(No Model.)

2 Sheets—Sheet 1.

E. A. HALDEMAN.

DOOR OPERATING MECHANISM.

No. 581,821. Patented May 4, 1897.

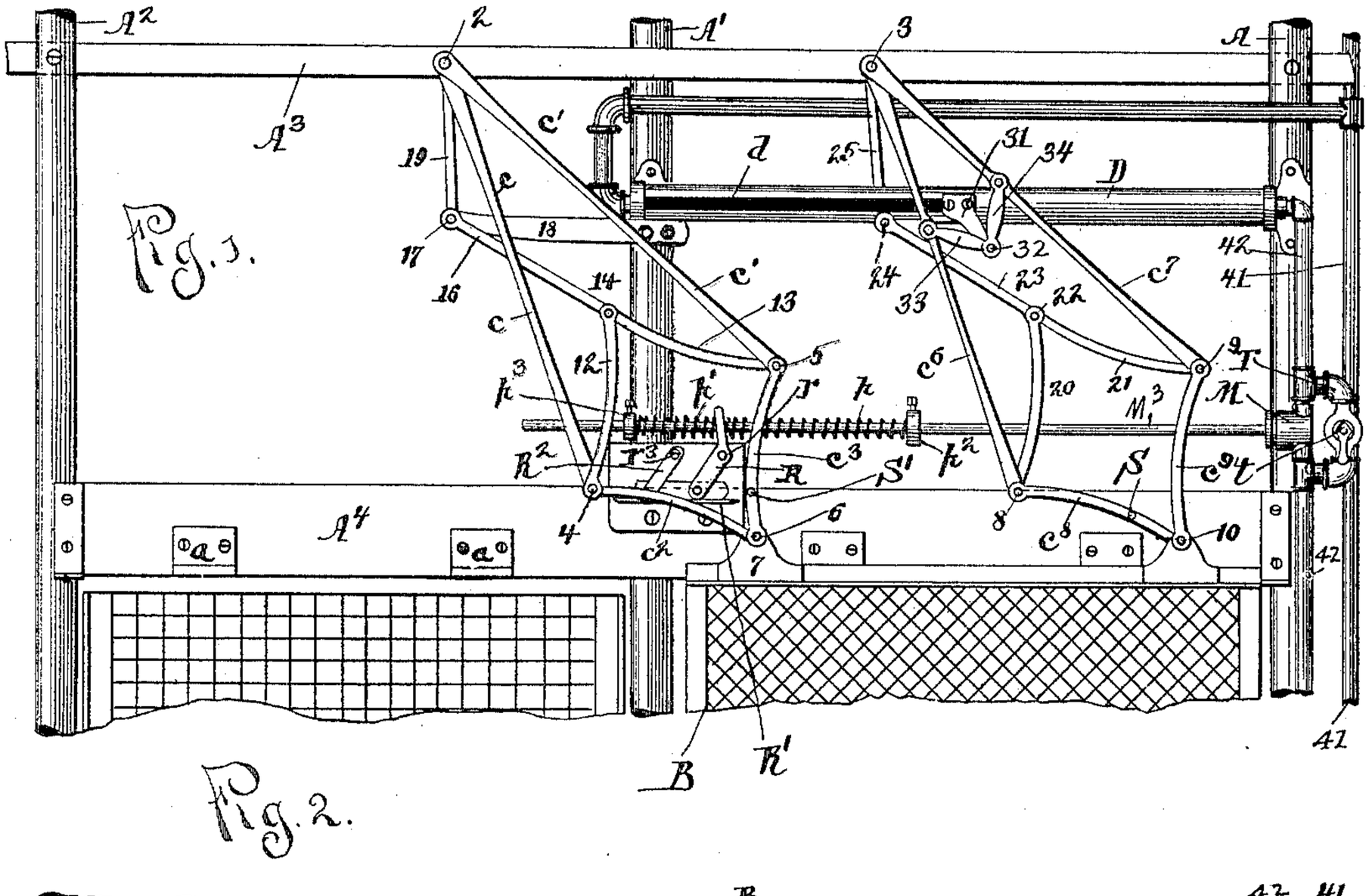

Fig. 1.

Fig. 2.

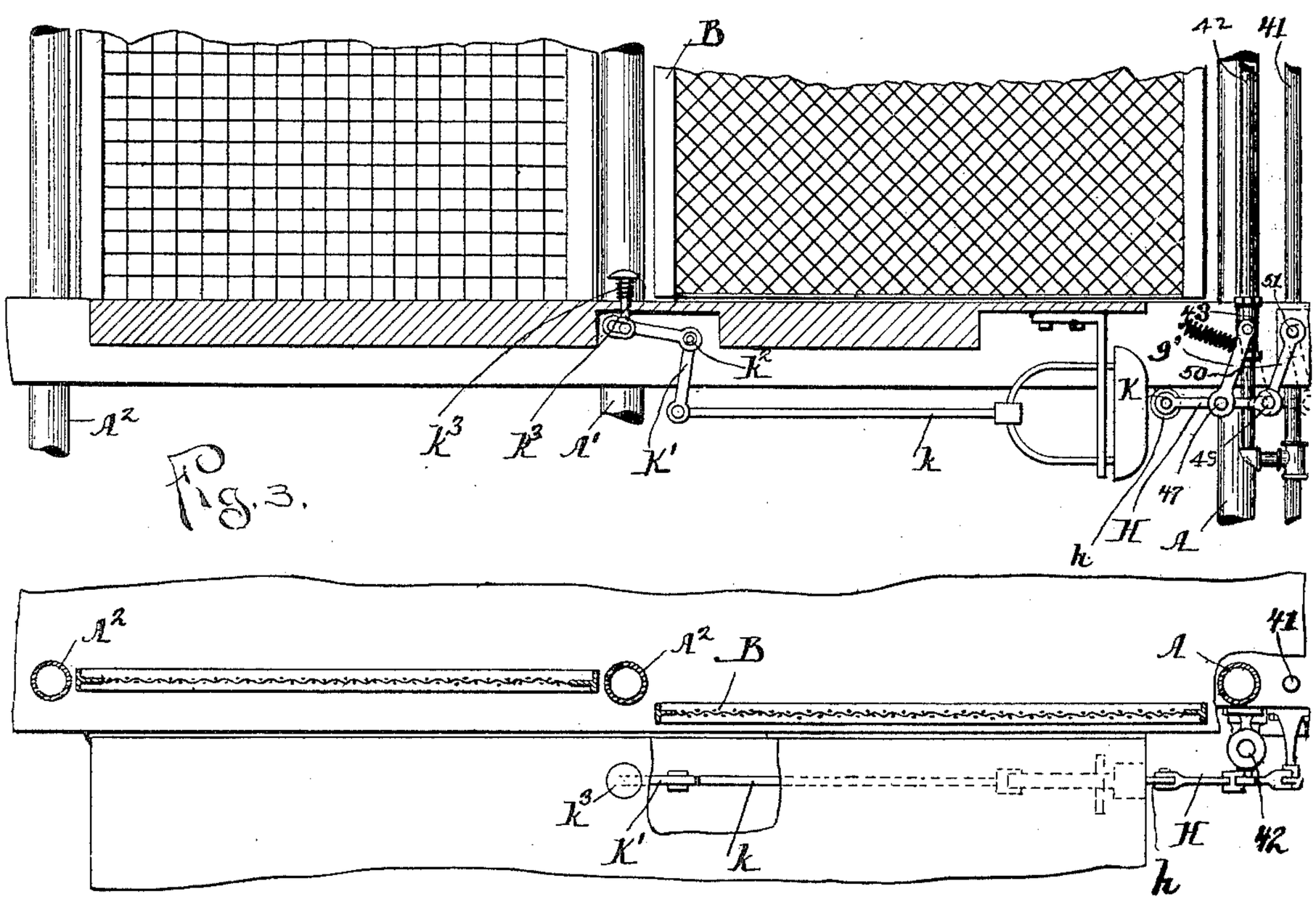

Fig. 3.

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(No Model.)

2 Sheets—Sheet 2.

E. A. HALDEMAN.

DOOR OPERATING MECHANISM.

No. 581,821. Patented May 4, 1897.

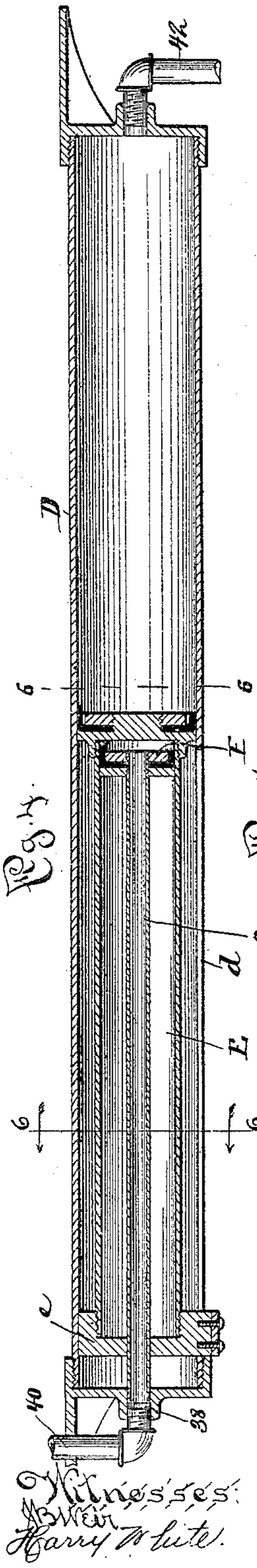

Fig. 4.

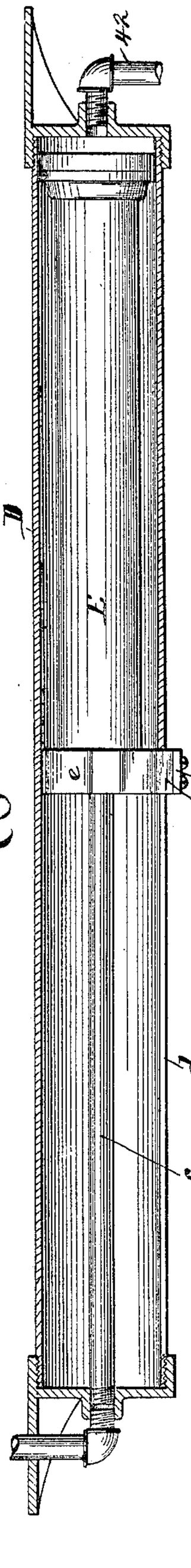

Fig. 5.

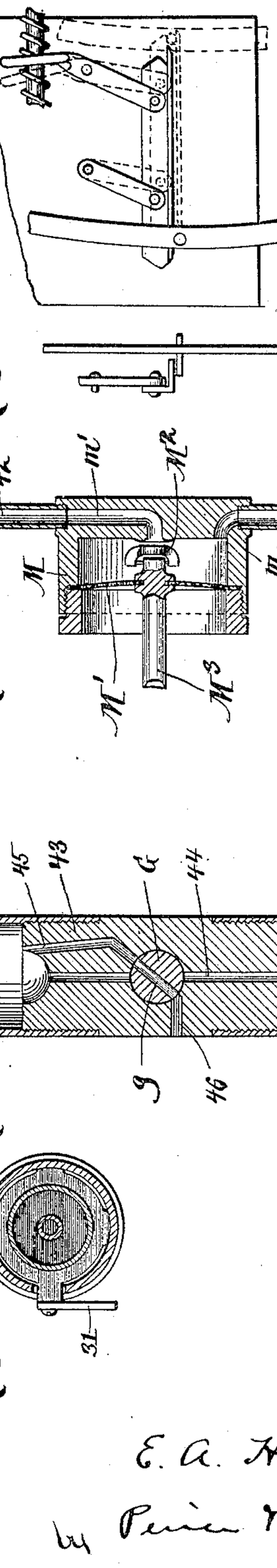

Fig. 6.

Fig. 10.

Fig. 8.

Fig. 7.

Fig. 9.

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UNITED STATES PATENT OFFICE.

EPHRAIM A. HALDEMAN, OF CHICAGO, ILLINOIS.

DOOR-OPERATING MECHANISM.

SPECIFICATION forming part of Letters Patent No. 581,821, dated May 4, 1897.

Application filed June 13, 1896. Serial No. 595,471. (No model.)

To all whom it may concern:

Be it known that I, EPHRAIM A. HALDEMAN, a citizen of the United States, and a resident of the city of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Door-Operating Mechanism, of which I do declare the following to be a full, clear, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

The invention has for its object to provide door-operating mechanism more particularly adapted for the opening and closing of doors that guard the entrances to elevator-cars.

The invention consists of various novel features of construction and combination of parts hereinafter described, illustrated in the accompanying drawings, and particularly pointed out in the various claims at the end of this specification.

Figure 1 is a view in front elevation showing a part of the hatchway of an elevator-shaft adjacent the upper portion of one of the doorways, showing also the upper part of the door and the mechanism whereby the door is operated. Fig. 2 is a view in elevation showing the lower part of the door and adjacent portion of the hatchway, showing the valve mechanism for controlling the flow of air to the operating-cylinder and showing in cross-section the floor of the car and in elevation the means beneath the car for operating the valve mechanism. Fig. 3 is a view in horizontal section through the hatchway and its door and adjacent parts, a portion of the elevator-car floor being shown in plan and the valve-operating mechanism being also shown in plan. Fig. 4 is an enlarged view, in horizontal section, through the operating cylinder and piston. Fig. 5 is a view similar to Fig. 4, but with a differential trunk-piston shown in elevation. Fig. 6 is a view in cross-section on line 6 6 of Fig. 4. Fig. 7 is a detail view, in vertical section, of the controlling-valve and its seat. Fig. 8 is a detail view, in vertical section, of the check-valve, its casing, and adjacent parts. Fig. 9 is a detail view showing a part of one of the door-hanger links and the striking-plate that will be engaged by a pin projecting from such link. Fig. 10 is a view in side elevation showing the striking-plate, its suspension-links, a part of one of the door-hangers, &c.

In the accompanying drawings I have shown my invention as applied to a single doorway, but it will be understood, of course, that the improvements hereinafter specified may be applied to as many doors as may be required.

A, A′, and A^2 designate suitable supporting-columns of the hatchway, between which columns extend the cross-bars A^3 and A^4, and B denotes the door whereby the opening of the hatchway is closed. The cross-bar A^4 above the doorway is shown as provided with the usual guide-plates *a*, whereby the upper edge of the door is guided in its movements, and it will be understood, of course, that, if desired, other suitable guides may be employed for the bottom of the door, although these form no part of my invention. To the cross-bar A^3 or to any other suitable fixed part of the structure are attached the pivot-pins 2 and 3, and to the pin 2 are pivotally connected the upper ends of the hanger-bars *c c′*, the lower ends of these bars being pivoted, as at 4 and 5, to the upper ends of the bars c^2 and c^3, the lower ends of which bars are pivoted, as at 6, to a bracket 7, projecting from the top of the door B. In like manner it will be seen that the hanger-bars c^6 and c^7 have their upper ends connected to the pivot-pin 3, while their lower ends are pivotally connected, as at 8 and 9, respectively, to the upper ends of the hanger-bars c^8 c^9, the lower ends of the bars c^8 and c^9 being pivoted, as at 10, to a bracket projecting from the upper edge of the door B.

At 4 and 5 are pivotally connected the lower ends of the links 12 and 13, the links 12 and 13 being pivoted, as at 14, to the lower end of a link 16, the upper end of which link 16 is pivoted, as at 17, to the arm 18, that is fixed to the column A′ and is shown as braced by a bar 19, depending from the cross-bar A^3. In like manner there are two links 20 and 21, the lower ends of which are pivotally connected at 8 and 9, while their upper ends are pivoted at 22 to the lower end of a link 23, the upper end of this link 23 being pivoted at 24 to the lower end of a bar 25, that depends from the cross-bar A^3.

The construction of antifriction-door-hanger mechanism above described is similar to that set forth in Letters Patent No. 446,516,

granted to me February 17, 1891, and in Letters Patent No. 561,164, granted to me June 2, 1896. By this mechanism the straight-line back-and-forth movement of the door is insured with very little friction, so that the power necessary to open and close the door is reduced to a minimum. It will be understood, of course, that as the door moves back and forth the links *c*, *c'*, c^2, and c^3 of one hanger and the corresponding links of the other hanger will spread, so that a free and easy back-and-forth movement of the door will occur.

The improved mechanism whereby the opening and closing of the door B will be effected will next be described.

Between the columns A and A', or conveniently supported in any other suitable position, is sustained the cylinder D, that carries the trunk-piston E. (See Figs. 1, 4, and 5.) The cylinder D is provided with a long slot or opening *d*, through which projects an extension 30 from the end *e* of the trunk-piston E, and to the projection 30 is attached an arm 31, the lower end of which pivotally connects, as at 32, to the lower ends of the links 33 and 34, the upper ends of these links being pivotally connected, as shown in Fig. 1, to the hanger-bars c^6 and c^7. From this construction it will be apparent that as the trunk-piston E is moved back and forth within the cylinder D a corresponding movement of the arm 31 will occur, and as this arm is connected to the adjacent antifriction-hanger it is manifest that a like back-and-forth movement will be imparted to the door.

It will be seen that by employing two links 33 and 34, connected, respectively, to the arms c^6 and c^7, the result is that as the bar or cross-head 31 is moved backward to effect the opening of the door the link 33 will exert a pushing action, while the link 34 will exert a pulling strain, and thus the force required to open the door will be distributed between the hanger-arms c^6 and c^7, and an easier and more uniform action will occur, with less strain and wear upon the parts than would be the case if a single link extended from the bar 31.

The body of the trunk-piston E forms a cylinder within which is mounted the fixed piston F, this piston being carried at the end of an air-supply pipe *f*, the opposite end of which pipe passes freely through an opening formed in the head *e* of the trunk-piston E and is connected to a port 38, formed in the end of the cylinder D, this port 38 having connected thereto a branch supply-pipe 40, that connects with the main stand-pipe 41, by which the air is supplied to the system. To the opposite end of the cylinder D is connected an air delivery and exhaust pipe 42, that is also connected to the main stand-pipe 41, as will presently more fully appear.

It will be observed that the branch pipe 40 is in constant communication with the supply-pipe or stand-pipe 41, and consequently the air-pressure is at all times upon the inner face of the head of the piston E; but inasmuch as the area exposed to air-pressure upon the left-hand side of this piston is much less than the area exposed upon the opposite side of the piston it follows that when the same fluid-pressure per square inch is exerted upon opposite sides of the piston E the piston will be moved backward against the force of the fluid-pressure exerted upon its smaller area. In other words, the piston E is a differential piston, and its movements respond to the difference in pressures exerted upon its opposite areas. Hence it is that although fluid-pressure is at all times upon the smaller area of the piston E, still when like fluid-pressure is admitted into the cylinder D by the pipe 42 the trunk-piston E will move from the position shown in Fig. 5 to the position shown in Fig. 4, and in thus moving will carry the door from the closed to the open position. On the other hand, it is obvious that as soon as fluid-pressure within cylinder D is released or sufficiently diminished by escape through the pipe 42 the constant pressure upon the smaller area of the trunk-piston E will cause this piston to move from the position seen in Fig. 4 back to the position shown in Fig. 5, thereby effecting the closing of the door.

The valve mechanism whereby the supply and discharge of air to and from that part of the cylinder D opposite the larger area of the differential piston are effected will next be described, reference being had more particularly to Figs. 2, 3, and 7 of the drawings. Within the pipe 42 is interposed a valve-seat 43, this valve-seat being cored to receive the valve G and being provided with the through-passage 44, the branch passage 45, and the escape port or passage 46. The valve G is formed with the through-passage *g*, adapted to connect with and form a passage for air through the channel 44 and adapted also when brought coincident with the passage 45 to connect such passage with the escape passage or channel 46. That is to say, when the valve G is turned so that its passage *g* is coincident with the passage or channel 44 the supply of air from the main stand-pipe 41 will pass through the branch pipe 42 to the cylinder D, (the intermediate check-valve mechanism being for the present disregarded.) On the other hand, when the valve G is turned to the position seen in Fig. 7 the air within the cylinder D will escape by the pipe 42, the channel 45, the passage *g*, and escape port or channel 46 to the open air.

The valve G, as shown in Fig. 2, extends outside its casing or seat, and has connected thereto a depending link *g'*, the lower end of which is pivotally connected, as at 47, to a push-bar H. Preferably one end of this push-bar is in like manner pivotally connected, as at 49, to a link 50, that is pivoted, as at 51, to some fixed part of the structure, the purpose of this link 50 being simply to insure a straight-line movement of the bar H. The

outer end of the push-bar H is preferably furnished with a friction-roller *h*, adapted to be struck by a shoe K, that is carried upon the end of a rod *k*, the opposite end of which rod is pivotally connected to an elbow-lever K′, that is pivoted, as at k^2, beneath the floor of the elevator-car. The elbow-lever K′ has its upper arm slotted to receive a projection at the lower end of a treadle-rod K^3, that is encircled by a coiled spring k^3, that serves to hold the treadle-rod K^3, the elbow-lever *k*′, and the shoe K normally in the retracted position seen in Fig. 3 of the drawings. The top of the treadle-rod K^3 will extend slightly above the floor of the elevator-car, where it can be conveniently depressed by the foot of the operator.

From the foregoing description it will be seen that when the operator depresses the treadle-rod K^3 the shoe K will be moved outward, so that as the elevator-car moves up or down the shoe K will engage with the friction-roller *h*, thereby forcing this roller and the bar H from the position shown in full lines, Fig. 2, to the position shown by dotted lines. When the parts are in the position shown in Fig. 2, the valve G will occupy the position seen in Fig. 7—that is to say, there will be a free passage for the escape of air from the cylinder D, and consequently the constant pressure of air upon the small area of the differential piston E will hold the door normally in a closed position. (Seen in Fig. 1.) When, however, the bar H is shifted by the shoe K from the position shown by full lines to the position shown by dotted lines in Fig. 2, the valve G will be turned until its passage or port *g* comes in line with the port or passage 44, (see Fig. 7,) thereby permitting the passage of air from the main stand-pipe 41 through the branch-pipe 42 to the end of the cylinder D opposite the larger area of the differential piston E. It is obvious that when the valve G is thus shifted the pressure of air upon the larger area of the piston E will cause this piston to move from the position seen in Fig. 5 to the position seen in Fig. 4 of the drawings, thereby shifting the door from the closed to the open position.

It will be understood, of course, that as the operator approaches the landing at which the door is to be opened he will simply depress the treadle-rod K^3 in order to effect the shifting of the valve mechanism in manner above defined.

In order to secure the easy opening and closing of the door—that is to say, to prevent its slamming as it is opened and closed—I have provided the mechanism next to be described. Within the branch pipe 42 is interposed a check-valve casing M, (see Fig. 8,) the ports *m* and *m*′ of which connect, respectively, with the upper and lower portions of the branch pipe 42. Within the casing M is fixed a flexible diaphragm M′, to one side of which is attached a check-valve M^2, adapted to obstruct one of the ports of the casing and from the opposite side of which extends a rod M^3, whereby the movement of the check-valve M^2 is effected in order to close or cut off the passage of air to the casing M. Upon the rod M^3 are mounted the coil-springs *p* and *p*′, the inner ends of these springs bearing against the yoke-shaped upper end of an elbow-lever R, that is pivotally mounted, as at *r*, to a bracket-plate rising from the cross-bar A^4 or to any other fixed part of the structure. Suitable adjustable collars p^2 and p^3 are set upon the rod M^3 and enable the force of the springs *p* and *p*′ to be adjusted to any required tension.

To the lower end of the elbow-lever R is pivotally connected a shoe or striking-plate R′, and to this plate is also pivotally connected a link R^2, that is pivoted, as at r^3, in parallelism with the lower arm of the elbow-lever R. The elbow-lever R and the link R^2 serve to sustain the striking-plate R′ in horizontal position, while permitting it to be raised and lowered, as will presently appear, in order to cause the elbow-lever R to shift the rod M^3 and the check-valve M^2.

Upon one of the hanger-links—as, for example, link c^8—is fixed a pin S, which will strike against the under side of the plate R′ as the door nearly reaches the end of its travel toward the open position—that is to say, as the door is opened and the antifriction-hanger attached to its front end is swung rearwardly the link c^7 will be lifted somewhat, so that the pin S will strike the under side of the plate R′ and lift this plate in such manner as to cause the elbow-lever R to rock about its pivot-point *r* and force the rod M^3 to so shift the valve M^2 as to close the mouth of the channel *m*′ of the casing M, (see Fig. 8;) but as soon, however, as the pin S passes from beneath the striking-plate R′ the spring *p* and the weight of the plate R′, together with the pressure of air against the diaphragm M′, will cause the valve M^2 to be lifted away from the mouth of the channel *m*′, so as to again permit the free passage of air through the pipe 42 into the cylinder D. Hence it will be seen that when valve G has been shifted so as to permit air to pass by the branch pipe 42 to the cylinder D and the piston E has been moved so as to cause the opening of the door B air will continue to be admitted to the cylinder D until the pin S, by raising the striking-plate R′, causes the elbow-lever R to be shifted so as to force the rod M^3 to close the valve M^2 against its seat, and thus temporarily check or cut off the supply of air from the cylinder D to the pipe 42. As soon, however, as the momentum of the door and the expansion of air within the cylinder D have carried the pin S away from beneath or to the rear of the striking-plate R′ this plate will descend and, as above explained, the valve M^2 will pass from its seat and thus permit air to again enter the cylinder D, so that although the backward movement of the door is temporarily checked the final opening of the door

is effected by the pressure of air being restored to the cylinder D.

It will also be seen by reference to Fig. 1 that one of the links, preferably the link c^7 of the antifriction-hanger attached to the rear end of the door, is provided with a projecting pin S′, which as the door is moved to its open position rides above the top of the striking-plate R′, but which as the door is moved to the closed position rides beneath and lifts this striking-plate just before the final closing of the door occurs—that is to say, as the door B moves from the open to the closed position the pin S′ will ride beneath and lift the striking-plate R′, and consequently cause the elbow-lever R and the rod M^3 to close the valve M^2 and prevent the escape of air from the cylinder D through the pipe 42. When the escape of air is thus arrested, it is manifest that the movement of the differential piston E will be checked, but as soon as the pin S′ passes from beneath the striking-plate R′, thereby permitting this plate to fall to the normal position seen in Fig. 1, the valve M^2 will be forced from its seat by the air escaping from the cylinder D, and the constant pressure of air upon the smaller area of the piston E will exert its force to effect the complete closing of the door.

By reference to Fig. 1 of the drawings it will be seen that the sections of pipe 42 at each side of the check-valve casing M are connected by what I term a "leakage-pipe" T, in which leakage-pipe is interposed a valve *t*, whereby the passage of air admitted through the leakage-pipe may be controlled, the valve *t* being an ordinary petcock or valve that may be set by hand in any position. The purpose of this leakage-pipe T and valve *t* is to insure the admission or escape of a certain amount of air to and from the cylinder D, notwithstanding the closing of the valve M^2, and thus preventing the complete stopping of the door at the time that the pins S or S′ are beneath the striking-plate R′. In other words, I have thought it best not to depend upon the momentum of the door or of the expansion of the air to carry the pins S and S′ beyond the striking-plate R′, and it is obvious that even if the momentum of the door in its opening or closing movement should not be adequate to carry the pins S and S′ from beneath the striking-plate the leakage of air through the pipe T will serve to effect such final movements of the door.

From the foregoing description it will be seen that my invention provides a most simple and effective means whereby the opening and closing of the doors of elevators or the like may be secured and whereby the checking of the doors in the opening and closing movements is effected.

It is manifest that the details of construction above set out may be varied within wide limits without departing from the spirit of the invention, and I do not therefore wish the invention to be understood as restricted to such details.

While I have described my invention as particularly adapted for elevator-doors, it is manifest that it can be used in other situations.

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

1. In apparatus of the character described, the combination with a door, of a hanger comprising pivoted bars c^6 and c^7, c^8 and c^9, a piston for shifting said hanger-bars and pivoted links 33 and 34 connected intermediate said hanger-bars whereby the strain is distributed between said bars, substantially as described.

2. In apparatus of the character described, the combination with a door to be shifted, of a differential piston and its cylinder provided with suitable fluid-supply pipes, said piston being operatively connected with the door and having its smaller area in free communication with the fluid-pressure supply, and valve mechanism for controlling the flow of fluid to said cylinder opposite the larger area of its piston, substantially as described.

3. In apparatus of the character described, the combination with a part to be shifted, of a differential trunk-piston operatively connected with said part, a cylinder for said piston provided with a pipe for admission of fluid under pressure to the interior of said trunk-piston, a pipe for supplying fluid to said cylinder, and valve mechanism for controlling the flow of fluid to and from said cylinder, substantially as described.

4. In apparatus of the character described, the combination with a part to be shifted, of a differential trunk-piston, a cylinder wherein said trunk-piston is mounted in manner free to reciprocate, a stationary piston within the trunk of said differential piston, a pipe for supplying fluid under pressure to the interior of said trunk-piston, a pipe for supplying fluid under pressure to the cylinder of said differential piston and suitable valve mechanism for controlling the flow of fluid to and from said cylinder, substantially as described.

5. In apparatus of the character described, the combination with a part to be shifted, of a differential trunk-piston and its cylinder, a piston within the trunk of said differential piston, a pipe for supplying fluid under pressure to the interior of said trunk-piston, suitable ports for the admission and discharge of fluid to and from the cylinder of said differential piston and valve mechanism for controlling the flow of fluid to and from said cylinder, said valve mechanism comprising a valve having a port therein to permit the air or fluid under pressure to pass to said cylinder, and an escape-port to permit the escape of fluid from said cylinder, and means for operating said valve, substantially as described.

6. In apparatus of the character described, the combination with a part to be shifted, of a differential piston and its cylinder, a main supply-pipe, a branch pipe leading from said main supply-pipe to the end of the cylinder opposite the smaller area of the differential piston, a branch pipe leading from the main supply-pipe to the end of the cylinder opposite the larger area of the differential piston, a valve-casing interposed in said last-named branch pipe, said casing having a delivery-passage and an escape port or passage therein, a valve within said casing for controlling the admission and escape of air through said casing and means connected with the elevator-car for operating said valve, substantially as described.

7. In apparatus of the character described, the combination with a part to be shifted, of a piston suitably connected with said part, a cylinder for said piston, suitable pipes whereby the passage of fluid under pressure to and from said cylinder is effected, valve mechanism for controlling the flow of fluid to said cylinder, a check-valve for controlling the passage of air through the pipe that leads to one end of said cylinder and means substantially as described for effecting the movement of said check-valve, substantially as described.

8. In apparatus of the character described, the combination with a part to be shifted, of a piston suitably connected with said part, a cylinder for said piston, suitable pipes whereby the passage of fluid under pressure to and from said cylinder is effected, valve mechanism for controlling the flow of fluid to said cylinder, a check-valve for controlling the passage of air through the pipe that leads to one end of said cylinder, a diaphragm connected to said check-valve, a rod connected to said diaphragm and means for shifting said rod to effect the closing of said check-valve, substantially as described.

9. In apparatus of the character described, the combination with a part to be shifted, of a piston suitably connected with said part, a cylinder for said piston, suitable pipes whereby the passage of fluid under pressure to and from said cylinder is effected, valve mechanism for controlling the flow of fluid to said cylinder, a check-valve for controlling the passage of air through the pipe that leads to one end of said cylinder, a diaphragm connected to said check-valve, a rod connected to said diaphragm, a lever or bar for shifting said rod and spring mechanism interposed between said lever or bar and said rod, substantially as described.

10. In apparatus of the character described, the combination with a part to be shifted, of a piston suitably connected with said part, a cylinder for said piston, suitable pipes whereby the passage of fluid under pressure to and from said cylinder is effected, valve mechanism for controlling the flow of fluid to said cylinder, a check-valve for controlling the passage of air through the pipe that leads to one end of said cylinder, a diaphragm connected to said check-valve, a rod connected to said diaphragm, a lever or bar for shifting said rod and adjustable spring mechanism interposed between said lever or bar and said rod, substantially as described.

11. In apparatus of the character described, the combination with a part to be shifted, of a piston suitably connected with said part, a cylinder for said piston, suitable pipes whereby the passage of fluid under pressure to and from said cylinder is effected, valve mechanism for controlling the flow of fluid to said cylinder, a check-valve for controlling the passage of air through the pipe that leads to one end of said cylinder, a diaphragm connected to said check-valve, a rod connected to said diaphragm and means for shifting said rod to effect the closing of said check-valve, said shifting means comprising a pivoted lever and a striking-plate connected to said lever, the upper end of said pivoted lever being in suitable engagement with said rod, substantially as described.

12. In apparatus of the character described, the combination with a part to be shifted, of a piston suitably connected with said part, a cylinder for said piston, suitable pipes whereby the passage of fluid under pressure to and from said cylinder is effected, valve mechanism for controlling the flow of fluid to said cylinder, a check-valve for controlling the passage of air through the pipe that leads to one end of said cylinder, means substantially as described for effecting the movement of said check-valve, and a leakage or by-pass pipe extending around said check-valve, substantially as described.

EPHRAIM A. HALDEMAN.

Witnesses:

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