(No Model.) 3 Sheets—Sheet 1.

T. W. HEERMANS.

AUTOMATIC STOP MECHANISM FOR ELEVATORS.

No. 602,660. Patented Apr. 19, 1898.

Fig. 1.

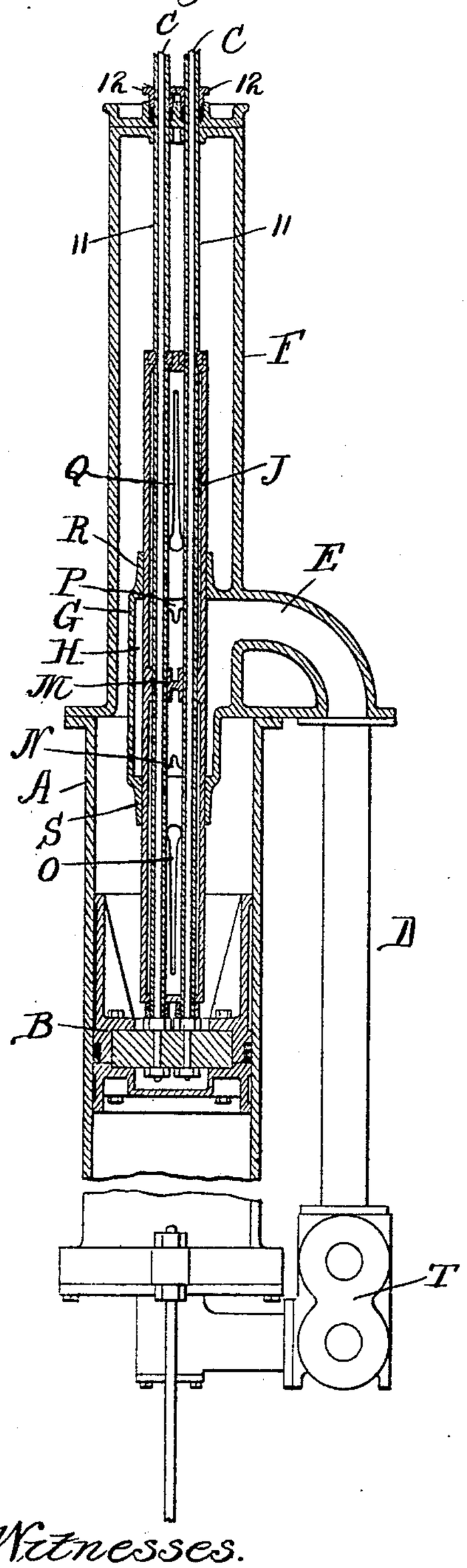
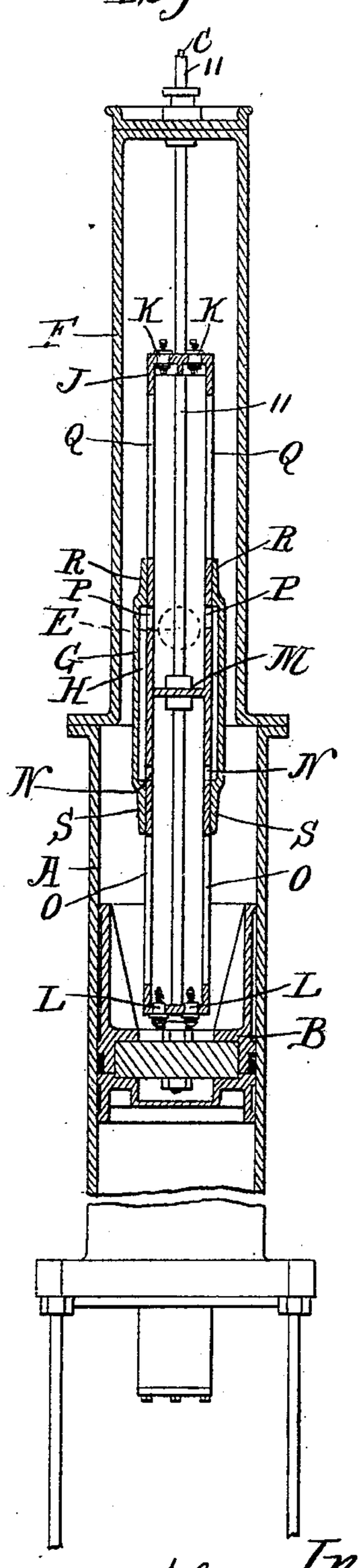


Fig. 2.



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(No Model.) 3 Sheets—Sheet 2.

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Fig. 3.

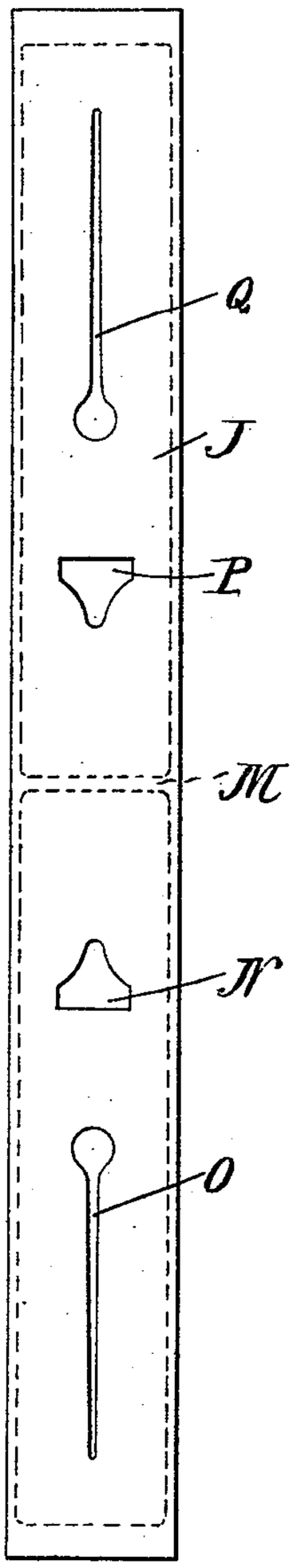

Fig. 4.

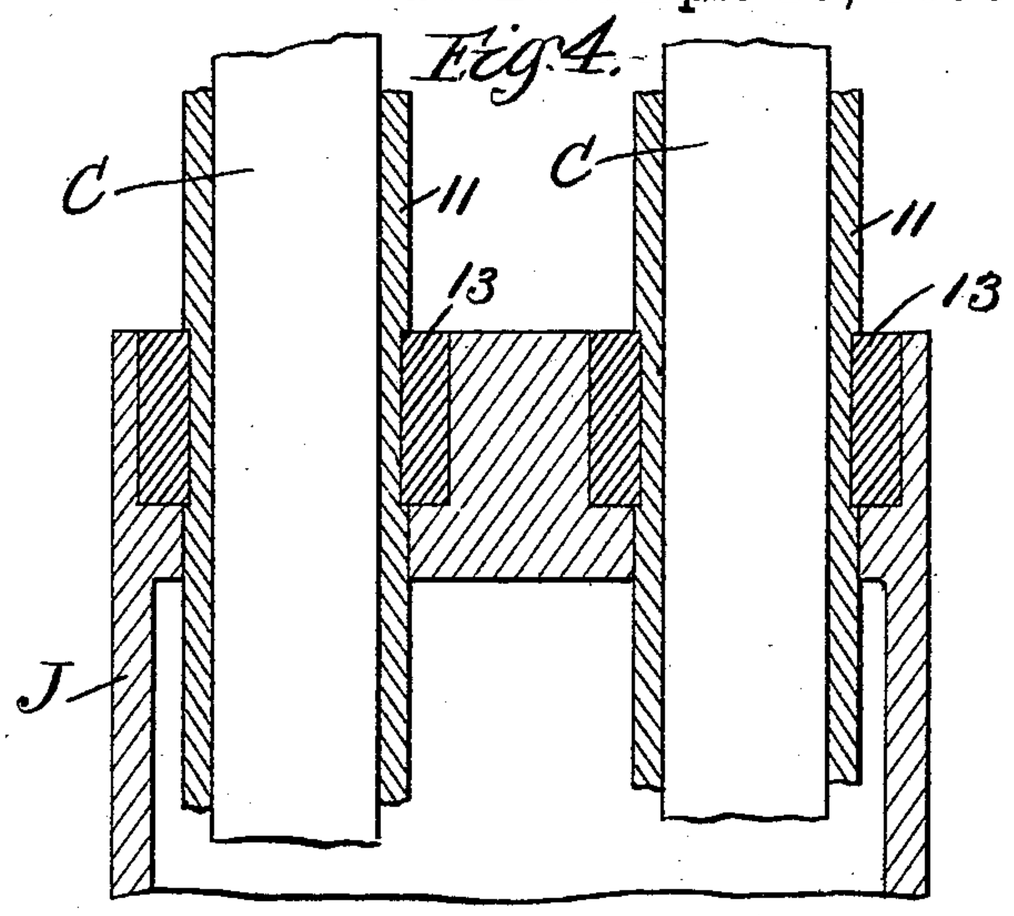

Fig. 5.

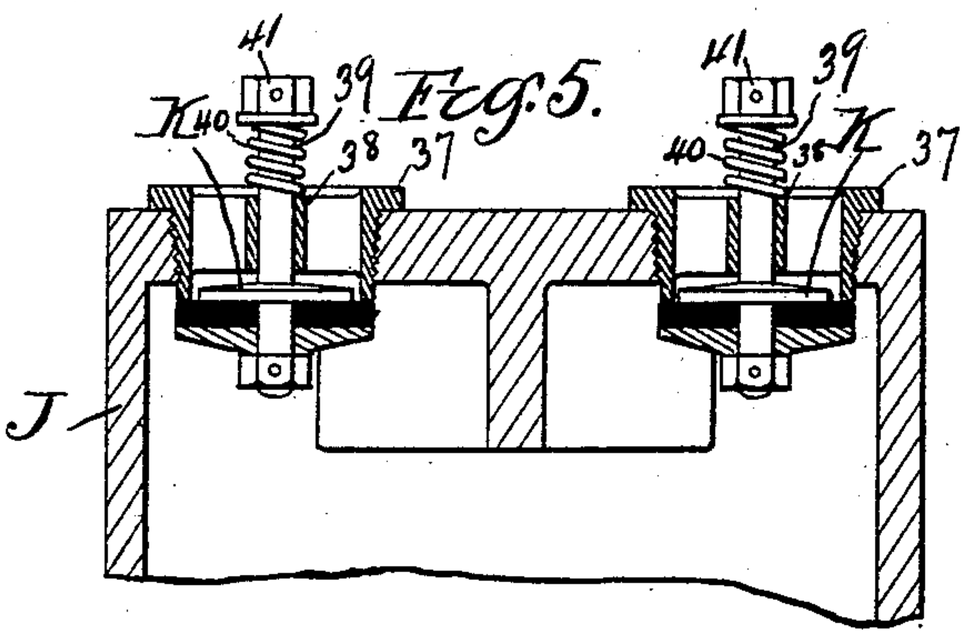

Fig. 6.

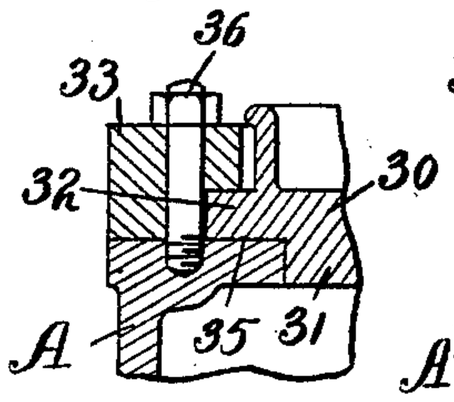

Fig. 7.

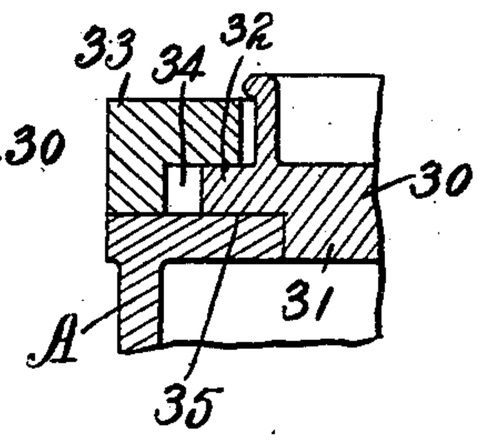

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Fig. 10.

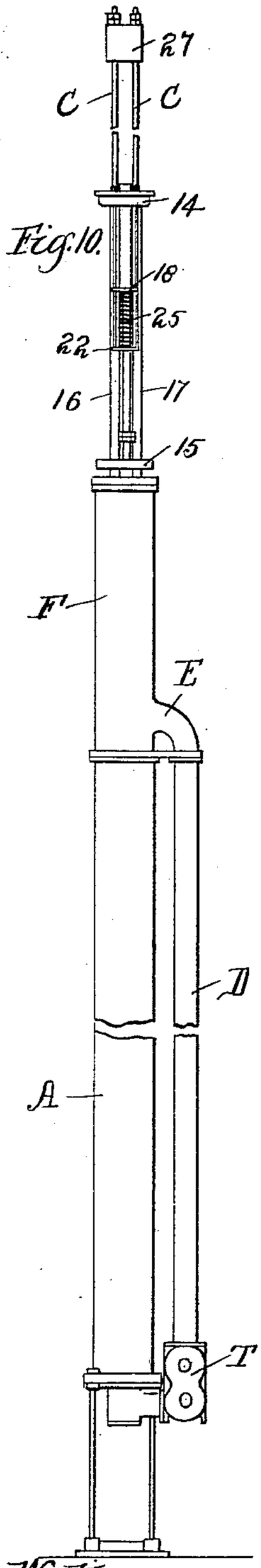


Fig. 8.

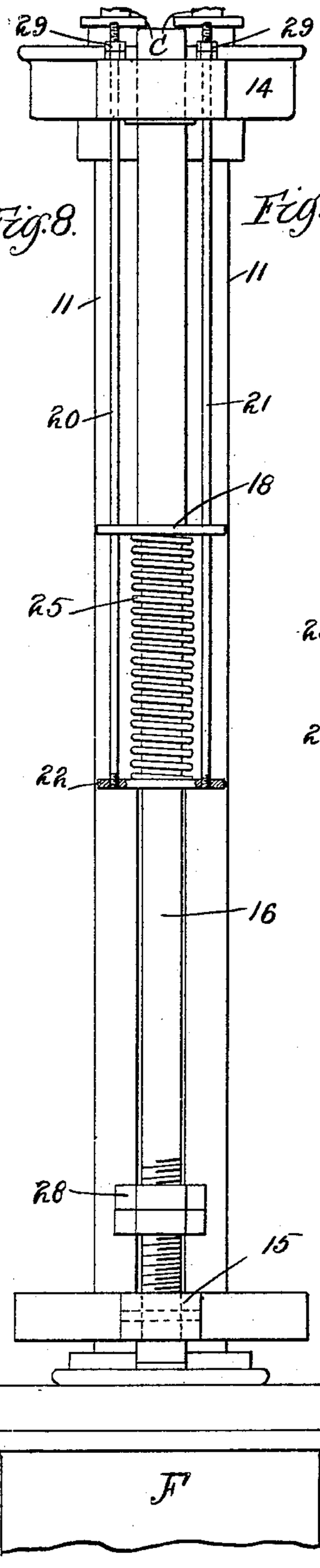
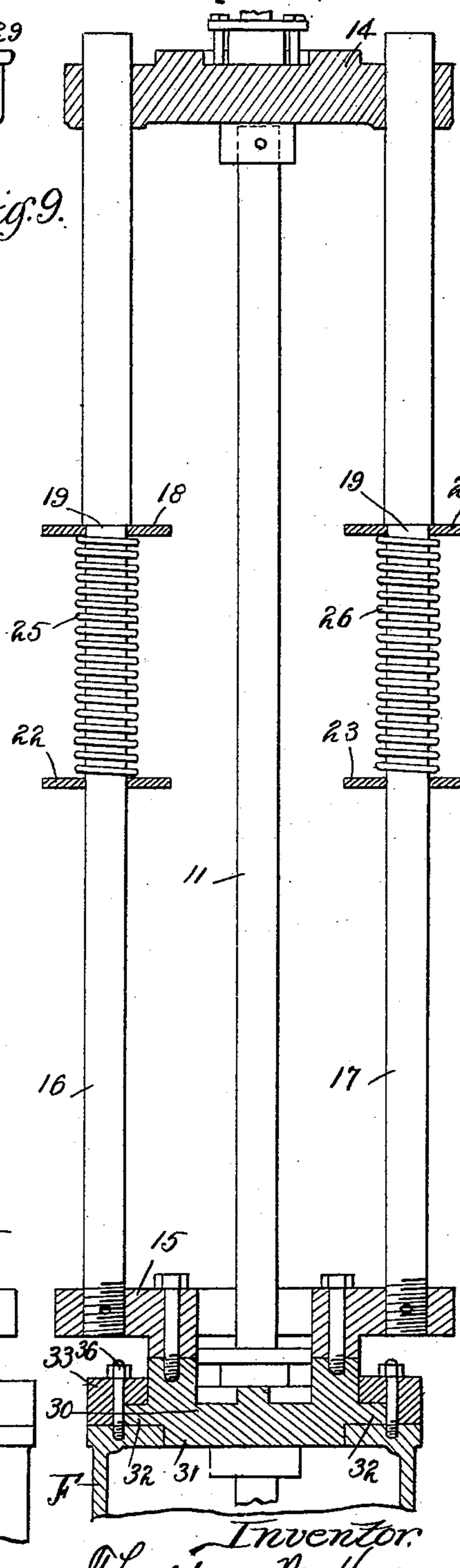


Fig. 9.



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UNITED STATES PATENT OFFICE.

THADDEUS W. HEERMANS, OF CHICAGO, ILLINOIS.

AUTOMATIC STOP MECHANISM FOR ELEVATORS.

SPECIFICATION forming part of Letters Patent No. 602,660, dated April 19, 1898.

Application filed November 4, 1895. Renewed March 25, 1898. Serial No. 675,197. (No model.)

To all whom it may concern:

Be it known that I, THADDEUS W. HEERMANS, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Automatic Stop Mechanism for Elevators, of which the following is a specification.

This invention relates to automatic stop mechanism for elevators.

The object of the invention is to simplify and improve mechanism of this class and to render the same more efficient in operation.

The invention consists, substantially, in the combination, location, and relative arrangement of parts, all as will be more fully hereinafter set forth, as shown in the accompanying drawings, and finally more specifically pointed out in the appended claims.

Referring to the accompanying sheets of drawings and to the various views appearing thereon, Figure 1 is a central longitudinal section of a hoisting-motor cylinder for elevators embodying my invention, parts being in side elevation. Fig. 2 is a view similar to Fig. 1, the section being taken in a plane at right angles to the plane of the section of Fig. 1. Fig. 3 is a detached detail view, in side elevation, of the plunger-cylinder, showing the arrangement of ports therein. Fig. 4 is a broken detail view, in longitudinal section, of the end of the plunger-cylinder upon an enlarged scale. Fig. 5 is a broken detail view, in longitudinal section, of the end of the plunger-cylinder, taken in a plane at right angles to Fig. 4 and showing the plunger-valves. Figs. 6 and 7 are detached detail sectional views of the head of the main cylinder, showing the manner of adjusting the piston-rods. Fig. 8 is a broken view, in side elevation, of the construction for centering the plunger-cylinder, parts being in section. Fig. 9 is a broken view, in front elevation, of the construction shown in Fig. 8, parts being in section. Fig. 10 is a general view of the entire construction.

The same reference sign is used to designate the same part wherever it occurs throughout the several views.

In the drawings, A designates the main cylinder of the hoisting-motor; B, the main piston, to which are secured the piston-rods C.

D is the circulating-pipe, through which the operating medium is introduced to and exhausted from the main cylinder through the port E. In practice and for convenience of construction I make the main cylinder in two parts, as may be shown most clearly in Figs. 1 and 2, and bolt the two parts together. The part F of the main cylinder has arranged therein and preferably formed integrally therewith a cylindrical sleeve or casing G, having centrally the length thereof a large cylindrical recess H, forming a part of the port E. Arranged to fit and to slide in the cylindrical sleeve or casing G is a hollow cylinder J, which I shall call the "plunger-cylinder." This plunger-cylinder has closed ends, in which are arranged the valves K L, the construction, arrangement, purpose, and mode of operation of which will be presently more fully described. A partition M is arranged centrally of the length of the plunger-cylinder J to prevent the passage of the operating medium from one end of said cylinder to the other. Through the shell of each end of the plunger-cylinder J are formed ports or passages N, O, P, and Q, the ports or openings N O being formed in one compartment of the plunger-cylinder and the ports or openings P and Q formed in the other compartment of said cylinder. In practice I prefer to form the ports O and Q of similar shape and contour and to arrange the same nearest the respective ends of the cylinder, and the ports N and P are similar to each other in shape and contour, and they are arranged nearer the partition M and on opposite sides thereof, respectively.

The ports or openings O and Q are preferably elongated, as shown, and tapering in area of opening toward the ends of the plunger-cylinder, and at the ends thereof nearest the partition M are formed into enlarged openings. The ports or openings N P are preferably short and of comparatively large area, rapidly contracting toward the ends thereof presented toward the diaphragm or partition M.

The chamber or recess H in the sleeve or casing G is formed by boring out the interior of said casing or sleeve, thereby leaving the ends R S thereof of just sufficient cross-sectional area as to receive snugly therein the plunger-cylinder, the joint being tight enough

to permit the plunger-cylinder to be slid back and forth therein, but at the same time to prevent the operating medium admitted to said recess from escaping therefrom. The central, or what may be termed "normal," position of the plunger-cylinder is such as to bring the port-openings N P into complete registry with recess H, and the ends of the plunger-cylinder to project beyond the ends R S of casing or slide G for the port-openings O Q to be completely uncovered. This is the position of the parts shown in Fig. 1.

Suppose the parts to be in the position shown in Fig. 1. It will be seen from the foregoing description that when the control-valve T is actuated, for instance, to admit the operating medium to the main cylinder said medium will pass through circulating-pipe D and port-opening E into recess H. The ends R S of casing or sleeve G, fitting tightly the plunger-cylinder, prevent the medium from entering either the main cylinder or the part F thereof except through the ports N P in the plunger-cylinder, which admit the medium from recess H into the interior of the plunger-cylinder, and thence through the ports or openings O Q in the plunger-cylinder to the main operating-cylinder, and also to the part F thereof, thereby causing the main operating-piston B to move in a direction away from sleeve or casing G. Continued movement of the main operating-piston effects, through mechanism presently to be described, a movement endwise and in the same direction of the plunger-cylinder. This endwise movement of the plunger-cylinder through the sleeve or casing G in the same direction of travel of the main operating-piston B results in the following action: The port-opening N is moved into the sleeve S, formed by the end of the casing G, thereby rapidly covering said port-opening, as it is of comparatively short length, and hence cutting off the flow of operating medium from port E and recess or chamber H through said port N, the plunger-cylinder, and ports O therein, into the main cylinder. During this operation the port-openings P remain in register with recess H, so that the entire volume of operating medium admitted to the main cylinder must pass from recess or chamber H through port P, the plunger-cylinder, and port Q therein; but the movement above described of the plunger-cylinder, while it permits the ports P to remain in open communication with recess or chamber H, causes said plunger-cylinder to remove to a position such that the enlarged ends of the ports Q are received in the sleeve R, thereby cutting off a portion of the area of opening of said ports from said plunger-cylinder in the main cylinder. It will also be readily seen that on account of the decreasing area of port-openings Q toward the end of the plunger-cylinder the flow of operating medium into the main cylinder is gradually cut off as the plunger-cylinder advances through the sleeve or casing G, in the manner above described, until finally the entire flow is cut off by the sleeve R, covering said port-openings. The parts are so adjusted and relatively arranged that when this point in the operation of the apparatus is reached the car has arrived at the limit of its travel in one direction, and hence comes to rest easily and smoothly and without jar or bump. In this position the main piston B is at the extreme limit of its travel in a direction away from the sleeve or casing G. The main cylinder and the portion F thereof are filled with operating medium which is under pressure on account of egress thereof being cut off and the weight of the car and its load. Now in order to permit the piston B to move in the opposite direction from this limit of travel—that is, toward the sleeve or casing G—and at the same time to permit it to have a rapid initial movement, so that the car will start off rapidly instead of creeping at the beginning of its movement, the operator on the car actuates the control-valve T in the usual manner to open the circulating-pipe D to the exhaust. The effect of this operation will cause the relief-valves K in the end of plunger-cylinder J to open, it being observed that said relief-valves are mounted to open inwardly for this purpose. This opening of relief-valves K is effected by reason of the pressure of the operating medium in the main cylinder, as above explained, and such unseating occurs the moment the control-valve T is actuated to open the main cylinder to the exhaust. The effect of this is to permit a rapid initial exhaust of the medium from the cylinder, thereby enabling the piston B to move rapidly from the very beginning of its travel in the opposite direction, and hence imparting to the car a rapid initial travel from the limit of its travel in one direction. This is a most important result, and so far as I am aware has never been before accomplished in a commercially-successful and practically-operative apparatus.

From the foregoing description it will be seen that the only path of exhaust during the movement referred to is through the relief or check valve K until the plunger-cylinder J is moved, by mechanism presently to be described and in a direction similar to that in which the piston is moving, into position for elongated ports Q to be uncovered by sleeve R and for ports N to again be brought into communication with chamber or recess H. When this point is reached, the pressure within the main cylinder is sufficiently reduced for the valves K to seat, and the exhaust continues through ports O and Q into the respective ends of the plunger-cylinder J, through ports N and P, chamber or recess H, and port E. The continued movement of piston B and plunger-cylinder J toward the head of section F effects an operation similar in all respects to that above described—that is, the ports P become covered by the sleeve R, and the ports O are gradually covered by the sleeve S as

the plunger-cylinder proceeds upon its travel, thereby gradually cutting off the exhaust of the medium from the main cylinder and consequently bringing the piston, and hence also the car, to rest smoothly and easily and without jar or bump in the other extreme limit of their respective travels. When this point is reached, the main cylinder and the portion F thereof are exhausted, or substantially so, of operating medium and the plunger-cylinder has been so displaced from its normal or control position that all opening to or from the interior of the main cylinder is cut off. When it is desired to move from this limit of travel of piston and car, the operator actuates control-valve T to admit operating medium to recess or chamber H. Thence it enters one end of plunger-cylinder J through ports N and O; but ports O being cut off by sleeve from communication with the main cylinder a pressure is created in plunger-cylinder J, which effects an unseating of valves L, said valves being mounted in the ends of the plunger-cylinder J and arranged similar to valves in the opposite end of said plunger-cylinder, except that the valves L are seated to open outwardly from the plunger-cylinder. The effect of this operation is to cause the main cylinder B, and hence also the car, to move promptly and rapidly from their respective relative limits of travel and in a manner as above described, thereby securing the same desirable advantages and results and avoiding the same objections as above noted.

I will now describe the mechanism for moving the plunger-cylinder and for centering it or returning it to its central or normal position.

The piston-rods C are arranged to pass through the plunger-cylinder J, as shown, and are loosely inclosed in sleeves 11, which are also arranged to pass through plunger-cylinder J and to project out through the head of portion F of the main cylinder, suitable stuffing-boxes 12, through which said sleeves are adapted to slide, being provided in the head of portion F of the main cylinder. The sleeves 11 are rigidly secured in any suitable manner to the plunger-cylinder J, as shown, for instance, in Fig. 4, wherein the head of the plunger-cylinder is shown with countersinks, in which are rigidly held sleeves 13, which in turn are swaged or otherwise fixed upon the sleeves. The piston-rods C are arranged to pass loosely through the sleeves 11, so as to be capable of movement independent of the sleeves. The projecting ends of sleeves 11 are rigidly secured in any suitable manner to a follower-plate 14, through which the piston-rods C are adapted to pass, said follower-plate being arranged to slide up and down said rods.

Upon the head of portion F of the main cylinder is mounted a plate 15, in which are adjustably secured the ends of rods 16 17, the two other ends of said rods being arranged to pass loosely through suitable perforations in follower-plate 14, as clearly shown in Figs. 8 and 9, said rods thereby serving as guides upon which follower-plate may freely slide.

Mounted upon each rod 16 17 to slide freely thereon is a plate 18 24, a shoulder 19, formed on the end of one of said rods, serving as a stop for said plates in one direction, as clearly shown in Fig. 9. Reference signs 20 21 designate rods having one of their ends adapted to pass loosely through perforations in follower-plate 14, and carrying plates 22 23 at their opposite ends, respectively, to which said rods are secured. Springs 25 26 are interposed between plates 18 24 and 22 23, respectively. A cross-head 27 is carried by the piston-rods C.

The operation of this part of my invention is as follows: Suppose the main piston B to move in a direction away from sleeve or casting G. The piston-rods C slide freely through follower-plate 14 and sleeves 11 until the cross-head 27 engages said follower-plate, which, with the plunger-piston J, is moved endwise coincident with the movement of the piston and piston-rods, thereby displacing the plunger-cylinder from its central or normal position in the direction in which the main piston is moving. The rods 16 17 being held stationary, the follower-plate 14 slides thereon and is guided thereby. The parts continue in this arrangement, the follower-plate 14 engaging plates 18 and 24, the plates 22 23 engaging or resting on the head-plate 15, or, if desired, instead of engaging or resting on the head-plate 15 directly I may screw-thread the rods 16 and 17 a portion of the length thereof, as shown, and mount thereon the nuts 28 and arrange the same in the path of movement of the plates 22 23 to engage said plates. This engagement, whether with the head 15 or with nuts 28, causes the springs 25 26 to be compressed as the cross-head 27 continues to move, carrying with it the follower-plate 14 and plates 18 and 24, the ends of rods 20 21 sliding freely through their receiving perforations in follower-plate 14. By adjusting the position of nuts 28 the amount of compression imparted to springs 25 26 may be adjusted.

From the foregoing description it will be seen that during that portion of the movement of cross-head 27 toward the main cylinder before it engages the follower-plate the main piston is moving away from the casing or sleeve G, the plunger-cylinder remaining stationary. As soon, however, as the cross-head 27 engages the follower-plate 14 the plunger-cylinder J begins to be displaced endwise by reason of the rigid connection of sleeves 11 with said follower-plate and said plunger-cylinder, respectively, the displacement of the plunger-cylinder being opposed by the compression of springs 25 26, which tend to return the plunger-cylinder to a normal or central position when such compression is relieved.

A similar operation to that above described occurs when the piston-rods move in the opposite direction—that is, in a direction to

carry the cross-head away from the end of the main cylinder. I will now describe such operation, supposing the parts to be in the position above described—that is, with the plates 22 23 in engagement with stop-nuts 28 or the head of the cylinder and the springs 25 26 compressed to their fullest extent toward the end of the cylinder. This point is reached when the main piston and the car have traveled to one extreme limit of their respective movements. When, therefore, the control-valve is suitably actuated to cause the main valve to be moved in the opposite direction, the first effect will be to cause springs 25 and 26 to be relieved of compression by reason of the coincident movement of the cross-head 27, thereby moving the plunger-cylinder in the same direction as the main piston—that is, to a central or normal position. The parts continue in this arrangement until the main piston B engages the end of said plunger-cylinder and they move together. The plunger-cylinder is thus positively displaced endwise by the engagement therewith of the moving piston B. Continued movements of the follower-plate cause plates 22 23 to be drawn toward the springs 25 26 and plates 18 24, thereby effecting a compression of the springs 25 26 in the same manner and for the same purpose as above described with respect to the movement of the parts in the opposite direction, the plates 18 24 abutting against shoulders 19 upon rods 16 17. By suitably adjusting the nuts 29 the amount of compression imparted to the springs 25 26 may be regulated. This is the position of parts as shown in Figs. 8 and 9.

It sometimes becomes necessary in erecting elevator structures to change the plane in which the piston-rods C travel, in order that the cross-head, as 27, carried thereby may avoid obstructions. I will now describe a construction wherein such change can be readily and easily made to suit the exigencies of any particular case, reference being had to Figs. 6, 7, and 9.

The cylinder-head proper is designated by reference sign 30 and is movably mounted in the open end of section F of the main cylinder. In practice I prefer to provide the head 30 with a cylindrical hub 31, adapted to receive in a circular seat formed in and through the end of the cylinder-section. The head 30 is also provided with a peripheral flange 32, arranged to rest upon the outer surface 35 of the cylinder end. 33 is a ring provided with a seat 34, formed in the edge of one face thereof and adapted to receive the flange 32 of the head. By clamping ring 33 to the cylinder end, as by means of bolts 36, the cylinder-head is tightly secured in place. By loosening the bolts 36 the cylinder-head 30 may be rotarily adjusted to any desired position, and as this head also carried the stuffing-boxes through which the sleeves 11 pass it will be readily seen that a rotary adjustment of said head effects a change in the plane in which the piston-rods reciprocate.

The construction of valves K and L, mounted in the ends of the plunger-cylinder J, is substantially the same, except, as above explained, the valves K are mounted to open inwardly, while the valves L are mounted to open outwardly. A description of one will therefore be sufficient.

Referring to Fig. 5, it will be seen that threaded seats are formed in the end of the plunger-cylinder which are adapted to receive from the outside threaded plugs 37, the inner end of which forms the seat for the valve K. The plug 37 is provided with a central hub 38, through which is adapted to pass the stem 39 of the valve. A spring 40, arranged to bear at one end upon a nut 41, carried by the end of the valve-stem 39, and at the other end upon the hub 38, serves to normally main, tain valve K to its seat.

From the foregoing description it will be seen that the arrangement is such that a stop can be effected at any point intermediate the extreme limits of travel of the car and the direction of travel reversed, the car starting off readily and with a rapid initial movement in the reverse direction.

Many variations in the details of construction, arrangement, and location of parts would readily suggest themselves to persons skilled in the art and still fall within the spirit and scope of my invention. I do not desire to be limited or restricted therefore to the exact details, sizes, proportions, arrangements, or locations shown and described; but,

Having explained the object and nature of my invention and an illustrative embodiment thereof and having explained the construction and mode of operation of such embodiment, what I claim as new and of my own invention, and desire to secure by Letters Patent of the United States, is—

1. In an elevator apparatus, the combination of a main cylinder and piston, and a plunger independent of said piston arranged to operate in said cylinder, and provided with port-openings arranged to control the admission to and from said main cylinder; as and for the purpose set forth.

2. In an elevator apparatus, a main cylinder and piston, in combination with a movable plunger independent of said piston arranged to operate in said cylinder, and provided with port-openings and means adapted to be actuated by said piston for displacing said plunger to control the admission to and exhaust from said main cylinder; as and for the purpose set forth.

3. In an elevator apparatus, a main cylinder and piston, in combination with a hollow plunger having closed ends and provided with port-openings through the shell thereof, arranged and adapted to control the admission to and exhaust from said main cylinder; as and for the purpose set forth.

4. In an elevator apparatus, a main cylinder and piston, a movable plunger independent of said piston and provided with port-openings of varying area, said plunger arranged to control admission to and exhaust from said main cylinder; as and for the purpose set forth.

5. In an elevator apparatus, a main cylinder provided with the usual port-opening, a main piston, a plunger independent of said piston arranged between said port-opening and said cylinder and provided with ports adapted to control the admission to and exhaust from said main cylinder, said plunger adapted to be actuated by said main piston; as and far the purpose set forth.

6. In an elevator apparatus, a main cylinder, provided with the usual port-opening, a main piston, a plunger independent of said piston arranged between said port-opening and said cylinder and provided with ports of varying area, and means actuated by said main piston for moving said plunger, whereby said ports are brought into communication with said port-opening thereby controlling the admission to and exhaust from said main cylinder; as and for the purpose set forth.

7. In an elevator apparatus, a main cylinder, a plunger provided with ports, means for normally maintaining said plunger in position for the ports therein to open communication between said cylinder and the exhaust and supply, and means for displacing said plunger, whereby the exhaust or supply may be cut off; as and for the purpose set forth.

8. In an elevator apparatus, a main cylinder, a plunger provided with ports of varying area, means for normally maintaining said plunger in position for the ports therein to open communication between said cylinder and its exhaust and supply, and means for displacing said plunger, whereby the exhaust or supply is gradually cut off; as and for the purpose set forth.

9. In an elevator apparatus, a main cylinder, an open-ended casing arranged in said cylinder in communication with the cylinder supply and exhaust, a plunger provided with ports arranged to travel through said casing and adapted to control communication between the casing and the cylinder; as and for the purpose set forth.

10. In an elevator apparatus, a main cylinder, an open-ended sleeve or casing arranged therein, and in communication with the cylinder supply and exhaust, a plunger provided with ports and arranged to travel back and forth in said sleeve or casing, and adapted to control communication between said casing or sleeve and the cylinder; as and for the purpose set forth.

11. In an elevator apparatus, a main cylinder, an open-ended sleeve or casing arranged therein and in communication with the cylinder supply and exhaust, a plunger provided with ports and arranged to move through said sleeve or casing, and means for displacing said plunger relative to said sleeve or casing, whereby the cylinder supply and exhaust are controlled; as and for the purpose set forth.

12. In an elevator apparatus, a main cylinder, an open-ended casing or sleeve formed therein and in communication with the cylinder supply and exhaust, a plunger arranged to move through said sleeve or casing, and provided with graduated ports, and means for moving said plunger relative to said sleeve, whereby the supply or exhaust is gradually cut off; as and for the purpose set forth.

13. In an elevator apparatus, a main cylinder, a casing or sleeve formed therein and in communication with the cylinder supply and exhaust, a plunger provided with closed ends and having ports formed through the shell thereof arranged in said sleeve or casing, and means for moving said plunger relative to said casing, thereby controlling the cylinder supply and exhaust; as and for the purpose set forth.

14. In an elevator apparatus, a main cylinder, a casing or sleeve formed therein and in communication with the cylinder supply and exhaust, a plunger provided with closed ends, and having ports formed through the shell thereof, means for moving said plunger through said sleeve or casing, whereby said ports are covered or uncovered and valves arranged in said plunger; as and for the purpose set forth.

15. In an elevator apparatus, a main cylinder, a casing or sleeve formed therein and in communication with the cylinder supply and exhaust, a plunger provided with closed ends and having ports formed through the shell thereof, means for moving said plunger through said sleeve or casing, whereby said ports are covered or uncovered, valves mounted in each end of said plunger, the valves at one end being arranged to open inwardly, and those at the other end arranged to open outwardly; as and for the purpose set forth.

16. In an elevator apparatus, a main cylinder, a plunger having closed ends arranged therein, and having a partition formed therein midway the length thereof, port-openings formed in each end of said cylinder, and means for covering and uncovering said port-openings; as and for the purpose set forth.

17. In an elevator apparatus, a main cylinder, a plunger arranged therein and having a partition formed therein midway the length thereof, port-openings formed in each end of said plunger, and relief-valves mounted in each end of said plunger; as and for the purpose set forth.

18. In an elevator apparatus, a main cylinder, a plunger provided with port-openings adapted to control the supply to and exhaust from said main cylinder, a piston and piston-rods, and means actuated by the movement of said rods for displacing said plunger; as set forth.

19. In an elevator apparatus, a main cylinder, piston and piston-rods, a plunger having

port-openings, adapted to control the admission to and exhaust from said main cylinder, said plunger arranged to operate within said main cylinder, and means actuated by the movement of the main piston for displacing said plunger.

20. In an elevator apparatus, a main cylinder, piston and piston-rod, a plunger having port-openings, adapted to control the admission to and exhaust from said main cylinder, valves mounted in said plunger, and means actuated by the movement of said piston for displacing said plunger; as and for the purpose set forth.

21. In an elevator apparatus, a main cylinder, piston and piston-rod, a plunger arranged within said main cylinder, and having port-openings adapted to control the admission to and exhaust from said main cylinder, means for normally holding said plunger in position to open communication between said main cylinder and its supply and exhaust, and means arranged to be actuated at the limits of travel of said piston for shifting said plunger; as and for the purpose set forth.

22. In an elevator apparatus, a main cylinder and piston, a plunger arranged within said main cylinder and provided with port-openings, springs arranged to hold said plunger in position to open said main cylinder to its supply or exhaust, and means for displacing said plunger against the action of said springs at each limit of stroke of said piston; as and for the purpose set forth.

23. In an elevator apparatus, a main cylinder, piston and piston-rod, a plunger having port-openings adapted to control the admission to and exhaust from said main cylinder, rods mounted on said main cylinder, a follower-plate arranged to slide on said rods, rigid connections between said plate and said plunger, and a cross-head mounted on said piston-rods adapted to engage said follower-plate and move said plunger; as and for the purpose set forth.

24. In an elevator apparatus, a main cylinder, piston and piston-rods, a plunger having port-openings adapted to control the supply to and exhaust from said main cylinder, stationary rods, a follower-plate mounted to slide thereon, rigid connections between said follower-plate and said rods, a cross-head carried by said piston-rods, adapted to engage said follower-plate and displace said plunger, and springs arranged to return said plunger-cylinder to its normal position; as and for the purpose set forth.

25. In an elevator apparatus, a main cylinder, piston and piston-rods, a plunger having port-openings, adapted to control the supply to and exhaust from said main cylinder, shouldered stationary rods, a follower-plate mounted to slide thereon and rigidly connected to said plunger, rods loosely passing through said follower-plate, and rigidly secured to plates, other plates mounted upon said stationary rods and adapted to abut against the shoulders thereon, springs interposed between said last-mentioned plates, said follower-plate adapted to be moved at the limits of travel of the main piston; as and for the purpose set forth.

26. In an elevator apparatus, a cylinder constructed in sections, one of said sections forming the main operating-cylinder, and the other of said sections having a sleeve formed therein adapted to receive a plunger, said plunger provided with port-openings adapted to control the supply to and exhaust from said main cylinder; as and for the purpose set forth.

27. In an elevator apparatus, a plunger, having port-openings and inwardly-opening valves at one end thereof and port-openings and outwardly-opening valves at the other end thereof in combination with a cylinder and piston; as and for the purpose set forth.

In witness whereof I have hereunto set my hand this 31st day of October, 1895.

THADDEUS W. HEERMANS.

Attest:

M. I. CAVANAGH,

S. E. DARBY.