No. 619,350. Patented Feb. 14, 1899.

H. ROWNTREE.

DOOR OPERATING MECHANISM.

(Application filed Mar. 7, 1898.)

(No Model.) 2 Sheets—Sheet 1.

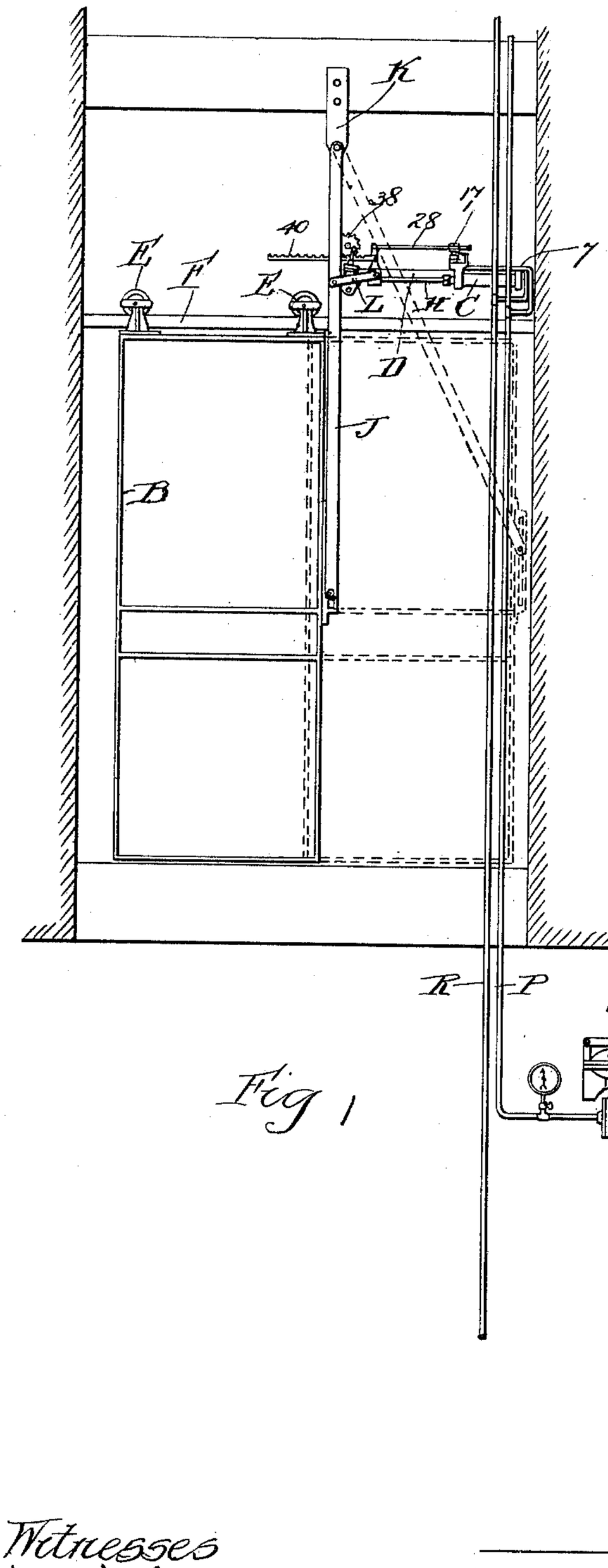

Fig. 1

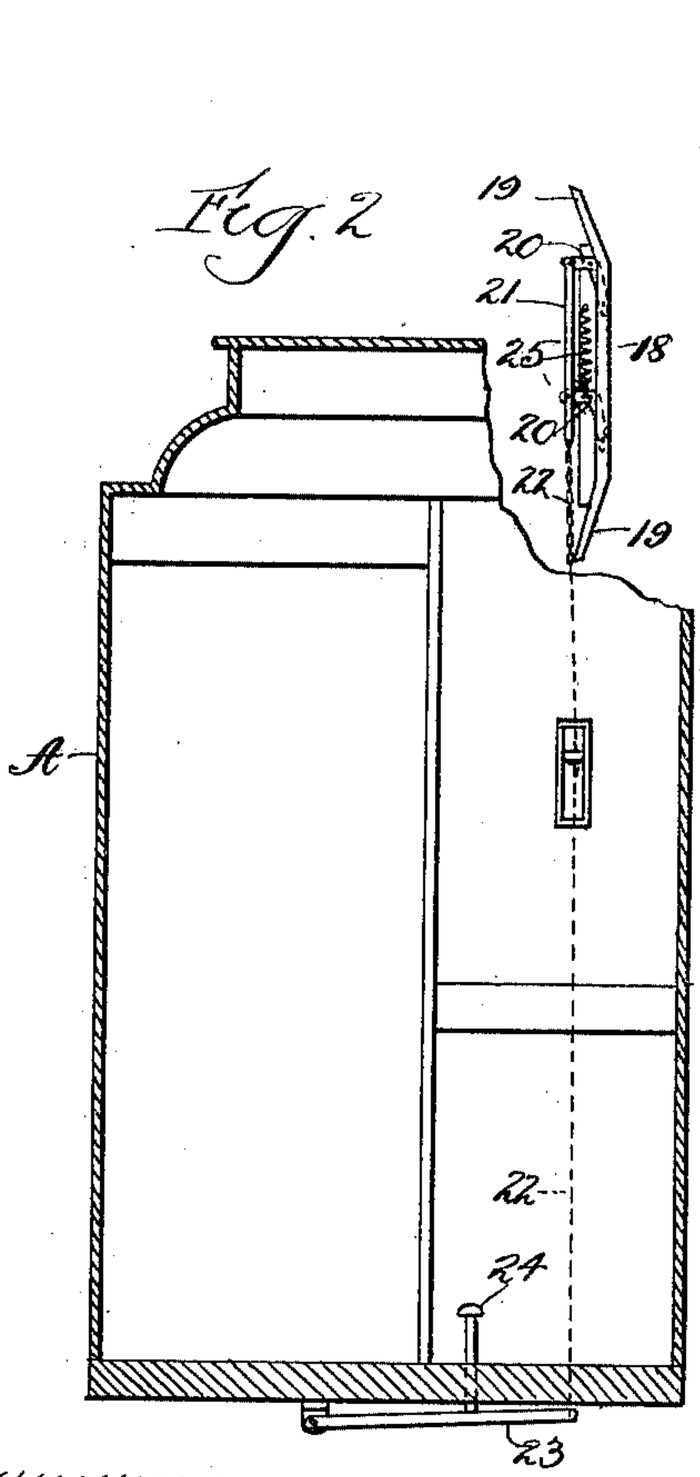

Fig. 2

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Fig. 5.

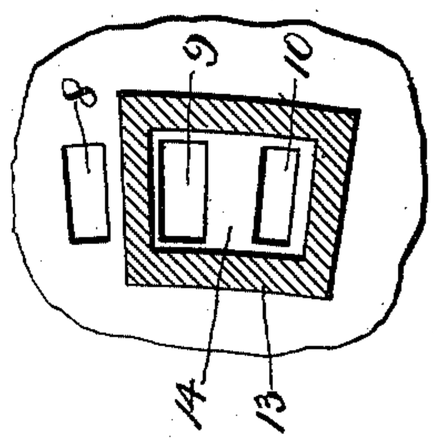


Fig. 3.

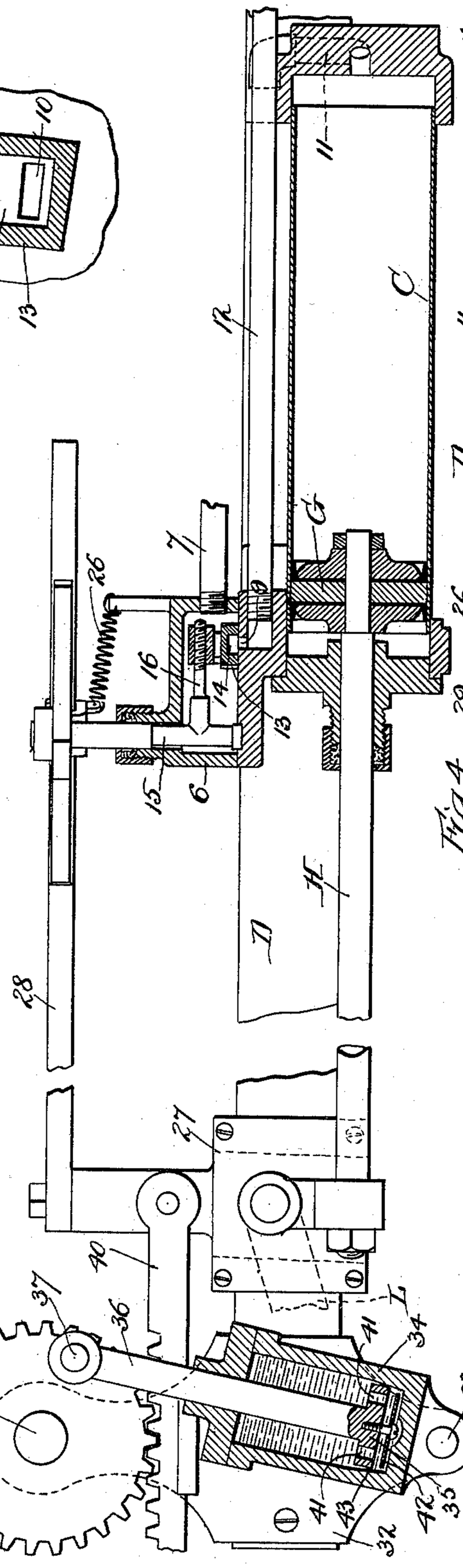
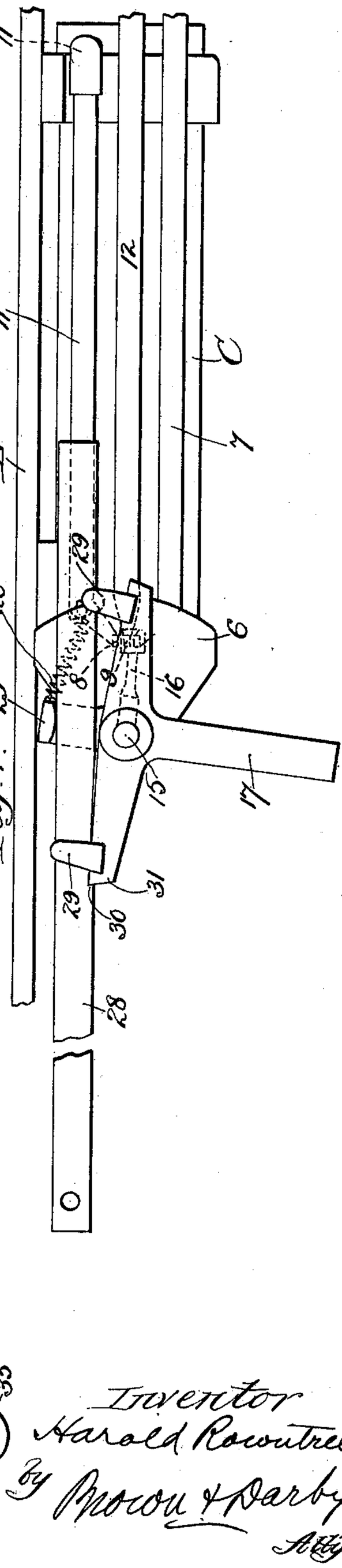


Fig. 4.



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UNITED STATES PATENT OFFICE.

HAROLD ROWNTREE, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE BURDETT-ROWNTREE MANUFACTURING COMPANY, OF SAME PLACE.

DOOR-OPERATING MECHANISM.

SPECIFICATION forming part of Letters Patent No. 619,350, dated February 14, 1899.

Application filed March 7, 1898. Serial No. 672,962. (No model.)

To all whom it may concern:

Be it known that I, HAROLD ROWNTREE, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Door-Operating Mechanism, of which the following is a specification.

This invention relates to door-operating mechanism.

The object of the invention is to provide efficient means for operating doors, and particularly the doors at the landings of elevator-shafts.

A further object of the invention is to provide means for efficiently cushioning the door as it approaches the limits of its movements.

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

Referring to the accompanying drawings and to the various views and reference-signs appearing thereon, Figure 1 is a view in elevation illustrating the general arrangement of apparatus embodying the principles of the invention as applied to the operation of the doors at a landing of an elevator-shaft. Fig. 2 is a view in vertical section of a car, showing the arrangement of trip mechanism for throwing the door-operating mechanism into action. Fig. 3 is a detail view, parts in side elevation and parts in longitudinal section, showing the mechanism for operating the door and also the means for cushioning the door at the limits of its movements. Fig. 4 is a detached broken detail view, in top plan, of a portion of the construction shown in Fig. 3. Fig. 5 is a detached detail sectional view illustrating the arrangement of valves through which the door-operating mechanism is controlled.

The same part is designated by the same reference-sign wherever it occurs.

In the arrangement of apparatus for automatically operating doors or gates at railway-stations or in elevator service, and particularly in the latter case, it is important to provide means for operating the doors or gates which are controllable from the car and which may be thrown into action from the car only when it is desired to operate the door. For instance, in the case of elevator service it is desirable to provide means under the control of the elevator-conductor whereby the door at any particular landing of the elevator shaft or well may be opened only when the car arrives at that particular landing. It is also of importance to provide means for efficiently cushioning the door in its movements to open or closed position in order to avoid slamming, whereby the door may be opened or closed easily, noiselessly, and without shock. It is the special purpose of the present invention to provide means for accomplishing these results in a simple and efficient manner.

In the accompanying drawings, illustrating an arrangement of apparatus embodying the principles of the invention, reference-sign A designates an elevator-car, B the door at a landing of the elevator-shaft, and C a cylinder suitably supported upon a bar or beam D, fixed in the framing of the elevator-shaft. The door B may be mounted in the framing of the elevator shaft or well to operate in any desired manner. In the particular form shown the door B is mounted upon hangers E, suitably supported upon a beam F, whereby said door may slide back and forth. Arranged within cylinder C is a piston G, having a rod H, from which suitable connection is made to the door, whereby when said piston G is moved within cylinder C the door is operated or moved correspondingly.

Many different forms of connections between the door and piston H may be adapted for use in connection with the invention. A simple and efficient arrangement is shown wherein a lever J is pivotally connected at one end to a bracket or in any other suitable or convenient manner, as at K, and is loosely and slidingly connected at the other end thereof to one edge of the door. A link L pivotally connects piston H to lever J at a point intermediate the ends of such lever.

From the foregoing description it will be seen that when piston G is moved back and forth within cylinder C the door B will be

moved through the described connections back and forth into open or closed position, according to the direction in which said piston is moved.

The piston G may be actuated under any convenient form of pressure, whether steam, water, or compressed air. Preferably I employ compressed air for the purpose stated, and in Fig. 1 I have shown a system wherein compressed air is employed and wherein reference-sign O designates a compressed-air reservoir, to which air is supplied through pipe connection N from a suitable air-pump M. Communicating with reservoir O is a supply-pipe connection P, which is arranged to extend throughout the entire length of the elevator shaft or well. A suitable pressure-regulator Q may be employed to regulate the pressure supplied to supply-pipe P. An exhaust-pipe R is also arranged to extend throughout the length of the elevator shaft or well.

In the application of the principles of my invention to the operation of doors at the landings in an elevator shaft or well it will be understood that an operating-cylinder C is located adjacent to each door or landing throughout the elevator shaft or well, the piston in such cylinder being suitably connected, as above described, to the door at the same landing therewith. Therefore both the supply-pipe P and the exhaust-pipe R are in suitable connection with the cylinder at each door to be operated. This connection is shown generally in Fig. 1 and more in detail in Figs. 3 and 4, wherein reference-sign 6 designates an inclosed valve-casing into which the supply-pipe connection 7 delivers. Arranged within valve-casing 6 are three port-openings 8, 9, and 10. Port-opening 10 opens communication between the chamber of valve-casing 6 and one end of cylinder C—for instance, the left-hand end of said cylinder as viewed in Fig. 3 and at a point on the left-hand side of piston G. Port-opening 8 communicates through a pipe connection 11 with the opposite end of the cylinder C, while port-opening 9 establishes communication between the interior or chamber of casing C and the exhaust-pipe R through pipe connection 12. A valve 13 is arranged to control the port-openings 8, 9, and 10. This valve may be of any suitable form or construction, but preferably and as shown provided with a recess 14 on the face thereof arranged to bring exhaust-port opening 9 into communication with either of the port-openings 8 or 10 when said valve is suitably moved. In the particular arrangement shown valve 13 occupies a position such as to establish communication between port-openings 9 and 10, thus leaving port 8 uncovered. Under this arrangement cylinder C is exhausted from its left-hand end and air-pressure is supplied thereto at the right-hand end through connection 11 from the chamber of casing 6. Therefore piston G will be at one of its extreme limits of movement. When, however, valve 13 is shifted so as to establish communication between ports 8 and 9, the reverse of this condition will be established—that is to say, the right-hand end of cylinder C will be opened to exhaust and the left-hand end of such cylinder will be opened to the supply-pressure, and hence piston G will be moved to the opposite limit of its travel from that shown in Fig. 3.

Many specifically different arrangements of apparatus may be employed for operating valve 13. In the particular form shown, to which, however, the invention is not limited, I suitably journal a rock-shaft 15 in valve-casing 6, and the valve is connected in any suitable or convenient manner to an arm 16 of said rock-shaft. Rock-shaft 15 is arranged to project through valve-casing 6, and mounted thereon is a trip-arm 17, through which said rock-shaft, and hence said valve, is actuated. This trip-arm may be operated or rocked by any suitable arrangement of means controllable from the car. In the particular form shown, to which, however, the invention is not limited, I mount on each car a trip-bar 18, having the inclined or bent ends 19, and suitably supported, as shown in Fig. 2, upon the ends of bell-crank levers 20. These bell-crank levers are suitably connected at their other ends, as through a bar 21, to which is connected a chain, rope, or other connection 22, leading to a lever 23, arranged to be operated in any suitable or convenient manner by the elevator-conductor, as through the foot-treadle 24. Spring 25 normally holds trip-bar 18 retracted into such position as to permit the car to pass a landing without engaging trip-arm 17 at that landing. If, however, it be desired to operate the door-operating mechanism at any particular floor or landing, the elevator-conductor will press treadle 24 when the car approaches that particular landing, thereby rocking lever 23, and hence through connections 22 and 21 rocking bell-crank levers 20 in a direction to project trip-bar 18 against the action of spring 25 and into position to engage trip-lever 17 at the particular landing or floor the door of which is to be operated The bent ends 19 of trip-bar 18 facilitate the easy engagement of trip-bar 18 with trip-arm 17.

From the foregoing description it will be seen that through means controllable from the car trip-arm 17 may be rocked to throw into action the door-operating mechanism at any particular or desired floor or landing of the elevator shaft or well and whether the car is ascending or descending. The rocking movement of trip-arm 17 is normally opposed by a spring 26, the action of which is to hold said trip-arm, and hence rock-shaft 15 and valve 13, in position to normally open one end of cylinder C to exhaust and the other end thereof to the supply-pressure, whereby piston G is held normally in one limit of its movement. This limit of movement corresponds to the closed position of the door. Therefore

in their normal condition the parts are arranged to normally close the doors, and when the apparatus is thrown into action through the rocking of trip 17 the door will be opened.

In order that the piston-rod H may be suitably steadied and guided in its movements, I connect said piston-rod to a cross-head 27, mounted to slide back and forth upon supporting bar or beam D. An arm 28 is connected to move with cross-head 27, and trip-arm 17 is provided with lugs, (indicated at 29,) arranged to embrace or engage said bar 28 in order to hold said arm and prevent the same from being accidentally thrown out of position. Bar 28 is provided with a notch or seat, (indicated at 30,) into which a projection 31 of trip-arm 17 engages when the parts are in their normal position—that is, when the door is closed—thereby locking the door in its closed position. Thus it will be seen that all the doors throughout the elevator shaft or well are normally in their closed position and are locked against movement until trip-arm 17 is rocked, and the means for rocking said trip-arm, as will be seen from the foregoing description, are controllable from the car.

I will now describe the arrangement for cushioning the door as it approaches either of the limits of its movements. Upon a bracket 32, suitably mounted on a fixed part of the framing—as, for instance, upon bar or beam D—is pivotally mounted at one end, as at 33, a cylinder 34, in which operates a piston 35, suitably formed on or connected to a piston-rod 36, arranged to project through the end of said cylinder and pivotally connected, as at 37, to a crank-pin mounted upon the face of a gear-wheel 38, said gear-wheel being suitably journaled in bracket 32. Suitably connected to cross-head 27 is a rack-bar 40, the teeth of which are arranged to engage the teeth of gear 38, whereby when said cross-head is moved said gear 38 is rotated. Cylinder 34 is intended to contain a non-compressible fluid—such, for instance, as glycerin, water, or other suitable liquid—and piston 35 is provided with a series of openings therethrough. A flap or disk 32 is loosely mounted upon the end of piston 45 for movement relative thereto.

From the foregoing description it will be seen that when piston 35 moves toward the upper end of cylinder 34 the fluid will readily pass through the openings in said piston, thus offering but slight resistance to the upward movement of said piston. Upon the downward movement of said piston, however, flap or disk 42 will immediately close said openings, and hence prevent the passage of fluid through openings, and forcing such fluid to pass between the peripheral edge of piston 35 and the inner wall of cylinder or chamber 34, said piston being of smaller external diameter than the internal diameter of said cylinder. By forcing the liquid contained in cylinder or chamber 34 to pass around the edges of cylinder 35 instead of freely through the openings a cushioning resistance is secured, which enables the door to be brought easily to the limit of its travel or movement, and in order that a cushioning effect may be secured at each limit of movement of the door the size and relative arrangement of gear 38 and rack 40 are such that when the main door-operating piston G travels from one end of main cylinder C to the other the cushioning-piston 41 will make a complete excursion from one end of cylinder or chamber 34 to the other end and back again.

Instead of the arrangement above described for securing a cushioning of the door as it nears the limit of its travel, or in conjunction and in coöperation therewith, the lower end of chamber or cylinder 34 may be slightly contracted in internal diameter, as indicated at 43, whereby the fluid contained in said cylinder or chamber is more closely confined at the extreme end of said cylinder, thereby securing an increased cushioning effect.

Of course it will be understood that the space, or rather the relative size, of cushioning-piston 41 is suitably proportioned to the amount of cushion desired.

From the foregoing description it will be seen that when main controlling-piston G approaches the limit of its movement in one direction the cushioning-piston 41 is also approaching the limit of its stroke toward the cushioning end of cylinder 34, and when the main controlling-piston G is approaching the other limit of its stroke the cushioning-piston will also be coincidently approaching the same or cushioning end of cylinder 34, as before; but when the controlling-piston G is at the middle of its stroke the cushioning-piston will be at the opposite limit or end of cylinder 34. Therefore during the first half of the stroke of the controlling-piston G in either direction practically no resistance is offered to the proper operation of the door; but from this point onward a resistance is offered to the operation of the door. This resistance may be made to gradually and steadily increase, and this increase in resistance may be effected in either of two different ways. For instance, piston 41 can be made to travel at a speed coincident with the speed of travel of main controlling-piston G, and the cushioned cylinder or chamber 34 may be made of decreasing internal diameter, as above stated and as indicated at 43. From this arrangement it will be seen that the opening for the escape of the fluid around the edge of cushioning-piston 41 gradually decreases as said piston approaches the cushioning end of said cylinder or chamber, thus increasing the resistance offered to the movement of the door. Instead of this arrangement, however, or in conjunction and in coöperation therewith the speed of cushioning-piston 41 may be accelerated with reference to the speed of the controlling-piston G. This acceleration of speed may be secured in any suitable or convenient manner—

for instance, by suitably regulating the relative location and arrangement of the parts in such manner that when the main or controlling piston G is about midway its stroke the crank-pin connection 37 is at a dead-point with respect to the axis of rotation of gear 38 and with the cushioning-piston at the top limit of its stroke. At this point it will be observed that piston 41 travels at a comparatively slow speed with respect to the speed of travel of piston G; but when piston G approaches the end of its stroke the speed of the stroke of piston 41 is increased, because crank-pin connection 37 has passed beyond its dead-line, and therefore much greater resistance is offered as the speed of piston 41 increases. Thus in both cases a gradually-increasing resistance is secured, thus securing a perfect cushioning of the door as it approaches the limits of its movement in either direction. Many changes, variations, and alterations in the details of construction and arrangement would readily suggest themselves to persons skilled in the art and still fall within the spirit and scope of my invention. While therefore I have shown and described a specific arrangement and embodiment of the principles of my invention, I do not desire to be limited or restricted thereto; but

What I do claim as new and useful and of my own invention, and desire to secure by Letters Patent of the United States, is—

1. In an elevator, the combination of a door, a cylinder and piston actuated by fluid-pressure, said piston operatively connected to the door, whereby when said piston is actuated said door is moved, a second cylinder and piston operatively connected to the door, said second cylinder adapted to contain a non-compressible fluid, whereby the door is cushioned as it nears the end of its travel, and means for increasing the cushioning effect as the door approaches the limits of its movements, as and for the purpose set forth.

2. In an elevator, the combination of a door, a cylinder and piston actuated by fluid-pressure and operatively connected to the door, a cushioning cylinder and piston operatively connected to the door, and means for accelerating the speed of travel of said cushioning-piston as it approaches the limit of its stroke, whereby the fluid contained in said cushioning-cylinder will offer increased resistance to the motion of the door as it nears the end of its travel, as and for the purpose set forth.

3. The combination with a door, of means for operating the door, a cushioning-cylinder, connections between the piston of said cylinder and said door, and means for accelerating the speed of travel of said cushioning-piston as the door approaches the limits of its movements, as and for the purpose set forth.

4. The combination with a door, of a cylinder and piston, connections between said piston and door, whereby when said piston is moved in said cylinder said door is moved to open or closed position, a cushioning-cylinder having a piston, and connections between said cushioning-piston and said operating-piston and adapted to increase the speed of the cushioning-piston as it approaches the limits of its stroke, whereby as the door approaches the limits of its travel it is cushioned, as and for the purpose set forth.

5. The combination with a door, of an operating cylinder and piston, and connections between said piston and door whereby when said piston is operated said door is opened or closed, a cushioning cylinder and piston, and connections between said cushioning-piston and said operating-piston whereby when said operating-piston moves from one limit to the other said cushioning-piston makes a complete excursion from one end of the cushioning-cylinder to the other and back again, as and for the purpose set forth.

6. The combination with a door, of an operating cylinder and piston, connections between said operating-piston and the door, a cushioning cylinder and piston, said cushioning-cylinder adapted to contain a non-compressible fluid, said cushioning-piston being perforated, connections between said cushioning-piston and said operating-piston whereby when the latter moves from one limit of travel to the other said cushioning-piston makes a complete excursion from one end of said cushioning-cylinder to the other and back again, and means for closing the openings in said cushioning-piston when said piston moves in one direction and arranged to uncover said openings when said cushioning-piston moves in the opposite direction, as and for the purpose set forth.

7. The combination with a door, of an operating cylinder and piston, connections between said piston and the door, a cushioning cylinder and piston, a gearing actuated coincidently with the movements of the operating-piston for actuating said cushioning-piston, as and for the purpose set forth.

8. The combination with a door, of an operating cylinder and piston, connections between said piston and the door, a cushioning cylinder and piston, and gearing intermediate said cushioning-piston and operating-piston, whereby as the latter approaches the limits of its travel in either direction the movements of said cushioning-piston are accelerated, as and for the purpose set forth.

9. The combination with a door, of an operating cylinder and piston, connections between the door and said piston, a gear-wheel upon the face of which the rod of said cushioning-piston is pivotally connected, and a rack actuated coincidently with the movements of said operating-piston for rotating said gear, as and for the purpose set forth.

10. The combination with a door, of an operating cylinder and piston, connections between the door and said piston, a cushioning cylinder and piston, means actuated by the movements of said operating-piston for reciprocating said cushioning-piston, said

means arranged to move said cushioning-piston from one end of said cushioning-cylinder to the other and back again during the travel of said operating-piston from one limit to the other, said cushioning-cylinder contracting in internal diameter at one end thereof, as and for the purpose set forth.

11. The combination with a door, of a cushioning cylinder and piston, said piston fitting loosely in said cylinder and provided with openings therethrough, a flap-valve arranged to cover and uncover said openings, said flap-valve being loosely connected with respect to said piston, means for operating said door, and connections between said operating means and said piston whereby the movements of the door are resisted as the door approaches the limits of its movement, as and for the purpose set forth.

12. The combination with a door, of an operating cylinder and piston, connections between said piston and door, a valve for controlling said cylinder, a trip-arm for said valve, means carried by the car for operating said trip-arm, said trip-arm when in normal position arranged to lock the door in closed position, and means for cushioning the door as it approaches the limits of its movements, as and for the purpose set forth.

13. The combination with a door, of an operating cylinder and piston, connections between said piston and the door, a valve for controlling said cylinder, a trip-arm for actuating said valve, said trip-arm when in normal position arranged to lock the door in closed position, means carried by the car for operating said trip-arm, and means actuated by the movements of said operating-piston for cushioning the door as it approaches the limits of its travel, as and for the purpose set forth.

14. The combination with a door, of an operating cylinder and piston, a cross-head actuated by said piston, connections between said cross-head and door, a bar carried by said cross-head and provided with a notch, a valve for controlling said cylinder, a trip-arm for operating said valve, said trip-arm provided with a projection arranged to enter the notch in said bar, whereby the door is normally locked in closed position, as and for the purpose set forth.

In witness whereof I have hereunto set my hand, this 5th day of March, 1898, in the presence of the subscribing witnesses.

HAROLD ROWNTREE.

Witnesses:
FRANK T. BROWN,
S. E. DARBY.