

Aug. 14, 1934.

E. L. DUNN

1,970,286

CLOSURE OPERATING MECHANISM

Filed March 5, 1930

4 Sheets-Sheet 1

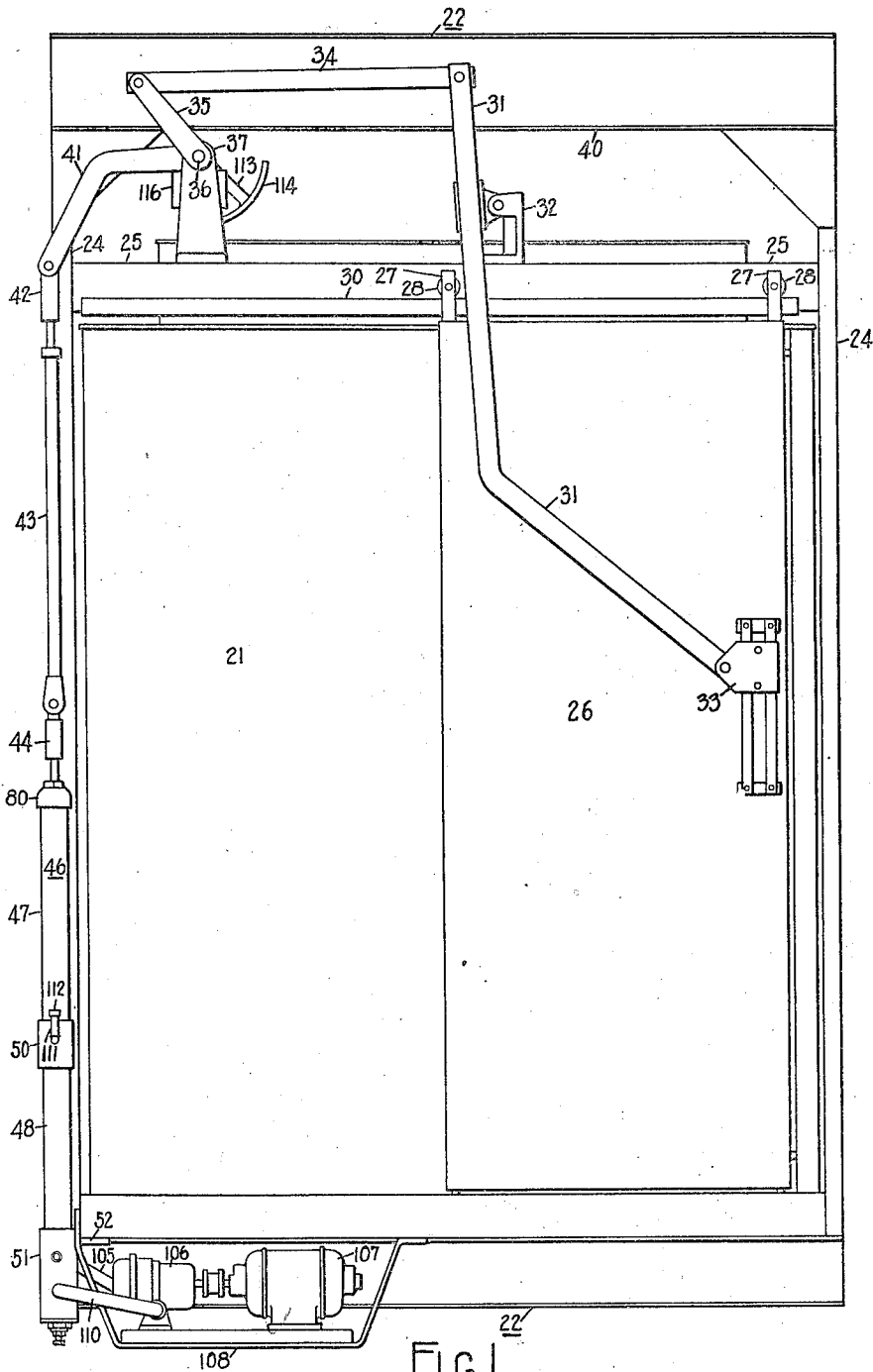


Fig. 1

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4 Sheets-Sheet 2

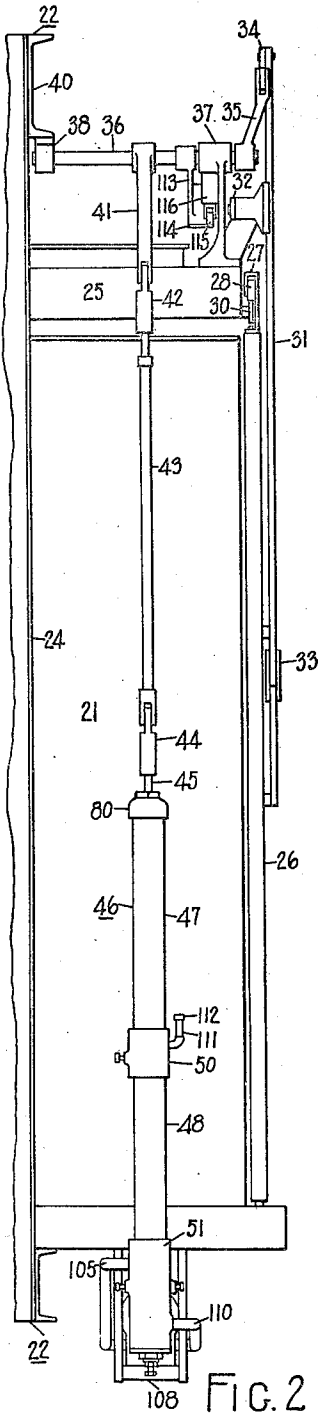


FIG. 2

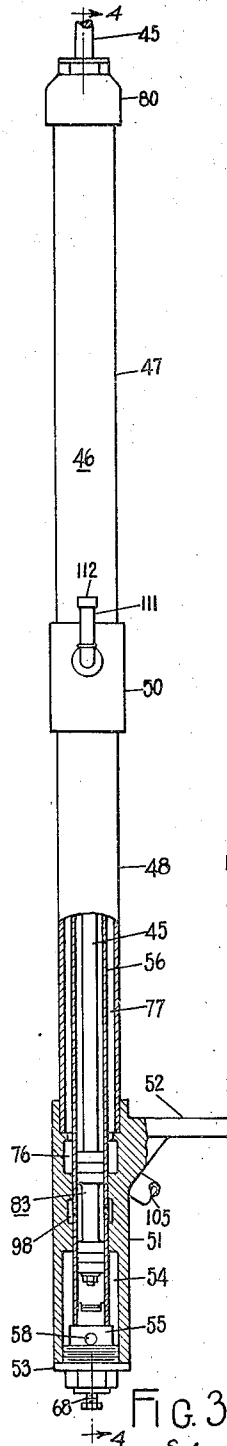


FIG. 3

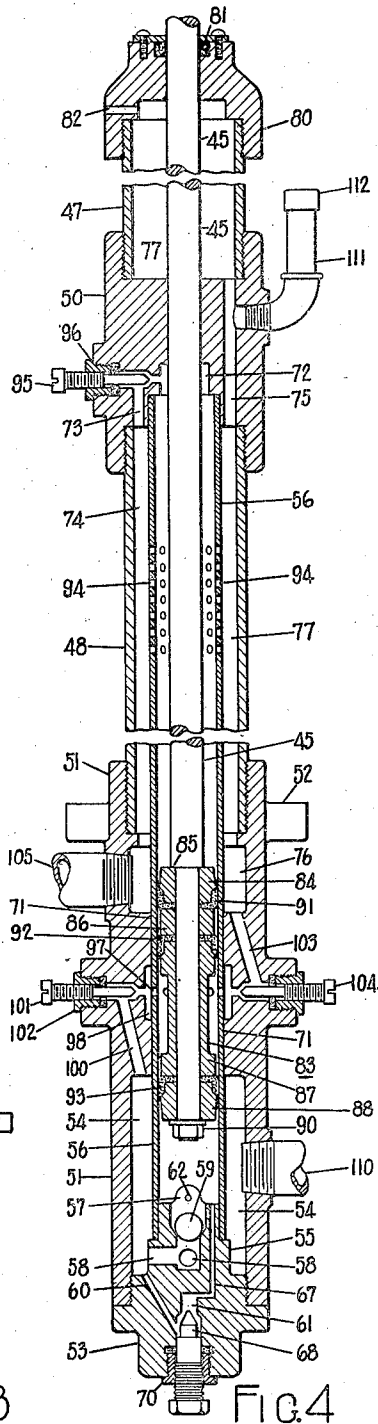


FIG. 4

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CLOSURE OPERATING MECHANISM

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4 Sheets-Sheet 3

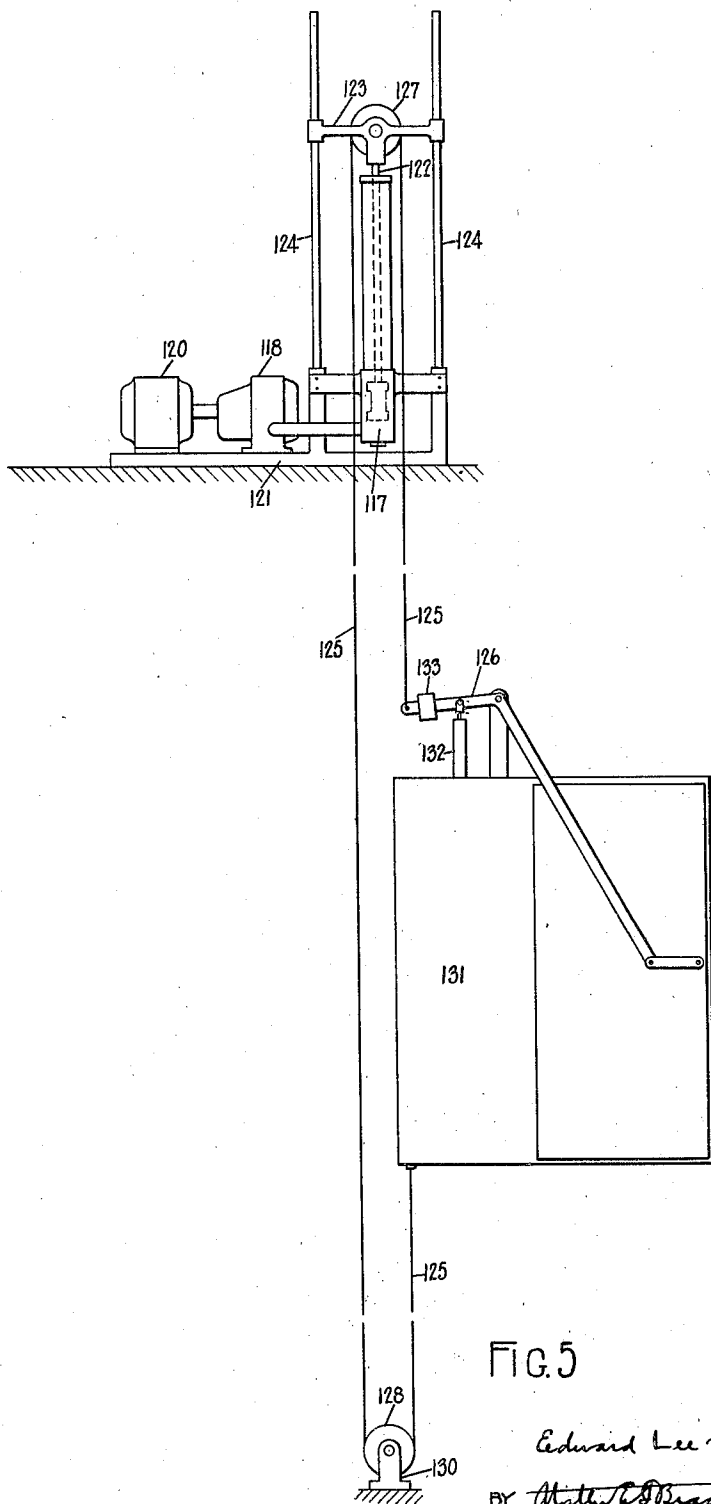


FIG. 5

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4 Sheets-Sheet 4

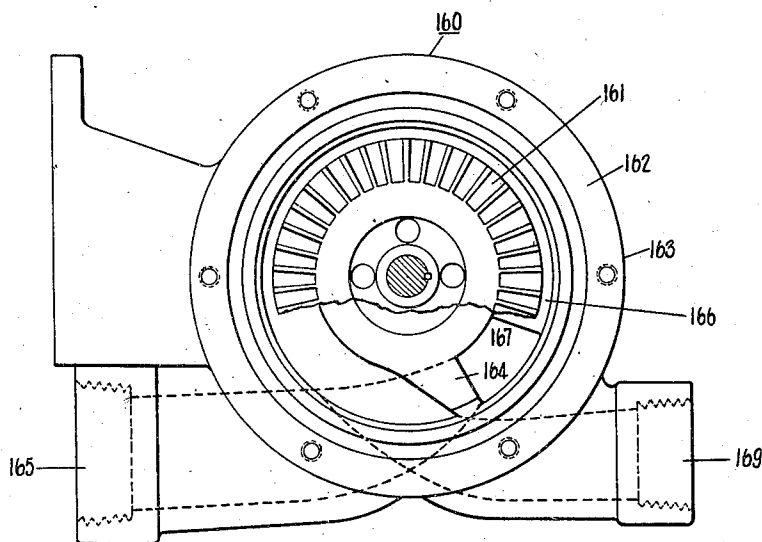


FIG. 7

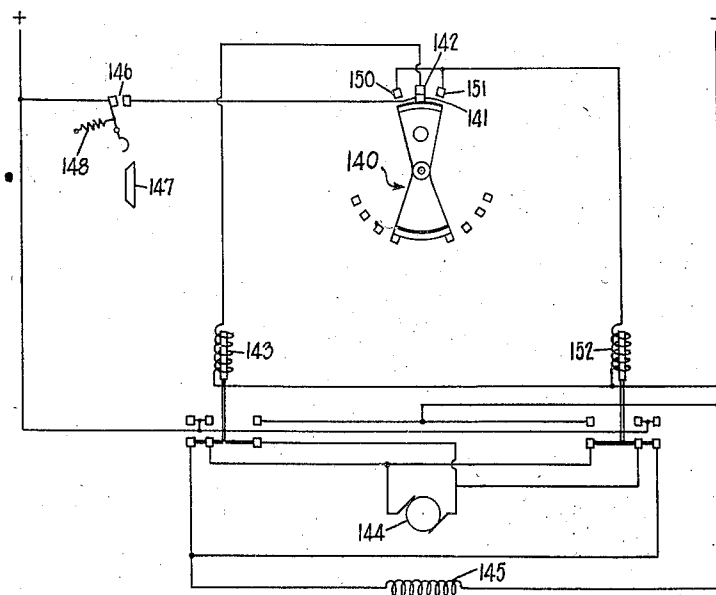


FIG. 6

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UNITED STATES PATENT OFFICE

1,970,286

CLOSURE OPERATING MECHANISM

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Application March 5, 1930, Serial No. 433,271

3 Claims. (Cl. 60—52)

The invention relates to closure operating mechanism and particularly to operating mechanism for the car doors or hatchway doors of elevator installations.

5 It has been found desirable to operate the closures affording access to the cars of elevator installations by power driven closure operating mechanism, particularly in installations in which the closures are frequently operated or in which
10 their manual operation is inconvenient. In view of the widespread use of electrical devices in present day elevator installations for effecting and controlling the operation of elevator cars, it is of advantage that the closure operating mechanism be electrically driven and controlled. It is
15 desirable that such electrically driven closure operating mechanism be capable of operating the closures at the rate of movement and to the extent which is found to be convenient and desirable in particular installations. It is also desirable
20 in cases where electrical motors are utilized for driving closure operating mechanisms that provision be made for lessening the possibility of injury to persons using the car, such for example as the possibility of the closure
25 coming in contact with their persons or effects, and jamming them between the closure and the edge of the closure opening as the motor continues in operation to move the closure to fully
30 closed position.

A feature of the present invention resides in the provision of closure operating mechanism driven by an electric motor for operating a closure in which the rate of operation of the
35 closure is independent of the rate of operation of the electric motor.

A second feature is a closure operating mechanism driven by an electric motor to operate a closure in which the termination of the operation
40 of the closure by the closure operating mechanism is independent of the termination of the operation of the electric motor.

A third feature resides in arresting the movement of a closure without stopping its electric motor driver in the event that in being moved to
45 operated position the closure encounters an obstruction.

A fourth feature resides in the provision of a fluid operated engine for operating a closure in
50 which the initiation of the starting and the stopping of the fluid engine is independent of valve mechanism.

A fifth feature is a fluid operated engine for
55 operating a closure in which the engine is op-

erated by fluid supplied by a rotary pump driven by an electric motor.

A sixth feature is a closure operating device which may be cheaply manufactured, which is easily installed and which is reliable in operation. 60

Other features and advantages will become apparent from the following description and appended claims.

The embodiment of the invention to be described contemplates the provision of a fluid operated engine carried by the elevator car for
65 controlling the opening and closing of the car door. An oscillatable arm pivotally mounted on the car and connected to the door is operatively connected to the piston of the door engine. 70
The door engine is provided with a fluid reservoir and a piston cylinder within which the piston is movable in the door opening and closing operations. A pump carried by the car and
75 driven by an electric motor, also carried by the car, is provided to draw fluid from the reservoir and force fluid under pressure into the piston cylinder to raise the piston for operating the oscillatable arm to open the door. The wall of
80 the piston cylinder is provided with perforations arranged so that when the door has been opened to the desired point it is not necessary to stop the motor to terminate the movement of the door. The motor continues in operation and continued operation of the pump causes a circulation
85 of fluid from the reservoir through the pump into the piston cylinder and back to the reservoir without effecting further movement of the piston. Thus, the column of fluid beneath the piston is maintained under pressure to keep the
90 piston in its raised position and maintain the door in open position as long as the pump continues to be driven by the electric motor.

The connections between the door and the piston of the door engine are so arranged that their
95 weight, together with the weight of the piston, biases the door to closed position. When the windings of the electric motor are deenergized, the pump is no longer driven and the column of fluid beneath the piston is no longer effective to
100 keep the piston in raised position. Consequently, the weight of the connections between the piston and the door together with the weight of the piston acts through the oscillatable arm to close the door. As the door is moved to closed
105 position the piston is moved downwardly within the piston cylinder forcing the fluid therefrom through the pump into the reservoir. Throttled by-passes are provided to afford communication
110 between the piston cylinder and the reservoir so

that the rate of operation of the door engine to open and close the door may be regulated. The upper and lower ends of the piston cylinder are provided with throttled by-passes and are arranged to act as checks to cooperate with the piston for retarding the door in the final part of the opening and closing operations so that the door will be brought to rest easily and quietly.

In the drawings:

Figure 1 is a front elevation of an elevator car illustrating closure operating mechanism embodying the invention applied to the car door.

Figure 2 is a side elevation of a portion of an elevator car illustrating the arrangement of the closure operating mechanism on the car.

Figure 3 is an enlarged view of the door engine with parts shown in section to illustrate details of construction.

Figure 4 is an enlarged section, partly broken away, taken along the line 4-4 of Figure 3 showing the construction of the door engine.

Figure 5 is a diagrammatic illustration of a modified arrangement in which the closure operating mechanism is mounted in the pent-house.

Figure 6 is a wiring diagram illustrating in simplified form an arrangement for controlling the operation of the driving motor for the pump.

Figure 7 is a view in side elevation of a form of pump suitable for use as a part of the closure operating mechanism, parts being broken away and removed.

Referring to Figures 1 and 2, the numeral 21 designates an elevator car carried by a car sling, designated as a whole by 22, to which hoisting roping is attached to effect movement of the car in the hatchway. An angle member 25 is secured to the uprights 24 of the car sling and extends between the uprights and parallels the sides and front of the car. A door 26 is suspended from hangers 27 which are provided with rollers 28 engaging a track 30, supported from angle member 25, to guide the door in movement transverse of the car entrance.

An oscillatable arm 31 is pivotally mounted on a bracket 32 secured to angle member 25 and is connected at one end to a plate 33 mounted on the door. The other end of arm 31 is pivotally connected by a link 34 to an arm 35 secured to a shaft 36. Shaft 36 is journaled in a bearing 37 secured to angle member 25 and a bearing 38 secured to the crosshead 40 of the car sling. An arm 41 also secured to shaft 36 is pivotally connected by a coupling 42 to a length of hollow tubing 43. A coupling 44 connects the tubing 43 to the piston rod 45 of a fluid operated door engine designated as a whole by 46.

Referring also to Figures 3 and 4, the door engine 46 has a tubular casing made up of two sections 47 and 48 of pipe or tubing connected to each other by a coupling 50. A member 51 is secured to the lower end of section 48 and is provided with a bracket-like extension 52 by means of which the door engine is mounted on the car. A plug 53 secured to the lower end of member 51 defines the lower end of a chamber 54 in member 51 and affords a fluid tight closure therefor. Chamber 54 will be hereinafter referred to as the pressure chamber. Plug 53 has an extension 55 of reduced diameter extending upwardly into pressure chamber 54 and terminating in a flanged portion on which the lower end of a piston cylinder 56 is tightly seated. A port 57 in extension 55 communicates with a series of passages 58 extending through extension 55 to pressure chamber 54. A check valve is provided

for closing port 57 to cut off communication between pressure chamber 54 and the interior of piston cylinder 56. This check valve comprises a ball 59 mounted in an opening in extension 55 at the upper end of port 57, the ball being retained in extension 55 by a pin 62. A passage 60 extends from pressure chamber 54 through plug 53 to a central opening 61 extending downwardly through the plug. A passage 67 extends from opening 61 to the interior of piston cylinder 56 and affords communication between the piston cylinder and the pressure chamber through opening 61 and passage 60 in plug 53. Passage 67, opening 61 and passage 60 thus constitute a by-pass around check valve 59. The effective area of this by-pass may be regulated by adjustment of a needle valve 68 threaded in a liquid tight bushing 70 which closes opening 61 at its lower end.

Piston cylinder 56 extends upwardly through pressure chamber 54, openings 71 in which it is tightly fitted in member 51 and through section 48 of the casing. The upper end of cylinder 56 is received in a counterbore in coupling 50. A pocket 72 in the coupling communicates with the interior of the cylinder and is connected by a by-pass 73 to a chamber 74 between the cylinder and the wall of section 48 of the casing. A passage 75 through coupling 50 connects the interior of section 47 of the casing with the chamber 74. The chamber within section 47 together with chamber 74, and a chamber 76 near the upper end of member 51 will hereinafter be referred to as the reservoir and, as such, designated by the numeral 77.

The piston rod 45 extends through piston cylinder 56 and section 47 of the casing and is guided in openings in coupling 50 and in a cap 80 closing the upper end of section 47 of the casing. Cap 80 is provided with a stuffing box 81 and a vent 82. A piston, designated as a whole by 83, is carried by the piston rod 45 at its lower end for movement in piston cylinder 56.

Piston 83 comprises a member 84 abutting a shoulder 85 on piston rod 45, a spacer 86, a body portion 87, and a member 88 engaged by a fastening device 90 to secure the piston to the piston rod. Expansible cup-shaped washers 91, 92 and 93 are interposed between member 84 and spacer 86, between spacer 86 and body portion 87, and between body portion 87 and member 88, respectively. The ends of the flanged portion of the cup-shaped washers are slightly spaced from the adjacent surfaces of member 84, body portion 87, and member 88 to insure a tight working fit of the piston in its movement in piston cylinder 56, as will be more fully described hereinafter.

The wall of cylinder 56 is provided with a plurality of rows of perforations 94 communicating with chamber 74. The purpose of perforations 94 will become apparent as the description proceeds. The portion of the piston cylinder above the perforations 94 together with the pocket 72 in coupling 50 constitutes a check cylinder for retarding the piston in the final portion of its upward movement in the piston cylinder. The rate of such retardation may be regulated by a needle valve 95 threaded in a bushing 96 in coupling 50 and arranged to control the effective area of by-pass 73. The wall of the piston cylinder is also provided with a series of perforations 97 communicating with a chamber 98 in member 51. A by-pass 100 leads from chamber 98 to pressure chamber 54 and its effective area is adjustable by means of a needle valve 101 threaded in a bushing 102 in member 51. A by-pass 103

leads from chamber 98 to the reservoir 77 and a needle valve 104 is provided for restricting the effective area of by-pass 103. This arrangement is provided to regulate the rate of movement of piston 83 within piston cylinder 56 as will be more fully described hereinafter. The portion of piston cylinder 56 below the perforations 97 constitutes a check cylinder for retarding the piston in the final portion of its descending movement in the piston cylinder. The rate of such retardation may be regulated by adjustment of needle valve 68.

A conduit 105 communicating with the chamber 76 of reservoir 77 is connected to the input side of a rotary pump 106 adapted to be driven by a high speed electric motor 107. A conduit 110 connected to the discharge side of pump 106 communicates with pressure chamber 54. The pump 106 and motor 107 are mounted beneath the car on a support 108.

A riser tube 111 communicating with passage 75 serves as a conduit through which oil, glycerin or other suitable non-compressible fluids may be introduced into the reservoir of the door engine. When fluid is introduced into reservoir 77 it flows through conduit 105, pump 106, conduit 110 into pressure chamber 54 to fill the pressure chamber. A portion of the liquid also flows from reservoir 77 through by-pass 103, chamber 98 and by-pass 100 to pressure chamber 54. A portion of the fluid flows from pressure chamber 54 through passage 60, opening 61, around needle valve 68 and through passage 67 into piston cylinder 56 until the space beneath piston 83 is filled with fluid. When all of the chambers and passages that lie below the chamber 76 as well as the conduits 105 and 110 and the interior of pump 106 are filled, the fluid rises in chamber 74 and flowing through perforations 94 fills the space in piston cylinder 56 above piston 83, including the space above perforations 94 and also the pocket 72. Sufficient fluid is introduced into the reservoir of the door engine to bring the height of the fluid level with the top of riser tube 111 which is normally closed by a cap 112.

As stated above, piston rod 45 is connected through tubing 43, arm 41, arm 35, link 34, and oscillatable arm 31 to the car door. The weight of these parts together with the weight of piston 83 bias the door to closed position. The door is moved to open position by operation of pump 106 to move piston 83 upwardly within piston cylinder 56.

A member 113 secured to shaft 36 is provided with an arcuate cam 114 adapted to engage a roller 115 for effecting separation of the contacts of a door switch 116 when the door is moved from closed position. The contacts of door switch 116 may be arranged in the circuit for controlling the operation of the elevator car so as to prevent the operation of the car when the door is not fully closed.

The energization and deenergization of motor 107 may be controlled in any suitable manner, the manner in which this is effected depending upon the type and requirements of the particular installation. One form of control has been illustrated in Figure 6 by way of example. In this arrangement the motor is controlled by the starting switch in the car. This switch, designated as a whole as 140, is under the control of the attendant in the elevator car. To illustrate a manner of controlling motor 107 by this switch, an arrangement is schematically shown in which the return of the car switch to neutral causes the circuit for the motor to be completed. The car switch is il-

lustrated as having, in addition to its lower control segment and contacts, an additional segment above its pivot. This segment carries a contact 141 for cooperating with stationary contact 142. Contacts 141 and 142 are engaged upon return of the car switch to neutral position. Upon movement of the car switch in either direction to an operative position, contact 141 separates from contact 142. Contacts 141 and 142 control the energization of the coil 143 of an electromagnetic switch. This switch, in turn, controls the energization of the armature 144 and field winding 145 of motor 107. With this arrangement, movement of the car switch out of neutral causes deenergization of motor 107, (assuming that contacts 150 and 151 are not present) while the return of the car switch to neutral causes the motor to be energized.

To illustrate the principles of preventing operation of motor 107 when the car is outside the closure operating zone at a landing, a switch 146 has been illustrated in the circuit leading to contact 141. This switch may be carried by the elevator car and biased to open position. Upon the arrival of the car in the closure operating zone at a landing, this switch is closed by a cam 147 at that landing against the force of its biasing means illustrated as a spring 148.

The operation is as follows: Assume that the door is in closed position. When it is desired to open the door the windings of motor 107 are energized. Motor 107, on operation, drives pump 106 to draw fluid from reservoir 77 through conduit 105 into the work chamber of the pump. The pump forces the fluid through conduit 110 into pressure chamber 54 of the door engine. As the pump is driven the pressure of the fluid is built up and the fluid is forced from the pressure chamber into piston cylinder 56 through passages 58 and port 57, raising ball check valve 59 off its valve seat. A portion of the fluid is also forced from pressure chamber 54 through passage 60, opening 61 and passage 67 into the piston cylinder.

As member 88 and body portion 87 of piston 83 do not have a liquid tight fit in cylinder 56 a small quantity of liquid is forced between these elements and the wall of the cylinder and within the flanged portions of cup-shaped washers 92 and 93 to expand the latter in order to effect a tight working fit of the piston in the piston cylinder.

The fluid forced under pressure into piston cylinder 56 causes piston 83 to be raised. Piston 83 in its upward movement acts through piston rod 45, tubing 43, arm 41, shaft 36, arm 35 and link 34 to turn oscillatable arm 31 clockwise about bracket 32 to move the door toward open position.

As pump 106 is driven a portion of the fluid is forced from pressure chamber 54 through by-pass 100, chamber 98 and by-pass 103 to chamber 76 of reservoir 77. When piston 83 has been moved so that member 88 and washer 93 are positioned above perforations 97 in the wall of the piston cylinder a portion of the fluid escapes therefrom through perforations 97 into chamber 98 and is forced through by-pass 103 to reservoir 77. Needle valve 104 is adjustable to restrict the effective area of by-pass 103 to regulate the amount of fluid that escapes from pressure chamber 54 and piston cylinder 56. In this manner a predetermined portion of the fluid forced into pressure chamber 54 for moving piston 83 to open the door is by-passed around the piston. Conse-

quently, the rate of movement of the piston within the piston cylinder, and hence the rate of movement of the door toward open position, may be regulated by adjustment of needle valve 104.

As previously stated the interior of piston cylinder 56 above piston 83 is also filled with fluid. As the piston is moved for opening the gate, the fluid above the piston acts to expand the cup washer 91 for securing a tight working fit of member 84 of piston 83 in the piston cylinder. Thus, the movement of the piston causes the fluid between the upper side of the piston and perforations 94 to flow through the perforations into chamber 74 of the reservoir.

When the door has been moved to within a short distance of its fully open position, piston 83 has been raised by the pressure of fluid on its lower side so that the upper end of the piston is positioned adjacent the uppermost row of perforations 94. The movement of piston 83 and door 26 is immediately retarded since the escape of fluid from the upper side of piston 83 to reservoir 77 through perforations 94 is cut off. As the upward movement of piston 83 continues the fluid trapped between the upper end of piston 83 and the end of pocket 72 can escape from piston cylinder 56 through by-pass 73. Since the effective area of by-pass 73 is restricted by needle valve 95 the fluid escapes slowly and, consequently, the piston and door are moved slowly in the latter part of the door opening operation so that the door is brought to rest easily and quietly.

When the door has been moved to open position piston 83 is positioned so that its lower end is above the lowermost row of perforations 94. Consequently, movement of the piston ceases as the fluid forced by pump 106 through pressure chamber 54 into piston cylinder 56 to move piston 83 then escapes from piston cylinder 56 through this row of perforations 94 into chamber 74 without effecting movement of the piston. The continued operation of pump 106 by motor 107 causes a circulation of fluid from reservoir 77 through conduit 105, pump 106, conduit 110, pressure chamber 54, passages 58, port 57, piston cylinder 56, and perforations 94 back to reservoir 77. The column of fluid under pressure in piston cylinder 56 maintains piston 83 in its raised position, thus maintaining the door in open position so long as motor 107 continues in operation.

In the initial part of the door opening operation member 113 moving with shaft 36 caused arcuate cam 114 to move into engagement with roller 115 resulting in separation of the contacts of switch 116. Cam 114 maintains switch 116 open while the door is open so that, with the switch arranged in a circuit controlling the energization of the hoisting motor, operation of the car when the door is not fully closed is prevented.

When it is desired to close the door, the windings of motor 107 are deenergized. When motor 107 is deenergized, pump 106 is no longer driven and ceases to maintain the column of fluid beneath piston 83 under pressure. The column of fluid thus becomes ineffective to maintain the piston in its raised position to keep the door in open position. The weight of piston 83 together with the weight of tubing 43, arm 41, link 34 and oscillatable arm 31 act to move piston 83 downwardly in cylinder 56 and to turn arm 31 counterclockwise about bracket 32 to move the door toward closed position.

When pump 106 stops, the normal pressure of

the fluid in cylinder 56 seats ball check-valve 59 to cut off communication between the cylinder and chamber 54 through port 57 and passages 58. As piston 83 moves downwardly some of the fluid beneath the piston is forced past members 88 and 87 and within the flanged portion of cup washers 93 and 92 to expand the washers and insure a tight working fit of the piston within the piston cylinder. Thus, the downward movement of piston 83 causes the fluid beneath the piston to be forced from cylinder 56 through perforations 97, chamber 98, by-pass 100, pressure chamber 54, conduit 110, pump 106, and conduit 105 to reservoir 77. A small portion of the fluid is forced from cylinder 56 through passage 67, opening 61, and passage 60 into chamber 54, and thence by way of conduits 110 and 105 to reservoir 77. A small portion of the fluid is also forced from chamber 98 through by-pass 103 directly to reservoir 77. The portion of fluid forced through by-pass 103 is small compared with the amount forced through by-pass 100 since needle valve 104 is set to provide a small effective area of by-pass 103 due to the fact that this by-pass is effective under high pressure conditions, i. e., when fluid is being forced beneath the piston by the pump to cause the opening of the door. By-pass 100, however, is effective under low pressure conditions when the piston is being lowered and therefore its effective area is large compared with that of by-pass 103. Thus, the major portion of the fluid flows through by-pass 100 during descent of the piston. Needle valve 101 is adjustable to restrict the effective area of by-pass 100 to regulate the passage of fluid from cylinder 56 to chamber 54 and thus affords an adjustment for regulating the rate of descent of the piston and hence the closing movement of the door. As piston 83 moves downwardly fluid is drawn from chamber 74 of reservoir through by-pass 73 to fill the space above perforations 94 between piston 83 and the end of pocket 72. When in the descent of piston 83, its upper end is positioned below the uppermost row of perforations 94 fluid also flows through perforations 94 to fill the space in cylinder 56 above the piston.

When the door has been moved nearly to closed position piston 83 is positioned so that the escape of fluid from cylinder 56 through perforations 97 to chamber 98 is cut off. As a result, the descent of the piston, and hence the movement of the door, is immediately retarded. As the piston continues to descend, the fluid beneath the piston can escape from cylinder 56 to chamber 54 and the reservoir only through the by-pass around check valve 59 formed by passage 67, opening 61, and passage 60. Since the effective area of this by-pass is restricted by the adjustment of needle valve 68 the fluid escapes slowly from cylinder 56. Consequently, the descent of piston 83 and the movement of the door occurs slowly in the latter part of the door closing operation so that the door is brought to rest easily and quietly.

Member 113 turns with shaft 36 in the door closing operation and when the door reaches fully closed position the arcuate cam 114 disengages roller 115 to permit engagement of the contacts of switch 116.

If desired, the door may be manually opened. The application of a manual force to open the door results in upward movement of the piston within the piston cylinder. Since there are no valves which have to be opened to provide for the escape of fluid from above the piston there

is no resistance from the door engine to the manual opening operation.

It is to be noted that the rate of door movement may be varied without changing the speed of operation of the electric motor 107 and pump 106. As described above, the opening speed of the door may be regulated by adjusting needle valve 104 so that sufficient fluid is by-passed around the piston of the door engine through by-pass 103 to vary the rate of movement of the piston to secure the desired rate of door movement. The rate of movement of the piston is substantially unaffected by variations in the speed of operation of motor 107, such for example as may be due to voltage fluctuations, as such speed variations result in building up the pressure of the fluid within piston cylinder 56 only slightly. The closing speed of the door may be regulated by adjusting needle valve 101 to control the escape of fluid from cylinder 56 into pressure chamber 54 through by-pass 100 during the descent of the piston. It is also to be noted that the fluid engine is arranged to retard the closure in the final part of its movement either to open or closed position.

The employment of an engine the piston of which is movable by fluid pressure for opening the door provides adequate power for overcoming any resistance to the opening of the door and also results in a fast and smooth opening operation. In the event that the door in opening strikes an obstruction, the pump driven by the electric motor builds up the pressure of the fluid within the piston cylinder to overcome the resistance offered to the opening of the door. However, in the event that the obstruction is of such a nature as to stop the movement of the door the rotary pump churns, thereby avoiding damage either to the door or its operating mechanism. Since the pump churns if an obstruction effectively stops the movement of the closure, the driving motor for the pump does not stall. As a result, a small constant speed motor may be utilized as the motive means for driving the pump.

Closing the door by gravity means, or equivalent means, in conjunction with the fluid engine results in the door being closed slowly and without great force, thus avoiding damage to the installation or injury to persons using the car. The piston moving downwardly within the piston cylinder acts in conjunction therewith as a long stroke dash-pot for insuring a relatively slow closing operation. In the event that the car door, when being moved to closed position, strikes an obstruction, such as a person entering or leaving the car, the movement of the closure ceases. Thus, the possibility of injuring persons entering or leaving the car by trapping them between the door and the side of the car is avoided. When the obstruction is removed the door continues to closed position.

In addition to other advantages, the closure operating mechanism of the present invention has all the desirable features of pneumatic operators which employ travelling conduits for supplying power for the operation of the door on the car. Furthermore, the use of liquid as the operating fluid avoids any jumping or intermittent action in the operation of the door, the force being maintained constant at all times.

It is also to be noted that although an electrically operated motor is employed as a prime mover for effecting the opening of the door, limit switches controlled by the position of the door for terminating the movement of the door by opening the circuit of the motor are not em-

ployed. The provision of perforations 94 in the wall of piston cylinder 56 permits a circulation of fluid from the reservoir through the pump and piston cylinder of the door engine and back to the reservoir, when the door reaches open position, whereby the continued operation of motor 107 maintains the door in open position. Such arrangement results in simplification of the control for the motor.

Motor 107 may be energized for driving pump 106 in the opposite direction as piston descends in the door closing operation, if desired. Figure 6 schematically shows circuits for effecting energization of motor 107 to drive the pump in the opposite direction. To illustrate a manner of effecting this energization by the manipulation of the car switch, additional contacts 150 and 151 are shown in position to be engaged by contact 141 after its separation from contact 142 as the car switch is moved out of neutral position. The engagement of either of these additional contacts by contact 141 completes the circuit for the coil 152 of an additional switch for effecting energization of armature 144 and field winding 145. This switch causes the current to be supplied to the motor armature in a direction which is reverse to that in which it was supplied by operation of the electromagnetic switch controlled by contact 142.

In the event of opposite rotative movement of motor 107, the rotation of the impeller blades of pump 106 in addition to decreasing the resistance to the flow of fluid from pressure chamber 54 through the pump to reservoir 77 acts to draw fluid from pressure chamber 54. Thus, a partial vacuum is produced in pressure chamber 54 and piston cylinder 56. As a result, the descent of piston 83 is accelerated and the rate of movement of the door toward closed position is increased. However, although motor 107 be operated to accelerate the closing of the door the power applied to close the door due to the partial vacuum is not sufficient to cause injury to persons who may be struck by the door.

For pump 106, one such as model No. 4G7, manufactured by Westco-Chippewa Pump Company of Davenport, Iowa, constructed substantially as disclosed in the patent to Holmes No. 1,682,756 dated September 4, 1928, has been found in actual practice to satisfactorily provide the operations herein set forth.

A side elevation of the pump shown in this patent is illustrated in Figure 7. This pump comprises a casing 160 and a rotor 161 operating within the casing. The casing is formed in two portions, a main body portion 162 and a supplemental portion (not shown) which is secured to the body portion at the flange 163. An extended flange portion 164 cooperates with a corresponding extended flange portion of the supplemental casing portion to direct the flow of fluid into outlet 169. An inlet 165 leads into two passageways, one in the casing body portion and the other in the casing supplement portion, each passageway leading into the pressure developing passageway 166 of the pump, adjacent the restricting portion 164 and its supplement, in substantially a tangential direction relative to the path of flow of fluid through the pump. The inlet port for the body portion of the casing is indicated as 167. The fluid is drawn through inlet 165 into the pump where it enters at the inlet ports at the sides of the rotor pockets. The rotor, moving counterclockwise, carries the fluid around the casing to the point where it is de-

deflected by flange portion 164 and its supplement tangentially into outlet 169, the outlet passage extending between the branches of the inlet passage. There is sufficient clearance between the rotor pockets and the casing to permit churning of the fluid when the flow of fluid is obstructed and to permit back flow of fluid from outlet 169 through the pressure passageway of the casing into the inlet 165 when the pump is stopped. Upon reversal of its direction of rotation, the rotor draws fluid through the outlet 169 into the pressure developing passageway 166 of the pump. The fluid is then carried clockwise with the rotor to the point where it is deflected by the flange into the inlet 165.

Although the operating mechanism for the door has been described as carried by the car, the fluid engine with its associated pump and motor may be mounted in the hatchway as diagrammatically illustrated in Figure 5. The door engine 117, pump 118 and motor 120 may be mounted on a support 121 in any desired location, as in the pent-house. The piston rod 122 of door engine 117 is arranged to operate a crosshead 123 movable on guides 124. A cable or tape 125 is connected at one end to arm 126 of the door operating mechanism on the car. Cable 125 is led over a sheave 127 on crosshead 123. From sheave 127 the cable extends downwardly to and around a tensioning sheave 128 mounted on a support 130 near the bottom of the hatchway. From sheave 128 cable 125 is led upwardly and its other end is connected to the frame of the car, which is designated 131. A checking device 132 is provided for checking the door in the latter part of its opening movement.

When the car is moving in the hatchway cable 125 is drawn over sheaves 127 and 128, driving the sheaves idly. When the car is positioned at any landing, energization of motor 120 effects movement of piston rod 122, as previously described, for moving crosshead 123 upwardly on guides 124. The movement of crosshead 123 is transmitted by sheave 128 through cable 125 to arm 126 for operating the arm to open the door. As the door nears open position, checking device 132 acts to retard the door and bring it to rest easily and quietly. When motor 120 is deenergized, piston rod 122 moves downwardly as previously described. The movement of crosshead 123 as piston rod 122 descends acts through cable 125 to regulate the rate of movement of arm 126 to close the door. It is to be understood that arm 126 is suitably operated, as by a weight 133 or equivalent means, to close the door. As the door nears closed position, the piston and the check cylinder at the lower end of fluid engine 117 cooperate to retard the door and bring it to rest easily and quietly.

A door operating device constructed in accordance with the present invention may readily be employed for operating the car doors of various elevator installations requiring different degrees of door movement without altering the stroke of the piston of the door engine. The desired amount of door movement may be secured for example by varying the relative lengths of arms 35 and 41 or the pivotal point of the door operating arm 31 so that although the operating stroke of the piston of the door engine is the same in various installations the desired amount of movement is imparted to the door.

Although the closure operating device of the invention has been described as an operator for

the car door of an elevator installation it is apparent that it is equally adapted for operating hatchway doors or other closures.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In an elevator installation in which a closure is provided for controlling access to and from the elevator car, operating mechanism for said closure, said mechanism comprising; a fluid engine having a piston; means connecting said piston to said closure; fluid for said engine; a rotary pump adapted upon operation to supply said fluid to said engine to cause operation of said engine to effect the opening of said closure and to maintain said closure in open position against the weight of said connecting means and said piston, said pump, when not in operation, permitting flow of fluid therethrough to allow the return of said closure to closed position by the weight of said connecting means and said piston and to allow the manual opening of said closure.

2. In an elevator installation in which a closure is provided for affording access to the elevator car, operating mechanism for said closure, comprising; a casing provided with a reservoir chamber; a piston cylinder in said casing; a piston movable in said cylinder and operatively connected to said closure; fluid in said chamber and said cylinder; a fluid pump having its intake connected to said reservoir chamber and its discharge connected to said piston cylinder; means for driving said pump to draw fluid from said reservoir chamber and force fluid into said piston cylinder to move said piston in one direction to effect movement of said closure to one of its operated positions; said piston cylinder being provided with perforations connecting the interior of said cylinder to said reservoir chamber, said perforations being adapted to permit fluid to flow from said cylinder at one side of said piston into said reservoir chamber during a part of the movement of said piston; the portion of said piston cylinder beyond said perforations in the direction of movement of said piston constituting a check for retarding said piston in its movement beyond said perforations; a passage connecting the check portion of said cylinder to said reservoir chamber; and adjustable valve means for controlling said passage to regulate the rate of retardation of said piston.

3. In an elevator installation in which a closure is provided for affording access to the elevator car, operating mechanism for said closure, comprising; a casing provided with a reservoir chamber and a pressure chamber; a piston cylinder in said casing; passages affording communication between said pressure chamber and the interior of said cylinder; a piston movable in said cylinder and operatively connected to said closure; fluid in said chambers; a fluid pump having its intake connected to said reservoir chamber and its discharge connected to said pressure chamber; means for driving said pump to draw fluid from said reservoir chamber and force fluid into said pressure chamber and through said passages into said piston cylinder to move said piston to one of its operated positions to effect movement of said closure to one of its operated positions; means

for moving said closure to its other operated position and for moving said piston to its other operated position in said cylinder; a check valve controlling communication between said pressure chamber and the interior of said piston cylinder through said passages, said check valve being seated to prevent the flow of fluid from said cylinder through said passages into said pressure chamber during movement of said piston to said other operated position; said casing being also provided with a third chamber; a passage connecting said third chamber with said pressure chamber; said piston cylinder having perforations connecting the interior thereof with said third chamber, said perforations being adapted to permit fluid to flow from said piston cylinder at one side of said piston into said pressure chamber during a part of the movement of said piston to said other operated position; the portion of said piston cylinder beyond said perforations in the direction of movement of said piston to said other operated position constituting a check for retarding said piston in its movement beyond said perforations; a by-pass around said check valve for permitting the escape of fluid from the check portion of said cylinder to said pressure chamber; and adjustable valve means for controlling said by-pass to regulate the rate of retardation of said piston.

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