3 Sheets—Sheet 1.

H. DAVIES.

DOUBLE HYDRAULIC ELEVATORS.

No. 193,929. Patented Aug. 7. 1877.

Fig. 1.

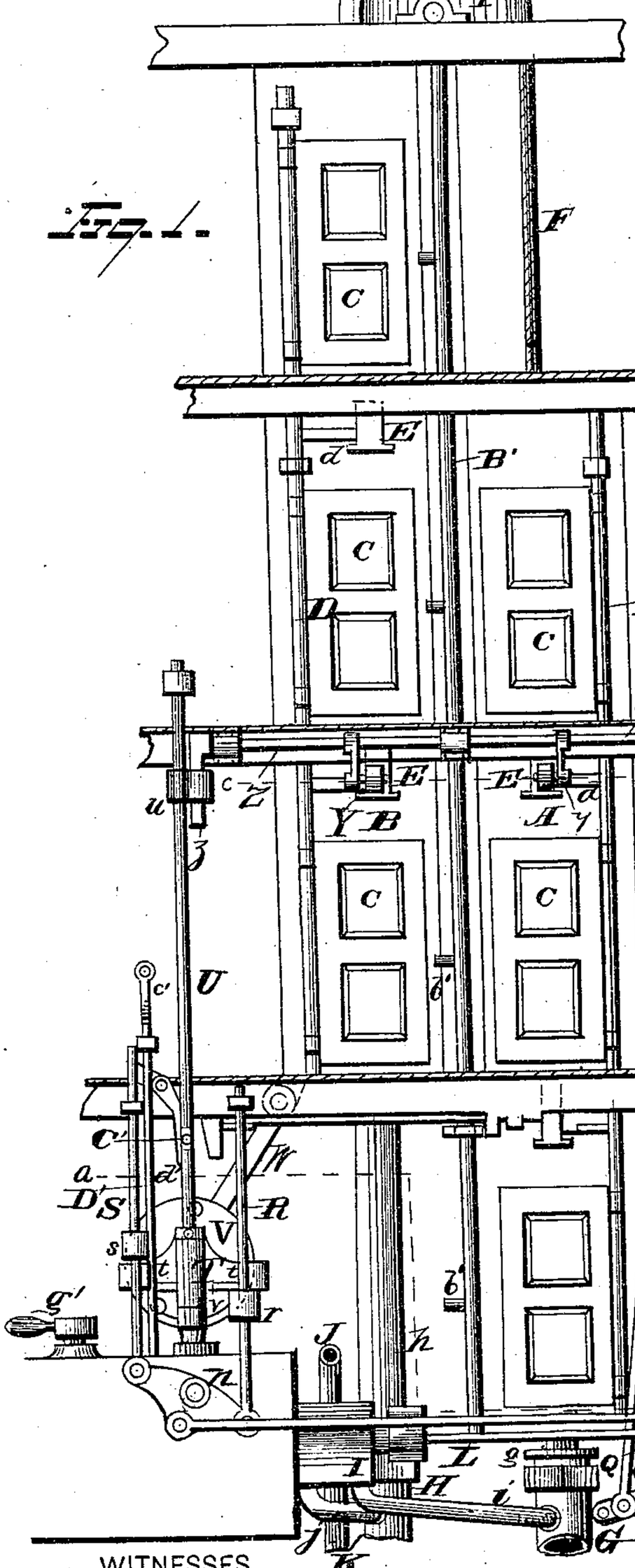
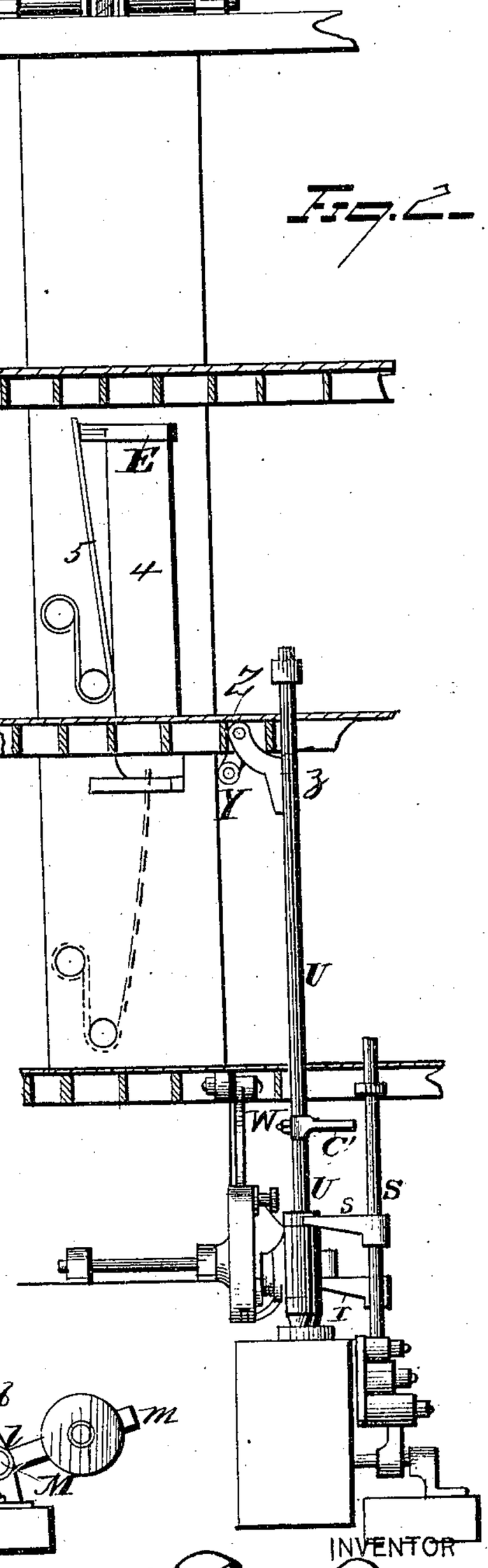


Fig. 2.



WITNESSES

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A. M. Bright.

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3 Sheets—Sheet 2.

H. DAVIES.

DOUBLE HYDRAULIC ELEVATORS.

No. 193,929. Patented Aug. 7, 1877.

Fig. 3.

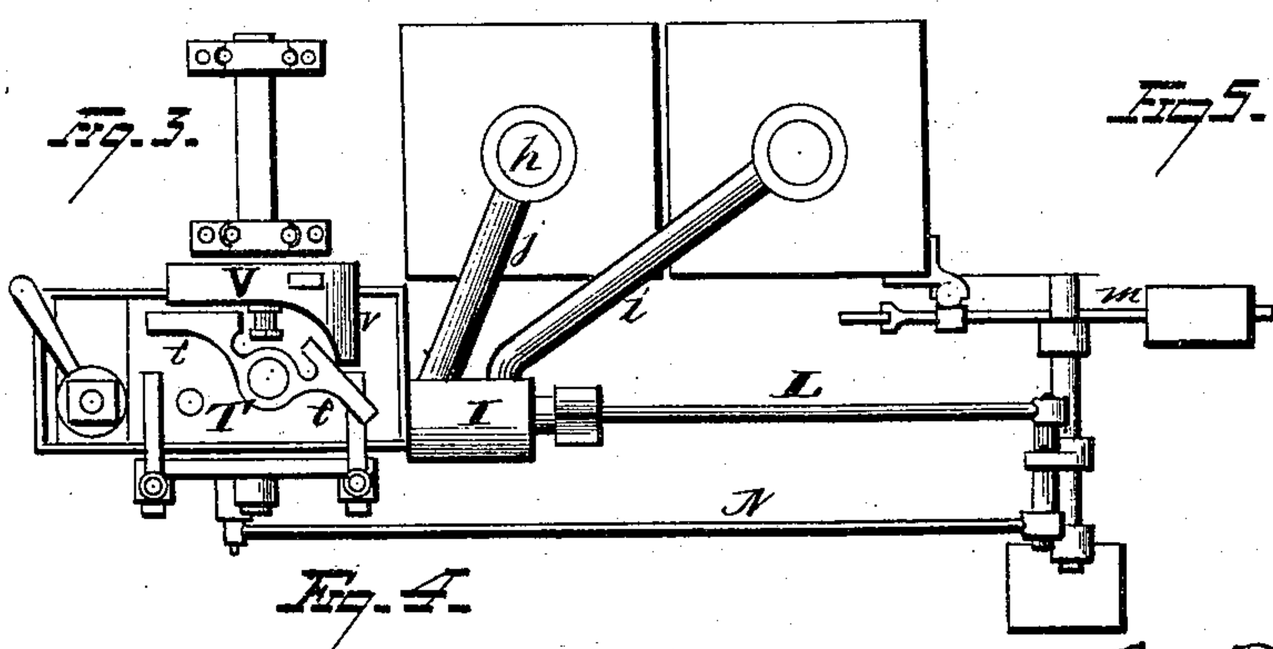


Fig. 4.

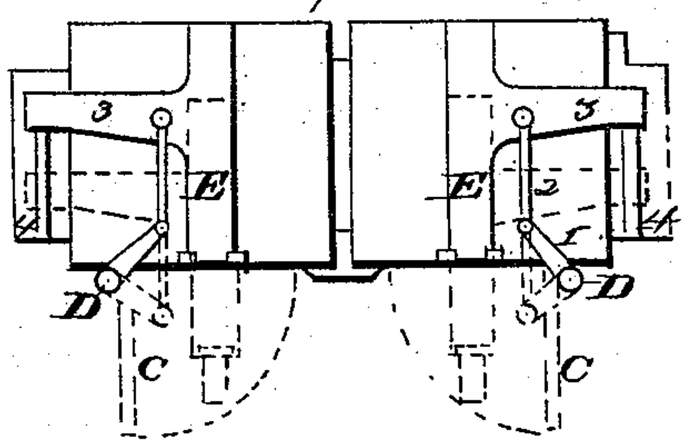


Fig. 5.

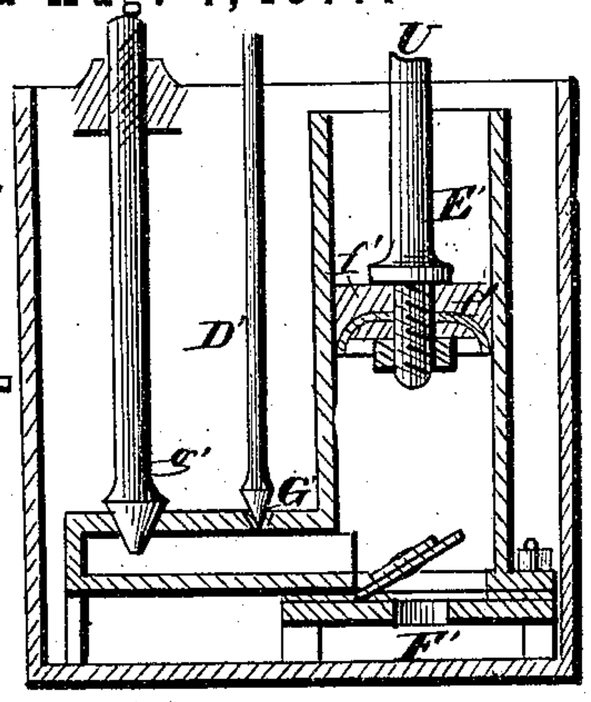


Fig. 6.

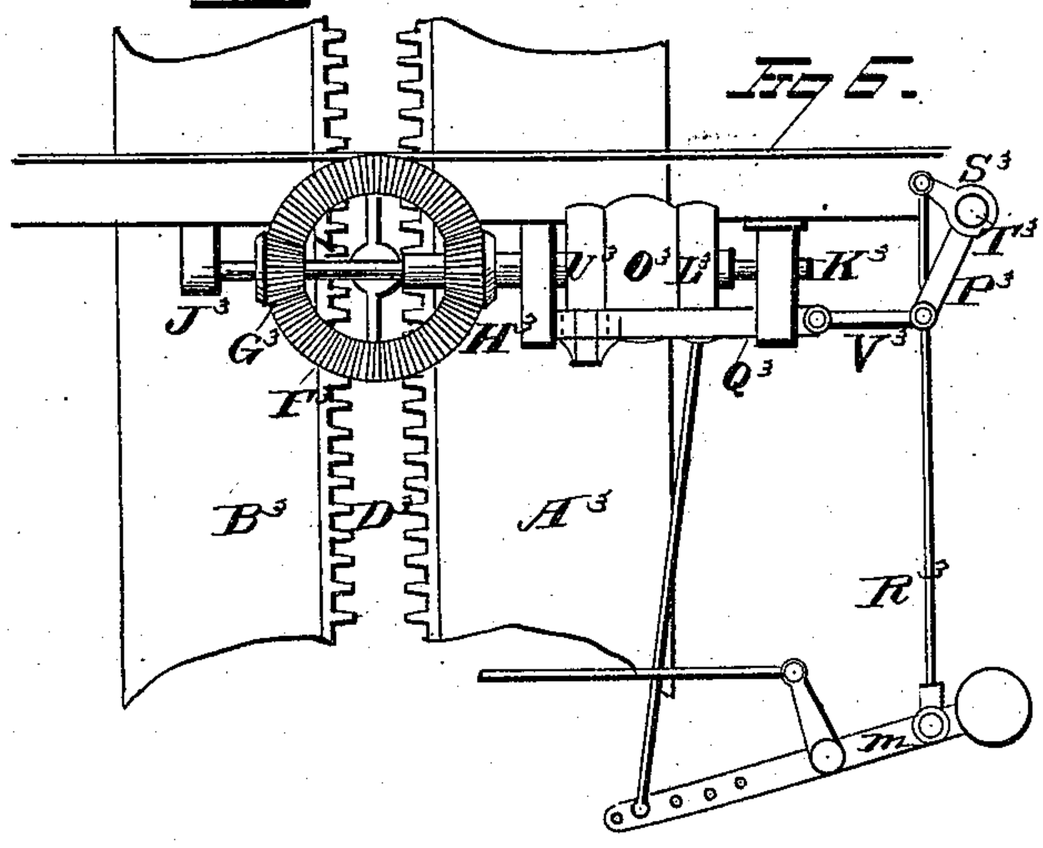


Fig. 8.

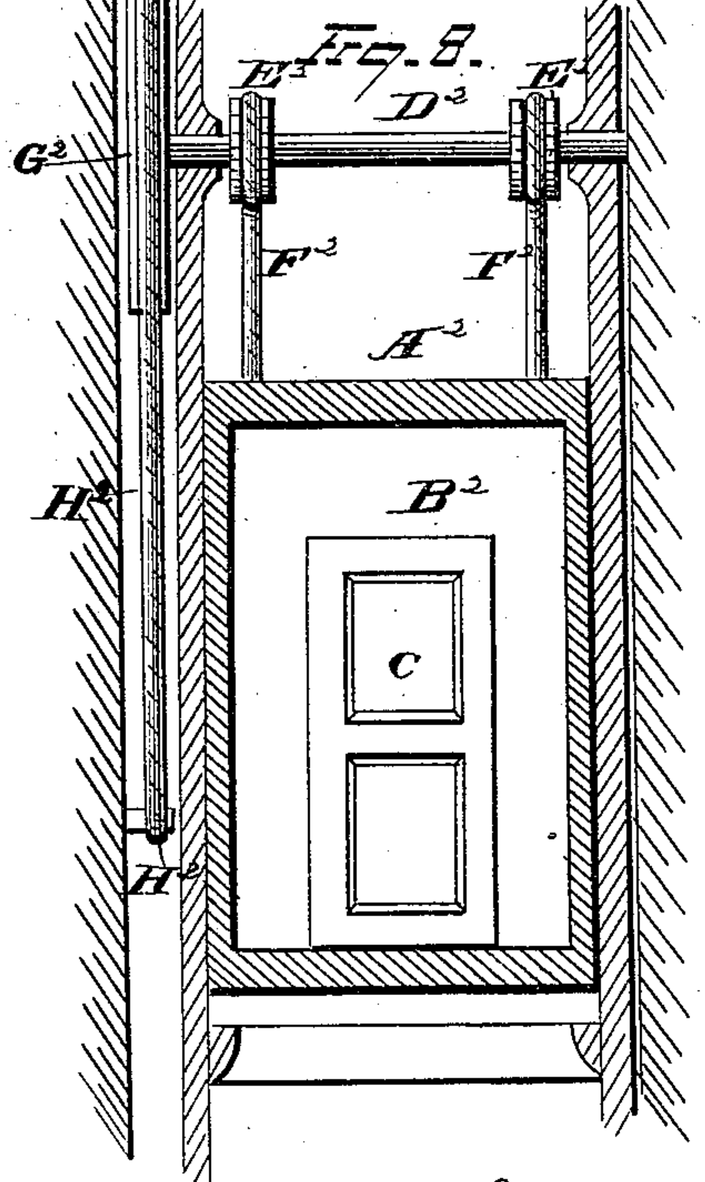
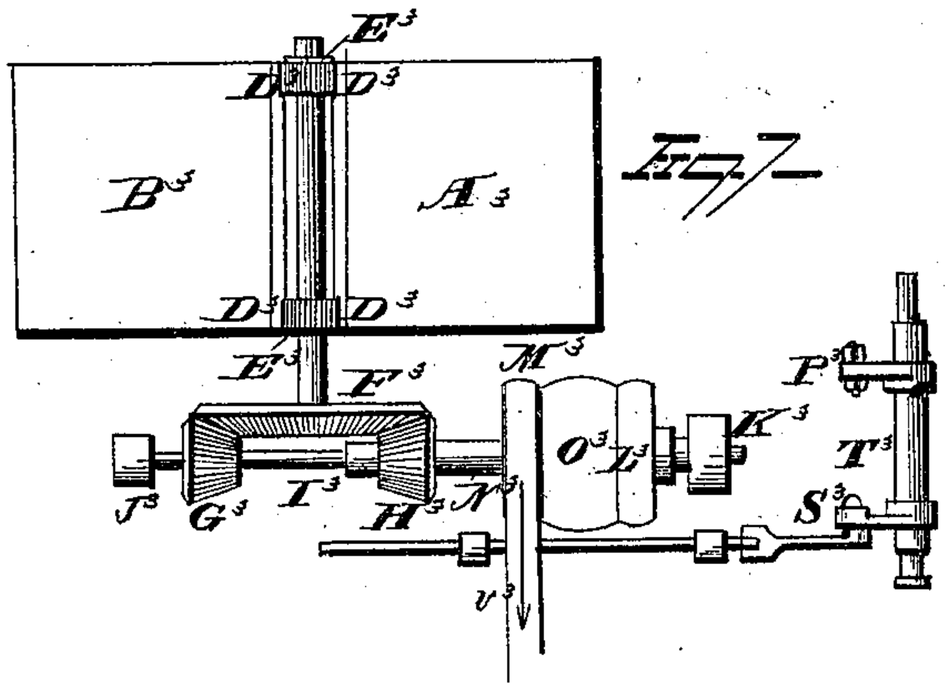


Fig. 7.



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3 Sheets—Sheet 3.

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DOUBLE HYDRAULIC ELEVATORS.

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Fig. 9.

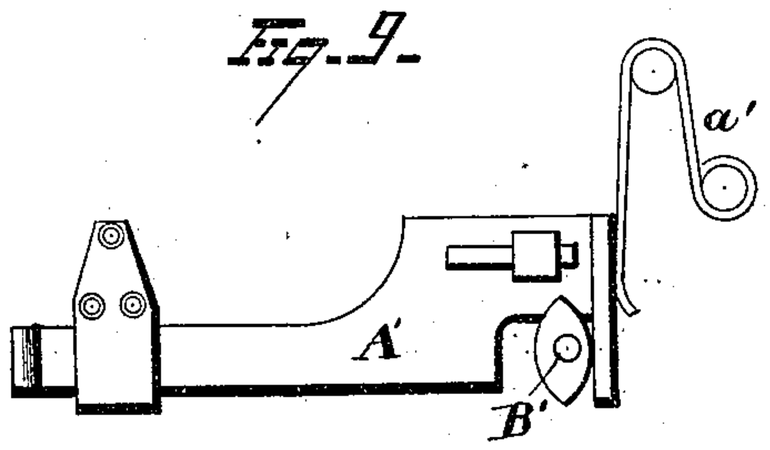
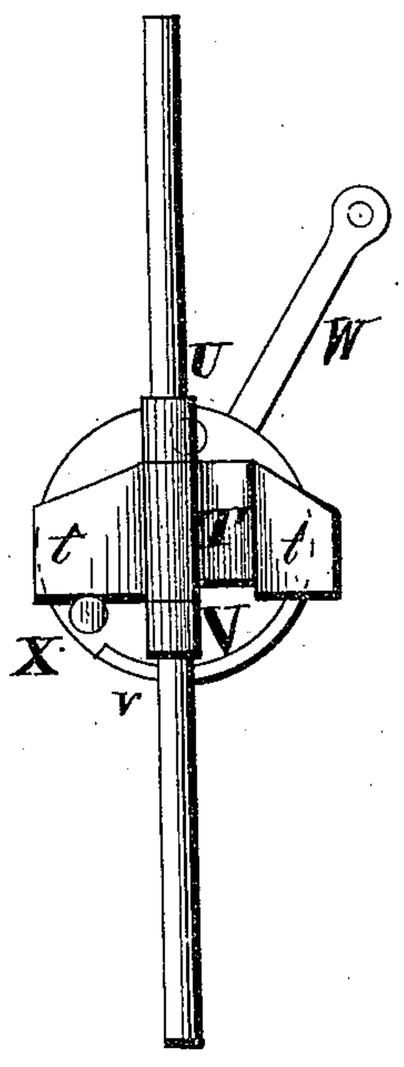


Fig. 10.



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UNITED STATES PATENT OFFICE.

HENRY DAVIES, OF NEWPORT, KENTUCKY.

IMPROVEMENT IN DOUBLE HYDRAULIC ELEVATORS.

Specification forming part of Letters Patent No. **193,929**, dated August 7, 1877; application filed March 23, 1877.

To all whom it may concern:

Be it known that I, HENRY DAVIES, of Newport, in the county of Campbell and State of Kentucky, have invented certain new and useful Improvements in Elevators; and I do hereby 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 pertains to make and use it, reference being had to the accompanying drawings, which form part of this specification.

My invention relates to improvements in elevators, more especially automatic elevators, and may be equally well used to raise and lower people or goods from one story to another, either in hotels, offices, private dwellings, or warehouses. The elevator is made with two large trunks connected together and operated by hydraulic motive power, so that one trunk will descend simultaneously with the raising of the other trunk. These trunks are each divided into a vertical series of compartments of such height, relative to the individual building in which the elevator works, that they shall correspond to the several stories of the building, and have a vertical adjustment equal to the distance between any two of them by being raised and lowered in the cellar a corresponding distance. As the elevator makes its first movement one trunk will descend from one story down to another, and at the same time the counterpart trunk will ascend a story. The next movement of the elevator exactly reverses the foregoing, and the former ascending trunk is lowered one story, while the trunk before lowered is now raised one story.

As passengers or goods in one chamber are drawn up one story they are then transferred from the one trunk to the other, and the latter trunk-chamber carries them a story higher. On reaching the third story a second transfer to the first trunk is made, and in this latter they are carried still another story up, while, if they are to be lowered from a higher to a lower story, the transfer from one trunk to another, exactly the reverse of the former operation, takes them down to the desired story. In this way two sets of passengers or goods can simultaneously be raised and lowered. While one set ascends in the one trunk the other set descends in the counterpart trunk, and permanent stoppage at any desired story can be made by either set. The doors to the several chambers are automatically opened and closed as the trunks respectively arrive at, or depart from, each story, and the construction is such that it is impossible to move the trunks until all the doors are closed, when the latter are held securely in such closed position till the trunks stop at the next story in either ascent or descent corresponding to the respective trunk. Thus all liability of accidents is prevented, as it is impossible to enter or leave the chambers of the elevator except when the latter is held in fixed position, and hence even children can safely and with perfect security against injury travel from one story to another by themselves.

The elevator is actuated by hydraulic rams, one operating each of the two trunks, and connecting with a common feed-pipe which introduces the water-pressure. A slide-valve and chest alternately feeds one of the rams, and exhausts the other, so that upon forcing one trunk up the other may fall of its own weight. The valve mechanism is operated automatically, first, by connecting means with one of the trunks, so that upon arriving at any of the stories the valve closes all communication with the water-ram chambers, and thus holds the elevator fixed against any movement until the valve is reversed by a second set of connections, which latter allows of an opposite movement of the elevator, and is operated by a self-regulating mechanism, technically known as a "cataract."

While the cataract determines the constant and uniform length of time intervening between the alternate movements of the elevator, mechanism is also provided by which the elevator may be held motionless any indefinite length of time, and thus it may be held stationary for any desired interval independent of the operation of the cataract. Means are also provided by which the chambers in the trunk can be automatically lowered or raised in their respective trunks, so as to compensate for any difference which may exist between the heights of any two stories of the building in which the elevator works.

Referring to the drawings representing my

elevator, Figure 1 is a view in front elevation; Fig. 2, a view in side elevation; Fig. 3, a plan, in section, taken through line *a b* of Fig. 1; Fig. 4, also a plan, in section, taken through line *c d;* Fig. 5, a vertical section of the cataract. Figs. 6 and 7 are, respectively, front elevation and plan views of a modification of my invention, showing the actuating-gear when steam or other motive power is substituted for the hydraulic. Fig. 8 represents mechanism for lengthening or shortening the lifts to correspond to different-height stories. Fig. 9 is a reverse plan view, in detail, of mechanism locking the trunks. Fig. 10 is a detail view of mechanism hereinafter referred to.

Two large trunks, respectively lettered A and B, and preferably in the form of parallelograms, are of height one story less than the height in stories of the building in which the elevator is to work, and are interiorly divided into rooms or compartments corresponding to the same in the building. Each compartment is provided with a door, C, rigidly secured to a hinged bar, D, one to each trunk, the said hinged bar being provided with right-angular lever-arms, *d*, which, engaging with spring-pressed bars E, sliding in and out from either trunk at right angles to their length, hold the doors constantly open, except when the spring-pressed bars are forced in by mechanism afterward described. The two trunks are connected at their tops by a chain or rope, F, passing over an upper pulley, *f*, centrally located between the two, while their bottoms, respectively, engage with plunger-rods *g h* of the hydraulic rams G and H, one to each trunk. These rams connect with pipes *i j*, leading into the valve-chest I, which latter is provided with feed-pipe J and waste-pipe K. Any suitable valve mechanism may be used to govern the feed and exhaust of water with these rams, such as a plain or piston B or D valve.

The slide-valve rod L engages with the upright arm *l* of a rocking shaft, M, which latter is actuated at its inner end by a weighted lever, *m*, and at its opposite outer end by a rod, N, connecting with the double-armed bell-crank lever *n*. The weighted lever *m* connects with a rod, O, which latter engages with a vertically-reciprocating rod, P. Collars *p* are rigidly secured to this rod P at upper and lower extremity of same, which are engaged with by a bracket or bifurcated arm, Q, projecting from the lower extremity of the trunk A situated farthest from the cataract mechanism.

As the trunk A ascends to its highest point the upper collar is engaged by the bracket, and, drawing the connecting-rod O up the rock-shaft M, operates the valve mechanism so as to close all communication of the valve-chest with either of the hydraulic rams; but upon the lowest descent of the trunk A the lower collar on rod P is engaged by the trunk-bracket, and the valve mechanism through the connecting means again closes all communication between the rams and the valve-chest, only in the first instance the valve slides from off the open port leading into ram G, operating trunk A, while in the second instance the valve slides off the open port connecting with ram H. These collars are placed on their vertically-reciprocating rod, in such relation to the trunk-bracket Q as to close these ports at just the accurate time to arrest the trunks and maintain them in proper position, so that the level of their compartments may coincide exactly with the level of the stories of the building, and the trunks are securely held in such position until communication is again opened between the rams and the valve-chest, which latter is operated by the connecting-rod N, as follows:

To either arm extremity of the double-armed bell-crank lever *n*, actuating this connecting-rod, are attached upright rods R and S, one to each arm, and provided, respectively, with right-angular arms *r s*. These latter are alternately pressed downward by the mechanism shown in detail in Fig. 10, and which consists in a collar, T, fitted loosely on the plunger-rod U of the cataract, and having angular arms *t*, one on either side of the same. A disk-wheel, V, provided with a double tapering rim, *v*, on its semicircular face periphery, has a sliding lever, W, working in a guide-way formed on the rear face of the disk, which connects with the lower extremity of the trunk B nearest the cataract.

Two studs, X, are formed on the front face of the disk, both a little to one side of the diametrical line of the same, and as the trunk B rises the sliding lever W turns the disk-wheel from right to left, causing the stud nearer the trunk to engage with the corresponding arm of the collar T, and raise the latter, which carries the plunger-rod U with it, and thus vertically raises the same.

When the trunk B has reached the end of its upstroke, the angular arm of the collar T, formerly engaging with the corresponding stud of the disk-wheel, escapes from or disengages its connection therewith. Upon the descent of the rod the double tapering rim *v* throws the other arm of the collar out from the face of the disk over onto the arm *s* of the upright S, thus causing the latter, by the described connecting mechanism, to operate the valve so as to open the exhaust leading from ram H, thus again placing the latter in operative condition to raise the trunk B another time. The same operation, only in its reverse process, is duplicated in raising and lowering the trunk A, the arm *r* being pressed down by the corresponding arm of the angular collar T.

The vertically-reciprocating rod P, it will be understood, operates at each rise and descent of the trunk A, to control by its connecting mechanism the valve, so as to close all communication of the valve-chest with the hydraulic rams, and thus, between the rise and fall of each trunk, the parts are held in con-

stant position against change, while upon the descent of plunger-rod U the valve opens port connection with the rams with each alternately.

The spring-pressed bars E engage with their respective hinged bars D by the lever-arms 1, connecting with the rigid rods 2, which latter directly operate the bars E. These sliding bars E have each an arm, 3, projecting through the sides of their trunks A and B, and of length sufficient to extend across the backs of the fixed slide-pieces 4, which latter are secured to the frame-work, as shown in Figs. 2 and 4. Springs 5, also secured to each trunk, bear against the arms 3, and thus tend to press the bars E out in projection from the vertical face of the trunks A and B.

Before the elevator can move the doors C must be closed by the hinged bars D, operated by the sliding bars E, which latter are forced in by the friction-rollers Y, journaled on right-angular arms *y* of a rock-shaft, Z. This shaft Z has a short lever-arm, *z*, at its extremity, next to the plunger-rod U, which is operated by an angular arm, *u*, on the latter, so that upon the rise of the rod U pressure is relieved from the rock-shaft Z, and the latter is freed from operation until the doors are again to be closed, corresponding to the movement of the elevator.

During the movement of the trunks the doors C are held closed by the friction-rollers till the arms 3 of the bars E pass behind the fixed slide-pieces 4, and the doors are then held closed by the latter till, under the movement of the trunks, the arms 3 pass from behind the slides 4, and, actuated by their spring-pressure, force out the sliding bars E, and thus again open the doors.

To maintain the elevator against movement of either trunk, a sliding bar, A^1, (shown in detail in Fig. 9,) controls the descent of the rod U by being horizontally moved in a line of direction toward the latter, so as to come under the angular arm *u*, thus effectually locking the rod against its descent until the sliding bar is forced back by a stud on the locking-bar B^1. This latter extends vertically and in central line between the two trunks, and is provided with handles *b'* for each story, so that, upon turning the bar B^1 a quarter of a revolution by means of its handles, the elevator is correspondingly locked or unlocked in its action. The sliding bar A^1 is pressed by the spring *a'*, so that its tendency is to hold the elevator locked until overcome by the unlocking movement of the bar B^1. When the plunger-rod U has descended about one-third of its stroke a pin, C^1, on the said rod operates the tappet-lever *d'*, which in turn engages with the rod D^1 of the relief-valve of the cataract, as afterward appears, so that upon the descent of the rod U the valve-rod D^1 is raised, while upon the rise of the rod U the valve-rod D^1 is pressed down by the spring *c'*. The relief-valve connecting with the rod D^1 is thus raised from its seat upon the descent of the plunger-rod U, and placed again over its seat upon the rise of the same.

The cataract (more clearly shown in Fig. 5) controls the valve mechanism operating the hydraulic rams, and regulates the water-pressure, alternately actuating each of the same, so that the trunks cannot move except as allowed by the time required for the flow of a certain quantity of water through the regulating valve-opening of the cataract. This cataract is made according to the well-known mechanical construction. The vertical pump-barrel E^1 has its foot submerged in water in the cistern or tank F^1, and the plunger-rod U connects with the piston *f'*. The valve-rod D^1 connects with the relief-valve G^1, while *g'* is the regulating valve mechanism.

Upon the rise or upstroke of piston *f'*, the piston rests upon the water, and the regulating-valve *g'*, being suitably set by hand, allows any desired length of time to intervene between the commencement of the descent of the plunger-rod and the raising of the relief-valve, which latter, operating under engagement with the plunger-rod, causes the latter to descend at once, thus closing the doors and changing the slide-valve.

By the downstroke of the piston *f'*, the plunger-rod U, by the described connecting mechanism, opens port connection of the valve-chest alternately with either hydraulic ram, and thus the time for closing the doors C is determined by the regulating-valve mechanism, which latter may be adjusted to correspond with any desired interval of time between the opening and the closing of the doors.

If desirable to hold the elevator stationary for any indefinite length of time not dependent upon the action of the cataract, it may be done by turning the locking-bar B^1 so as to place the sliding bar A^1 beneath the angular arm *u* of rod U, and thus preventing its descent until the bar A^1 is slid back again by suitably operating the locking-bar B^1.

In case any of the stories in the building are of different relative heights, steps may be temporarily used to step from the floor of a story into or out from the compartments of the trunks; but I have devised a mechanical contrivance which works as follows, and is shown in the detail view, Fig. 8: A^2 represents a section of a trunk in which B^2 is a sliding chamber, and is supported by a shaft, D^2, hung in bearings in either side wall of the trunk.

Ropes F^2 connect with the chamber at one extremity, while their upper ends are secured to pulleys E^2, which, together with the large side pulley G^2, revolve with the shaft D^2. The latter pulley, G^2, has the lower end of its rope H^2 secured to wall of the trunk-case, so that when the trunk is raised carrying the shaft D^2, the latter with its three pulleys will be revolved, and since the rope H^2 is wound over its pulley G^2 in an opposite direction to the ropes F^2 wound over pulleys E^2, the rope H^2

will be unwound from off its pulley, and the ropes F^2 will be wound over their corresponding pulleys. Thus the chamber B^2 will be drawn up within its trunk a distance varying inversely with the difference in circumference between the pulleys E^2 and the pulley G^2.

On the other hand, if the chamber is to be lowered instead of raised in its trunk, the rope H^2 should be secured to the wall above pulley G^2, in which instance, upon the rise of the trunk, the chamber would not be raised the same absolute distance as its trunk, and thus, in either event, the difference in height between the stories is compensated readily and automatically, the doors C being constructed to slide vertically on the bars D.

While I have described my elevator as driven by hydraulic pressure, it is evident that other motive power can be substituted in various mechanical contrivances, one of which I show by way of illustration in Figs. 6 and 7. A^3 B^3 are sections of the trunks described. D^3 are four racks secured to the same. E^3 are two pinions gearing into the racks. F^3 is a bevel-wheel upon the pinion-shaft. G^3 and H^3 represent two bevel-wheels, G^3 being keyed onto its shaft I^3, journaled in bearings J^3 K^3. The pulley L^3 is also keyed onto this shaft I^3, while the pulley M^3 and wheel H^3 are keyed onto a sleeve, N^3, revolving loosely on the shaft I^3. The pulley O^3 is also loose. The lever P^3 is connected with the band-shifter Q^3 by rod V^3, and the rod R^3 connects with lever S^3 upon the shaft T^3, while the lower extremity of rod R^3 engages with the weighted lever *m*, before described.

Upon revolving the band v^3 in line of arrow direction the trunk-section A^3 is raised and B^3 lowered until the bracket Q strikes the upper collar *p* of rod P, before described, and by means of the levers *m* P^3 S^3 and rods R^3 V^3 the band v^3 will be shifted to the loose pulley O^3, and thus the elevator would be arrested. The plunger-rod U will now descend, as in the former case, when the mechanical connections before described for operating the valve mechanism will now engage with the belt v^3 instead thereof, and shift the latter over onto the tight pulley L^3. The wheel G^3 will accordingly be set in motion, trunk-section B^3 will be raised, and section A^3 be lowered. The bracket Q will strike the lower collar *p* on rod P, thus shifting the band v^3 over onto loose pulley O^3, to await the descent of the plunger-rod U, when it is shifted onto tight pulley M^3, and the operation of raising and lowering alternately the respective trunks is continuously carried on.

It will be understood that instead of a single pump or cataract, as described, two pumps or cataracts may be used, each of the latter engaging with one of the two trunks by arms projecting from the latter, and engaging with the respective plunger-rods of the pumps by collars located on the latter, so that the said arms may strike the under side of the collars only. In this way the trunks may descend independently of the plunger-rods. Or other similar variation from the mechanism shown may be used without departing from the principle of my invention. So, too, instead of the spring-pressed bars E urging the doors C open, weighted levers may be used, or a small piston may be substituted, by which the doors might be opened noiselessly by having the piston fall on a cushion of air.

If desired, I may secure the doors C loosely to their supporting-bars D, so that the latter may turn or swing independently of the doors, and when the doors, in such instance, are swung open by hand, the back or hinge section of the doors will come against stop-lugs on the said bars D. Some of the doors may thus be shut and others open, while the elevator is still; and it is evident that any one of the doors being thus left open will prevent the movement of the trunks as effectually as if all were simultaneously open.

The weighted lever *m* is provided with slots ranged along its body extremity, which engages with the rod O, so that the latter, connecting with the said slots, may operate the valve mechanism quicker or slower, as may be desired, and the trunks will correspondingly be stopped more gradually or more suddenly, as the case may be.

It is apparent that many different immaterial variations from the mechanism shown may be substituted without departing from the principle or spirit of my invention. So, too, I do not confine the use of my elevator to buildings, as the same may be used to raise and lower articles or persons between points or grounds of level not covered by a roof. Neither is it necessary that the same should work in a vertical straight line, as it equally well can be used placed at an angle to the vertical, as when resting against a side hill or similar inclination.

If desired, I may do away with the doors attached to and moving with the trunks, while doors are placed in a case in which the trunks work, and are stationary, being opened and closed by the mechanism before described, only the fixed slide-pieces 4 would not be required.

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

1. In a hydraulic elevator, the combination of two hydraulic rams with a valve, which latter operates to admit liquid to one of the rams, while at the same time it allows the liquid to escape from the other ram, substantially as and for the purpose set forth.

2. The trunks of an elevator, in combination with independent hydraulic rams and valve mechanism, whereby the movement of the elevator serves to automatically shift the valve, and alternately admit and exhaust pressure from the respective rams, substantially as and for the purpose set forth.

3. The combination, with the trunk-actuating rams and valve mechanism, of the cata-

ract and intermediate engaging connections, substantially as described.

4. The combination, with the trunks alternately actuated by hydraulic pressure, of the connecting sliding rod, the cataract, and the intermediately-engaging disk-wheel, whereby the movement of the said trunks is adjustably regulated, substantially as described.

5. The combination, with the trunk-actuating rams, valve, and valve-rod, of the rock-shaft, the weighted lever, and the connecting mechanism, whereby the valve is operated under the automatic rise and fall of the trunks, substantially as described.

6. The combination, with the trunks and the cataract plunger-rod, of the intermediate engaging mechanism for locking or unlocking the trunks in their vertical movement, substantially as described.

7. The combination, with the trunks and connecting mechanism, of the cataract plunger-rod and the relief-valve rod, the two latter alternating in an intermittent vertical reciprocation at each rise and fall of the trunks, substantially as described.

8. The combination, with the hinged bar rigidly connecting the doors, of the transverse spring-pressed bars, the same operating to automatically open the doors as the elevator reaches its extreme limit of movement, substantially as described.

9. The trunks of an elevator, provided with self-opening doors, automatically locking the same against movement in either direction, substantially as set forth.

10. The combination, with the outwardly spring-pressed doors, of the horizontal rock-shaft and friction-rollers, the latter bearing in against the doors under engagement with the cataract plunger-rod, substantially as described.

11. The combination, with trunk A, carrying bracket Q, of rods O and P and weighted lever *m*, the latter provided with a series of gage-slots, substantially as described.

12. The combination, with trunk B and sliding lever W, of the disk-wheel V, substantially as described.

13. The combination, with the disk-wheel V, having right-angular face-studs, and the double inclined projecting-rim *v*, of the angular collar T and plunger-rod U, substantially as described.

14. The combination, with the vertical locking-bar B^1, provided with suitable handles, of the horizontal spring-pressed bar A^1, engaging with the plunger-rod U, substantially as described.

15. The combination, with the rock-shaft Z, having arms *y*, carrying friction-rollers Y, and lever-arm *z*, of the plunger-rod U, provided with stud *u*, substantially as described.

16. The combination, with the hinged bars D, operating doors C, of the spring-pressed bars E, and rock-shaft Z, the latter carrying friction-rollers, substantially as described.

In testimony that I claim the foregoing I have hereunto set my hand this 13th day of March, 1877.

HENRY DAVIES.

Witnesses:
L. C. BLACK,
W. A. HICKS.