June 28, 1932. T. BRADY 1,864,796

GATE OPERATING MECHANISM

Original Filed July 10, 1926 4 Sheets-Sheet 1

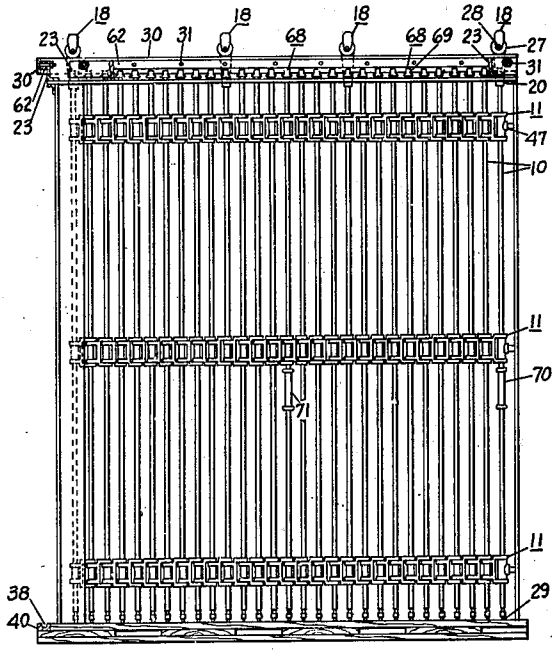


FIG. 1

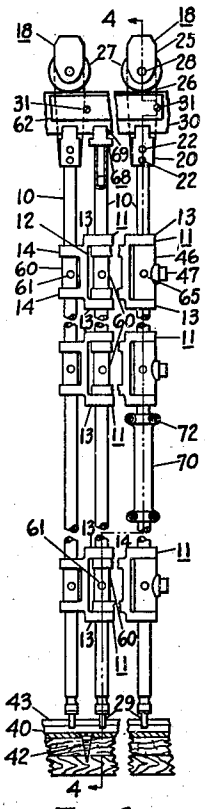


FIG. 3

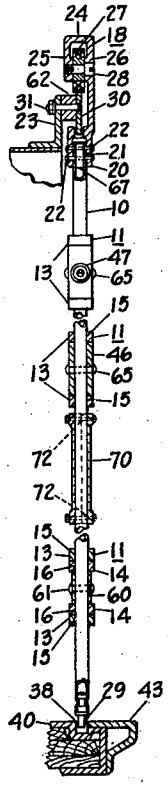


FIG. 4

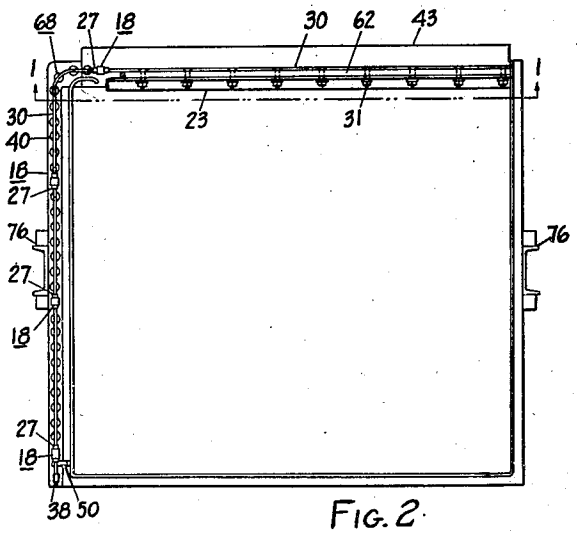


FIG. 2

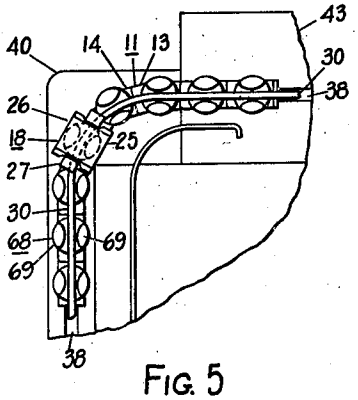


FIG. 5

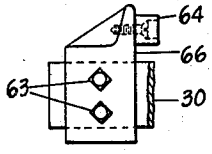


FIG. 6

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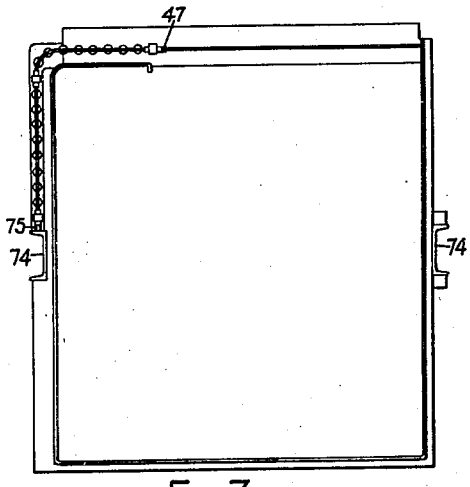


FIG. 7

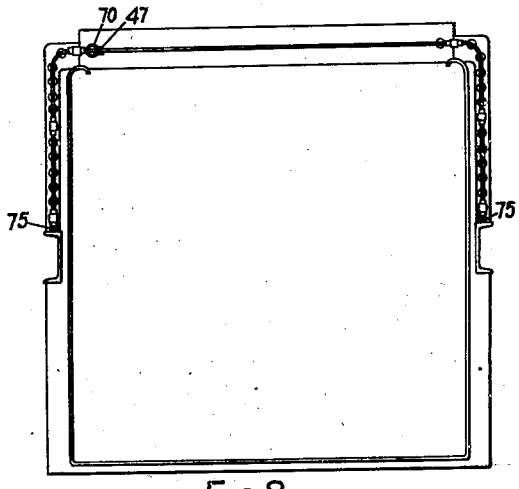


FIG. 8

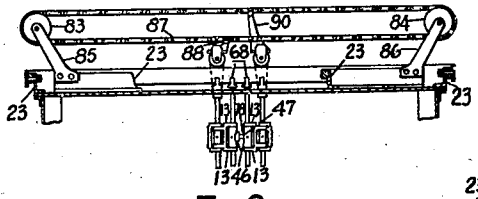


FIG. 9

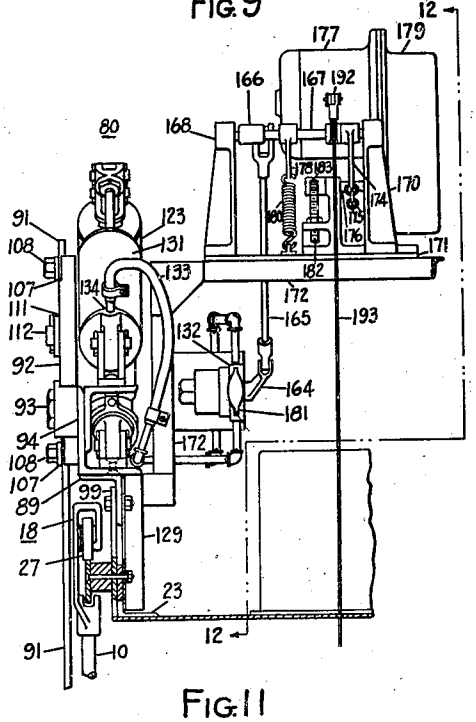


FIG. 11

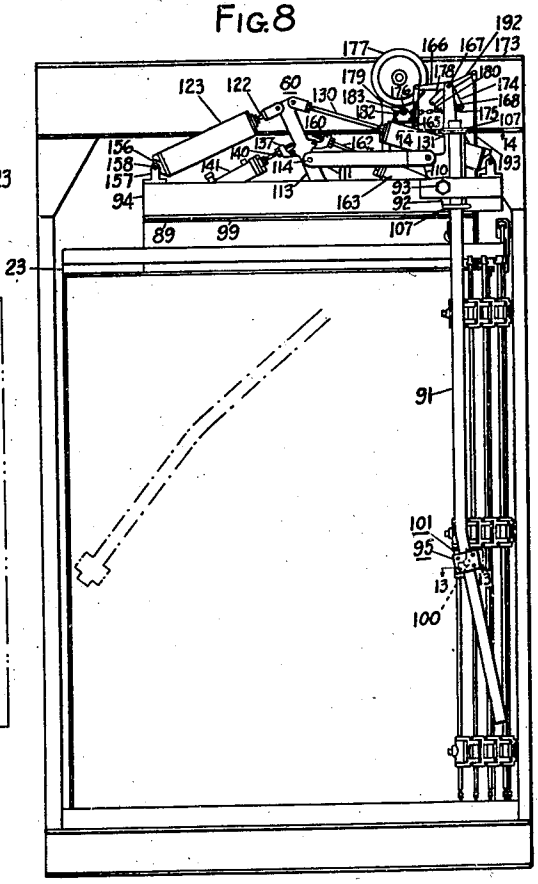


FIG. 10

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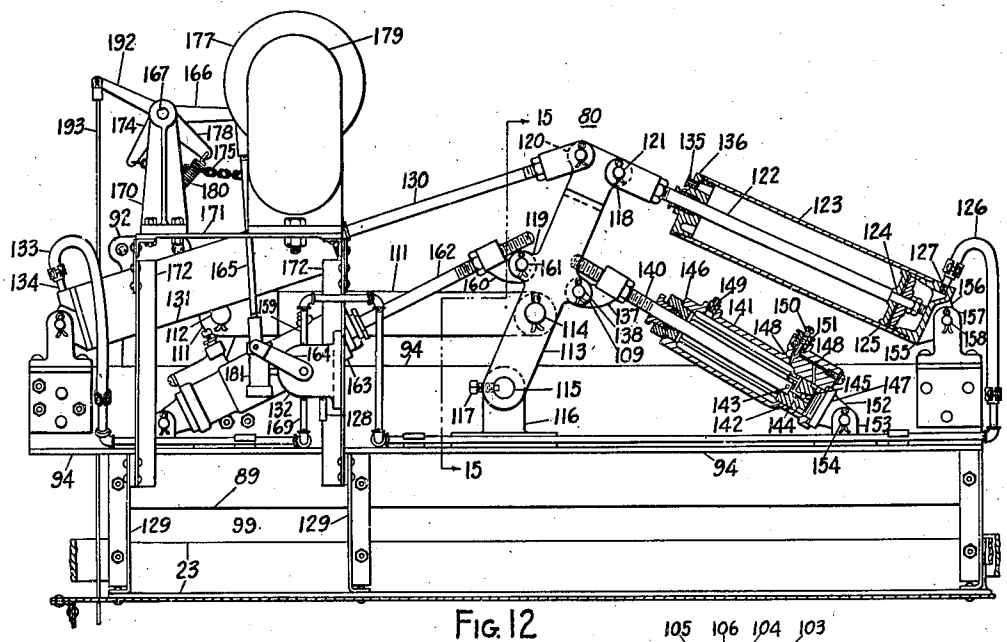


FIG. 12

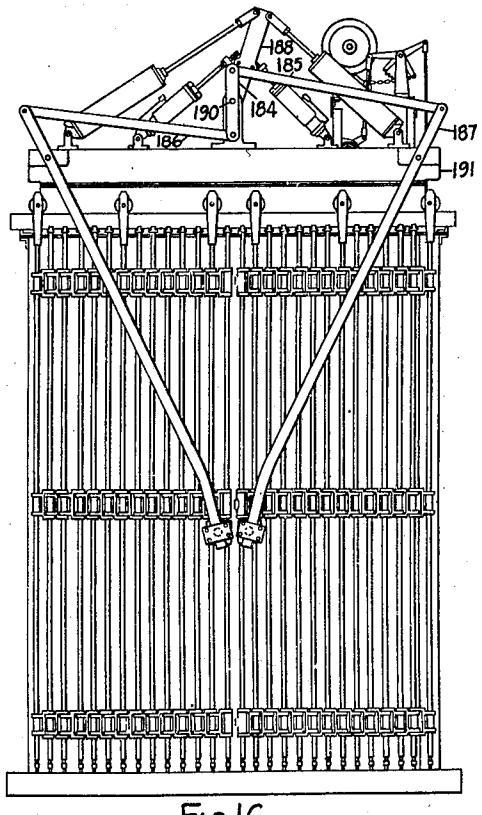


FIG. 16

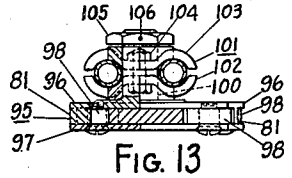


FIG. 13

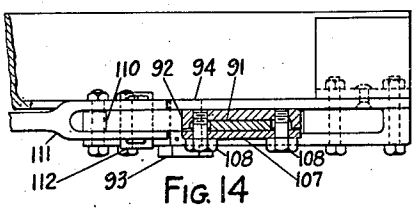


FIG. 14

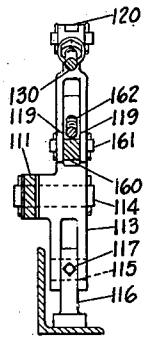


FIG. 15

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GATE OPERATING MECHANISM

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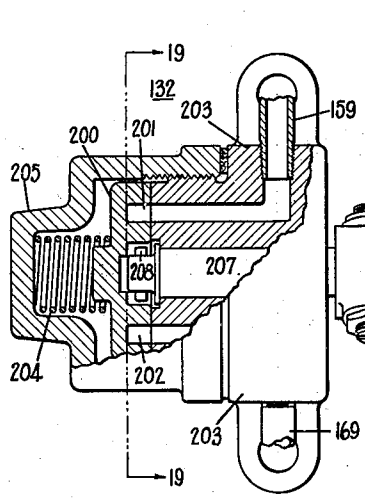


Fig. 18

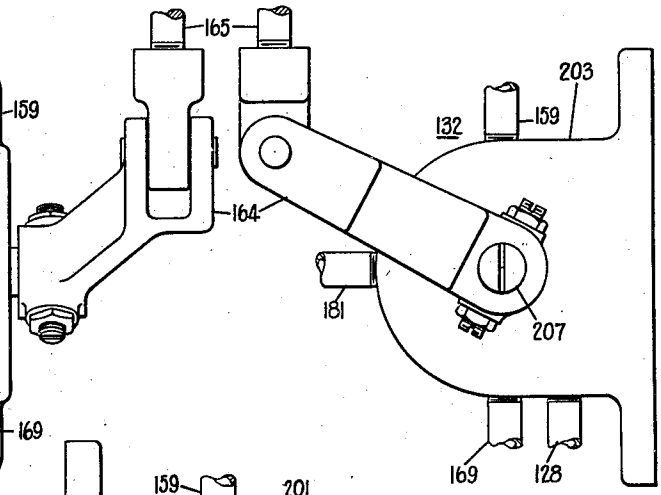


Fig. 17

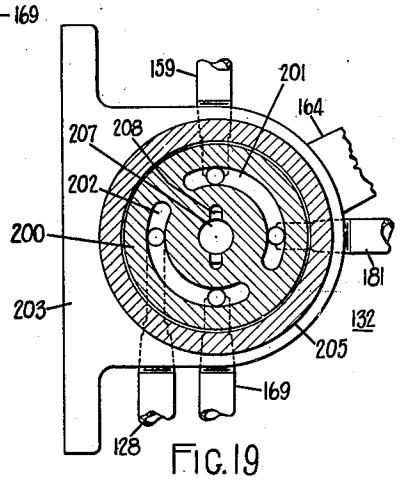


Fig. 19

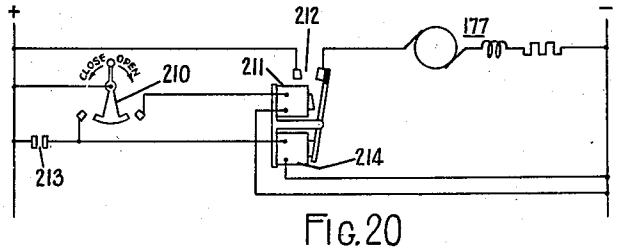


Fig. 20

Thomas Brady INVENTOR

BY Walter E. Bradley ATTORNEY

Patented June 28, 1932

1,864,796

UNITED STATES PATENT OFFICE

THOMAS BRADY, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO OTIS ELEVATOR COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY

GATE OPERATING MECHANISM

Original application filed July 10, 1926, Serial No. 121,572. Patent No. 1,685,225, dated September 25, 1928. Divided and this application filed October 4, 1927. Serial No. 223,966.

The invention relates to gate operating mechanism and particularly to operating mechanism for gates of elevator cars.

This application is a division of Patent No. 1,685,225, granted September 25, 1928, on application Serial No. 121,572, filed July 10, 1926.

One feature of the invention is to provide a fluid actuated gate engine for operating a gate.

A second feature is the provision of a gate engine having an adjustable stroke so that gates having various widths of opening may be operated.

A third feature resides in the provision of liquid checks for checking the gate in both directions of motion.

A fourth feature is the provision of a gate engine which permits manual operation of the gate upon failure of power.

A fifth feature lies in the provision of a gate engine of the above character which is of simple construction, and which is silent and reliable in operation.

Other features and advantages will become apparent from the specification, taken in connection with the accompanying drawings wherein the invention is embodied in concrete form.

In the drawings:

Figure 1 is a view in elevation, with parts broken away, of a gate shown in closed position on an elevator car, the car being illustrated in section along line 1—1 of Figure 2;

Figure 2 is a plan view of the same, with parts omitted in order to illustrate certain structural details and with the gate shown in open position;

Figure 3 is an enlarged view, with parts broken away, illustrating structural details of the gate;

Figure 4 is a view in partial section taken along broken line 4—4 of Figure 3;

Figure 5 is an enlarged fragmental plan view of a portion of the gate, illustrating the manner in which the gate turns around a corner;

Figure 6 is a detail view of a rail bumper and its mounting;

Figure 7 is a plan view, with parts omitted in order to illustrate certain structural details, of the gate in open position and abutting the car frame;

Figure 8 is a view similar to Figure 7, with the gate arranged in two sections, illustrating the manner in which these sections extend along opposite sides of the car while the gate is in open position;

Figure 9 is a fragmental view of the gate of Figure 8, with the sections in their closed positions and provided with mechanism for causing, upon movement of one section, corresponding movement of the other section;

Figure 10 is a view in front elevation of the gate of Figure 1 provided with power operating mechanism, the parts being in gate open position;

Figure 11 is an enlarged view in side elevation of the power operating mechanism illustrated in Figure 10;

Figure 12 is a view taken along line 12—12 of Figure 11, certain parts being shown in section to illustrate structural details;

Figure 13 is an enlarged detail in partial section, taken along line 13—13 of Figure 10;

Figure 14 is an enlarged detail with parts omitted, taken along line 14—14 of Figure 10;

Figure 15 is an enlarged detail, taken along the line 15—15 of Figure 12;

Figure 16 is a view in front elevation of the gate arranged in two sections and provided with power operating mechanism, the parts being in gate closed position; and

Figure 17 is an enlarged view of the valve mechanism shown in Figure 12;

Figure 18 is a side view of the valve mechanism with parts in section;

Figure 19 is a view in section taken along the line 19—19 of Figure 18; and

Figure 20 is a diagram of a portion of the control circuits for an elevator car, illustrating schematically a suitable arrangement for controlling the valve operating motor by a car switch.

The form of gate illustrated in Figures 1 to 5 is composed of a plurality of vertical rods or tubes 10 connected by hinge members 11. The hinge members are preferably arranged in three rows, one row at the top of the gate, one at the bottom and one in the

middle. Each hinge member comprises a yoke 12, a pair of lugs 13 extending outwardly therefrom and a similar but oppositely extending pair of lugs 14. A wider space is provided between the lugs 13 than between the lugs 14 in order to permit the lugs 14 on the adjacent hinge member to extend therebetween. Apertures 15 are provided in lugs 13 and similar apertures 16 in lugs 14. With a pair of adjacent hinge members in assembled relation, the apertures 15 and 16 are in vertical alignment so as to receive one of the tubes 10. These hinge members are positioned on the tube by a sleeve 60 extending between lugs 14. This sleeve is secured to the tube by means of a pin 61 passing through the sleeve and the tube, at a point midway of the length of the sleeve. Lugs 13 and 14 have a turning fit on the tube 10.

The two end tubes and one or more of the intermediate tubes 10, depending upon the width of the gate, extend upwardly into hangers 18. A wide gate might have several intermediate hangers. As shown in Figures 3 and 4, a boss 20, formed on the bottom of hanger 18, is provided with a vertical aperture 21 into which the tube 10 extends. The upper end of the tube 10 has a filling plug 67 inserted therein for strengthening purposes. The upper end of the tube 10 is secured within aperture 21 by means of pins 22 passing through the boss, tube and filling plug. The frame of the hanger is formed with a yoke portion 24 and two sides 25 and 26, the side 26 supporting the boss 20. An antifrictionally mounted roller 27 is supported between the sides of the hanger as by a screw 28 threaded into the side 25 of the hanger. This roller rides on the track 30. The boss 20 extends upwardly in the form of lugs at each side of the track 30 to form a guide for the hanger 18. These lugs are convexly curved on the side facing the track, as illustrated in Figure 5, to allow the hanger to pass around a corner. The track 30 acts both as a support and as a guide for the gate. The intermediate tubes not secured to hangers have guide pintles 68 inserted in their upper ends. Each guide pintle 68 has a cylindrical shank (see Figure 3) extending downwardly into the tube 10. The shank has a turning fit within the tube thus permitting the guide pintle to swivel on the top of the tube. The guide pintle has upwardly extending lugs 69 similar to the lugs on the boss 20 of a hanger. These lugs present convex faces to the track, as illustrated in Figure 5, and serve to guide the tube 10 along the track.

As shown in Figure 2, the track 30 extends across the front, bends at the front left-hand corner and continues along the side of the car to the rear thereof. The track is supported at intervals along the path just described in any suitable manner, as by bolts 31 passing through the track 30, spacing members 62, and angle bars 23 secured to the top of the car and extending across the front of the car and along the side thereof.

The lower ends of the tubes 10 carry pintles 29 which extend downwardly into a guide way 38. Each pintle 29 (see Figure 4) has an upper portion extending into a tube. This upper portion has an annular groove about midway of its length into which the tube is crimped, thus securely holding such portion within the tube. The guide way 38 has the same contour as the overhead track 30 and is formed in a plate member 40 which is secured to the car floor by means of screws 42. This plate member is cut away at the gate opening to receive the car sill 43 as shown in Figure 4.

Sleeves 46 extend between lugs 13 of the right end hinge member in each row and are secured to the right end tube 10 by means of pins 65 passing through the sleeves and tube. Bumpers 47 are secured to sleeves 46 midway of their length and engage the side of the car when the gate is fully closed. Bumpers, similar to bumpers 47, are secured to supports 50 mounted at the rear of the car in the line of travel of the gate, these bumpers engaging sleeves 60 of the left end hinge members when the gate is completely opened. In lieu of these bumpers, a bumper 64, mounted as illustrated in Figure 6, may be used to form a stop for the gate, particularly where the gate, in its fully opened position, does not extend to the rear of the car. Referring to Figure 6, the support 66 for the bumper 64 is adjustably mounted on track 30, the support being formed with a rectangular hole through which the track extends. Set screws 63 are provided to secure the support on the track in its adjusted position. The bumper 64 is positioned on the support in the path of travel of the roller 27 carried by the left end hanger.

It is to be understood that, if desired, the track and rollers may be arranged at the bottom of the gate with the guide way disposed at the top.

A cylindrical handle 70 is provided on the right end tube 10, preferably below the middle hinge member. This handle surrounds the tube and is clamped thereon as by screws 72 passing through the halves of the handle. The handle comprises a central tubular portion having thin walls to permit the insertion of the hand between the handle and the next tube. At the ends of this tubular portion, the handle is formed into thick beads through which screws 72 pass. The handle protects the surface of the tube from being tarnished by constant contact with the hand of the operator and is preferably made of a composition material such as bakelite. More than one handle may be employed, if desired, to facilitate the operating of the gate. Such

an arrangemnt would be particularly desirable in case of wide cars. In Figure 1 the gate is illustrated as provided with an additional handle 71 secured to an intermediate tube.

With the gate thus arranged for manual operation and in closed position as illustrated in Figure 1, to open the gate the operator may grasp the handle 71 on the intermediate tube, pulling the gate to the left. The left end tube 10 is illustrated in Figure 1 as substantially on the bend of the track. Upon movement of the gate to the left, the lugs on the left end hanger, extending upwardly on each side of the track, cause the hanger to follow the curved portion of the track around to the side of the car. Thus the tube, carried by the hanger is guided around the corner, aided by the coaction of the pintle 29 and guideway 38. Likewise the succeeding tubes not secured to hangers are guided around the corner by the coaction of the lugs 69 of the guide pintles 68 and the track at the top and the coaction of pintles 29 and guideway 38 at the bottom. Figure 5 illustrates the different positions which the various parts may assume. As previously explained, the left end tube 10 is free to turn in lugs 14 of the left end hinge members and likewise each succeeding tube is free to turn in both lugs 13 and 14 of successive hinge members. Tubes not provided with hangers are also free to turn on their guide pintles 68. The movement of the left end tube around the corner is permitted by relative turning between this tube and its hinge members and relative turning between these hinge members and the adjacent tube. The successive tubes and hinge members act in a similar manner during the continued movement of the gate around the corner. As the handle 71 of the intermediate tube nears the left side of the car, the operator releases this handle and grasps handle 70 on the right end tube to complete the movement of the gate. The track 30 and guideway 38 guide the gate between the side of the car and the car frame 76. Upon the gate reaching its open position, it is stopped by the engagement of the sleeves 60 of the left end hinge members with the bumpers secured to supports 50. It is to be understood that the bumpers are made of material suitable to absorb any shocks. The gate is illustrated in its open position in Figure 2. It is to be noted that the right end tube 10 extends slightly out from behind the front portion of the car with the gate in open position. The gate may be closed by reverse operation. The operator grasps the hande 70 of the right end tube, pulling the gate to the right. As the intermediate portion of the gate moves to the front of the car, the operator may release the handle 70 and complete the gate closing operation by means of the handle 71. As the gate reaches its closed position, it is stopped in a similar manner by the engagement of bumpers 47 with the right-hand side of the car. Due to the construction of the hanger bosses 20 and guide pintles 68, the gate is prevented from leaving the track due to faulty operation, such as lifting of the gate.

The portion of the car wall, illustrated as extending around to the front, may be omitted, if desired, and the gate may be arranged to open all the way around to the side. In this event, should the car not be deep enough, the track and guideway may be extended around another corner at the rear of the car so as to allow for the movement. Should the car be too deep, a bumper of the type shown in Figure 6, already described, may be used. Although the gate has been described as arranged on an elevator car controlled by an operator, it is to be understood that it is equally adapted for cars which are controlled by the passengers themselves. Furthermore, the gate may be used on elevator cars of the freight type as well as those employed for passenger service. Also, it is to be understood that the hatchway doors located at the various landings may be constructed and arranged in a similar manner.

It is to be noted that the positioning of the hinge members on the tubes by the sleeves 60 permits each hinge member to be mounted so as to be free to turn on the tubes which extend therethrough, resulting in large radial bearing surfaces between the tubes and hinge members. The effectiveness of these bearing surfaces is greatly increased by having the hinge member lugs considerably spaced lengthwise of the tubes. The spacing of these lugs, in conjunction with the fact that the apertures provided therein are of such size as to permit the free turning and movement of the tubes, eliminate such friction as might be caused by misalignment of the apertures of the lugs or deflection of the tubes during operation. It is to be further noted that tubes intermediate the hangers are supported from these hangers by the sleeves 60 acting through the hinge members. This construction not only permits a material reduction of the total number of hangers, with the consequent decrease in friction, but also permits the use of the swivel guide pintles for these intermediate tubes, the friction of which guide pintles is substantially negligible. Furthermore, the sleeves and lugs of the hinge members present extensive bearing surfaces for carrying the weight of the intermediate tubes and render the sections of the gate intermediate the hangers substantially freely floating. Thus it will be seen that the total friction of the gate is reduced to a minimum, permitting its operation with the application of but very little force.

It has been found in actual practice that the gate is practically silent in operation, due to the fact that the tubes are maintained

separated at all times, the danger of injury to the operator or passengers, such as pinching of the hands or fingers, is substantially eliminated. Furthermore, due to the fact that the gate uncovers the whole of the passageway into the car when opened, the traffic may be handled with maximum despatch.

Although the gate described in connection with Figures 1 to 5 inclusive is arranged to extend to the rear of the car when in open position, it may also be arranged to extend only part way around to the side as illustrated in Figure 7. In this figure the gate extends only to the car frame 74 when in open position. This arrangement permits the elimination of the passageway for the gate between the car and the car frame and thus the provision of the maximum car space for the size of car frame employed. Such provision of car space is particularly desirable in installations wherein conservation of hatchway space is extremely important. The structural details of the gate are the same as those of the gate previously described. Bumpers 75, similar to bumpers 47 secured to the sleeves of the right end tube, may be secured to the car frame in the path of sleeves 60 of the left end tube to form a stop for the gate as it moves into its open position. On the other hand, a bumper 64, mounted as illustrated in Figure 6 and already described, may be used in lieu of the bumpers 75, if desired, particularly where the gate, in its fully opened position, does not extend to the car frame 74.

In some installations it may be desirable to arrange the gate in two sections so as to form a two-way or center opening gate, such as illustrated in Figures 8 and 9. In accordance with this arrangement, the two sections separate when the gate is opened, one section moving one way, that is, passing around the front right-hand corner of the car, and the other section moving the other way, that is, passing around the front left-hand corner of the car. As in the case of the gate arranged as illustrated in Figure 7, the two sections extend only to the car frame when the gate is in open position. Thus a gate arranged in this manner would be particularly desirable for use where both maximum car opening and conservation of space are important factors. As shown in Figure 9, the left end tube of the right section of the gate and the right end tube of the left section of the gate are provided with guide pintles 68 at their upper ends. Sleeves 78 similar to sleeves 46, with the exception that they are not provided with bumpers, are secured, as by pins passing through the sleeves and tube, to the left end tube of the right section of the gate and extend between the lugs 13 of the hinge members. Sleeves 46 are secured to the right end tube of the left section of the gate between the lugs 13 of the hinge members. When the gate is completely closed, as shown in Figure 9, bumpers 47 carried by the sleeves 46 of the left section of the gate engage the sleeves 78 of the right section. As in the case of the gate arranged to extend only part way around to the side of the car, as described in connection with Figure 7, bumpers 75 are secured to the car frame in the path of sleeves 60, provided for each section, to form stops for the gate as it moves into its open position. On the other hand, bumpers mounted as illustrated in Figure 6, and already described, may be used in lieu of bumpers 75 if desired, particularly where the gate, in its fully opened position, does not extend to the car frame.

Although each section of the gate may be operated individually, it is preferred to provide an arrangement whereby the movement of one section automatically causes corresponding movement of the other. A suitable arrangement for effecting such movement is illustrated in Figure 9. Only one operating handle 70 is provided, this handle being secured to the right end tube of the left section of the gate (see Figure 8). To the right hanger of this left section of the gate an upwardly extending arm 88 is secured. The lower trace of a chain 87 is fastened to the upper end of this arm. The chain 87, the tension of which is maintained constant as by a belt tightener, not shown, passes over pulleys 83 and 84 mounted as on brackets 85 and 86. These brackets may be secured to the angle bar 23 so as to be positioned at the left and right of the car as shown. An upwardly extending arm 90, to which the upper trace of the chain is fastened, is secured to the left hanger of the right section of the gate.

With the gate arranged for operation as above described and in closed position as illustrated in Figure 9, to open the gate the operator may grasp the handle 70 on the right tube of the left section of the gate, pulling this section to the left. Upon movement of this section of the gate to the left, the arm 88 and hence also the lower trace of the chain 87 will move to the left, causing the movement of the upper trace of the chain, to which the arm 90 is fastened, to the right and thus effecting the movement of the right section of the gate to the right. Thus the opening and likewise the closing of one section of the gate will cause a corresponding movement of the other section. The handle 70 may be placed on the right section of the gate if desired, thus effecting operation of the left section through movement of the right section.

Up to this point, the gate has been described as adapted for manual operation. However, the gate is equally adapted for power operation. A suitable arrangement of power operating mechanism is illustrated in Figures 10 to 16 inclusive. Referring particularly to Figure 10, a pneumatic gate en-

gine carried by the car at the top thereof and indicated as a whole by the numeral 80, actuates an operating arm 91 to move the gate into open and closed positions. This arm is connected to the gate by means of a bracket 95 through which the lower end of the arm extends. As illustrated in Figure 13, this bracket consists of two rectangular plates 96 and 97. These plates are formed with spacing members 81 and at the four corners are provided with guide rollers 98, thus permitting free sliding movement of the gate operating arm within the bracket. Plate 96 is formed with a shank 100 which extends through a gate clamp 101. Gate clamp 101 consists of two similar and opposed clamp members 102 and 103. These clamp members conform to the two left end tubes of the gate and are clamped thereto by bolts 104. The shank 100 of the plate 96 is free to swivel in the gate clamp 101, being provided with a nut 105 on the end thereof for retaining the shank within the clamp. The nut 105 is locked on the shank 100 as by a pin 106. With the gate in open position as shown in Figure 10, the gate operating arm 91 is parallel with the tubes of the gate and is at the right of the gate opening. At a point just above the guide bracket 95 the gate operating arm bends downwardly toward the right at an angle to permit the application of the driving force to the guide bracket in nearly a horizontal direction for all positions of the gate.

The upper end of the gate operating arm 91 is adjustably secured to an elbow 92. As clearly illustrated in Figure 14, this arm is positioned in a U-shaped recess formed in the elbow 92 and is retained therein by means of two straps 107 held tight against the gate operating arm by bolts 108 passing through the straps and elbows. By loosening these bolts 108, the gate operating arm may be adjusted within the elbow 92 as desired, whereupon the bolts are again tightened, thus locking the arm in position. The elbow 92 is pivotally supported by a screw 93 passing through the upright portion of the engine base plate 94. This plate, as illustrated in Figure 11, is secured to an angle bar 89. This angle bar is secured to an upright plate 99 which in turn is attached to angle bar 23, secured to the top of the car. The elbow 92, is formed with a lug 110 to which the bifurcated end of a link 111 is pivotally secured as by pin 112. Link 111 extends horizontally from elbow 92 toward the center of the car and is pivotally connected at its other end to a lever 113 by means of pin 114 (see Figures 10 and 12). As shown in Figure 15, lever 113, at its lower end, is formed into a fork which fits over a pedestal 116. The lever 113 is pivotally mounted on the pedestal as by a shaft 115 extending through the forked ends of the lever and the pedestal. The shaft is postioned in the pedestal as by a set screw 117. A portion of the lever 113 just above the bolt 114 is slotted, the portion of the lever at each side of the slot being provided with a pair of oppositely projecting lugs 109 and 119, the purpose of which will appear later. Above this slotted portion, the lever extends upwardly and is formed at its upper end with oppositely extending connection lugs 118 and 120 for the piston rods of the pneumatic cylinders of the gate engine. As illustrated for piston rod 122, lug 118 is apertured to receive a pivot bolt 121 which extends through the bifurcated end of the rod.

Referring to Figure 12, piston rod 122 extends into the pneumatic cylinder 123 and has a piston 124 secured to the free end thereof. Piston 124 is provided with a cup leather 125 which prevents the leakage of compressed air from the under side to the upper side thereof. An apertured plug 135 in the cylinder head 136 permits the free passage of air into and out of the pneumatic cylinder above the piston 124. Compressed air may be fed to the cylinder 123 below the piston by means of the hose 126 connected to aperture 127 in the bottom plug 155. A tongue 156, formed on the bottom plug 155 extends between the sides of the bearing block 157 mounted on the engine base plate 94. The cylinder is pivotally supported on this bearing block by the shaft 158 extending through the tongue and the sides of the block. The shaft is positioned in the block 157 as by cotter pins. As in the case of piston rod 122 piston rod 130 pivotally extends from lug 120 into pneumatic cylinder 131. Piston rod 130 and pneumatic cylinder 131 are of the same construction as piston rod 122 and pneumatic cylinder 123. Compressed air may be fed to pneumatic cylinder 131 by means of hose 133 connected to aperture 134 of the cylinder.

Each of the pneumatic cylinders is provided with a liquid check. These checks are operated by the cylinders acting through lever 113, the piston rods of the checks being pivotally connected by yokes 137 and 160 to the lever at lugs 109 and 119. The yoke 137 has one end thereof between the lugs 109 of the slotted part of lever 113 and is connected thereto by pivot bolt 138 passing through the lugs 109 and the yoke. The other end of the yoke is threaded to receive the piston rod 140. This piston rod extends into the liquid check cylinder 141 and has a piston 142 secured to its free end by means of a pin 143 extending through the piston and piston rod. The piston 142 is snug-fitting within the liquid check cylinder 141 and has a bypath 144 therethrough provided with a ball check 145 which permits a flow of liquid from the side of the piston to which the piston rod is connected to the other side thereof but prevents a reverse flow of the liquid.

The liquid check cylinder 141 has a number of circumferentially spaced longitudinal grooves in the inner wall thereof, these grooves extending from the inner side of the cylinder head 146 to within a short distance of the bottom plug 147. A bypath 148 connects one of these longitudinal grooves with the ungrooved portion of the cylinder 141 at a point adjoining the bottom plug 147. A needle valve 150 is threaded into the plug 151 so as to permit adjustment to vary the effective area of the bypath 148. An apertured filling plug 149 is threaded into the liquid check cylinder near the cylinder head 146. The bottom plug 147 has a projecting tongue 152 extending between the sides of the bearing block 153 mounted on the engine base plate 94. The liquid check cylinder is pivotally supported on this bearing block by the shaft 154 extending through the tongue and the sides of the block. As in the case of yoke 137, yoke 160 has one end thereof between the lugs 119 of the slotted part of the lever 113 and is secured thereto by pivot bolt 161 passing through the lugs 119 and the yoke. The other end of the yoke is threaded to receive a piston rod 162 of the liquid check cylinder 163. Piston rod 162 and liquid check cylinder 163 are of the same construction as piston rod 140 and liquid check cylinder 141.

The admission of compressed air to the pneumatic cylinders 123 and 131 is controlled by means of valve mechanism 132. This valve mechanism is provided with an inlet pipe 128, connected to a suitable source of compressed air (not shown), and outlet pipes 159 and 169, connected to hose 126 and 133 respectively.

This mechanism, in its preferred form, comprises a valve 200, having ports 201 and 202. This valve is maintained on its seat formed on the valve body portion 203 by means of a spring 204 extending between the valve and the valve cap 205. The various pipes leading to and from the valve mechanism are connected to ports in the valve body portion. The ports 201 and 202 in the valve 200 act to connect the pipes leading to the opening and closing cylinders with the supply and muffler pipes. With the valve in the position illustrated in Figure 19, the opening cylinder is connected to the source of supply, while the closing cylinder is connected to exhaust through the muffler. Counterclockwise rotary movement of the valve one-quarter of a revolution alters the connections so as to have the closing cylinder connected to the source of supply by port 201 and the opening cylinder connected to the exhaust by port 202.

The valve is operated by means of a shaft 207 having a pin 208 extending into a keyway in the valve. On the outer end of the shaft is provided an operating arm 164 which is pivotally connected to one end of the link 165. Link 165 is pivotally connected at its other end to a lever 166 which is fixed upon a shaft 167 rotatably supported by the standards 168 and 170. These standards are secured to a platform 171 supported on an angle frame 172 attached at the front to stiffening angles 129 and at the rear to the underside of the crosshead 173 of the car frame. A lever 174 is secured to shaft 167. This lever extends downwardly and has a chain 175 attached to its free end. The chain 175 has its opposite end attached to a shaft 176. This shaft is connected through reduction gearing within the casing 179 to the motor 177. Adjustable stops 182 are secured upon the motor base in positions to be engaged by a crank 183 carried by the shaft 176 to limit the angular motion of the shaft. A lever 178, also secured to shaft 167, has a tension spring 180 attached to its free end. The other end of the tension spring 180 is attached to the frame 172. Another lever 192 is secured to shaft 167 and has a rope 193 attached to its free end. Rope 193 extends downwardly through the top of the car and has a handle (not shown) secured to its lower end. This handle is positioned so that it is within easy reach of the operator.

Assume that the gate is in open position as illustrated in Figure 10. In order to cause the operation of the gate engine to close the gate, the motor 177 is energized. This may be accomplished in various ways, as for example, in an elevator under the control of an operator within the car, by causing the motor to be energized in response to the movement of the car switch out of off position.

A suitable arrangement of circuits for controlling the motor by the car switch is illustrated schematically in Figure 20. In the arrangement illustrated, the car switch 210 is always moved in the same direction, toward "close", to start the car in operation. Its initial movement completes the circuit for coil 211 of a rocker switch. This coil acts to effect the engagement of contacts 212 to complete the circuit for motor 177. Any suitable arrangement may be provided for maintaining the contacts 212 engaged after de-energization of coil 211.

The motor, upon energization, acts through the reduction gearing to cause rotative movement of shaft 176 to wind up the chain 175. Lever 174, connected to chain 175, is therefore swung clockwise, as viewed in this figure, causing a corresponding angular movement of attached shaft 167. Lever 166, secured to shaft 167, is turned with the shaft, thus raising link 165 and effecting an upward swinging movement of the valve operating arm 164. Valve 200 is thus operated to cause the admission of compressed air through hose 126 to pneumatic cylinder 123. At the same time hose 133 is connected by the valve 200

to the muffler 181 mounted on the exterior of the valve, thus permitting the escape of compressed air in pneumatic cylinder 131. The pressure of the air upon piston 124 within cylinder 123 causes the piston to move away from the bottom plug 155 and the piston rod 122 to move outwardly of the cylinder. Lever 113, connected to piston rod 122, is thus swung about its supporting shaft 115. As a result, the elbow 92 being connected to lever 113 by link 111, is swung clockwise about its pivotal screw 93. Thus the gate operating arm 91, carried by the elbow 92, also swings clockwise and, sliding in guide bracket 95, effects the closing operation of the gate. The position of the gate operating arm with the gate in close position is indicated in dotted lines. Inasmuch as pneumatic cylinder 131 is connected to the atmosphere on both sides of its piston during this operation, piston rod 130 offers no resistance to the closing movement.

At the beginning of the closing movement, the liquid check piston 142 is at its innermost position in liquid check cylinder 141, as shown in Figure 12. In this position the piston has its inner end in contact with the bottom plug 147 and its cylindrical surface in contact with the ungrooved portion of the cylinder wall. As piston 142 starts to move away from the bottom plug 147, the reduced pressure resulting in the space between the inner end of the piston 142 and the plug 147 causes the ball check 145 to open. This permits liquid to flow into this space from the side of piston 142 to which the piston rod it attached through the bypath in the piston. At the same time a limited amount of liquid flows into this space through the bypath 148. Thus the resistance offered to the initial closing movement of the gate by the action of the piston 142 within the ungrooved portion of the cylinder is negligible. Once the piston 142 has moved into the grooved portion of cylinder 141, the liquid flows directly around from one side of the piston to the other through the grooves. Thus free movement of the gate toward its closed position is permitted. As the gate nears its fully closed position, however, it is retarded by the action of the liquid check piston within cylinder 163. The action of this piston within its cylinder to retard the movement of the gate at the end of the gate closing operation is the same as the action of liquid check piston 142 within cylinder 141 to retard the movement of the gate at the end of the gate opening operation. It is believed that, inasmuch as the structure of piston 142 and cylinder 141 is illustrated in section, the retarding operation will be more readily understood by an explanation of the action of this piston and cylinder. It will be assumed, therefore, that the gate is being opened. The piston 142, therefore, is moving toward the right, as viewed in Figure 12. While the piston is moving in the grooved portion of the cylinder, the liquid moves freely in the grooves from one side of the piston to the other, permitting free movement of the gate toward its open position. As the piston enters the ungrooved portion of the cylinder, its movement, and therefore that of the gate, is immediately retarded. This retardation is due to the inability of the liquid to continue to pass around the piston and to the action of the ball check 145. This check prevents the flow of liquid trapped between the piston and the bottom plug 147 through the piston bypath 144 into the grooved portion of the cylinder. The flow of this trapped liquid to the other side of the piston therefore must be by way of the bypath 148 and, as this passage is restricted by the needle valve 150, this flow occurs very slowly. Thus this piston and the gate are retarded in their movement. The piston, thus restrained, moves very slowly as it continues in motion and is finally brought to a stop as it engages the bottom plug 147. The gate, therefore, is brought to rest easily and quietly and yet within a minimum of time. Thus, in the gate closing operation, as the gate nears its closed position, it is retarded by the action of the liquid check piston within cylinder 163 in the same manner as the above described action of piston 142 in cylinder 141 during the gate opening operation.

The gate opening operation is similar to the gate closing operation. The motor may be deenergized by moving the car switch in the "open" direction, or automatically by contacts 213 which are arranged to be momentarily closed as the car arrives a certain distance from a landing at which a stop is being made. Either arrangement causes the energization of coil 214 of the rocker switch to effect the separation of contacts 212. This deenergizes motor 177. Upon deenergization of motor 177, the tension spring 180, acting through lever 178, turns the shaft 167, and causes levers 166 and 174 to revolve in a counter-clockwise direction, as viewed in Figure 10. The revolving of lever 174 moves chain 175 to the right, causing it to unwind from shaft 176. The resulting movement of this shaft acting through the reduction gearing within casing 179 causes the reverse rotative movement of motor 177. The revolving of lever 166 moves link 165 downwardly, as viewed in Figure 10, to actuate the connected valve operating arm 164 into position to cause the admission of compressed air through hose 133 to pneumatic cylinder 131. At the same time hose 126 is connected to the muffler 181 thus permitting the escape of the compressed air in pneumatic cylinder 123. The pressure upon the piston within pneumatic cylinder 131 causes piston rod 130 to swing lever 113 about its supporting shaft 115. Connected

link 111 and elbow 92 are thus actuated, effecting, through movement of gate operating arm 91, the opening of the gate. The gate is checked at the end of its opening movement by piston 142 entering the ungrooved portion of liquid check cylinder 141 in the manner already described. No resistance to this opening movement is offered by the action of the liquid check piston within cylinder 163, the action being the same as that described for piston 142 within liquid check cylinder 141 during the gate closing operation.

The compressed air supply to the gate engine may fail owing to such causes as the breakage of the supply mains or trouble with the compressor. In this event the gate may be operated by hand. In both of the two positions assumed by the valve operating arm 164, one or the other of the pneumatic cylinders 123 and 131 is connected through valve 132 to the atmosphere. At the time one cylinder is connected to the atmosphere the other is connected by the valve 132 to the supply mains. In the event that the air pressure in the mains fails, no resistance can be offered by the air within the mains to the movement of the piston within the cylinder connected to the mains. Therefore hand operation of the gate will cause the pistons within the pneumatic cylinders to slide idly within these cylinders without offering any resistance to the manual operation. The liquid checks will operate to check the gate at each end of its movement just as in the power operation.

In the event that the electric current supplied to the motor 177 should fail, the gate may still be operated. This is made possible by the manual operation of the valve 200. Valve 200 is biased to gate opening position by the spring 180. Therefore, as described above, upon the deenergization of motor 177 the spring 180 will cause the gate to open. To close the gate the operator grasps the handle connected with the rope 193 and pulls the lever 192 downwardly. Thus the shaft 167 is turned against the resistance offered by the spring 180 and the valve operating arm 164 is actuated as above described to cause the closing of the gate.

The gate engine may be accommodated to various widths of gate openings by changing the position of the threaded yokes 137 and 160 upon their respective check piston rods thereby effecting a corresponding variation in the permissible stroke of the pneumatic cylinder pistons and in the movement of the gate operating arm 91.

This pneumatic gate engine may be used to operate the two-way or center opening arranged gate in the manner illustrated in Figure 16. In this figure the lever 188 connected to the piston rods of the pneumatic cylinders is keyed to its supporting shaft 190. This shaft has a crank arm 184 secured thereto. Links 185 and 186 are pivotally connected to the ends of crank arm 184 and to gate operating arms 187 and 189 respectively. The gate operating arms for convenience of illustration are shown as pivoted directly on the engine base plate 191 but it is obvious that these gate operating arms may be carried by elbows similar to elbow 92. In operation it will be noted that the swinging of the crank arm 184 moves the links 185 and 186 in opposite directions, thus effecting the desired motion of the two sections of the gate.

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:

In combination; an elevator car having a gate; an operating member for said gate; a base secured to the top of the car; a lever pivotally mounted at one end on said base; means operatively connecting said operating member to said lever; fluid pressure cylinders pivotally mounted on said base at opposite sides of said lever; a piston for each pressure cylinder pivotally connected to the other end of said lever; liquid check cylinders pivotally mounted on said base at opposite sides of said lever; a piston for each check cylinder pivotally connected to said lever intermediate its ends; a valve; connections from said valve to each of said pressure cylinders, to said source and to atmosphere; an electric motor operably connected to said valve, said motor when energized causing movement of said valve into position to cause compressed fluid to be admitted to one of said pressure cylinders to cause movement of said lever about its pivot to move the gate operating member in a direction to close said gate, said valve at the same time permitting the exhausting of the other of said pressure cylinders, said motor being maintained energized during operation of said car to maintain the valve in position to keep the gate closed; a spring operable upon deenergization of said motor to move said valve into position to cause compressed fluid to be admitted to said other pressure cylinder to cause movement of said lever about its pivot to move the gate operating member in the opposite direction to open said gate, said valve at the same time permitting the exhausting of said one pressure cylinder; one of said check pistons acting in its cylinder to retard the final closing movement of said gate and the other of said check pistons acting in its cylinder to retard the final opening movement of said gate; and

means connected to said valve and extending into said car for operating said valve manually to effect the closing of said gate in the event of failure of the supply of electric power to said motor.

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

THOMAS BRADY.