(No Model.)

4 Sheets—Sheet 1.

C. G. CURTIS & S. S. WHEELER.

HYDRAULIC ELEVATOR.

No. 266,108. Patented Oct. 17, 1882.

FIG-1-

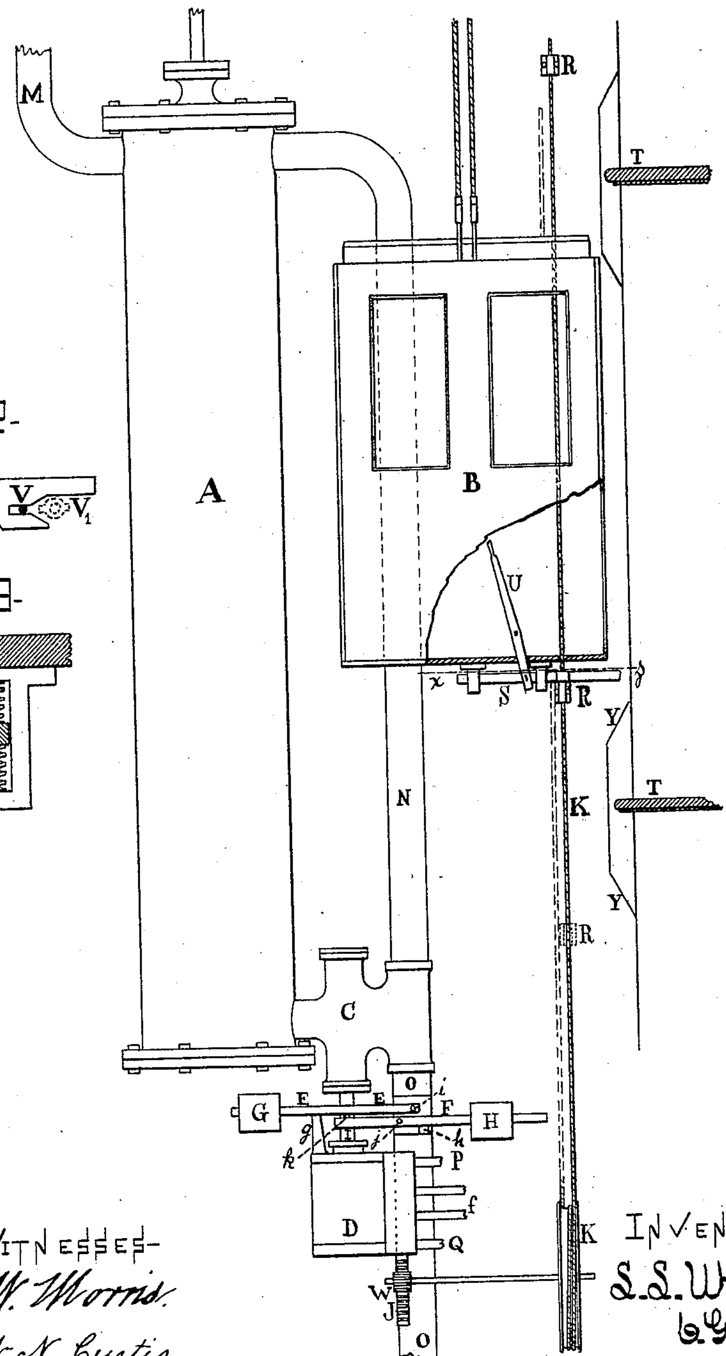


FIG-2-

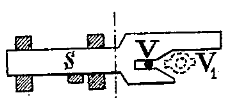
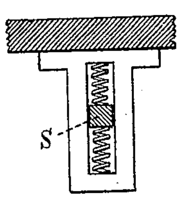


FIG-3-



Witnesses-
W. H. W. Morris.
Herbert N. Curtis.

Inventors-
S. S. Wheeler
C. G. Curtis,
by Curtis & Crocker.
Attorneys.

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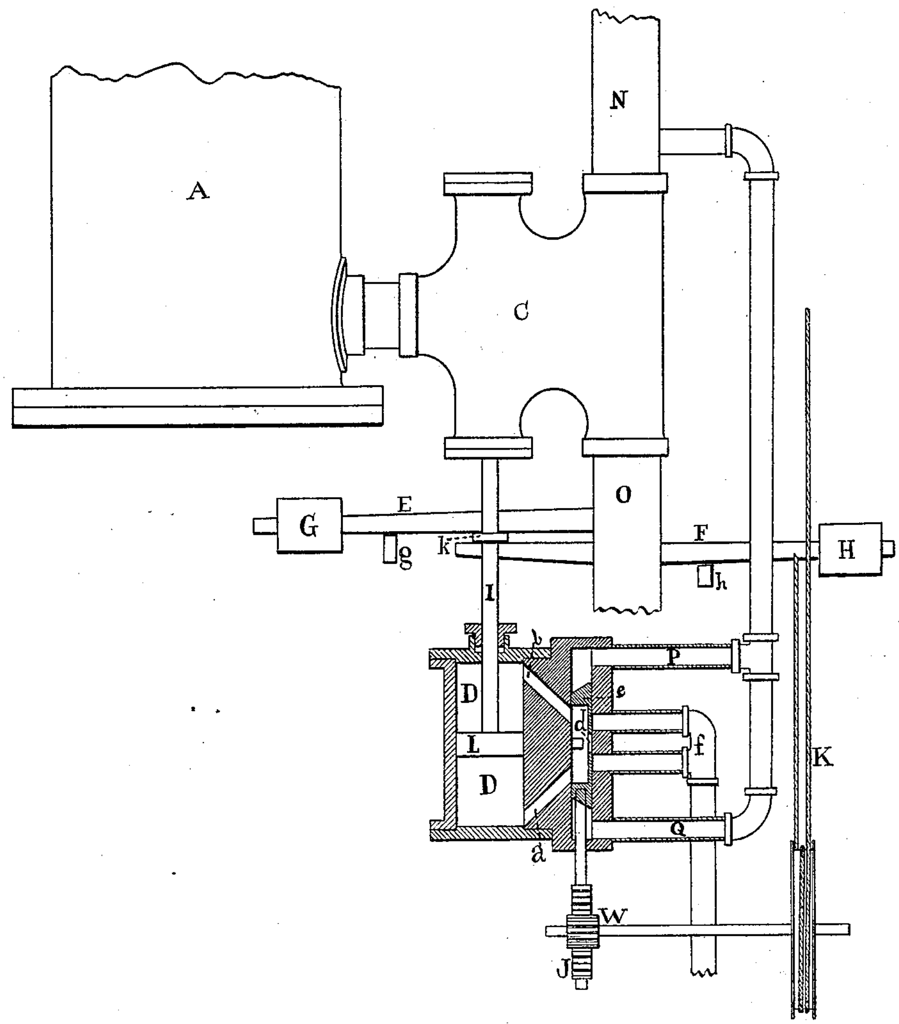
FIG. 4



WITNESSES.

W. H. W. Morris.

Herbert N. Curtis.

INVENTORS.

S. S. Wheeler and C. G. Curtis,

by Curtis and Crocker

Attorneys

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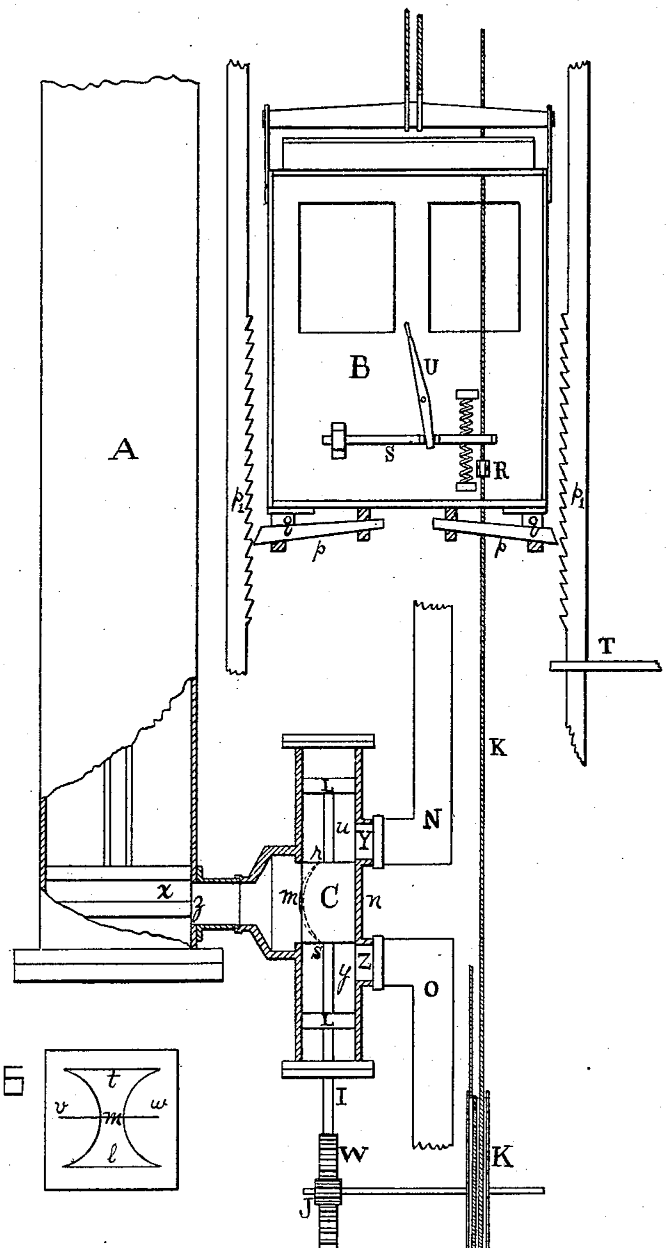
FIG. 5.

FIG. 6



WITNESSES—
W. H. W. Morris.
Herbert N. Curtis.

INVENTORS—
S. S. Wheeler and C. G. Curtis
by Curtis & Crocker
Attorneys

N. PETERS, Photo-Lithographer, Washington, D. C.

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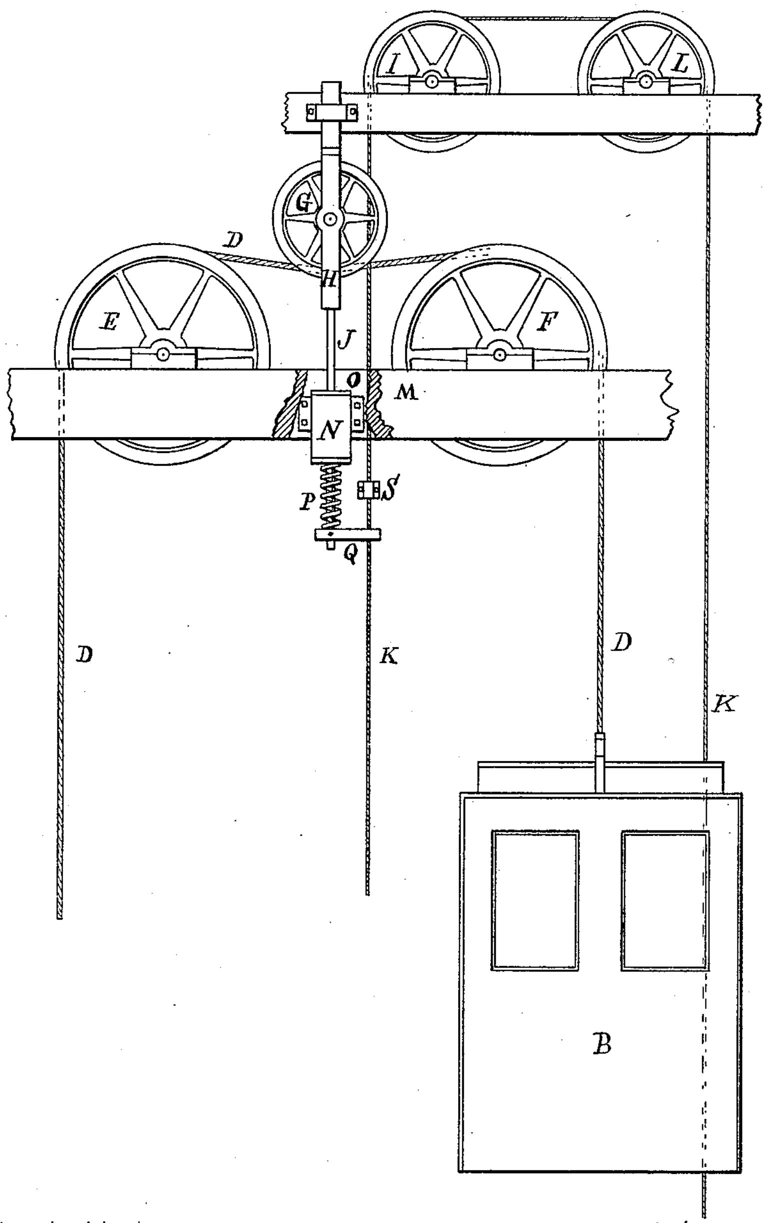
FIG-7-



WITNESSES-

W. H. W. Morris.

Herbert N. Curtis.

INVENTORS-

S. S. Wheeler and C. G. Curtis,

by Curtis and Crocker

Attorneys.

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

CHARLES G. CURTIS AND SCHUYLER S. WHEELER, OF NEW YORK, N. Y.

HYDRAULIC ELEVATOR.

SPECIFICATION forming part of Letters Patent No. 266,108, dated October 17, 1882.

Application filed February 6, 1882. (No model.)

To all whom it may concern:

Be it known that we, SCHUYLER S. WHEELER and CHARLES G. CURTIS, citizens of the United States, residing at New York, in the county of New York and State of New York, have invented new and useful Improvements in Hydraulic Elevators, of which the following is a specification.

Our invention relates to that class of elevators which are operated by means of hydraulic pressure acting in a cylinder upon a piston connected to the elevator-car, either directly or through a system of ropes and pulleys, and in which the motion of the car is controlled by the operation of a valve or valves, the effect of which operation is to allow the pressure to act on one side of the piston or on both sides, according as it is desired to raise or to lower the car. Such elevators consists generally of a vertical cylinder, in which works a piston connected to the car, a "stand-pipe" leading from the water-supply to the top of the cylinder, a "circulating-pipe" leading from the top to the bottom of the cylinder, a "discharge-pipe" leading from the bottom of the cylinder, and a valve operated from the car by means of a valve-rope, through which valve the circulating and discharge pipes communicate with the bottom of the cylinder. This valve has three positions—one opening communication between the bottom of the cylinder and the circulating-pipe, another opening communication between the discharge-pipe and the bottom of the cylinder, and a third shutting off all communication. Supposing the car to be at the top of the elevator-shaft and the piston at the bottom of the cylinder, and it is desired to cause the car to descend, the valve is set so as to allow the water above the piston to circulate around into the lower part of the cylinder, filling up the space below the piston and exerting an upward pressure which neutralizes the downward pressure above the piston, and consequently allows the car to descend by its own weight. In order to raise the car the "circulation" is shut off, and the column of water below the piston allowed to discharge and act by "suction" upon the descending piston, which effect, added to the weight of the column of water above, produces a constant driving-pressure upon the piston. When these apparatuses become large, and especially when the speed at which the car moves gets to be high, the living force or energy of the moving masses becomes so great as to render it a matter of considerable importance to stop the car gradually, in order to avoid the strain to the machinery caused by the sudden stoppage of so great a mass of matter. For example, in elevators as now constructed the car when loaded sometimes weighs two thousand five hundred pounds, and moves at a speed of from four to five feet per second. This, if stopped in a space of six inches, would produce a pressure of over two thousand pounds, which, added to the weight of the car, would increase the strain on the "leaders" or hoisting-ropes to four thousand five hundred pounds. The strain on the valve, cylinder, and pipes would be correspondingly increased.

To avoid the injurious effects thus produced, thereby rendering it possible to increase the speed at which the car moves, to avoid the disagreeable sensation caused by a sudden downward start of the car, and to cause the car to be brought to a standstill exactly as its platform reaches the level of the floor are the chief objects of our improvements. These objects we accomplish by interposing between the controlling device, which the operator himself manipulates, and the valves of the hydraulic cylinder an automatic mechanism constructed to close and open the valves at fixed uniform speeds, so as to stop the car with a uniformly-diminishing motion, and to start it with a uniformly-increasing motion. In this way the direct operation of the valves, which it becomes very important to have properly performed in fast-moving elevators, is taken out of the hands of the operator and made entirely automatic, the controlling mechanism only enabling the operator to determine the level at which the car shall stop. To accomplish the first two objects we employ a small supplementary cylinder and piston, which is controlled from the car and worked by water under pressure to operate the main valve. By these means, and independently of the manner in which the valve-rope is handled in the car, we cause the valve to close gradually and regularly, so that the car becomes stopped without subjecting any of the parts to excessive strain. The third object we accomplish by bolting small shoulders or lugs on the valve-rope, one at each floor, in such positions that they are struck and the valve-rope moved by the car in time to cause the main valve to close and stop the car at the desired floor. When the speed of the car is very variable we make use of the valve-rope to close the main valve directly by means of lugs; but we make the ports of the valve of a peculiar shape, so that as the speed of the car diminishes the area of the valve-port will decrease at a constant rate, and therefore the car will be stopped in the desired manner.

Our invention also embraces other improvements, which are: an apparatus for regulating the amount which the valve may be opened, so that the car will descend at a fixed speed whatever load it may contain, and an automatic arrangement whereby, should the valve-rope fail to work, the car will be gradually stopped before striking the end of the elevator-shaft.

In the accompanying drawings, Figure 1 is an elevation of a hydraulic elevator, showing the main valve operated by a supplementary cylinder, according to our improvements. Figs. 2 and 3 are details of the same. Fig. 4 is a detail drawing of the supplementary cylinder. Fig. 5 is an elevation of a hydraulic elevator, showing the main valve moved directly by the valve-rope, with peculiar ports, according to our improvements. Fig. 6 is a diagram showing the shape of these ports; and Fig. 7 is an elevation of our automatic device for regulating the opening of the main valve according to the load in the car.

The same letters of reference refer to the same parts in all the figures except Fig. 7.

In Fig. 1, B is the elevator-car; A, the hydraulic cylinder; M, the stand-pipe; N, the circulating-pipe; O, the discharge-pipe; and C, the main valve. The connection between the car and the piston-rod is not here shown, but may be made in any well-known manner. The main valve, which may be of any form, but preferably balanced, has as we have already explained three positions. In its lowest position it admits the water from the circulating-pipe into the cylinder below the piston, which causes the car to descend; in its middle position it shuts off all communication with the lower part of the cylinder, which causes the car to stop; and in its highest position it allows the water below the piston in the cylinder to discharge, which causes the car to ascend. Our improvement here consists in operating this valve by means of a supplementary hydraulic piston and cylinder, D, the valve of which is of peculiar construction, and is worked directly from the car B by the valve-rope K acting through a rack and pinion, J W. By the use of this supplementary cylinder in operating the main valve we secure a gradual and perfectly uniform closing and opening of the main valve independently of the manner in which the valve-rope is handled by the operator in the car, the important advantages of which we have already enumerated. In order to make the car stop with its platform exactly at the level of the desired floor, and to do this automatically, we bolt small shoulders or lugs R onto the valve-rope K, one at each floor, in such positions that they will be struck by a fork, S, on the car and carried along with it, thus working the supplementary valve which admits water to the supplementary cylinder in time to close the main valve and stop the car as it reaches the level of the desired floor. In order that the fork S may not strike the lugs R in passing until the car arrives at the floor T at which the operator wishes to stop, the fork S is shaped as shown in plan in Fig. 2, (which is a section on line x z,) and set in guides, so as to be capable of being moved toward or away from the valve-rope K by the lever U. When the fork S is thrown forward, as shown in Figs. 1 and 2, the valve-rope K, which is guided by a collar in the bottom of the car, passes through the slot V until the fork S comes to one of the lugs R with which it engages, thereby moving the valve-rope and working the supplementary valve. When the fork is withdrawn the valve-rope K passes through the fork S where the opening V is large enough to allow the lugs to pass without striking, and the car moves on without affecting the valve. Consequently when the car is to be stopped at any floor the fork S must be thrown forward after having passed the floor next above or below and before reaching the lugs R corresponding to the floor where the car is to be stopped. In thus operating the main valve by means of the supplementary cylinder it is necessary that the supplementary valve should be closed by the valve-rope and remain closed until the main valve becomes closed, during which time, if the fork were to remain engaged with the lug, the valve-rope would be carried far enough to throw the supplementary valve the other way, the effect of which would be to move the main valve in the opposite direction. To obviate this difficulty we place inclined surfaces Y, one above and one below each floor T, against which surfaces the fork S strikes and by which it is thrown back, so as to disengage it from the valve-rope K and allow the car to proceed to the floor without carrying the valve-rope with it. These surfaces Y are placed in such positions that they free the valve-rope from the fork just as the valve has closed the supplementary valve. The fork S should be between cushions or springs, as shown in Fig. 3, in order to impart the velocity of the car to the valve-rope by degrees, and so avoid the shock which would otherwise occur when the fork S struck the lug R.

The construction of the supplementary cylinder and valve is shown in Fig. 4 in its application to the main cylinder and valve, in which A is the main cylinder; C, the main valve; D, the supplementary cylinder; L, the piston; I, the main-valve stem and piston-rod of supplementary cylinder; e, the slide-valve of supplementary cylinder, worked directly by the valve-rope K through the rack J and pinion W. This valve e, controlling the flow of water to and from the cylinder D, is so designed that when occupying its highest position it allows water to flow from the branch Q of the circulating-pipe N through the port *a* into the lower part of the cylinder D, and the water in the cylinder D above the piston L to discharge through the port *b*, the orifice *d* in the valve *e*, and the discharge-pipe *f*. This causes the piston to raise the main valve. In its lowest position it allows water to enter by the branch pipe P through the port *b* above the piston L, and the water below the piston to discharge through the port *a* and orifice *d* of valve *e* and the discharge-pipe *f*. This causes the piston L to draw down the main valve. In its central position it shuts off the flow of water from the supply-pipe and opens communication between the two ends of the cylinder through the ports *a* and *b*. This allows the piston L to return to its central position, whither it is impelled by the weighted arms E and F, which act upon the valve-stem I in the following manner: The weighted arm E, pivoted at *i*, (see also Fig. 1,) bears on a pin fixed to a collar, *k*, on the piston-rod I, on which it exerts a downward pressure until the collar *k* descends far enough to allow the arm E to rest on the stop *g*. Similarly the arm F, pivoted at *j*, exerts an upward pressure on the pin of collar *k* until it rises far enough to allow the arm F to rest on the fixed stop *h*. Thus there is always a pressure from one of the weights G or H tending to force the main valve back to its central position. The size of the passages *b* and *a*, through which the water is thus forced from one end of the cylinder D to the other, being fixed, the speed at which the main valve closes in either direction is dependent upon the pressure of the weighted arms upon the collar *k*, and may easily be set to suit the speed of the car by sliding the weights along the arms. The speed of opening the main valve may also be set to suit the comfort of the passengers by placing cocks or valves in the supply-pipes P and Q.

The method hereinbefore described of working the main valve of a hydraulic elevator by means of a supplementary cylinder and piston controlled from the car will not operate successfully without some modification or the addition of a speed-governor attached to the car when the speed of the car is otherwise variable—that is to say, when the speed is sometimes greater or less, depending upon the load in the car. Under these circumstances we prefer to operate the main valve directly by the valve-rope through a rack and pinion, as shown in Fig. 5, in which A is the hydraulic cylinder; B, the car; C, a section through the middle of the main valve; N, the circulating-pipe; O, the discharge-pipe; K, the valve-rope, and W J the rack and pinion. In this method, as in that shown in Fig. 1, the valve-rope is moved so as to close the valve and stop the elevator by having clamped upon it lugs R, which engage with the cushioned sliding fork S, and are carried along by the car until the valve becomes closed and the car stopped. This valve is of peculiar construction, L, C, and L being solid pistons on the valve-stem I, on which is the rack W; Y, the orifice or port through which the water enters from the circulating-pipe N; *m*, the port communicating with the cylinder, and Z the discharge-port. It is obvious that this valve is balanced, except as regards the pressure from the cylinder on the solid piston C, which produces a corresponding amount of friction between the other side of the piston and the surface *n*. It would probably be better to make the valve entirely balanced by replacing the solid piston C by two short pistons, such as L, placed at the same points on the stem as the ends of the piston C, allowing the water to enter between them, and so avoiding friction. The valve is here shown in the central position, with communication to the bottom of the cylinder shut off. By turning the pinion J, thereby depressing the piston C, the water is allowed to enter the cylinder-bottom through the port *m* from the space *u*, or, by raising the piston C, to discharge from the cylinder-bottom through the port *m* and the space *y*. The peculiarity of this valve is the shape of the port communicating with the cylinder-bottom, the edge of which, behind the block C, is shown by the dotted curve *r s*, and the shape of which is shown in the diagram, Fig. 6. This diagram represents the cylindrical surface of the valve through which the port-hole is cut, developed, or spread out flat, and the upper end, *v w*, of the piston C, which has been depressed to its lowest position, so as to open the upper half of the port or hole *m*, and allow the water to flow from the space *u* into the cylinder-bottom. To discharge the water from the cylinder-bottom the piston C is raised so as to cover the upper half, *m t*, of the port and open the lower half, *m l*. The reason for making the port this shape, which should theoretically be that of a surface bounded by two parabolas and two straight lines, *t* and *l*, is that as the valve closes the car moves more slowly, and consequently moves the valve itself more slowly, so that in order to stop the car with a uniform retardation the orifice through which the water flows should diminish in area uniformly, notwithstanding the change in speed of the valve itself. It is important in this method to have the fork S properly cushioned, either by springs, air-cushions, or dash-pots, for obvious reasons.

In Fig. 5 the piston X is shown covering the orifice through which the water enters the bottom of the cylinder; but we disclaim this as new, having been anticipated by O. E. Merrill in his United States Patent No. 235,693.

Fig. 7 is an elevation of our apparatus intended to automatically regulate the speed of the descending car, according to its load, through the intervention of a stop, limiting the opening of the valve by the valve-rope, the position of which stop is affected by the amount of load in the car. B is the car; D, the hoisting-ropes, which, as usual, pass over pulleys E and F; K, the valve-rope, passing over pulleys I and L, and then down between the supporting-timbers M and O of pulleys E and F. G is another pulley set in a vertical sliding frame, J H, the function of which is to deflect the hoisting-ropes D, which resist the deflection by an amount depending upon the load in the car and upon the angle of deflection. The part J of the frame J H is a piston-rod, which passes down through the dash-pot N and through the spiral spring P, and terminates in the arm Q. As the valve-rope K has clamped upon it a lug, S, which limits the opening of the valve, so as to cause the car to descend by striking the arm Q, it is clear that the greater the load in the car the higher will the frame J H and the arm Q be raised by the deflected ropes D against the tension of the spring P and the less can the valve be opened. If it were also desired to use the same device to regulate the speed of ascent, it would only be necessary to clamp another lug below the arm Q, which will then determine the opening of the valve in the other direction, according to the load in the car. It would be better to use a weight hung on the frame J H, instead of a spring for the deflecting force, and also to have the deflection considerably greater than the drawings show. The object of the dash-pot N is to prevent jouncing of the car when the car is stopped. Another method of effecting the opening of the valve by the load in the car would be by the diminished pressure on the water in the cylinder below the piston, caused by more weight in the car acting on an auxiliary piston limiting the opening of the valve against a spring.

We claim—

1. A hydraulic elevator consisting of a movable car or platform and apparatus for raising and lowering the same by means of hydraulic pressure acting in a cylinder upon a piston, in combination with a starting and stopping apparatus controlled by the operator and constructed so as to automatically start the car with a fixed acceleration and to stop the car with a fixed retardation, independently of the speed at which the controlling mechanism is worked by the operator, substantially as described.

2. A hydraulic elevator, substantially as described, in combination with a starting and stopping apparatus controlled by the operator and constructed to close and open the valve which controls the flow of water into and out of the cylinder at a fixed speed or speeds, independently of the speed at which the controlling mechanism is worked by the operator, substantially as described.

3. A hydraulic elevator, substantially as described, in combination with the stopping apparatus controlled from the car and constructed to act automatically to close the valve at a uniform rate, so as to insure the bringing of the car to rest with its platform at the level of the desired floor, substantially as and for the purposes described.

4. In a hydraulic elevator consisting of a movable car or platform and apparatus for raising and lowering the same by means of hydraulic pressure acting in a cylinder upon a piston, the combination, with a valve controlling the flow of water into and out of the said cylinder, of a supplementary cylinder provided with a piston moved by fluid-pressure under the control of the operator, substantially as described, and mechanically connected to the said valve, so that the movement of the supplementary piston closes and opens the said valve, substantially as described.

5. The combination, with the cylinder of a hydraulic elevator, of a valve having a tapering port of gradually-increasing width in the direction of motion of the valve-piston, substantially as shown and described, so that the gradually-diminishing speed of the valve-piston will effect the closing of the port-orifice at a uniform rate, substantially as described.

6. A hydraulic elevator, substantially as described, in combination with an apparatus for automatically regulating the size of orifices through which the water flows into and out of the cylinder according to the load in the car, substantially as described.

CHARLES G. CURTIS.
SCHUYLER S. WHEELER.

Witnesses:
CHARLES E. SPRAGUE,
OTTO BAUMANN.