Sept. 18, 1928. 1,684,433

W. B. CROWELL

ELEVATOR DOOR OPERATING MECHANISM

Filed June 21, 1923 2 Sheets-Sheet 1

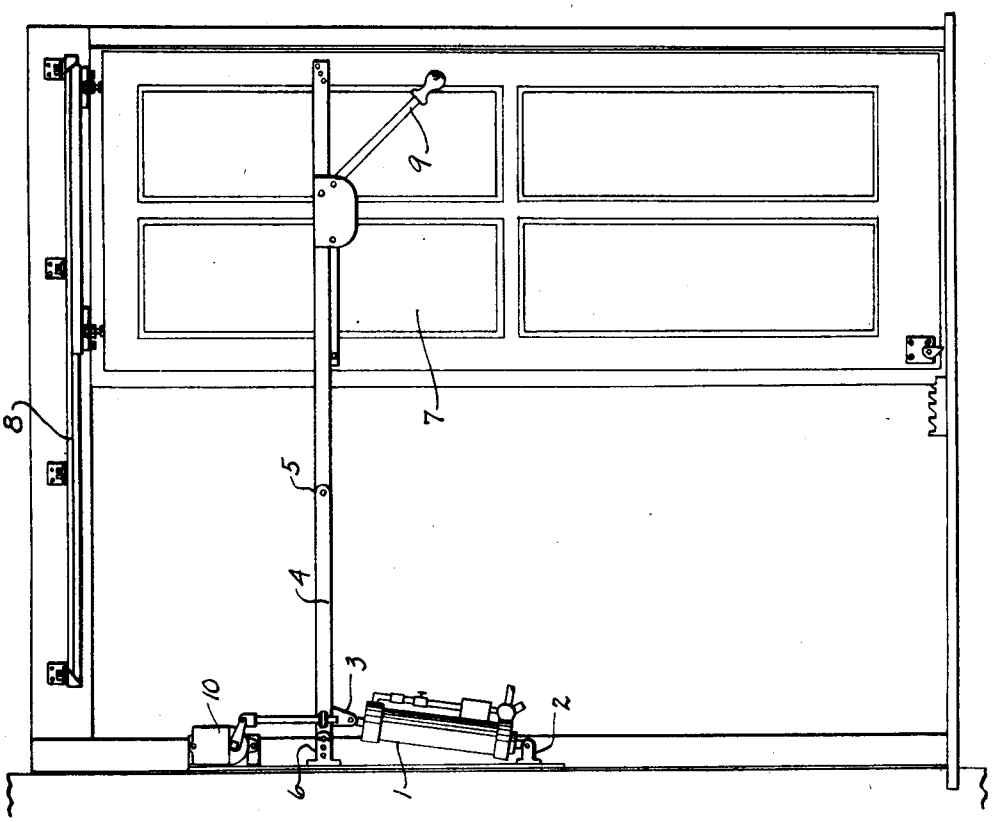


Fig. 1

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Fig 2

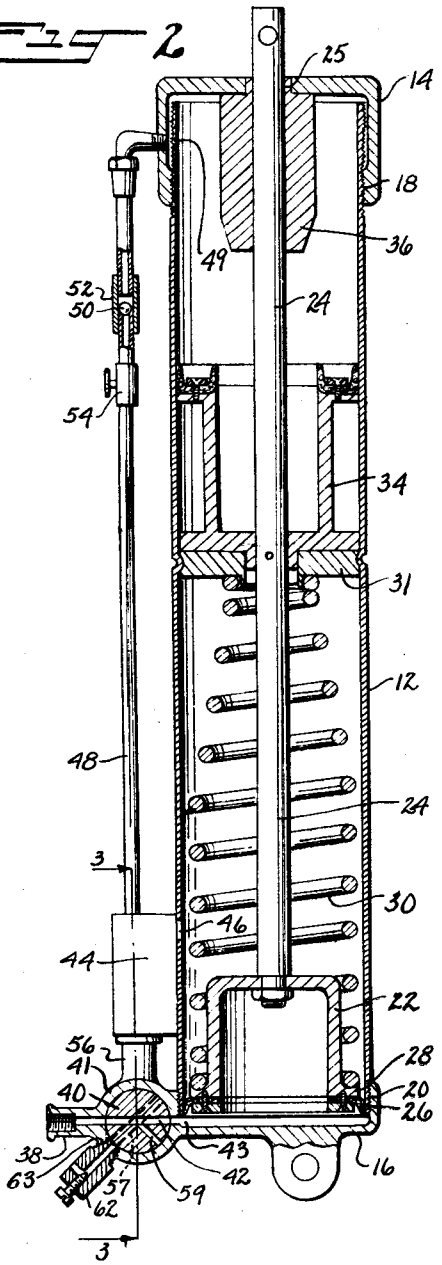


Fig 4

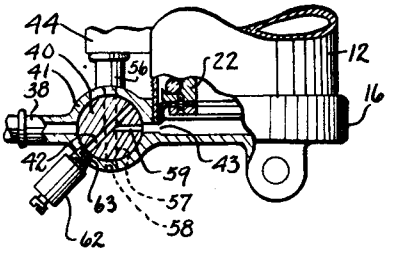


Fig 3

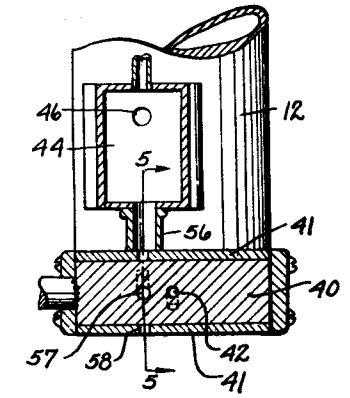
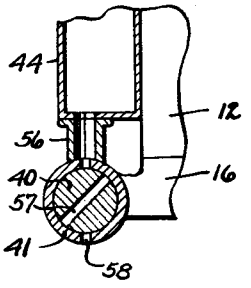


Fig 5



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ELEVATOR-DOOR-OPERATING MECHANISM.

Application filed June 21, 1923. Serial No. 646,780.

The present invention relates to a door-operating mechanism, and more particularly to a fluid pressure actuated device in which cushioning action is attained in the movements of the mechanism by means of a portion of the operating pressure fluid.

In the operation of elevator doors, one of the first requisites is safety in operation, and in order to attain such safety elevator doors are generally manually operated. Such manual operation results in a loss of operating speed and also places an unnecessary burden upon the elevator operators. Because of the heavy work in connection with the handling of elevator doors, it is the common practice to employ men for such operation, although it would be preferable in many cases to employ women for this type of work. With power operation of the elevator doors it becomes practical to employ women for the general elevator operation. Various devices have heretofore been suggested for power operation of elevator doors so as to overcome the heavy manual operation, but none of the devices have proved entirely satisfactory as far as I am aware.

Among the objects of the present invention are:

To provide a means for operating elevator doors and other mechanisms in which any desired speed of operation may be attained.

To provide a means for operating elevator doors and other mechanisms in which the operation of the mechanism takes place with a yieldable force so that in case of an object obstructing the movement of the mechanism, the mechanism may be halted without the application of an unduly great force.

To provide cushioning means in a power-operated mechanism in which the operating fluid may be employed to attain cushioning or checking action and thus avoid the use of extraneous liquids or fluids.

To provide a power-actuated means for operating elevator doors and other mechanisms which is simple in operation and which may be adapted to be installed with the form of elevator door-operating mechanism now generally employed.

With these and other objects in view, the invention comprises the various features hereinafter described and more particularly defined in the claims.

The various features of the invention will be described in connection with the accompanying drawings, in which—

Fig. 1 is a view of the device as applied for actuating elevator doors;

Fig. 2 is a sectional view in elevation of the preferred form of the invention;

Fig. 3 is a fragmentary sectional view taken on the line 3—3 of Fig. 2 showing the control valve in position for admission of pressure fluid to the operating cylinder;

Fig. 4 is a fragmentary sectional view of the lower portion of the operating cylinder showing the control valve thereof in exhaust position, and

Fig. 5 is a sectional view through the exhaust chamber, exhaust pipe and control valve of the cylinder showing the position of the main exhaust port in the valve when the valve is in the position shown in Fig. 1 for admission of fluid pressure.

The present invention is particularly adapted for the operation of elevator door mechanisms, although it is to be understood that the device may be employed and adapted for the operation of other mechanisms, such, for example, as signal devices, in which a rapid action together with cushioning in the movements of the mechanism is required. For the purpose of illustrating the preferred mode of application of the invention, a device embodying the features thereof is shown in Fig. 1 in operative position as applied to the toggle levers of an elevator door.

The numeral 1 designates the operating device which is pivotally supported at one end upon a bracket 2 attached to an elevator hatchway, and is connected through its piston rod to a lug 3 on a link 4 of a toggle lever 5. The toggle lever 5 is pivotally attached at one end to a bracket 6 on the elevator hatchway and is pivotally connected at its other end to an elevator door 7, as shown in the drawings. The elevator door is supported in the usual manner on rollers adapted to move on an overhead track 8. In order that the door may be manually operated in case of failure of power, a handle 9 is provided which is connected to the toggle levers in the usual manner. Should the door be manually operated, without applying compressed air or other operating fluid to the power mechanism, the device will operate merely as a door check and provide cushioning or checking action in the opening and closing movements of the

door. A switch 10 operatively attached to the toggle lever 5 is connected in the elevator operating circuit, and serves to break the controller circuit when the elevator door is opened.

The preferred form of the invention comprises a cylinder casing 12 having an upper head 14 and a lower head 16 which are attached to the cylinder preferably by means of screw-thread connections 18 and 20. In the cylinder is a piston 22 having a piston rod 24 connected thereto, the piston rod being adapted to pass upwardly through an opening 25 in the upper head 14 of the cylinder. The piston 22 may be of any suitable form, but I prefer the use of a hollow cup piston of the form shown in the drawing having a flange 28 which is adapted for holding a spring 30 which surrounds the piston rod 24 and is held in place at its upper end by means of a partition 31 in the cylinder. This spring 30 is compressed as the piston 22 moves upwardly in the opening movement of the door. The resulting compression of the spring 30 stores energy in the spring, and this energy thus stored is sufficient to cause a return movement of the piston 22 to its lowermost position when atmospheric pressure prevails below the piston. Attached to the face of the piston 22 is a leather washer 26 by means of which a smooth sliding action between the piston and cylinder is attained and which serves also to prevent leakage of pressure fluid between the piston and cylinder walls.

The piston 22 may be actuated in its forward movement by means of pressure fluid which is admitted below the piston through a port 43 in the cylinder head 16. Attached to the cylinder head 16 and preferably integral therewith is a valve casing 41 within which is a valve 40 to control admission of operating fluid to the cylinder. Connected to the valve casing 41 is a nipple 38 to which an operating fluid conducting pipe may be attached. A passageway or port 42 in the valve 40 serves to conduct fluid to the port 43 when the valve is turned so as to permit passage of fluid. The operation of the valve may be controlled by means such, for example, as a manually operated lever having stops whereby the lever may be readily placed in position for admission or cut-off. In addition to controlling admission and cut-off of the operating fluid, the valve may also be employed for controlling the exhaust of operating fluid from the operating cylinder in a manner to be more fully described.

In order to attain cushioning action for the forward stroke of the piston, I provide means for by-passing a part of the pressure fluid after a predetermined movement of the piston in the cylinder, and utilizing the by-passed fluid for opposing the forward movement of the piston. For the purpose of by-passing fluid, I provide a chamber 44, preferably attached to a cylinder near the lower end thereof above the valve casing 41. The external chamber 44 communicates with the cylinder casing 12 through a port 46, and with the upper end of the cylinder casing by means of a pipe or conduit 48 through a port 49 in the upper head 14. Attached to the piston rod 24 in the end of the cylinder to which fluid is by-passed, is a second piston 34, which may be of any form adapted to slide in the cylinder and provide cushioning action by means of the fluid between the piston and cylinder head. I preferably employ a piston of the cup plunger type and provide a stationary plunger 36 attached to the cylinder head 14, which will pass into or be enveloped by the cup piston in its upward stroke. The cup plunger is adapted to seat on the partition 31 when the piston 22 is in its lowermost position in the cylinder. A leather cup washer is provided at the top of cup plunger 34 to prevent leakage of pressure fluid between the plunger and cylinder walls and also to provide a smooth sliding contact between the inner walls of the cup plunger and the plunger 36 attached to the cylinder head. By means of the conduit 48 pressure fluid is passed from the portion of the cylinder below the piston, after movement thereof to uncover the port 46, to the chamber between the cup plunger and the cylinder head 14, and provides cushioning action for the forward stroke of the piston. The passage of fluid through the conduit 48 is regulated by means of a regulating throttle valve or reducing valve 54 by means of which any desired pressure drop may be attained from the piston end of the cylinder to the plunger end thereof. In order to permit passage of fluid only in one direction through the conduit, I provide a check valve of any suitable form such, for example, as a ball valve shown in Fig. 2 of the drawings, comprising a ball 50 held in place in the conduit by means of a coupling sleeve 52.

In order to provide for exhaust of pressure fluid from the piston end of the cylinder during the return stroke of the piston from its uppermost position to the point at which the port 46 is again covered, an exhaust pipe 56 is connected to the chamber 44. Any suitable means of control through the exhaust pipe 56 may be provided, but I preferably connect the pipe with the valve casing 41 so that exhaust and admission may be controlled by the same valve. In the valve 40 I provide a port 57, and in the valve casing 41 I provide a corresponding port 58 so that when the valve is in exhaust position there will be a free passage through the ports from the chamber 44 to the atmosphere. During the return movement of the piston from the port 46 to the lower end of the cylinder, communication with chamber 44 is cut off, and the residual pressure fluid in the cylinder is gradual-

ly exhausted therefrom through the port 43 and a passage 59 which communicates with passage 42 which in the exhaust position is turned so as to communicate with an exhaust opening 63 in the valve casing, as shown in Fig. 4 of the drawings. The residual fluid in the cylinder is thereby compressed and a cushioning of the piston is thereby attained. A regulating screw 62 is secured in the exhaust opening 63 in the valve casing 41 by means of which the exit of operating fluid may be controlled and by which any desired cushioning pressure within certain limits may be attained during the return movement of the piston to the piston end of the cylinder.

The operation of the device is as follows:

Compressed air or other pressure medium is passed through the nipple 38 through a port 42 in the valve 40 and is admitted to the lower end of the cylinder below the piston therein. A pressure of from 35 to 70 pounds may be used, which in the operation of elevator doors will give a satisfactory speed of operation, and will be more rapid than would normally be obtained by manual operation. By the admission of pressure fluid the piston 22 is moved upwardly against the force of the opposing spring 30, and the cup plunger or cushioning piston 34 in the upper part of the cylinder moves upwardly, causing an initial slight compression of the air or pressure medium in the chamber between the cup plunger and the cylinder head 14. After the piston 22 has moved upwardly in the cylinder to a point where the port 46 is uncovered, pressure fluid passes through the port 46 and upwardly through the pipe 48, through the regulating valve 54, past the ball check 50 and into the plunger end of the cylinder through port 49 in the cylinder head 14. By the time the port 46 is uncovered by the piston 22, the cup plunger has moved upwardly around the plunger 36 so that only the area of the upper part of the cup plunger carrying the leather washer 35 is subjected to the fluid pressure. As the piston moves upwardly beyond the port 46, more and more pressure fluid passes into the plunger end of the cylinder causing an increase of pressure on the cup plunger and consequently a greater cushioning action until the end of the stroke is reached. By holding the valve 40 in position for admission the piston is retained in its upper position and the door mechanism is thereby maintained in open position. When it is desired to close the door, a valve 40 is turned so that communication between the cylinder and the pressure fluid pipe is cut off and the exhaust port 57 is turned into exhaust position as indicated in Fig. 4. In this position exhaust takes place from the cylinder through port 46 into chamber 44, through pipe 56 and port 58 in the valve casing while the port 46 is uncovered. In this position of the valve 40 the passage 59 registers with the inlet port 43, and the passage 42 communicating therewith registers with the port 63, controlled by regulating screw 62. The resulting pressure drop below the piston 22 permits the spring 30, aided by the fluid under pressure remaining in the upper portion of the cylinder above the plunger 34, to return the piston 22 to its lowermost position. During this return movement of the piston 22 in the cylinder, the pressure fluid is at first exhausted through port 46, chamber 44, pipe 56, a passage 57 in the valve 40, and into the atmosphere through the exhaust port 58 in the valve casing. As soon as the piston 22 moves by the port 46 in its return stroke, further exhaust through the main exhaust passageway is prevented, and the pressure fluid is entrapped in the lower or piston end of the cylinder, causing a cushioning action in the return stroke. A gradual exhaust of pressure fluid from the lower end of the cylinder is permitted, however, through the regulating screw 62, by means of which the speed of action of the piston at the end of its stroke, or the amount of cushioning action, may be controlled. The final exhaust of pressure fluid takes place through the port 43, passage 59, passage 42, and into the atmosphere through the regulating screw.

While the form of the invention which has been described constitutes the preferred form thereof, it is to be understood that various changes or modifications may be made in the apparatus without departing from the spirit or scope of the invention. In place of the cup plunger and plunger to attain cushioning action in the forward stroke of the piston, for example, I might employ an ordinary piston to attain the same result by entrapping air at the end of the cylinder. In place of the chamber 44, to connect the port 46 with the main exhaust port and with the upper end of the cylinder, I might employ separate conduits for this purpose, and in place of a single valve for controlling admission and exhaust, I might employ separate independent valves, or valves which are connected so as to be inter-dependent in their movements.

Having thus described the invention, what is claimed as new is:

1. In a device of the class described, a cylinder, a piston therein, means for operatively connecting one of said parts to a mechanism to be operated, means for admitting pressure fluid to operate said piston in one direction, spring means for opposing the said fluid pressure and for returning the piston when the said fluid pressure is released, a cup and plunger in the cylinder for cushioning the movements of said piston, a conduit connected to the lower portion of the cylinder and adapted to conduct fluid to the cup and plunger to produce cushioning action during the pressure fluid operated stroke of the piston, means for releasing the fluid pressure on

the piston, and means for entrapping a portion of the operating fluid to attain cushioning action during the return stroke of the piston.

2. In a device of the class described, a cylinder, a piston in the cylinder, means for connecting one of said parts to a mechanism to be operated, means for admitting pressure fluid to said cylinder on one side of said piston for the purpose of moving said piston in one direction, means for by-passing to the opposite side of said piston a portion of said pressure fluid after a predetermined movement of the said piston to cushion the movement thereof, an exhaust passage for exhausting a portion of said pressure fluid after the admission of pressure fluid to the first named side of said piston has been cut off, means for temporarily retaining a remaining portion of said pressure fluid in said cylinder to cushion the return movement of the piston, and means for exhausting the said remaining portion of the fluid from the cylinder at substantially the end of the return movement of said piston, whereby oscillating movement of the said mechanism is prevented.

3. In a device of the class described, a cylinder, a piston, means for connecting one of the said parts to a mechanism to be operated, means for admitting pressure fluid on one side of the piston, a spring for opposing the movement of said piston, means for by-passing a portion of said fluid after a predetermined movement of the said piston to cushion the movement thereof, an exhaust passage for exhausting piston-operating fluid, and means for gradually exhausting the last portion of fluid from the cylinder to attain cushioning action of the piston on the return stroke thereof.

4. In a device of the class described, a cylinder, a piston in the cylinder, means for connecting one of the parts to a mechanism to be operated, means for admitting pressure fluid to said cylinder on one side of said piston, a spring for opposing movement of the piston by fluid pressure, a cup and plunger in the cylinder to provide cushioning action for said piston, a conduit connecting the plunger end of the cylinder with a port in the cylinder at a point intermediate the ends thereof whereby pressure fluid will be admitted to the plunger end of the cylinder when in the movement of the piston the said port is placed in communication with the operating pressure fluid, an exhaust conduit connecting the said port, a valve in said conduit having a port therein through which the pressure fluid may be exhausted from the exhaust conduit, the said valve having a second port which is restricted serving to gradually exhaust pressure fluid from the piston end of the said cylinder after the said piston has passed the said port in its return movement.

5. In a device of the class described, a cylinder, a piston in the cylinder, means for operatively connecting one of the parts to a mechanism to be operated, means for admitting pressure fluid to one side of the piston, a spring for opposing the said fluid pressure and for returning said piston when the fluid pressure is released, a plunger in the cylinder at one end thereof, a cup operatively connected to the piston and adapted to cooperate with said plunger to cushion the movement of the piston in the direction of the plunger, an external chamber communicating with the cylinder intermediate its ends, a conduit connecting said chamber with the cylinder at the plunger end thereof, an exhaust conduit from said chamber, means to control the exhaust from said conduit, and means for cushioning the return stroke of the piston.

6. In a device of the class described, a cylinder, a piston in the cylinder, means for operatively connecting one of the parts to a mechanism to be operated, means for admitting pressure fluid to one side of the piston, a spring for opposing the said fluid pressure and for returning said piston when the fluid pressure is released, a plunger in the cylinder at one end thereof, a cup operatively connected to the piston and adapted to cooperate with said plunger to cushion the movement of the piston in the direction of the plunger, an external chamber communicating with the cylinder intermediate its ends, a conduit connecting said chamber with the cylinder at the plunger end thereof, a check valve in said conduit, and means in said conduit for regulating the pressure of fluid passing therethrough, an exhaust conduit from said chamber, means to control the exhaust from said conduit, and means for cushioning the return stroke of the piston.

7. In a device of the class described, a cylinder, a piston in the cylinder, means operatively connecting one of the parts to a mechanism to be operated, a valve controlling admission of fluid pressure to said cylinder to operate the piston in one direction, a coil spring for operating said piston in the opposite direction, a second piston in said cylinder for cushioning the movement of the first named piston, a chamber external to said cylinder, a port in said cylinder communicating with said external chamber, a conduit between said external chamber and said cylinder at a point between said second piston and the adjacent cylinder end and adapted upon movement of the first mentioned piston a predetermined distance, to establish communication between opposite ends of the cylinder to provide cushioning fluid for said second mentioned piston, an exhaust conduit connected with said external chamber, an exhaust valve in said conduit dependent in operation on said admission valve,

means for trapping a portion of fluid on the return stroke of the piston, and means for controllably exhausting said entrapped fluid to attain cushioning action of the piston.

8. In a device of the class described, a cylinder, a piston in the cylinder, means operatively connecting one of the parts to a mechanism to be operated, means for admitting pressure fluid to said cylinder to operate the piston, a coil spring for moving said piston in the direction opposite to that in which it is moved by fluid pressure, a cushioning piston adjacent one head of the cylinder and providing a chamber between said piston and head, a chamber external to said cylinder, a port in said cylinder communicating with said external chamber, a conduit between said external chamber and the chamber between the cushioning piston and head adapted to conduct pressure fluid to the latter chamber when the piston uncovers said port, an exhaust conduit connected to said external chamber, an exhaust valve in said exhaust conduit, and means for providing cushioning action on the return stroke of the piston.

9. In a device of the class described, a cylinder, a piston in the cylinder, means operatively connecting one of the parts to a mechanism to be operated, a conduit for admitting pressure fluid connected to said cylinder for moving said piston in one direction, mechanical means for moving said piston in the opposite direction, cushioning means at one end of the cylinder, a chamber external to said cylinder, a port in said cylinder intermediate the ends thereof communicating with said external chamber, a conduit between said external chamber and said cushioning means for conducting pressure fluid thereto when the piston uncovers said port, an exhaust conduit from said chamber operating on the return movement of the piston when said port is uncovered thereby, an exhaust conduit from the admission end of the cylinder, and means in said conduit for trapping fluid after the piston covers said port on return movement of the piston.

10. In a device of the class described, a cylinder, a piston in the cylinder, means operatively connecting one of the parts to a mechanism to be operated, a conduit for admitting pressure fluid connected to said cylinder for moving said piston in one direction, mechanical means for moving said piston in the opposite direction, cushioning means at one end of the cylinder, a port in said cylinder intermediate the ends thereof, a conduit from said port to said cushioning means, an exhaust conduit from said cylinder communicating with said port, an exhaust conduit from the admission end of the cylinder, means for regulating the exhaust through the latter conduit, and a valve controlling the admission and exhaust conduits.

11. In a device of the class described, a cylinder, a piston in the cylinder, means for connecting one of the parts to a mechanism to be operated, means for admitting pressure fluid to said cylinder on one side of said piston, mechanical means for moving said piston in the direction opposite to that in which it is moved by pressure fluid, means for by-passing a portion of said fluid for cushioning the forward movement of piston, means for retaining said cushioning fluid to assist in the return movement of said piston, means for cushioning the return movement of said piston, and means whereby cushioning fluid is expelled at substantially the end of the return stroke of the piston.

12. In a device of the class described, a cylinder, a piston in the cylinder, means operatively connecting one of the parts to a mechanism to be operated, a second piston in said cylinder operatively connected to the first piston and providing an end chamber in said cylinder between said second piston and the adjacent cylinder head, a port in said cylinder external therein to said end chamber, a conduit from said port to said end chamber, means for regulating the passage of fluid through said conduit, an exhaust conduit connected to said port, a second exhaust conduit connected to the cylinder at the first piston end thereof, a valve controlling admission of pressure fluid to said cylinder to move said first mentioned piston in one direction and exhaust through said second exhaust conduit, a coil spring for moving said piston in the opposite direction, and pressure regulating means connected to said second exhaust conduit to control cushioning action of said piston.

13. A door operating mechanism having in combination a piston, a cylinder in which the piston operates, operating connections between a door and said piston, means for storing energy during the operation of the piston in one direction comprising a single coiled spring and a chamber in said cylinder above said piston, and means for conveying fluid under pressure to said chamber as said piston moves in the direction to open the door, the pressure fluid thus stored in said chamber above said piston serving to assist said single coiled spring in actuating said piston on the return stroke.

14. A door operating mechanism having in combination a piston, a cylinder in which the piston operates, operating connections between a door and said piston, means for imparting an upward movement to said piston and operating connections to open said door, means for storing energy during such upward movement of the piston comprising a coiled spring and a chamber in said cylinder above said piston, means for admitting and temporarily retaining fluid under pressure in said chamber for a sufficient time to enable the pressure fluid thus admitted and retained

to assist said coiled spring in actuating said piston on the return (door closing) stroke, said fluid under pressure passing beneath said piston before entering the chamber above said piston.

15. A door operating mechanism having in combination means for applying manual power to open the door, mean constantly acting and of sufficient power to of itself close the door, and means for supplying additional power to assist said constantly acting means, said last named means being supplied before the completion of the opening stroke.

16. In an elevator door operating mechanism, the combination with a door of a set of toggle levers pivotally connected to the door at one end and to a stationary support at the other, means acting through said toggle levers for opening the door, means comprising a piston connecting with said toggle levers and a spring disposed so as to exert a force upon said piston tending to move the latter in the direction to close the door, said spring having sufficient power to effect such closing of the door through the instrumentality of said piston and connecting toggle levers, and means for supplying additional power to assist said spring comprising a fluid pressure connection for admitting fluid under pressure to the door closing side of said piston while said piston is moving in the direction to open the door.

Signed at New York city, N. Y., this 19th day of June, 1923.

WILLIAM B. CROWELL.