May 24, 1932. E. L. DUNN 1,860,333

CLOSURE OPERATING MECHANISM

Filed April 18, 1929 2 Sheets-Sheet 1

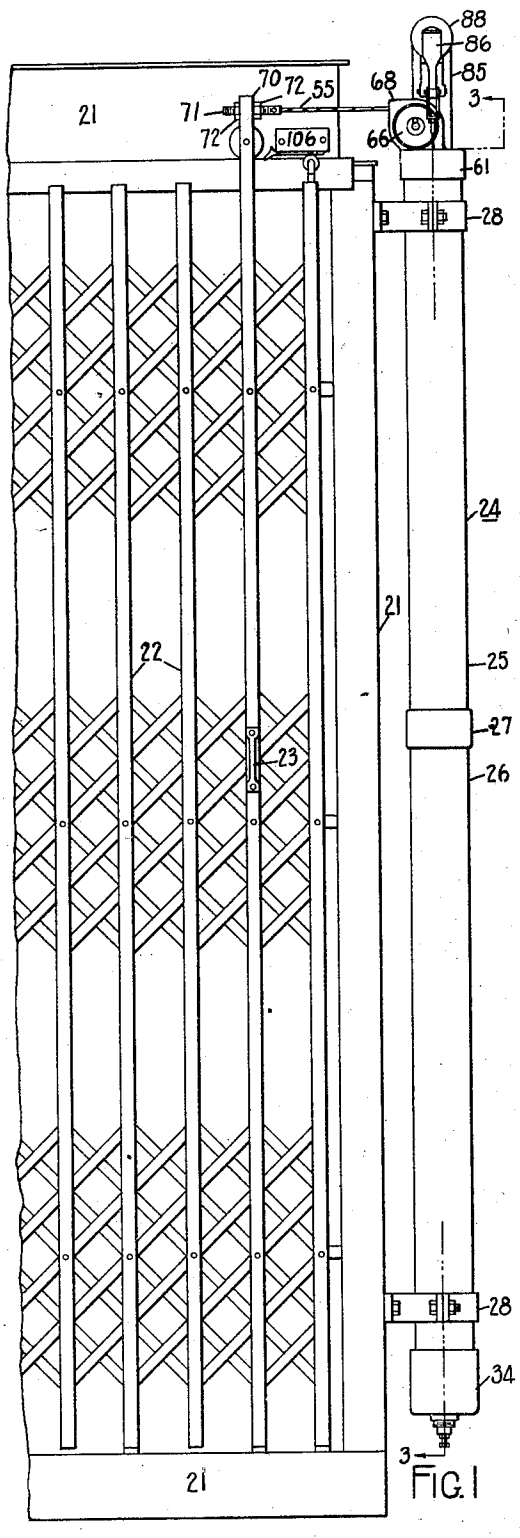


FIG. 1

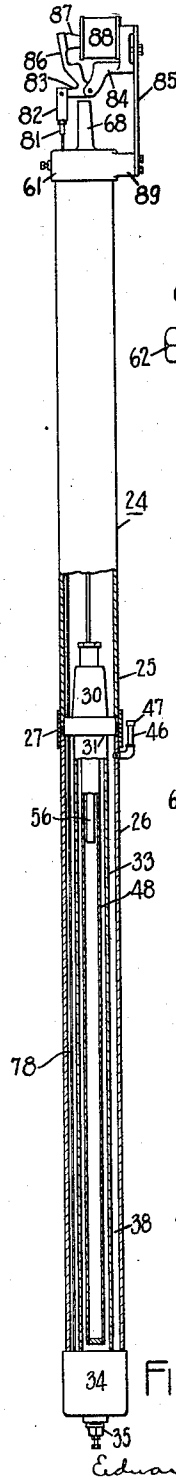


FIG. 2

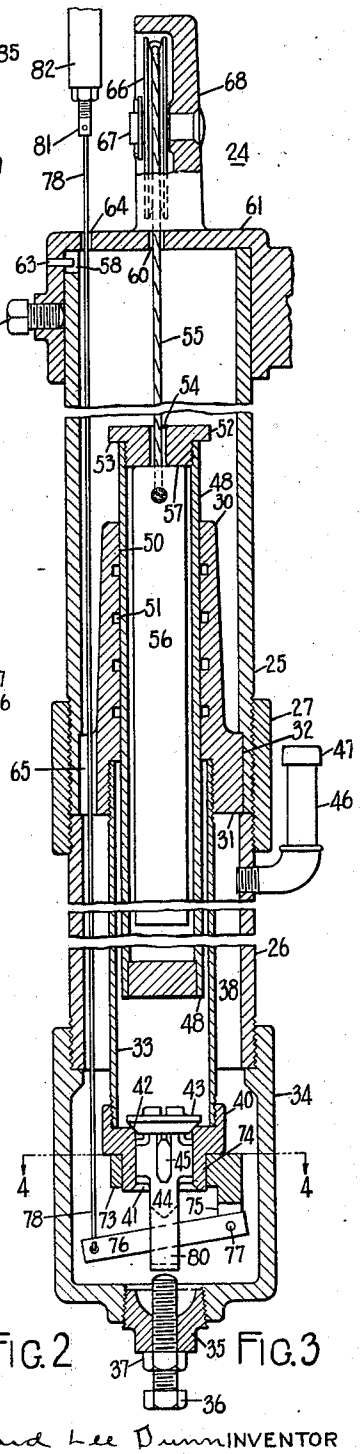


FIG. 3

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CLOSURE OPERATING MECHANISM

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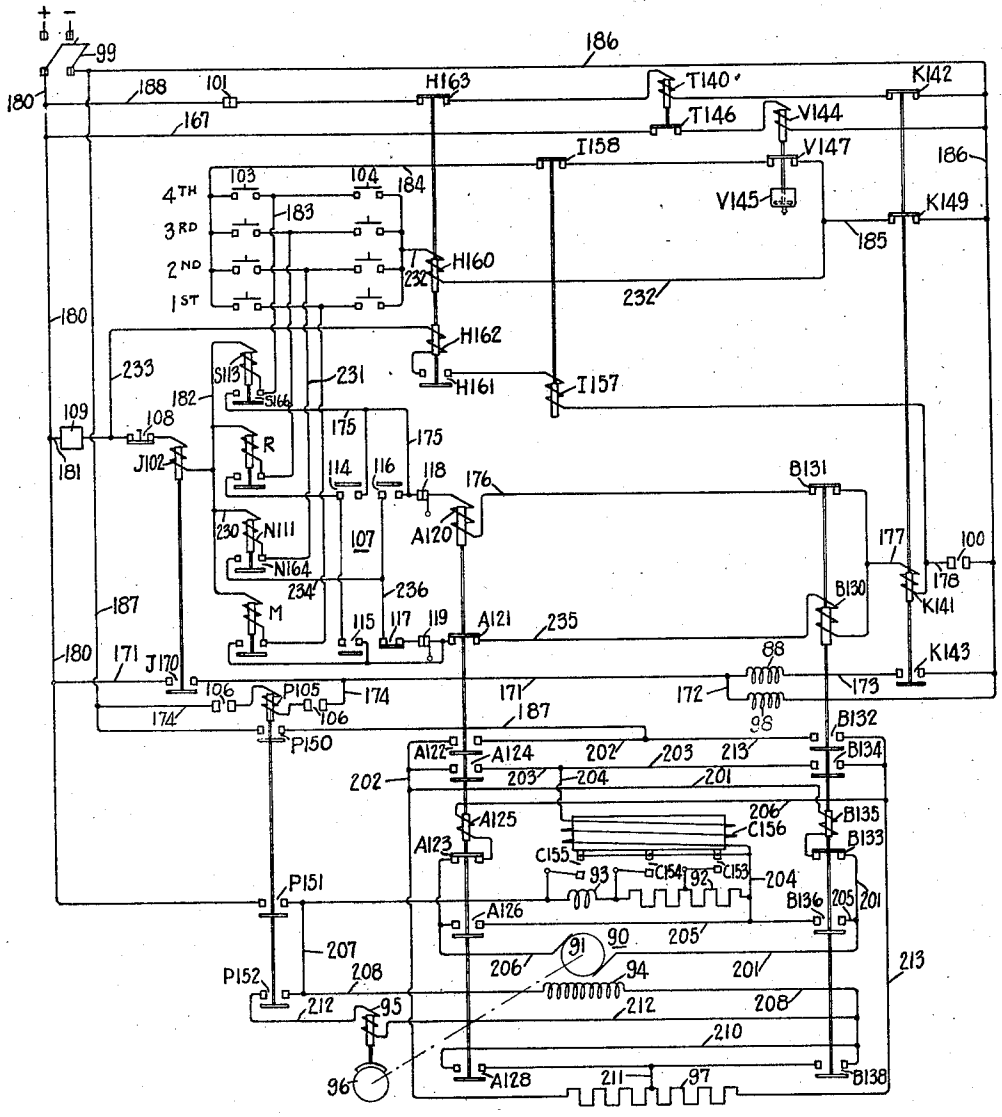


FIG. 5

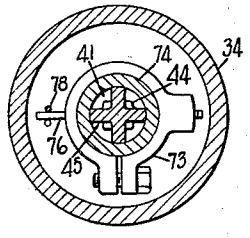


FIG. 4

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Patented May 24, 1932 1,860,333

UNITED STATES PATENT OFFICE

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CLOSURE OPERATING MECHANISM

Application filed April 18, 1929. Serial No. 356,052.

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

It is advantageous in certain types of elevator installations to provide mechanism for automatically operating the elevator car gate and hatchway doors, particularly in cases where these closures must be frequently operated and in cases where their manual operation is inconvenient. It is also of advantage to provide mechanism for automatically operating the car gate or a hatchway door to one of its operated positions with the movement of such closure to its other operated position effected either manually or by additional actuating mechanism. For example, in elevator systems wherein the operation of the car is under the control of the passengers themselves and wherein a closure must be in closed position before the car may be operated, it is particularly desirable that operating mechanism be provided for moving the closure to closed position in order that the car may be operated from any point.

One feature of the invention is the provision of mechanism for operating a closure to one of its operated positions which offers a minimum of resistance to the operation of the closure to its other operated position.

Another feature of the invention is the provision of mechanism for operating a closure to one of its operated positions which offers a minimum of resistance to the manual movement of the closure to such position.

A third feature of the invention is the provision of mechanism for operating a closure to one of its operated positions which is adapted to maintain the closure in any position to which it is moved.

A fourth feature of the invention is the provision of closure operating mechanism which may be adjusted to cause the closure to automatically return slowly to closed position when released.

A fifth feature of the invention is the provision of closure operating mechanism which, when adjusted to effect the automatic slow return of the closure to closed position, is operable to accelerate the closing operation.

A sixth feature of the invention is the provision of closure operating mechanism which is of simple and rugged construction and which is reliable in operation.

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

The closure operating mechanism will be described by way of illustration, as applied to the gate of an elevator car.

In the drawings:—

Figure 1 is a front elevation of a portion of an elevator car showing closure operating mechanism embodying the invention applied to the car gate;

Figure 2 is a view, partly in section, showing details of the closure operating mechanism as seen from the right of Figure 1;

Figure 3 is an enlarged section, partly broken away, taken along the line 3—3 of Figure 1 showing the construction of the closure operating mechanism;

Figure 4 is a sectional view taken along the line 4—4 of Figure 3 showing the manner in which the valve of the closure operating mechanism is guided; and

Figure 5 is a diagram of the control circuits of an automatic push button elevator system illustrating the adaptation of the closure operating mechanism to such an installation.

In Figure 1 the reference character 21 indicates an elevator car while the reference character 22 indicates the car gate which is illustrated as of the collapsible type. The gate is arranged to be manually opened as by the grasp 23, it being understood that a grasp may be provided for operating the gate from both inside and outside the car. The gate is adapted to be returned to closed position, when open, by the closure operating mechanism of the present invention, designated as a whole by numeral 24 and hereinafter referred to as the gate closing device.

In the illustrated embodiment of the invention, the gate closing device comprises a tubular casing made up of two sections 25 and 26 of pipe or tubing connected to each other by a coupling 27. The casing is secured to the side of the elevator car 21 by ring clamps

28 or other suitable supports. Prior to joinder of sections 25 and 26 a piston guide 30 is inserted in the section 25 in such manner that a flange 31 thereon fits in a counterbore 32 on section 25 and the lower end of the piston guide rests upon a portion of the end of section 26 when the sections 25 and 26 are coupled together. The piston guide 30 extends upwardly into section 25 and a hollow piston cylinder 33 secured in a recess in the lower end of piston guide 30 extends downwardly in the section 26 to a point near the lower end thereof. The lower end of section 26 of the casing is provided with a cap 34 having an opening closed by a plug 35 through which an adjusting screw 36 is threaded. The screw 36 is secured in place by a lock nut 37 thereon. The cap 34 and its related parts define the lower end of a chamber 38 in section 26 and afford a liquid tight closure therefor.

A member 40 is secured to the lower end of cylinder 33 and has a port 41 therein affording a passage from the interior of cylinder 33 to the chamber 38. A valve seat 42 is formed in the member 40 at the upper end of port 41 for cooperation with a check valve 43 adapted to close the port 41. The valve 43 has a stem 44 which is guided by projections 45 thereon in member 40 and extends downwardly in chamber 38 to a point directly above the adjusting screw 36.

A riser tube 46 on section 26 serves as a conduit through which oil, glycerin or other suitable non-compressible liquids may be introduced into chamber 38 of section 26 where the liquid rises until it normally fills chamber 38 to a height level with the top of the riser tube. Also a portion of the liquid passes through port 41 into cylinder 33 around valve 43. A cap 47 normally closes the riser tube.

The piston guide 30 has a central opening 50, provided with spaced oil baffles 51, which forms the guide for a hollow vertically reciprocable piston 48. The lower end of the piston 48 is closed and the upper end thereof is interiorally threaded to receive a plug 52 having a flange 53 resting on the upper end of the piston. The plug 52 is formed with a central opening 54 through which a cable 55 passes. A counterweight 56 is suspended by cable 55 within the piston with the upper end thereof normally in contact with the inner surface 57 of plug 52. The piston 48 is loosely fitted in piston guide 30 so that when the piston is in its upper position its weight tends to cause it to descend in cylinder 33. The descent of the piston is normally prevented by the liquid entrapped in cylinder 33 by closed check valve 43.

The cable 55 passes through a central opening 60 in a cap 61. This cap is adjustably secured to the upper end of section 25 by a set screw 62 and has a pin 63 extending into the interior thereof for cooperation with a longitudinal slot 58 in the end of section 25. With such arrangement, the cap 61 may be adjusted to align an opening 64 therein with a passage 65 in piston guide 30. When so adjusted, the cap is locked in position on section 25 by the set screw 62.

The cable 55 extends upwardly over a pulley 66 journalled on a pin 67 in a pulley guard and support 68 on cap 61. The cable 55 extends from the pulley 66 towards gate 22 and the free end of the cable is attached to an upright bar 70 of the gate 22 by a coupling screw 71. This screw has an adjusting nut 72 at each side of bar 70. The piston 48 and counterweight 56, when in their lowermost position in piston cylinder 33, maintain the gate 22 in its closed position through cable 55. The counterweight 56 is not sufficiently heavy to alone cause the car gate 22 to move to closed position but serves to maintain the gate in the position to which it is moved and to take up the slack in cable 55.

A magnet 88 is provided for effecting the closing of the gate, this magnet being arranged to lift the check valve 43 from its seat through the intermediary of a lever 76. A clamp ring 73 is secured about a shank 74 on the member 40 and has projecting bifurcations 75 between which the lever 76 is pivoted at 77. The lever 76 passes through a slot 80 in the valve stem 44 and has a rod 78 attached to its other end. The rod 78 extends upwardly in chamber 38 through the passage 65 in the flange 31 of piston guide 30 and through the hole 64 in cap 61 aligned with passage 65. The rod 78 may be laterally adjusted to a position in alignment with the passage 65 in piston guide 30 by adjustment of clamp ring 73. A coupling 81 on the end of rod 78 secures it to a link 82 pivoted to an arm 83 of a bell crank. The coupling 81 permits adjustment of the lever 76 within the slot 80. The bell crank is mounted on a bracket 84 fastened to a plate 85 secured to an extension 89 of the cap 61. The other arm 86 of the bell crank supports the armature 87 of the magnet 88 whose coil is mounted on the bracket 84.

In operation, the car gate 22 may be manually opened by means of the grasp 23. As the gate 22 is moved to open position the counterweight 56 is raised through cable 55 and the piston 48 is carried therewith through contact of the upper end of the counterweight and the inner surface 57 of plug 52. As piston 48 moves upwardly, suction is produced in the piston cylinder 33 causing the check valve 43 to be raised off the valve seat 42. This permits the liquid from chamber 38 to pass through port 41 into cylinder 33, lowering the liquid level in chamber 38. When the upward motion of piston 48 stops, the pressure of the liquid in piston cylinder 33 acting on valve 43 closes the port 41. The liquid in the piston cylinder is thus en-

trapped to prevent it from flowing back into chamber 38 as would occur if valve 43 remained open.

The gate 22 remains in the position to which it has been moved as the piston 48 is supported by the liquid entrapped in piston cylinder 33 and cannot descend to close the gate until the valve 43 is raised. Upon energization of magnet 88 to effect the closing of the gate, the armature 87 of the magnet is attracted, rocking the arm 83 of the bell crank clockwise to lift rod 78. Rod 78 moves lever 76 clockwise about its pivot 77 and the lever 76 engages the upper end of slot 80 in the valve stem 44, causing the check valve 43 to be lifted off valve seat 42. When the valve 43 is lifted off valve seat 42, the liquid entrapped in piston cylinder 33 passes therefrom through port 41 into chamber 38. As piston 48 is no longer supported in its upper position by the liquid it adds its weight to that of the counterweight 56, these bodies descending to move the gate 22 to closed position. As the liquid escapes from cylinder 33, it opposes the free descent of piston 48 and thus regulates the speed at which the gate closes. This speed may be varied by adjusting the position of lever 76 within slot 80.

The gate closing device may be arranged to automatically return the gate to closed position. To obtain such operation, the screw 36 is adjusted to raise the valve stem 44 sufficiently to normally maintain the face of valve 43 a slight distance above the seat 42. The gate closing device then functions as follows: When the gate 22 is moved to open position the counterweight 56 and piston 48 are moved upwardly in piston cylinder 33 through cable 55. As piston 48 moves upwardly the resultant difference in pressure between the chamber 38 and the piston cylinder 33 causes the check valve 43 to move upwardly increasing the opening between the face of check valve 43 and valve seat 42. Liquid then passes from chamber 38 through port 41 into piston cylinder 33 until the upward motion of piston 48 ceases. When the upward motion of piston 48 ceases, the valve 43 descends to its lower position with the valve face slightly above valve seat 42. When the car gate 22 is released, the piston 48 and counterweight 56 descend, acting through cable 55 to move the gate 22 to closed position. The closing speed of the gate is determined by the rate at which the liquid passes from cylinder 33 to chamber 38, this in turn being governed by the distance of the check valve 43 from its seat. By turning adjusting screw 36, the valve may be raised or lowered, thus regulating the size of the opening between the valve 43 and its seat 42 and therefore the speed at which the gate is closed. With this arrangement, upon energization of magnet 88 the check valve 43 is lifted to increase the clearance between valve 43 and seat 42, permitting the liquid to escape more rapidly from cylinder 33 to chamber 38. Thus, if the car gate 22 has been released and is automatically closing at a slow rate, the energization of magnet 88 accelerates the closing operation.

The gate may be closed manually through grasp 23. The gate closing device offers no resistance to the manual closing of the gate inasmuch as the counterweight 56 is free to descend in piston 48. Thus, the manual closing operation may be performed at any desired speed. Furthermore, as the counterweight acts to aid the closing operation, the manual closing may be done with very little effort. When the check valve 43 is adjusted for automatic closing, the piston follows the counterweight in the manual closing operation, the speed with which the piston descends being dependent upon the amount of clearance between valve 43 and its seat. The piston continues its descent after the gate is fully closed until the inner surface of plug 52 engages the upper end of the counterweight. When the gate operating device is arranged to maintain the gate in open position until magnet 88 is energized, the piston 48 remains in its upper position during the manual closing operation. Upon energization of the magnet 88 to raise the check valve, however, the piston descends until the inner surface of plug 52 engages the top of the counterweight.

The adaptation of the gate closing device of the present invention to an automatic push button elevator system is illustrated in Figure 5. It will be assumed that the valve 43 of the gate closing device is set to maintain the gate in the open position to which it is moved and that each hatchway door is arranged to close automatically when released. For convenience, a four floor installation is shown.

The various electromagnetic switches employed in the system are designated as follows:

A—Up direction switch,
B—Down direction switch,
C—Accelerating switch,
H—Car holding switch,
I—Hall breaking switch,
J—Retiring cam switch,
K—Non-interference switch,
M—First floor switch,
N—Second floor switch,
R—Third floor switch,
S—Fourth floor switch,
P—Potential switch,
T—Time limit relay switch,
V—Time limit hall breaking switch.

Throughout the following description these letters, in addition to the usual reference numerals, will be applied to the parts of the above enumerated switches. For example contacts K 143 are contacts on the non-interference switch, while actuating coil A

120 is the coil that operates the up direction switch.

The elevator car is raised and lowered by a motor, designated as a whole by 90, which for convenience is illustrated as of the direct current type. The armature of the elevator motor 90 is designated 91, its starting resistance 92, its series field winding 93 and its separately excited field winding 94. 95 is the release coil for the elevator motor electromagnetic brake 96, and 97 is the stopping resistance or dynamic brake. Door lock contacts are provided for each door, these contacts being arranged in series relation and represented by a single pair of contacts designated 100. Auxiliary door contacts are also provided for each door, these contacts being arranged in series relation and are represented by a single pair of contacts designated 101. The door lock contacts are closed only when their respective doors are closed and locked while the auxiliary door contacts are closed whenever their respective doors are closed, even though the doors are not locked. Door lock contacts 100 are provided to prevent the operation of the elevator car except when all hatchway doors are closed and locked. The purpose of the auxiliary door contacts 101 will be seen as the description proceeds. A retiring cam is provided to control the door locks, only the actuating magnet 98 for the cam being illustrated. Two pairs of gate contacts 106 are provided, these contacts being arranged in the circuit for the actuating coil P 105 of the potential switch. A push button 104 for each floor is provided in the car, these buttons to be hereinafter referred to as car buttons. Also, a push button 103 is provided at each floor, these buttons to be hereinafter referred to as hall buttons. A floor controller is provided, this mechanism being designated as a whole as 107 and comprising contacts 114, 115, 116 and 117 for the intermediate floors and terminal switches 118 and 119 for the top and bottom floors respectively. A stop switch 108 is provided in the car. The various safety devices, such as final limit switches, car safety operated switch, governor operated switch, are indicated generally at 109. The service switch for connecting the system to a suitable power source is indicated at 99.

Assume that the elevator car is at the third floor and that the car gate 22 is in open position with the gate contacts 106 separated. Assume further that all the hatchway doors are closed and that all hatchway doors, except that at the third floor where the elevator car is positioned, are locked in closed position with their related door lock contacts 100 engaged. The auxiliary door contacts 101 associated with all the hatchway doors including that at the third floor are engaged. The above described condition of the car gate contacts 106, the door contacts 100, auxiliary door contacts 101, as well as the condition of the contacts and terminal switches of the floor controller 107 when the car is at the third floor, is that illustrated in Figure 5. When the service switch 99 is closed coil T 140 of relay T becomes energized, since auxiliary door contacts 101 are engaged, and the contacts T 146 separate. The circuit for coil T 140 may be traced from the positive main, through the left-hand blade of service switch 99, wire 180, wire 188, auxiliary door contacts 101, contacts H 163, coil T 140, contacts K 142, wire 186, the right-hand blade of switch 99, to the negative main. The purpose of relay T will be described hereinafter.

A prospective passenger at the fourth floor desiring to use the elevator car operates the hall button 103 at the fourth floor. As a result, coil J 102 of the retiring cam switch is energized, causing contacts J 170 to engage. The circuit for coil J 102 may be traced from line 180, through wire 181, safety devices 109, stop button 108, coil J 102, wire 182, coil S 113 of the fourth floor switch, wire 183, fourth floor hall button 103, wire 184, hall breaking switch contacts I 158, time limit hall breaking switch contacts V 147, wire 185, non-interference switch contacts K 149, to wire 186. The engagement of contacts J 170 completes the circuit for retiring cam magnet 98 and prepares the circuits for gate closing magnet 88 and actuating coil P 105 of the potential switch P. The circuit for retiring cam magnet 98 may be traced from wire 180, through wire 171, contacts J 170, wire 172, magnet 98, to wire 186. Upon energization of retiring cam magnet 98, the retiring cam is operated to effect the locking of the hatchway door at the tird floor and the engagement of its related door contacts 100.

Coil S 113 which effects the engagement of floor switch contacts S 166 which correspond to the fourth floor is in the above traced circuit for coil J 102 and therefore is also energized upon operation of the fourth floor hall button. The coil S 113 upon energization causes the engagement of floor switch contacts S 166. The engagement of contacts S 166, together with the engagement of door lock contacts 100, establishes a circuit for actuating coil A 120 of the up direction switch and actuating coil K 141 of the non-interference switch. This circuit is from line 180, through wire 181, safety devices 109, stop button 108, coil J 102, wire 182, coil S 113, floor switch contacts S 166, wire 175, terminal switch 118 of floor controller 107, coil A 120, wire 176, back contacts B 131 of down direction switch B, wire 177, actuating coil K 141 of the non-interference switch K, wire 178, door lock contacts 100 which are now engaged as a result of the operation of the retiring cam, to line 186. As the circuit for coils J 102 and S 113 is com-

pleted through the hall button contacts on operation of hall button 103 the coils are consequently energized only during the interval the hall button is pressed. However, these coils are maintained energized, after the button is released, through the circuit above traced due to the engagement of self-holding contacts S 166 of the fourth floor switch.

As coil K 141 is energized, the non-interference switch contacts K 149 separate to interrupt the circuit of the hall buttons 103 and car buttons 104. Thus, the operation of other hall buttons 103 does not interfere with the trip of the car to the fourth floor. Auxiliary contacts K 142 also separate, deenergizing coil T 140. Upon deenergization of coil T 140, switch contacts T 146 engage, energizing the actuating coil V 144 of time limit hall breaking switch contacts V 147. The circuit of coil V 144 is from wire 180, through wire 167, contacts T 146 and coil V 144, to wire 186. The coil V 144 upon energization separates time limit hall breaking switch contacts V 147. The separation of contacts V 147 establishes an additional break in the circuit to hall buttons 103. The purpose of this arrangement will be seen as the description proceeds. Energization of coil K 141 also engages the contacts K 143, completing the circuit for gate closing magnet 88 prepared by contacts J 170. This circuit may be traced from wire 180, through wire 171, contacts J 170, magnet 88, wire 173, contacts K 143, to wire 186. The magnet 88, upon energization, lifts the valve 43 and the gate closing device starts to move the car gate to closed position as previously described. The actuating coil K 141 of the non-interference switch is made subject to the door lock contacts 100 to prevent the engagement of contacts K 143 to energize the gate magnet 88 prior to the locking of the hatchway door. Thus, the possibility of a person opening the hatchway door and being struck by the closing gate is obviated.

The up direction switch A operates simultaneously with non-interference switch K, causing the separation of its contacts A 121 and A 123 and the engagement of its contacts A 122, A 124, A 126 and A 128. The separation of contacts A 121 opens the circuit for actuating coil B 130 of the down direction switch, these contacts and the corresponding contacts B 131 of the down direction switch serving as electrical interlocks. The separation of contacts A 123 in wire 206 disconnects dynamic brake resistance 97 from across the armature 91 of elevator motor 90. The engagement of contacts A 124 and A 126 connects accelerating switch coil C 156 across the elevator motor armature 91. The circuit for coil C 156 may be traced from the right-hand armature brush, through wire 201, back contacts B 133 and hold-down coil B 135 of the down direction switch B, wire 201, wire 202, contacts A 124, wire 203, wire 204, coil C 156, wire 204, wire 205, contacts A 126, wire 206, to the left-hand armature brush. The engagement of contacts A 122 and A 126 prepares the circuit for armature 91. The engagement of contacts A 122 and A 128 prepares the circuits for the elevator motor separately excited field winding 94 and brake release coil 95.

When the gate reaches closed position the gate contacts 106 are engaged, completing the circuit for actuating coil P 105 of the potential switch. This circuit may be traced from wire 180, through wire 171, contacts J 170, wire 174, gate contacts 106, coil P 105, gate contacts 106, wire 187, to wire 186. The potential switch, upon operation, causes the engagement of contacts P 150, P 151 and P 152. To reduce current consumption, the circuit of gate magnet 88 may be arranged to be opened when the gate reaches closed position. For this purpose auxiliary contacts adapted to separate as the potential switch P closes, or auxiliary gate contacts adapted to separate as the gate reaches closed position, may be inserted in the circuit of the gate magnet. The engagement of contacts P 150 and P 151 completes the circuits for the armature 91 and separately excited field winding 94. The circuit for armature 91 is from wire 180, through contacts P 151, series field winding 93, starting resistance 92, wire 204, wire 205, contacts A 126, wire 206, armature 91, wire 201, contacts B 133, hold-down coil B 135, wire 202, contacts A 122, wire 187, contacts P 150, to wire 186. Hold-down coil B 135 maintains the contacts B 133 firmly engaged. The circuit for the separately excited field winding 94 is from wire 180, through contacts P 151, wire 207, wire 208, winding 94, wire 210, contacts A 128, wire 211, the left half of dynamic brake resistance 97, wire 202, contacts A 122, wire 187, contacts P 150, to wire 186. The engagement of contacts P 150, P 151 and P 152 completes the circuit for brake release coil 95. The circuit for brake release coil 95 is from wire 180, through contacts P 151, wire 207, contacts P 152, wire 212, coil 95, by way of wire 210 to wire 186 as traced for field winding 94.

The elevator motor armature and separately excited field winding being energized and the brake 96 released, as a result of the energization of brake release coil 95, the elevator motor starts the car in the up direction. As the counter E. M. F. of the motor builds up, the coil C 156 causes the engagement of contacts C 153, C 154 and C 155 in succession to short-circuit the starting resistance 92 and series field winding 93 in steps. As a result, the elevator motor is brought up to full speed. As the car leaves the third floor, the intermediate switch contacts 115 of the floor controller 107 are engaged to enable the car to return to the third floor.

When the car nears the fourth floor, the terminal switch 118 of controller 107 opens interrupting the circuit of retiring cam switch coil J 102, coil S 113 of floor switch S, coil A 120 of up direction switch A and non-interference switch coil K 141. Upon deenergization of coil S 113, the floor switch contacts S 166 separate in preparation for a subsequent operation. The deenergization of coil A 120 results in the separation of contacts A 122, A 124, A 126 and A 128 and the reengagement of contacts A 121 and A 123. The engagement of contacts A 121 prepares the circuit for actuating coil B 130 of down direction switch B for a subsequent operation. The engagement of contacts A 123 connects the dynamic brake resistance 97 across the elevator motor armature 91. The circuit for resistance 97 may be traced from the right-hand armature brush, through wire 201, contacts B 133, coil B 135, wire 202, resistance 97, wire 213, wire 206, up direction switch hold-down coil A 125, contacts A 123, to the left-hand armature brush. The hold-down coils A 125 and B 135 maintain the contacts A 123 and B 133, respectively, firmly engaged. The separation of contacts A 124 and A 126 opens the circuit for accelerating switch coil C 156, resulting in the separation of contacts C 153, C 154 and C 155. The separation of contacts A 122 and A 126 opens the circuit for armature 91. The separation of contacts A 122 and A 128 opens the circuits for separately excited field winding 94 and brake release coil 95. Upon the deenergization of coil 95, the brake 96 is applied and, assisted by the dynamic brake resistance 97 connected across the motor armature 91, brings the car to rest at the fourth floor.

Upon deenergization of coil J 102, retiring cam switch contacts J 170 separate, resulting in the deenergization of actuating coil P 105 of the potential switch and retiring cam magnet 98. Deenergization of coil P 105 results in the separation of potential switch contacts P 150, P 151 and P 152 which control the circuits for the elevator motor and brake release coil 95, these circuits having previously been opened by the separation of the contacts of the up direction switch A. The deenergization of magnet 98 results in the operation of the retiring cam to unlock the hatchway door at the fourth floor and the separation of the related door lock contacts 100.

The deenergization of coil K 141 causes contacts K 143 to separate and contacts K 142 and K 149 to engage. The separation of contacts K 143, together with the separation of contacts J 170, results in the deenergization of gate magnet 88. The deenergization of magnet 88 results in the descent of valve 43 of the gate closing device 24 to its normal position in preparation for a subsequent gate closing operation. Contacts K 149, upon engagement, prepare the common circuit through wire 185 for hall buttons 103 and car buttons 104. However, the hall buttons 103 are ineffective to control operation of the car, as the circuit for the hall buttons is maintained interrupted in wire 184 by time limit hall switch contacts V 147. On engagement of contacts K 142, coil T 140 is energized, separating contacts T 146. The separation of contacts T 146 results in the deenergization of coil V 144 of the time limit hall switch. Contacts V 147 of this switch do not reengage immediately the circuit for coil V 144 is broken, their action being delayed by a dash-pot V 145. The dash-pot is arranged to retard the engagement of contacts V 147 but does not interfere with their separation on energization of coil V 144. The dash-pot is arranged to provide an interval of several seconds duration between interruption of the elevator motor circuits as the elevator car nears the fourth floor and the engagement of contacts V 147 to prepare the circuit through wire 184 for hall buttons 103. The prospective passenger is thus afforded an opportunity to open the hatchway door to enter the car without interference with control of the elevator car by operation of hall buttons 103 at other landings.

Let it now be assumed that after the arrival of the elevator car at the fourth floor in response to the hall button 103, the prospective passenger opens the hatchway door to enter the car with the intention of making a trip to the second floor. As the hatchway door moves from closed position, the auxiliary door contacts 101 separate. This breaks the circuit for coil T 140, resulting in the engagement of contacts T 146. The engagement of contacts T 146 completes the circuit for coil V 144 of the time limit switch, causing the restoration of contacts V 147 to their fully separated position. The prospective passenger then opens the car gate to enter the car. As the car gate 23 is opened, the piston 48 is lifted opening valve 43, permitting liquid to enter piston cylinder 33. As the movement of gate 23 ceases, the valve 43 closes and the liquid entrapped in cylinder 33 supports piston 48 to maintain the gate in the position to which it is moved, as previously described.

After the passenger enters the car, the hatchway door at the fourth floor closes and auxiliary door contacts 101 engage. The engagement of contacts 101 causes the reenergization of coil T 140, resulting in the separation of contacts T 146. The separation of contacts T 146 deenergizes coil V 144 and contacts V 147 again start to engage, their reengagement being retarded as before by dash-pot V 145. Contacts V 147 thus remain separated for several seconds after the hatchway door closes, maintaining the circuit for hall buttons 103 interrupted. The passenger is thus afforded an interval of several sec-

onds after the hatchway door closes and auxiliary door contacts 101 engage in which to operate a car button 104 without being subject to interference with the control of the car by operation of a hall button 103.

Assume that after the hatchway door closes the passenger in the car operates the car button 104 corresponding to the second floor. This results in the energization of retiring cam switch coil J 102, coil N 111 of the floor switch for the second floor and actuating coil H 160 of the car holding switch. This circuit may be traced from wire 180, through wire 181, safety devices 109, stop button 108, coil J 102, wire 230, coil N 111, wire 231, second floor car button 104, wire 232, coil H 160, wire 185, contacts K 149, to wire 186.

Switch H, upon operation in response to the energization of its coil H 160, causes the separation of its contacts H 163 and the engagement of its contacts H 161. The purpose of contacts H 161 will be explained later. The separation of contacts H 163 again breaks the circuit for coil T 140, causing the reengagement of contacts T 146 and the consequent reenergization of coil V 144. As a result, contacts V 147 are again restored to their fully separated position. Should the permitted time interval expire and contacts V 147 reengage before a car button is pushed, the separation of contacts H 163 to effect the separation of contacts V 147, in response to the pushing of a car button, restores the car to the exclusive control of the occupant of the car, provided a hall button has not been pushed.

The operation of the second floor switch N, as a result of the energization of its coil N 111, causes the engagement of its contacts N 164. The purpose of these contacts will be explained later.

The energization of coil J 102 results in the engagement of contacts J 170, preparing the circuits for actuating coil P 105 of the potential switch and the gate magnet 88 and completing the circuit of retiring cam magnet 98, as previously described. On energization of magnet 98 the retiring cam is operated to lock the hatchway door at the fourth floor and engage the related door lock contacts 100. The engagement of contacts 100, together with the engagement of contacts H 161, completes the circuit for holding coil H 162 of switch H and hall breaking switch coil I 157. This circuit may be traced from wire 180, through wire 181, safety devices 109, wire 233, coil H 162, contacts H 161, coil I 157, wire 178, door lock contacts 100, to wire 186. The energization of coil I 157 results in the separation of switch contacts I 158 to further open the hall button circuit in wire 184.

The engagement of door lock contacts 100, together with the engagement of second floor switch contacts N 164, completes the circuit for non-interference switch coil K 141 and down direction switch actuating coil B 130, this circuit being also a holding circuit for second floor switch coil N 111 and retiring cam switch coil J 102. This circuit may be traced from wire 180, through wire 181, safety devices 109, stop button 108, coil J 102, wire 230, coil N 111, contacts N 164, wire 234, wire 236, intermediate switch 117, terminal switch 119 of the floor controller, contacts A 121 of up direction switch A, wire 235, coil B 130, wire 177, coil K 141, wire 178, door lock contacts 100, to wire 186.

As coil K 141 is energized, non-interference switch contacts K 149 separate to interrupt the circuit of hall buttons 103 and car buttons 104 in wire 185. Auxiliary contacts K 142 also separate to further open the circuit of coil T 140. Contacts K 143 engage to energize the gate magnet 98 and the gate starts to close, as previously described.

The down direction switch B is operated, by coil B 130, simultaneously with the operation of non-interference switch K, to effect the separation of its contacts B 131 and B 133 and the engagement of its contacts B 132, B 134, B 136 and B 138. The separation of contacts 131 opens the circuit for actuating coil A 120 of the up direction switch. The separation of contacts B 133 disconnects dynamic brake resistance 97 from across the armature 91. The engagement of contacts B 134 and B 136 connects accelerating switch coil C 156 across the armature 91. This circuit may be traced from the right-hand armature brush, through wire 201, wire 205, contacts B 136, wire 204, coil C 156, wire 203, contacts B 134, wire 213, wire 206, coil A 125, contacts A 123, to the left-hand armature brush. The engagement of contacts B 132 and B 136 prepares the circuit for armature 91. The engagement of contacts B 132 and B 138 prepares the circuit for the field winding 94 and brake release coil 95.

When the gate reaches closed position the gate contacts 106 engage, energizing the actuating coil P 105 of the potential switch and contacts P 150, P 151 and P 152 are engaged, as previously described, to complete the circuits for armature 91, field winding 94 and brake release coil 95. The circuit for armature 91 is from wire 180, through contacts P 151, series field winding 93, starting resistance 92, wire 204, wire 205, contacts B 136, wire 201, armature 91, wire 206, contacts A 123, coil A 125, wire 213, contacts B 132, wire 187, contacts P 150, to wire 186. It will be noted that the current flows through armature 91 in the reverse direction to that in which it flowed when the up direction switch was closed. The circuit for the separately excited field winding 94 is from wire 180, through contacts P 151, wire 207, wire 208, winding 94, contacts B 138, wire 211, the right half of resistance 97, wire 213, contacts B 132, wire 187, contacts P 150, to wire 186. The circuit for brake release coil 95

is from wire 180, through contacts P 151, wire 207, wire 212, contacts P 152, coil 95, by way of wire 208 to wire 186 as traced for field winding 94.

The elevator motor armature and field winding being energized, and brake 96 released as a result of energization of coil 95, the elevator motor starts the car in the down direction. As the counter E. M. F. of the motor builds up, the coil C 156 causes the engagement of contacts C 153, C 154 and C 155 in succession to short-circuit the starting resistance 92 and series field winding 93 in steps. As a result, the elevator motor is brought to full speed. As the car leaves the fourth floor, the terminal switch 118 of the floor controller closes to enable the car to return to the fourth floor. As the car passes the third floor in the down direction, the intermediate switch contacts 115 of the floor controller separate and the intermediate switch contacts 114 engage.

As the car nears the second floor, the intermediate switch contacts 117 of the controller 107 separate interrupting the circuit for coil J 102, coil N 111, coil B 130 and coil K 141. As coil N 111 deenergizes, the floor switch contacts N 164 separate in preparation for a subsequent operation. As coil B 130 deenergizes, contacts B 132, B 134, B 136 and B 138 separate and contacts B 131 and B 133 engage. Engagement of contacts B 131 prepares the circuit of coil A 120 to enable a subsequent trip in the up direction. The engagement of contacts B 133 connects the dynamic brake resistance 97 across the motor armature 91. The circuit for resistance 97 has been traced previously in the description of the operation of the car in the up direction. The separation of contacts B 134 and B 136 opens the circuit for accelerating switch coil C 156, resulting in the separation of contacts C 153, C 154 and C 155. The separation of contacts B 132 and B 136 opens the circuit for armature 91. The separation of contacts B 132 and B 138 opens the circuits for the field winding 94 and brake release coil 95. The deenergization of coil 95 results in the application of brake 96 which, assisted by dynamic brake resistance 97 connected across the motor armature 91, brings the car to rest at the second floor.

Upon deenergization of retiring cam switch coil J 102, contacts J 170 separate to interrupt the circuits of potential switch coil P 105 and retiring cam magnet 98. On deenergization of coil P 105, contacts P 150, P 151 and P 152 separate. These contacts control the circuits of motor 90 and brake release coil 95, these circuits having previously been opened on separation of the contacts of down direction switch B. As retiring cam magnet 98 is deenergized, the retiring cam operates to unlock the hatchway door at the second floor and separate the related door lock contacts 100.

As coil K 141 deenergizes, the contacts K 149 and K 142 engage while contacts K 143 separate. Upon engagement of contacts K 149 the car button and hall button circuits are prepared in wire 185. The hall button circuit remains open in wire 184 at contacts V 147. The separation of contacts K 143, together with the separation of contacts J 170, deenergizes magnet 88 of the gate closing device.

The separation of door lock contacts 100 interrupts the circuit through holding coil H 162 of the car holding switch H 161 and hall breaking switch coil I 157. Coil I 157 on deenergization permits contacts I 158 to engage, preparing the hall button circuit in wire 184. The hall button circuit, however, remains open at contacts V 147. Coil H 162 on deenergization permits contacts H 161 to separate and contacts H 163 to engage. Separation of contacts H 161 is in preparation for a subsequent operation under control of a car button. The engagement of contacts H 163, together with the engagement of contacts K 142, completes the circuit for coil T 140. Coil T 140 on energization effects the separation of contacts T 146, resulting in deenergization of coil V 144. As coil V 144 is deenergized, the contacts V 147 start to engage but their engagement is retarded for the interval provided by the dash-pot V 145. The interval provided by dash-pot V 145 affords the occupant of the car an opportunity to open the hatchway door to leave the car. This eliminates the possibility of the car starting in response to a hall button 103 before the occupant has had a reasonable opportunity to open the hatchway door after the car arrives at its destination.

When the occupant of the car opens the car gate to leave the car, the piston 48 of the gate closing device is raised in preparation for a subsequent gate closing operation. When the occupant of the car opens the hatchway door, the auxiliary door contacts 101 separate, deenergizing coil T 140. As a result, contacts T 146 engage, energizing coil V 144 to cause the restoration of contacts V 147 to their fully separated position. The hall button circuit thus remains interrupted until the contacts V 147 engage under the retarding action of dash-pot 145 after the hatchway door closes and auxiliary door contacts 101 engage.

In the event that the occupant of the car desires to change his destination, he may operate the stop button 103 stopping the car. It is to be noted, however, that the circuit including hall breaking switch coil I 159 is not interrupted if the stop occurs between floors. Consequently the hall breaking switch contacts I 158 remain separated to prevent control of the car being taken from

the occupant by operation of a hall button, regardless of the time which elapses before another car button is operated.

Although the gate closing device has been described as adapted to an automatic push button elevator system, it is equally applicable to other types of control systems, such as systems in which the car is provided with an operator to control both the starting and stopping of the car or only the starting thereof. The gate closing device is also adapted to other systems in which the control is effected by push buttons. Furthermore, a manually operable gate control switch may be provided, in the system in which the mechanism is employed, to control the energization of magnet 88. In any of these systems, with the gate closing device provided, a person is relieved of the burden of closing the gate and also a closed car gate is assured while the car is in motion, thus protecting occupants of the car from the possibility of injury by contact with projections in the hatchway.

It is to be noted that in the embodiment illustrated the ratio of piston movement to closure movement is one to one. Thus, any error in the operation of the closure operating device can only affect the movement of the closure in an equal, but not greater amount. Furthermore, this low ratio facilitates adjustments of the closure operating mechanism to secure the operation desired. The lengths of the various elements of the closure operating mechanism are determined by the amount of closure movement. It is to be understood that other ratios of movement may be provided, if desired.

The gate closing device is adapted to close the gate whether the gate is arranged to be opened by power or manually.

While the gate closing device has been described as closing the car gate, it is also readily adapted to open the gate.

Although the closure operating mechanism has been illustrated and described as applied to a collapsible car gate, it is equally suited to operate rigid or flexible car gates or hatchway doors whether they are vertically or horizontally moved. The closure operating mechanism is also adapted to operate swinging doors.

The provision of a counterweight freely movable in the piston of a long stroke closure operating mechanism facilitates the manual closing operation, as the counterweight moves independently of the piston, and without resistance, to aid in moving the gate to closed position.

The closure operating device offers very little resistance to the opening operation as, when the counterweight is moved, the only resistance encountered is due to lifting the counterweight and piston from the liquid in which the latter is immersed.

When the closure operating mechanism is arranged with the check valve normally resting on the valve seat, a further advantage resulting is that the closure is maintained in any position to which it is moved.

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 system, a closure adapted when open to afford access to the elevator car, means for biasing said closure to one of its limit positions, and means for controlling said biasing means to prevent its operation to move said closure to said limit position, said biasing means comprising two relatively movable members whose relative movement is unaffected by said preventing means, one of said members being connected to said closure whereby the closure may be manually moved to said limit position unaffected by said preventing means.

2. In an elevator system, a closure adapted when open to afford access to the elevator car, means for biasing said closure to closed position, means for controlling said biasing means to prevent its operation to move said closure to closed position, said preventing means permitting movement of said closure to open position, and means for rendering said preventing means ineffective to prevent the operation of said closure to closed position by said biasing means, said biasing means comprising two relatively movable members whose relative movement is unaffected by said preventing means, one of said members being connected to said closure whereby the closure may be manually moved to closed position unaffected by said preventing means.

3. In an elevator system; a closure adapted when open to afford access to the elevator car; and operating means for said closure, said operating means comprising, a chamber, gravity means operable within said chamber to bias said closure to closed position, fluid within said chamber, and valve means for said chamber adapted when closed to prevent escape of said fluid from said chamber, said fluid, when said valve is closed, supporting said gravity means to prevent its operation to move said closure to closed position.

4. In an elevator system, a closure adapted when open to afford access to the elevator car, and operating mechanism for said closure, said operating mechanism comprising, a casing, a cylinder in said casing, said cylinder having a passage at its lower end communicating with the interior of said

casing, gravity means operable in said cylinder to bias said closure to closed position, a non-compressible liquid in said cylinder and said casing, and means adapted to close said passage to prevent the flow of said liquid from said cylinder to the interior of said casing, the liquid in said cylinder supporting said biasing means, when said passage is closed, to prevent its operation to move the closure to closed position.

5. In an elevator system; a closure adapted when open to afford access to the elevator car; and operating means for said closure, said operating means comprising, a casing having a chamber, fluid within said chamber and that portion of the interior of said casing external to said chamber, a valve for controlling communication between said chamber and said portion of said casing, said valve when open permitting the flow of said fluid between said chamber and said portion of said casing, and means within said chamber having sufficient weight to move said closure from open to closed position, said fluid when the valve is closed supporting said weight means to prevent its operation to move said closure means to closed position.

6. In an elevator system, a closure adapted when open to afford access to the elevator car, and operating mechanism for said closure, said operating mechanism comprising, a casing, a cylinder in said casing, said cylinder having a passage at its lower end communicating with the interior of said casing, weight means operable in said cylinder to bias said closure to closed position, a non-compressible liquid in said cylinder and said casing, a valve for closing said passage to prevent the flow of said liquid from said cylinder to the interior of said casing, the liquid in said cylinder, when said valve is closed, supporting said biasing means to prevent its operation to move said closure to closed position, and means for causing the lifting of said valve to permit the flow of liquid from said cylinder into the interior of said casing thereby allowing said biasing means to move said closure to closed position.

7. In an elevator system; a closure adapted when open to afford access to the elevator car; and operating means for said closure, said operating means comprising, a casing having a chamber, fluid within said chamber and that portion of the interior of said casing external to said chamber, a valve for controlling communication between said chamber and said portion of said casing, said valve when open permitting the flow of said fluid between said chamber and said portion of said casing, means within said chamber having sufficient weight to move said closure from open to closed position, said fluid when the valve is closed supporting said weight means to prevent its operation to move said closure to closed position, and a magnet for causing the lifting of said valve to permit the flow of liquid from said chamber into said portion of said casing thereby allowing said weight to move said closure means to closed position.

8. In an elevator system; a closure adapted when open to afford access to the elevator car; and operating means for said closure, said operating means comprising, a casing, a cylinder within said casing, a counterweight connected to said closure means, said counterweight being of insufficient weight to move said closure, a hollow piston within said cylinder and adapted to be supported by said counterweight, said counterweight being within said piston and the combined weight of said piston and counterweight being sufficient to bias said closure means to one of its limit positions, a check valve for controlling communication between said casing and said cylinder, and liquid within said casing and cylinder, said liquid when said valve is closed supporting said piston, thereby preventing the movement of said closure means to said one limit position by the combined weight of said piston and counterweight, said counterweight being movable within said piston unaffected by said liquid whereby said closure means may be manually moved to said one limit position.

9. In an elevator system; a closure adapted when open to afford access to the elevator car; and operating means for said closure comprising, a casing having a chamber and a passage communicating therewith, weight means operable within said chamber to bias said closure to one of its limit positions, fluid within said chamber, said biasing means, upon operation to move said closure to said one limit position, displacing said fluid from said chamber through said passage into a portion of said casing external to said chamber, a valve adapted to control the flow of said fluid, and means adapted on operation to lift said valve to accelerate the movement of said closure by said biasing means.

10. In an elevator system; a closure adapted when open to afford access to the elevator car; and operating means for said closure comprising, a hollow cylinder, weight means operable within said cylinder to bias said closure to closed position, fluid within said cylinder, said fluid being adapted in the event its escape from said cylinder is prevented, to support said biasing means to prevent operation thereof to move said closure to closed position, valve means for controlling the flow of said fluid from said cylinder and thus to control the speed with which said closure is closed by said biasing means, and means operable to prevent the full closure of said valve means so that the escape of said fluid from said cylinder is not completely prevented, whereby said biasing means, upon release of said closure after movement thereof from

said closed position, is effective to return said closure slowly to said closed position.

11. In an elevator system; a closure adapted when open to afford access to said car; and operating mechanism for said closure comprising, a casing having a chamber, weight means operable in said chamber to bias said closure to closed position, fluid in said casing and chamber, said fluid being adapted, in the event its escape from said chamber into said casing is prevented, to support said biasing means to prevent its operation to move said closure to closed position, valve means for controlling the flow of said fluid between said casing and said chamber and thus to control the speed with which said closure is closed by biasing means, said valve means being opened during movement of said closure from said closed position, and means operable to prevent the return of said valve means to fully closed position so that the escape of said fluid from said chamber is not completely prevented, whereby said closure, upon being released after its movement from said closed position, is slowly returned to said closed position by said biasing means.

12. In an elevator system; a closure adapted when open to afford access to the elevator car; and operating mechanism for said closure comprising, a casing having a chamber, weight means operable in said chamber to bias said closure to closed position, liquid in said casing and chamber, said liquid being adapted, in the event its escape from said chamber into said casing is prevented, to support said biasing means to prevent its operation to move said closure to closed position, and valve means for controlling the flow of said fluid between said casing and said chamber, said valve means being adapted to open during movement of said closure from said closed position and to close whenever said movement of said closure from said closed position stops, thereby preventing escape of liquid from said chamber into said casing so as to maintain said closure in any position to which it is moved.

13. In an elevator system; a closure adapted when open to afford access to the elevator car; and operating mechanism for said closure comprising, a casing having a chamber, weight means operable in said chamber to bias said closure to closed position, liquid in said casing and chamber, said liquid being adapted, in the event its escape from said chamber into said casing is prevented, to support said biasing means to prevent its operation to move said closure to closed position, valve means for controlling the flow of said liquid between said casing and said chamber, said valve means being adapted to open during movement of said closure from said closed position and to close whenever said movement of said closure means from said closed position stops, thereby being effective to prevent the escape of liquid from said chamber into said casing so as to maintain said closure in any position to which it is moved, and means operable to adjust said valve means so that it cannot return to fully closed position whereby said closure, upon being released after movement from said closed position, is returned to said closed position by said biasing means at a rate determined by the amount which said valve means is maintained open by said adjusting means.

14. In an elevator system, a closure adapted when open to afford access to the elevator car, and operating mechanism for said closure, said operating mechanism comprising, a casing having a chamber communicating with the interior of said casing, weight means in said chamber operable to bias said closure to closed position, valve means for controlling said communication between said chamber and said casing, a non-compressible liquid in said chamber and said casing, the liquid in said casing when said valve means is closed supporting said biasing means to render said biasing means ineffective to move said closure to said closed position, said valve means when open rendering said biasing means effective by permitting said liquid to flow from said chamber into said casing, and means cooperating with said valve means to vary the rate at which said liquid flows from said cylinder to said casing when said valve is opened, thereby varying the rate at which said closure is moved by said biasing means.

15. In an elevator system; a closure adapted when open to afford access to the elevator car; and operating means for said closure, said operating means comprising, a casing having a chamber, weight means operable within said chamber to bias said closure to closed position, fluid within said chamber, and valve means for said chamber adapted when closed to prevent escape of fluid from said chamber, said fluid when said valve is closed supporting said biasing means to render said biasing means ineffective to move said closure to said closed position, said closure being operable from said closed position unaffected by said valve means.

16. In an elevator system; a gate for said car; and operating mechanism for the elevator gate comprising, an elongated casing made up of a plurality of joined tubular sections, said casing being secured to said car, a piston guide positioned in one section and resting upon one end of the adjacent section, an elongated piston cylinder secured to said piston guide and extending downwardly therefrom, said cylinder being provided with a passage at its lower end communicating with the interior of said casing, an elongated hollow piston movable in said piston guide and cylinder, said piston having a loose fit in said piston cylinder, a non-compressible liquid in said casing and said cylinder, a

sheave supported by the casing at the upper end thereof, a cable secured at one end to said gate, said cable passing over said sheave and through openings in the top of said casing and the top of said piston, a counterweight within said piston and movable with respect thereto, said counterweight being connected to the other end of said cable and being of insufficient weight to move said gate to closed position, said counterweight being adapted to support said piston, the combined weight of said counterweight and said piston being sufficient to bias said gate to its closed position, a check valve at the upper end of said passage controlling the flow of said liquid between said cylinder and said casing, said liquid when said valve is closed supporting said piston in said cylinder to prevent the movement of said gate to closed position by the combined weight of said piston and counterweight, a lever for lifting said valve, and a magnet supported by said casing, said magnet having an armature connected to said lever, said magnet when energized acting through said armature and lever to lift said valve to permit the flow of liquid from said cylinder into said casing, thereby allowing said gate to be moved to closed position by the combined weight of said piston and counterweight, the movement of said counterweight, in said piston being unaffected by said liquid, whereby said gate may be manually closed.

In testimony whereof, I have signed my name to this specification.

EDWARD LEE DUNN.