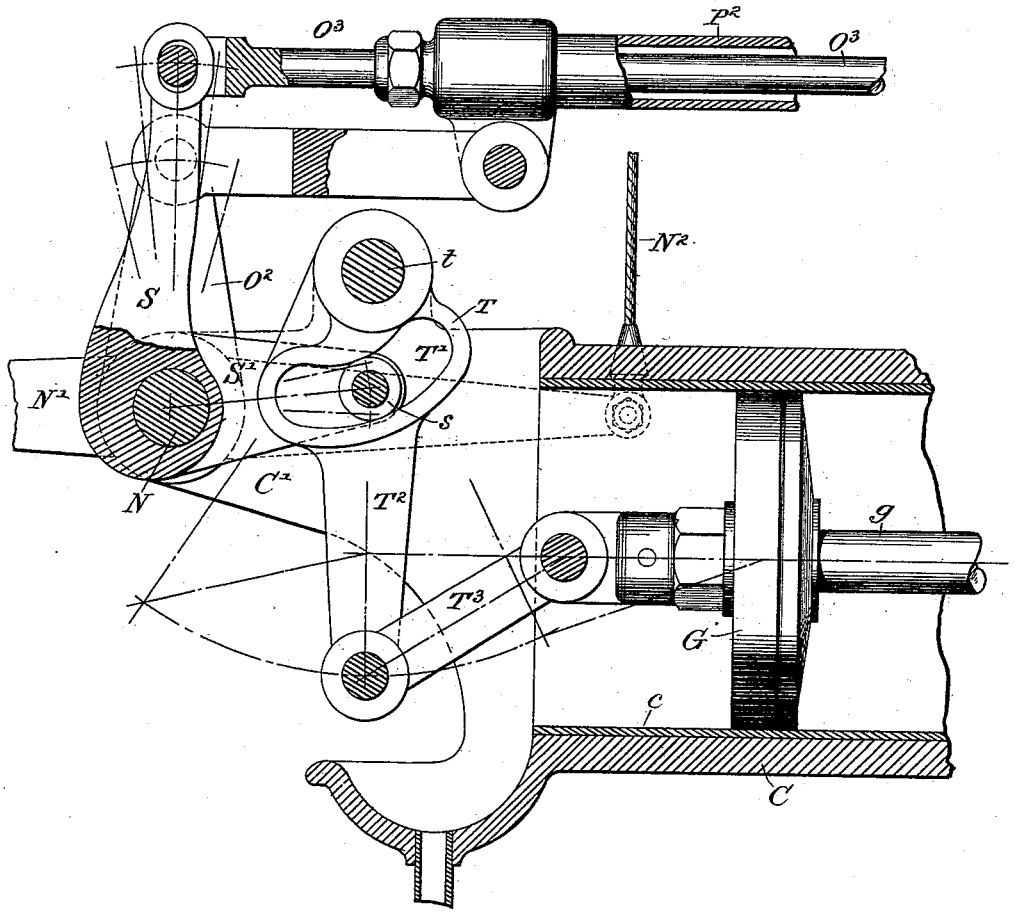
VALVE FOR HYDRAULIC ELEVATORS.

No. 420,801. Patented Feb. 4, 1890.

Fig 17.



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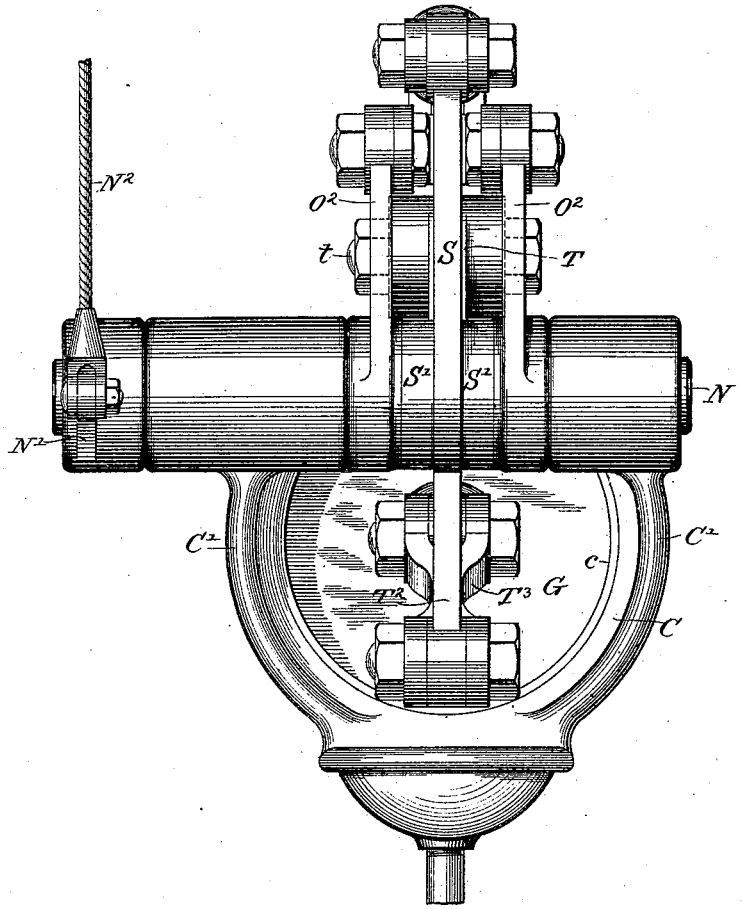
VALVE FOR HYDRAULIC ELEVATORS.

No. 420,801. Patented Feb. 4, 1890.

Fig 18.



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UNITED STATES PATENT OFFICE.

WILLIAM H. HULTGREN, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO HERBERT A. BEIDLER, OF SAME PLACE.

VALVE FOR HYDRAULIC ELEVATORS.

SPECIFICATION forming part of Letters Patent No. 420,801, dated February 4, 1890.

Application filed June 10, 1889. Serial No. 313,660. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM H. HULTGREN, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Valves for Hydraulic Elevators; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

My invention relates to that class of elevator-valves employed for controlling the supply of water to the operating-cylinder of the elevator and the discharge of water therefrom, as necessary for moving the elevator either up or down or holding the same immovable.

The invention consists in the matters hereinafter described, and pointed out in the appended claims.

In the drawings, Figure 1 is a side elevation of a valve embodying my invention. Fig. 2 is a central longitudinal section of the same. Fig. 3 is an end view of the parts shown in Fig. 2. Figs. 4 to 8 illustrate changed positions of the auxiliary or pilot when the upper part of the valve is moved by hand. Figs. 9 to 13 illustrate several changed positions when the lower part of the valve is moved by hand. Fig. 14 is a top plan view, Fig. 15 is a bottom plan view, and Fig. 16 a section, of a flat or D valve. Fig. 17 shows in central vertical section another form of operative connection between the controlling-pistons and the port of the pilot-valve which is actuated thereby. Fig. 18 is an end elevation of the same.

As illustrated in the drawings, A is a main-valve cylinder, and B and C cylinders which form parts of devices for actuating or controlling the main valve, and which are herein denominated "controlling-cylinders." Said cylinders A, B, and C are located in alignment with each other and preferably made of the same diameter.

The valve-cylinder A is provided with a central annular port *a*, communicating with the lateral discharge-passage A′, which leads to the operating-cylinder of the elevator. Within the said cylinder A are located two pistons D D, arranged at a somewhat greater distance apart than the width of the port *a* and rigidly connected with each other. The said cylinder A and the piston together form the main controlling-valve, by means of which the influx of water to an exit of water from the operating-cylinder is governed. The said cylinder A is constructed in a well-known manner with a lining or bushing A^2, affording bearing-surface for the pistons D D, and provided with a plurality of parallel slots *a′ a′* opening into the port *a*. The valve-cylinder A is opened at one end to the atmosphere, the end of the cylinder being commonly connected with a discharge-pipe for the water flowing from the operating-cylinder. At its opposite end the said cylinder A opens into or communicates with an annular space or port *e*, located between the cylinder A and the cylinder B, and communicating with the water-inlet passage E, Fig. 1, which is connected with a water-main or other pipe supplying water under pressure. When the pistons D D are moved toward the discharge end of the cylinder A, water is admitted from the inlet-passage E, through the port *a*, to the passage A′, leading to the operating-cylinder, while by moving the said pistons in the opposite direction, or away from the discharge end of the cylinder A, communication between the passages E and A′ is closed and the said passage A′ is brought into communication with the discharge end of the cylinder. By moving the said valve-pistons D D to the right or left, therefore, the inflow of water to the controlling-cylinder and its exit therefrom may be controlled as desired, while by placing the valve-pistons in an intermediate position communication with the operating-cylinder is entirely closed. The main valve is constructed and operates substantially in the same manner as similar valves heretofore employed for the same purpose.

F is a piston located in the controlling-cylinder B, and G is a piston located within the controlling-cylinder C. The said pistons are connected with each other and with the valve-pistons D D by piston-rods *f* and *g*.

H is a diaphragm or partition located be-

tween the cylinders B and C, and provided with a central aperture h, through which the piston-rod g passes and within which it closely fits. Said partition is shown as provided at either side with packing-rings h' h', bearing against the piston-rod for the purpose of preventing the leakage of water past the diaphragm. The cylinder C is open at its end, so that the outer face of the piston G is exposed to atmospheric pressure only.

In the particular construction of the parts illustrated the cylinders A and B are formed in a common cylindric casting containing the annular port e at its central part, while the cylinder C is formed by a separate casting, the diaphragm H being placed between the two castings and secured by the bolts which connect said castings, in the manner illustrated. The said cylinders B and C are shown as provided with separate bushings or linings b c, constructed in a manner heretofore common and well known.

At one side of the cylinder B is located a valve-chest I, which is connected with a source of means affording a supply of water under pressure, and which contains an auxiliary or pilot valve for controlling the admission of water to the adjacent or inner ends of the cylinders B and C, behind the pistons F and G, for the purpose of moving either one or the other of said pistons, and thereby controlling the movement of the valve-pistons D D. The valve-chest I in the particular construction shown is supplied with water under pressure by means of a passage i, leading to the main inlet-port e of the valve. Said valve-chest may, however, be otherwise supplied with water under pressure, and the pressure within the valve-chest may be greater or less than that within the controlling-cylinder, if found convenient or desirable.

I′ is the valve-seat, which is provided with two ports J and K, which communicate with the cylinders B and C, respectively.

I^2 is a central exhaust-port, which communicates by passages i' and i^2, formed in the metal of the cylinders B and A, with the discharge end of the cylinder A, outside of the valve-pistons D D.

The auxiliary or pilot valve consists of two parts L and M. The part L rests in contact with the valve-seat I′, and contains at its opposite ends two ports l l' and a central port l^2, which registers with the exhaust-port I^2 when the said part L is in its central position. The part M of the valve is similar to an ordinary **D**-valve, being provided with a central recess m, made of such length as to afford communication between one of the ports l l' of the part L and the central port l^2 thereof, but having end surfaces so arranged as to cover said ports l l' when the said part M is centrally over the part L.

The valve L, instead of bearing its full length on the valve-seat, is provided with transverse ribs or projections l^3 l^3 at the ends of the valve, outside the ports l l' and between the said ports and the middle port l^2, adjacent to the latter, wide spaces l^4 l^4 being formed between said projections, into which the ports l l' open, so that said ports will be in communication with the ports J K during a considerable part of the movement of the valve. The valve is shown in Fig. 1 as having the form of a piston-valve, the valve-seat and the parts L and M being cylindric and the ports l l' l^2 being formed by an annularly-arranged series of openings in the valves. The valve-chest is also shown as cylindric to fit the valves, and provided with a bushing I^3, constructed in a familiar manner.

The devices shown in Figs. 1 and 2 for moving or shifting parts L and M of the pilot-valve will now be described.

N is a horizontally-arranged rock-shaft mounted in arms C′ C′ cast upon the open end of the cylinder C. N′ N′ are operating-levers rigidly attached to the said rock-shaft and connected at their outer ends with ropes or cables N^2 N^2, which extend upwardly through the elevator-shaft, and one of which passes through the elevator, so that it may be grasped and controlled by the operator. By pulling upwardly or downwardly upon either of said ropes the rock-shaft may be turned in either direction, as desired.

O is a crank-arm rigidly attached to the rock-shaft N and connected at its outer end with a valve-stem O′, which passes through the end of the valve-chest and is attached to the part M of the valve. In the particular construction illustrated said rod O′ passes through a tubular valve-stem P, by which the part L of the valve is actuated. The tubular valve-stem P passes through a gland or stuffing-box i^3 at the end of the valve-chest and is provided at its outer end with a gland p, through which the valve-stem O′ passes. A yoke p' serves to connect the inner end of the tubular valve-stem with a part L of the valve. The escape of water from the valve-chest about said rods is thus prevented. The particular arrangement of the valve-rods described is not, however, essential, as the same may be separate from each other as far as general results are concerned.

The valve-stem P is connected at its outer end with one end of a transversely-arranged lever Q, the opposite end of which is connected with the piston-rod g and the pistons F and G, preferably by means of a link Q′. Said lever Q is pivoted at a point between its ends to a link Q^2, the opposite end of which is pivoted to the cylinder C or other stationary part.

It follows from the construction described that when the controlling-valve pistons are removed toward the right, so as to admit water to the operating-cylinder of the elevator, the part L of the valve will be carried toward the left, and when the said pistons are moved toward the left to allow the exit of water from the operating-cylinder the said part L of the

valve will be moved toward the right. The movement of the part M in the valve is controlled solely by the operator in the elevator.

In order that the operation of the valve may be more readily understood, the operation of the parts will now be described, referring to Figs. 4 to 8, showing several changed positions of the valve.

When the several parts of the apparatus are in the position shown in Figs. 1 and 2, the port *a* will be closed, and any movement of water into or out of the operating-cylinder of the elevator will be prevented, so that the elevator will be held immovable. To cause the elevator to ascend it is obviously necessary to move the valve-pistons D D toward the right, and this is accomplished by allowing water to flow through the port J in the controlling-cylinder B, so as to carry the piston F toward the right, while at the same time bringing the port K into connection with the exhaust-port I^2 to allow the escape of water from the cylinder C. On the contrary, if when the elevator is at rest it is desired that the latter should descend, the valve-pistons must be moved to the left, this movement being produced by opening the port K to allow the passage of water from the valve-chest to the cylinder C, while bringing the port J into communication with the exhaust-port I^2. As will be readily seen from the drawings, the pressure of the water upon the inner valve-piston D is counterbalanced by the equal pressure thereof upon the piston F, while the outer piston D and the piston G are similarly exposed to the atmosphere. It follows that the said several connected pistons are perfectly counterbalanced and are free to move by the pressure of water behind the pistons of either one of the controlling-cylinders. In the operation of the parts the ports J and K and the exhaust-port I^2 are opened and closed by the movement of the part M of the valve, accomplished by the operator in the elevator by means of the ropes N^2 N^2 and rock-shaft N. Starting with the parts of the pilot-valve in a central position, as shown in Figs. 2 and 16, if the part M is shifted to the left, as shown in Fig. 4, the port l' will be uncovered, when water will be forced into the cylinder B, thereby causing the valve-pistons to move toward the right and allowing the inflow of water from the inlet-port *e* to the operating-cylinder and causing the ascent of the elevator. At the time the part M of the valve is moved or shifted by the operator the part L of the valve stands at its central position, as shown in Fig. 4, and in position to allow the inflow of water from the valve-chest through the ports l' and J to the cylinder B, and from the cylinder C outwardly through the port K and through the valve-ports l l^2 to the exhaust-port I^2. As soon as the several valve-pistons begin to move toward the right under the action of the water on the piston F, however, the part L of the valve is moved or carried to the left by the action of the lever Q and rod P until the said part L is brought into position with the ports l l' thereof beneath or opposite the end bearing-surfaces of the part M of the valve, and the ports are covered by the valve in the manner shown in Fig. 5. At the moment the said ports l l' are closed by the ends of the said part M the flow of water through the several ports and passages will be arrested and the pistons F and G, together with the valve-pistons D D, will be held immovably in the position to which they were carried by the water-pressure before closing of the ports l l'. When the part M of the valve is shifted to the full extent of its throw to the left, water will continue to flow into the cylinder B until the piston F has traveled the full length of its stroke and the valve is fully open, unless the pilot-valve M is sooner shifted by the operator, the parts being so arranged that the ports l l' will not be closed to the motion of the part L until the stroke of the pistons is complete. It follows from the above that as long as the ports remain in the position shown in Fig. 5 the valve-pistons will remain at the extreme limit of their movement toward the right, and the water will continue to enter the operating-cylinder and the elevator to ascend. When it is desired to stop the upward movement of the elevator the part M of the pilot-valve is moved by the operator back to its central position, as illustrated in Fig. 6. At this time the part L will be at the extreme limit of its movement toward the left, so that the cylinder-port K is in communication with the valve-chest through the port l, while the cylinder-port J is connected with the exhaust-port I^2 by means of the recess l^4, so that water from the valve-chest will enter the cylinder C and force the piston G toward the left, and thereby actuating the pistons D D in the same direction and allowing the escape of water from the operating-cylinder. As the valve-pistons move toward the central position the part L of the valve will be moved or shifted by the action of the lever Q toward the right, so that at the moment the valve-pistons reach the position shown in Fig. 16 the said part L will be restored to its central position and both ports l l' will be closed by the part M, thereby preventing any flow of water through the cylinder-ports and holding the valve-piston immovable and the elevator at rest.

Fig. 1, taken in connection with Figs. 4, 5, and 6, illustrates fully the several positions of the parts in the operation of starting and stopping the elevator as the latter is ascending. The same series of movements take place in starting and stopping the elevator when the latter is descending. The descent of the elevator is produced by the outflow of water from the operating-cylinder, and the elevator is caused to fall, therefore, by a movement of the several pistons toward the left in the drawings. It follows that to produce a down-

ward movement of the elevator from its state of rest the part M of the pilot-valve must first be moved from its central position toward the right, thereby admitting water to the port K and the inner end of the cylinder C, and the part L of the valve will then be automatically moved toward the right in the same manner as before described.

In Fig. 7 the part M of the valve is shown as moved or shifted to the right and the valves are being moved into position to allow the outflow of water from the operating-cylinder. As shown in Fig. 8, the part L has been again shifted to its central position with reference to the part M, and the controlling-pistons are stationary, so that the main valve is held immovable in position to allow the escape of water and the descent of the elevator. As will clearly appear from comparison of Figs. 6 and 7, when the valves are moving toward the left to close the main valve in the ascent of the elevator, water from the cylinder B escapes through the recess l^4 of the part L of the valve; but when said valves are moving in the same direction to open the main valve in descending the water escapes from said cylinder B, through the port J, to the exhaust-port I^2, through the ports l' and l^2 of the said part L.

The valve will operate in substantially the same manner when the part L thereof is actuated by hand, and the part M automatically or by the action of the moving pistons. The movements of the valve when thus operated are clearly shown in Figs. 9 to 13, and are as follows: In this instance the part M, which is actuated by the valve, is moved in the same direction with the valve instead of in an opposite direction, so that a simple lever like the lever Q cannot be used to communicate motion from said pistons to the movable port of the valve; but some other device—such, for instance, as that illustrated in Fig. 17 of the accompanying drawings—must be used for this purpose. The ports J and K and exhaust-port I^2 are opened and closed by the movement of the part L of the valve, such movement of the said part L being produced by the operator through the medium of the ropes N^2 and connections in the manner hereinbefore described. Starting with the ports of the slide-valve in a central position, as shown in Figs. 2 and 16, if the part L is shifted to uncover the port l', as shown in Fig. 9, water will flow into the cylinder B, thereby causing the valve-pistons to move to the right and allowing the inflow of water from the port *e* to the operating-cylinder and causing the ascent of the elevator. When the said part L is moved by the operator, the part M will remain in the same position shown in Fig. 9, and will allow the inflow of water to the cylinder B from the port J and from the cylinder C through the port K and recess l^4 to the exhaust-port I^2. As soon as the several connected pistons begin to move toward the right under the pressure of the water in the cylinder B behind the piston F, the lever Q is moved so as to carry the part M toward the right, bringing it into the position shown in Fig. 10. Water continues to flow into the cylinder B until the valve is fully opened, unless the pilot-valve is sooner shifted by the operator. It will be clear from the above that as long as the parts remain in the position shown in Fig. 10 the valve-pistons will be held to the extreme limit of their movement toward the right and the water will continue to flow into the operating-cylinder and the elevator to ascend. When it is desired to stop the upward movement of the elevator, the part L of the pilot-valve is moved toward the left by the operator and brought to a central position, as shown in Fig. 11. At this time (the part M of the valve being at the limit of its movement toward the right) the port K will be brought into communication with the valve-chest by means of the port *l*, while the port J will be brought into communication with the exhaust-port I^2 by means of the ports l' l^2, so that the water under pressure will flow into the cylinder C behind the piston G thereof, forcing the valve-pistons D D to the left and cutting off the inflow of water to the operating-cylinder. As the said valve-pistons approach their central position the part M of the pilot-valve will be moved back toward the left by the action of the lever Q, so that at the moment the valve-pistons reach the position shown in Fig. 16 the said part M will be restored to its central position, and both ports J and K being then closed (by the end portions of the said part M resting over the ports l l') the valve-pistons will remain immovable and the elevator will be sustained at rest.

Figs. 12 and 13 illustrate the movements of the ports of the valve when the elevator is descending, Fig. 12 showing the ports when the water is flowing into the cylinder C to open the main valve, and Fig. 13 showing the position of the pilot-valve when the main valve is open and water is flowing from the operating-cylinder.

Figs. 14 and 15 illustrate the same features of construction in the pilot-valve which have been heretofore described as applied to a flat or D valve instead of a piston-valve. As illustrated in said figures, the valve-seat is flat, the part L of the valve is of rectangular form and is provided with longitudinal as well as transverse flanges l^3, the edges of which rest in contact with the flat valve-seat, and the part M of the valve bears both at its side and end margins against the top of the said part L in a manner readily understood. Said part L is provided with ports l l' l^2, arranged and operated in the same manner as the ports of the piston form of valve.

In Figs. 17 and 18 I have shown a device for operating the pilot-valve from the pistons of the controlling-cylinders which may be used in place of the simple lever-connection hereinbefore described. In this instance the

connecting devices between the pistons and valve serve to move the valve in the same direction that the pistons are moved, so that this particular device may be conveniently employed in connection with the form of valve shown in Figs. 9 to 13, wherein the upper part M of the pilot-valve is controlled automatically by the movement of the valve-pistons. As shown in said Figs. 17 and 18, a rock-shaft N is employed having operating-levers N′ N′ and two upwardly-extending rigid arms O^2 O^2 connected with a hollow tubular valve-stem P^2, said parts O^2 O^2 and P^2 corresponding with the arm O and valve-stem O′ shown in Fig. 2. S is a lever mounted to turn freely on the shaft N and connected at its upper end with a valve-stem O^3 corresponding with the valve-stem P shown in Fig. 2. S′ S′ are two arms rigidly connected with the arm S and extending horizontally inward from the rock-shaft. Said arms S′ S′ are arranged approximately at right angles with the arm S and form therewith a bell-crank lever adapted to swing or rock freely upon the crank-shaft N. T is an oscillating cam mounted upon a stationary pivot *t*, and is arranged above the level of the crank-shaft N. Said cam is provided with a cam-slot T′, adapted to engage a roller *s*, mounted between the arms S′ S′ at the free ends of the latter. The cam T is provided with an arm T^2, which is connected at its free end with the end of the piston-rod *g* by means of a link T^3. It follows from this construction that when the said piston-rod and the several pistons connected therewith are moved in the cylinders the cam will be given an oscillatory movement about its pivot. The cam-slot T′ is so shaped as to give an oscillatory movement of the rigidly-connected arms S and S′ S′, and the movement of the said arms S′ S′ is transmitted by means of the valve-rod O^3 to that part of the pilot-valve which it is desired to operate automatically. When the cam is in its central position, the roller *s* stands at the center of the cam-slot and the part of the pilot-valve actuated by the valve-stem O^3 is held in intermediate position, as shown, for instance, in Fig. 11. Said cam-slot is so arranged as to lift the arms S′ or carry the latter toward the pivot of the cam and to move the valve-stem to the left when the cam is moved outwardly by movement of the pistons to the left. A reverse movement of the cam, produced by a travel of the pistons to the right, moves the valve-stem O^3 in the same direction. In the application of this form of actuating device to the form of pilot-valve shown in Figs. 9 to 13 the tubular valve-rod P^2 will be connected with the part L of the pilot-valve, while the valve-stem O^3 will be connected with the part M of said pilot-valve, so that the said part L will be controlled by the operator, while the part M will be automatically actuated.

It is to be understood from the above that as far as the main features of my invention are concerned a suitable connection between the pistons of the controlling-valve and one of the movable parts of the pilot-valve may be provided of any desired or preferred character without departure from my invention.

I am aware that a hydraulic valve has been provided heretofore with a pilot-valve consisting of a single part constructed to control the flow of water to and from the controlling-cylinders of the valve. I am, however, as far as I am aware, the first to employ a two-part pilot-valve one part of which is controlled by the operator in the moving elevator, while the other is actuated automatically by means of an operative connection with the pistons by which the main valve of the elevator is controlled.

R, Fig. 2, indicates a valve placed in the passage *i* between the valve-chest and the source of water-supply. By closing this valve the pilot-valve can be positively held from movement, so that the person having control of the engine can at any time place the parts in condition to prevent the elevator from being moved. The ability to so control the elevator is of great advantage, for the reason that it is often desirable that the elevator should be secure from possibility of movement—as, for instance, to guard against its use by unauthorized persons in the absence of the attendant. Said valve R furthermore may be employed to control the flow of water through the passage *i*, so as to increase or diminish the rapidity with which the main valve is moved, and to thereby cause the same to open or close in a longer or shorter time, as may be found desirable or necessary.

U in Figs. 1 and 2 indicates, as a whole, a valve for closing the passage leading from the valve A to the hydraulic cylinder when the elevator-cab reaches the limits of its movement in either direction. This valve embodies features of novelty which are described and claimed in a separate application for patent, Serial No. 316,708, filed in the United States Patent Office on the 6th day of July, 1889.

I claim as my invention—

1. The herein-described valve mechanism for hydraulic elevators, comprising a main valve, two controlling-cylinders arranged in alignment with each other and connected with the main-valve casing, pistons in said controlling-cylinders rigidly connected with each other and with the movable part of the main valve, a two-part slide-valve controlling the flow of water under pressure to said controlling-cylinders, valve-actuating devices in the elevator-shaft connected with and actuating one part of said valve, and means connecting the other part of the said valve with the pistons of the controlling-cylinders, substantially as described.

2. The combination, with the main valve, of two controlling-cylinders and rigidly-connected pistons in said controlling-cylinders, a valve-chest communicating with a source

supplying water under pressure and provided with ports leading to said controlling-cylinders, and a two-part slide-valve controlling said ports, one part of said valve being operated by hand and the other by the movement of the pistons of the controlling-cylinders, substantially as described.

3. The combination, with the main valve, of two controlling-cylinders arranged end to end, a diaphragm or partition separating said cylinders, pistons in said cylinders, a connecting-rod uniting the pistons passing through the said diaphragm, a valve-chest communicating with a source supplying water under pressure, and provided with ports connecting said valve-chest with the said controlling-cylinders, and a two-part slide-valve, one part of which is actuated by hand and the other by the movement of said pistons, substantially as described.

4. The combination, with a main valve, of two controlling-cylinders, rigidly-connected pistons therein, a valve-chest provided with ports leading to said controlling-cylinders and an exhaust-port, and a two-part valve consisting of a part L, having a central port and two outer ports, and recesses l^1 l^1, communicating with the outer ports, and a part M, having a central recess acting upon the outer surface of the part L, substantially as described.

5. The combination, with the main valve, of two controlling-cylinders, rigidly-connected pistons therein, a valve-chest provided with ports connected with the said controlling-cylinders, and an exhaust-port, a two-part slide-valve, a tubular valve-stem passing through the side of the valve-chest and connected with the part L of the valve, a valve-stem passing through the tubular valve-stem and connected with one part of the valve, a hand actuating device connected with one of said valve-stems, and operative connections between the other valve-stem and the pistons of the controlling-cylinders for automatically actuating the other part of the valve, substantially as described.

6. The combination, with a main-valve cylinder A, provided with a central annular port, and valve-pistons sliding therein, of controlling-cylinders located in alignment with each other and with the main-valve cylinders, a diaphragm or partition between said controlling-cylinders, pistons in said cylinders rigidly connected with each other and with the valve-pistons, a valve-chest provided with ports communicating with said controlling-cylinders and with an exhaust-port, a two-part slide-valve within said valve-chest, one part of which is actuated by hand, and operative connections between the pistons of the controlling-cylinders and the other part of the valve, whereby the latter is automatically actuated, substantially as described.

7. The combination, with a main valve, of two controlling-cylinders, rigidly-connected pistons therein, a valve-chest provided with ports leading to said controlling-cylinders and an exhaust-port, and a two-part valve consisting of a part L, having three ports, and a part M, having a central recess acting upon the outer surface of the part L, valve-rods for actuating both parts of the said valve, a hand actuating device connected with the rod by which the part L of the valve is moved, and means for automatically actuating the part M of the valve, comprising an oscillatory cam T, which is connected with and moved by the pistons of the controlling-cylinders, and a roller actuated by the cam and connected with and giving motion to the valve stem or rod of said part M of the valve, substantially as described.

8. The combination, with the main valve, controlling-cylinders and pistons, a valve-chest provided with ports leading to the said cylinders, and a two-part valve, one part L of which is actuated by hand, of means for automatically actuating the other part M of the valve, comprising an oscillating cam T, connected with and actuated by the pistons of the controlling-cylinders, a pivoted arm S′, carrying a roller engaging said cam, and an arm S, rigidly attached to the arm S′ and connected with and moving the said part M of the valve, substantially as described.

In testimony that I claim the foregoing as my invention I affix my signature in presence of two witnesses.

WILLIAM H. HULTGREN.

Witnesses:
C. CLARENCE POOLE,
HARRY COBB KENNEDY.