

March 23, 1937.

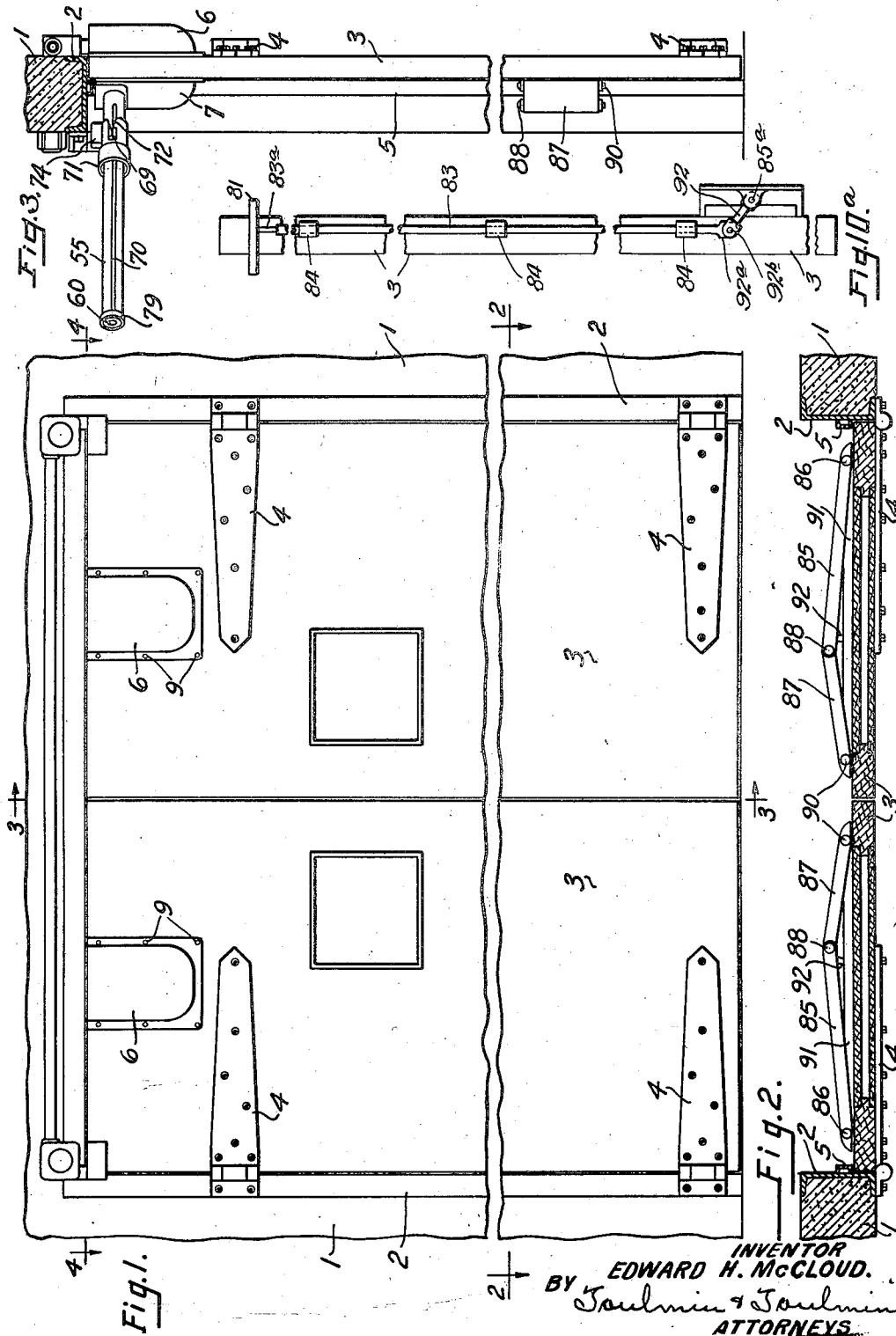
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2,075,000

SWINGING DOOR OPERATOR

Filed Dec. 31, 1934

7 Sheets-Sheet 1



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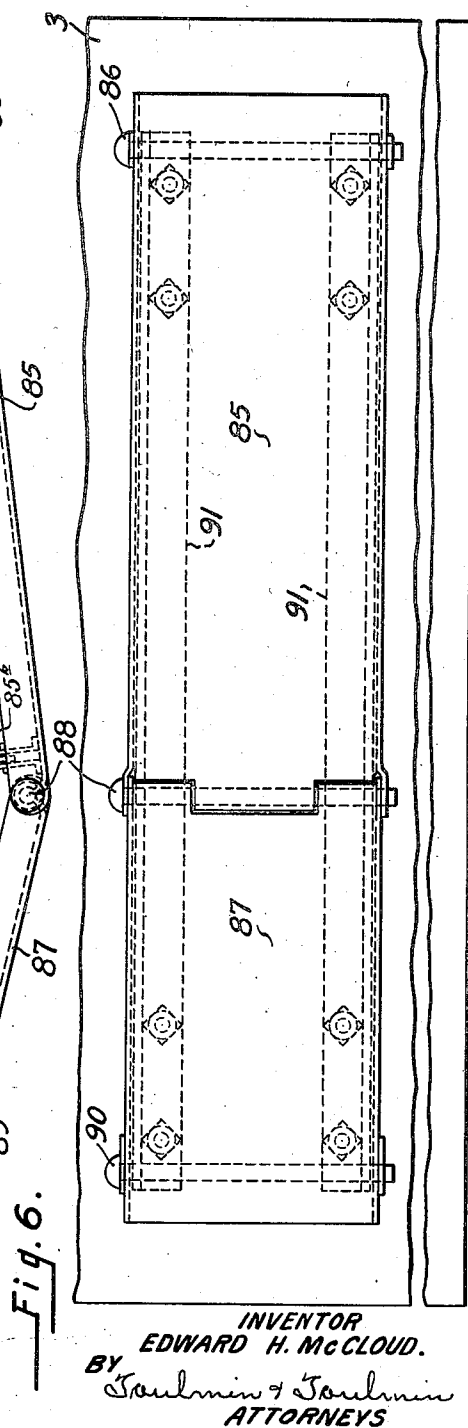
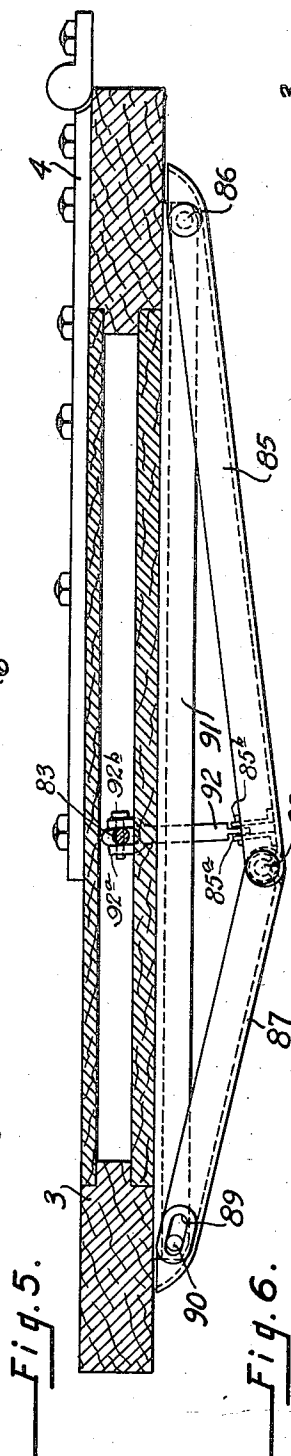
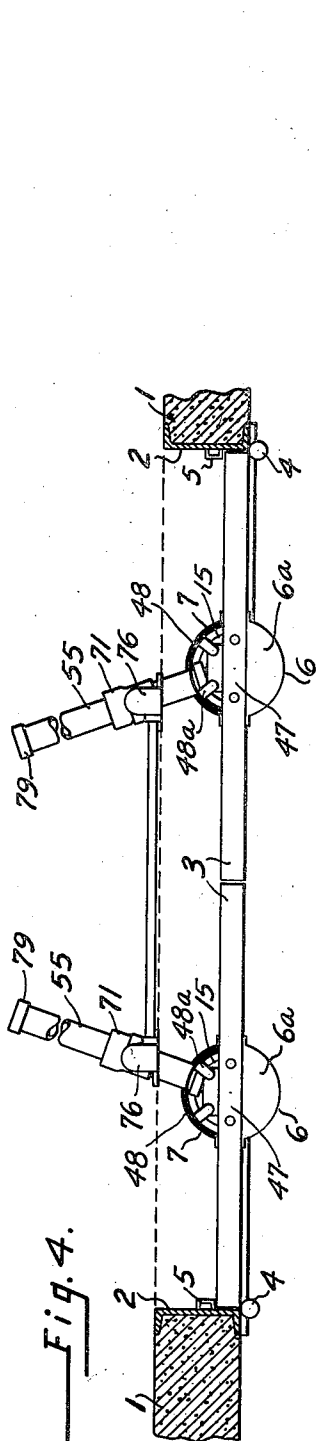
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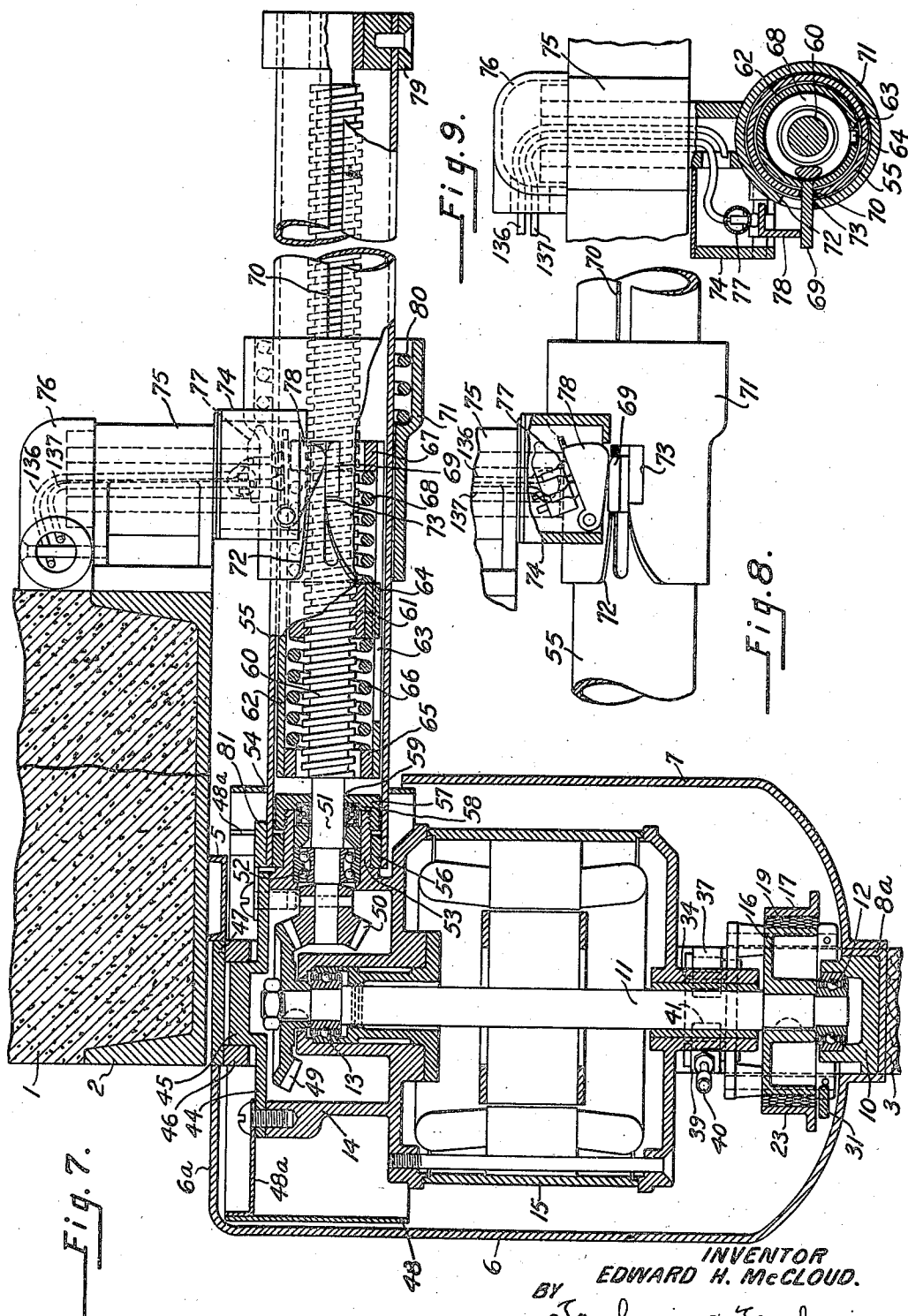
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7 Sheets-Sheet 3



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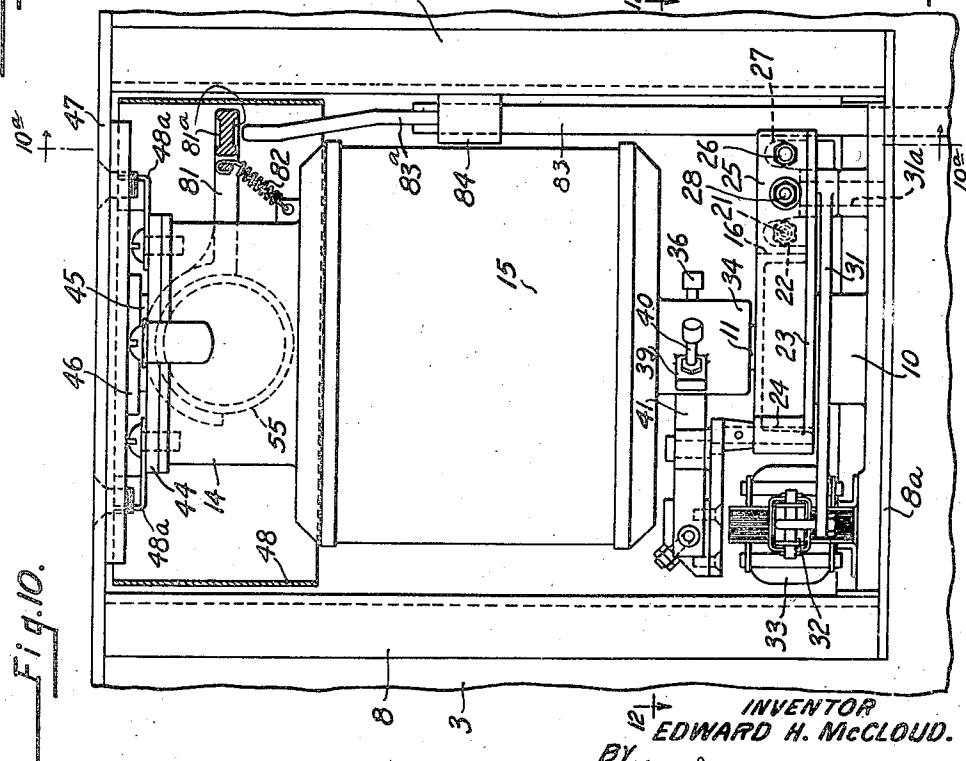
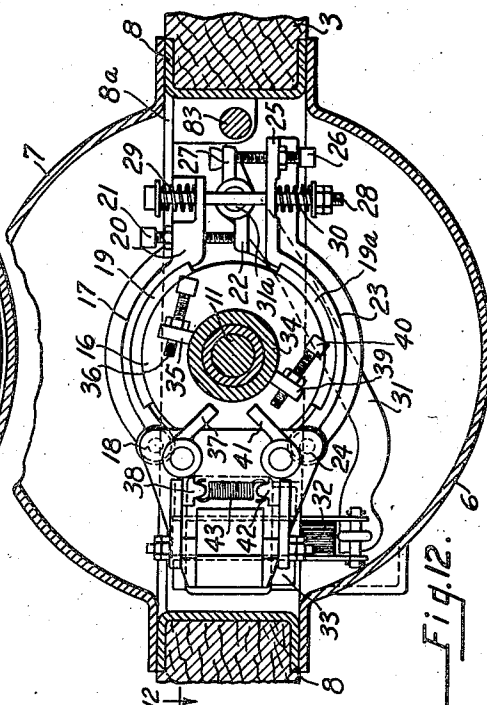
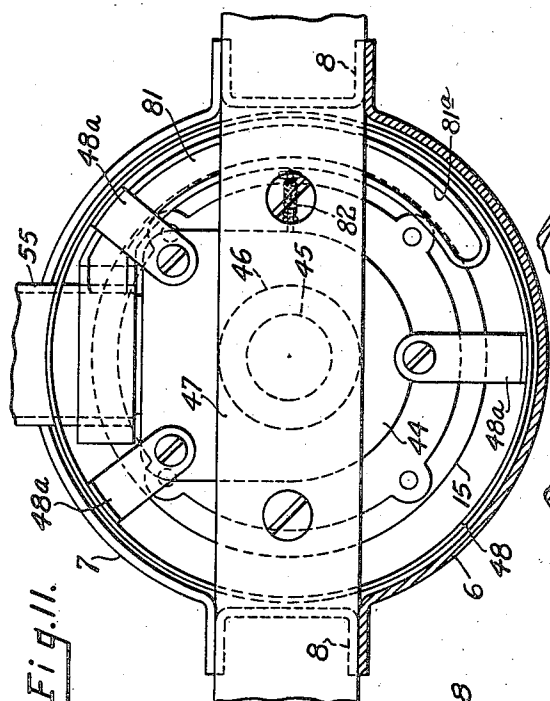
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7 Sheets-Sheet 4



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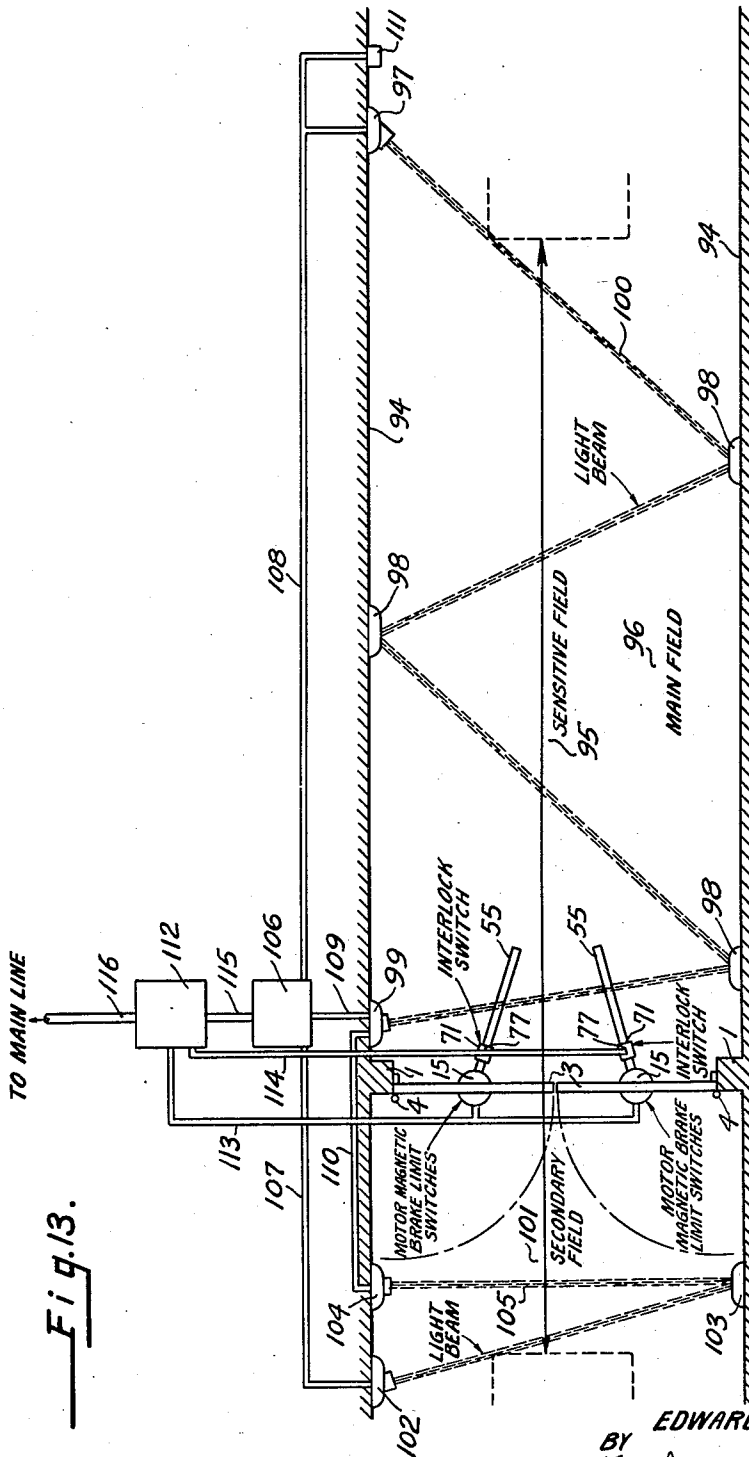
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7 Sheets-Sheet 5



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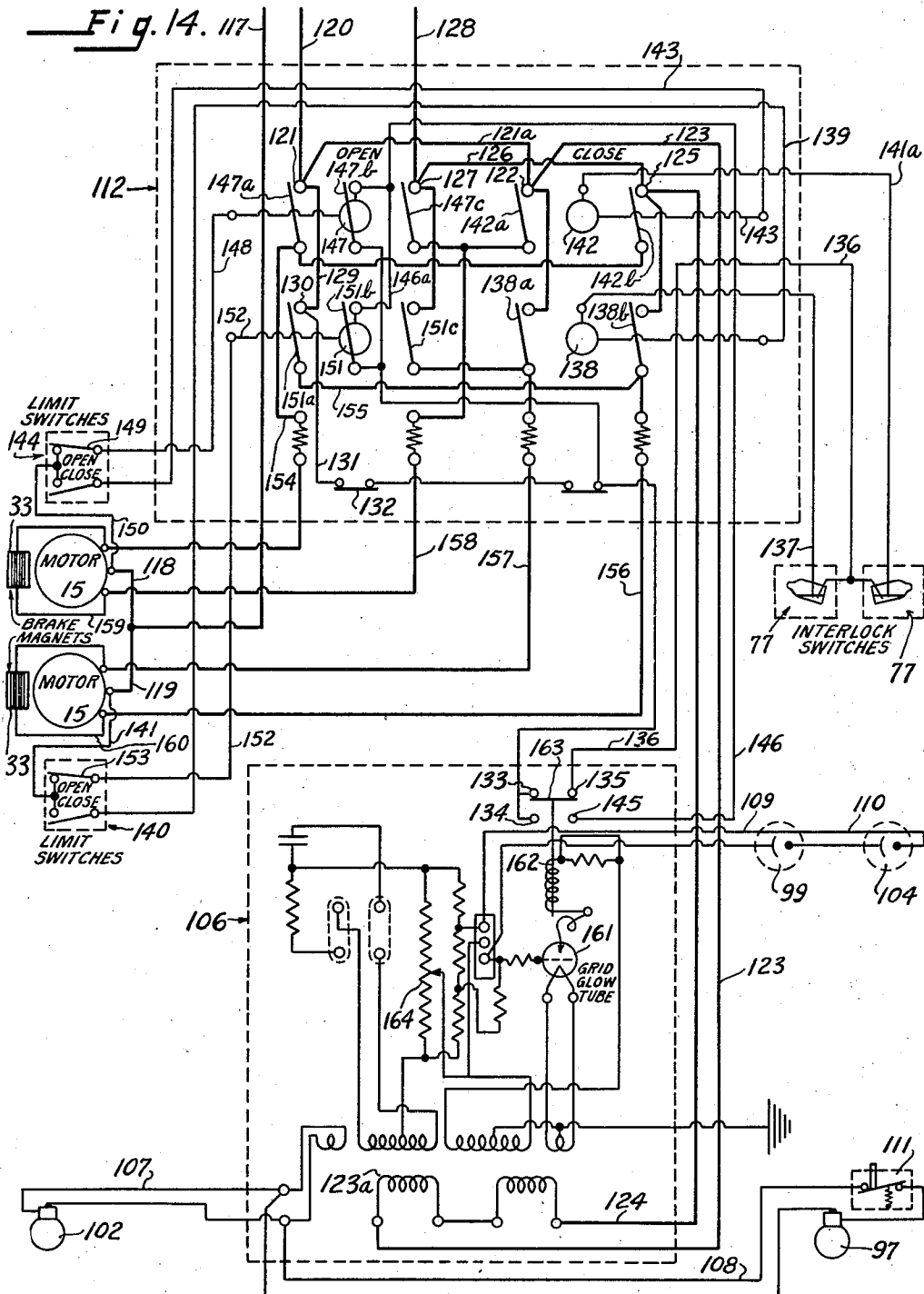
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SWINGING DOOR OPERATOR

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7 Sheets-Sheet 6



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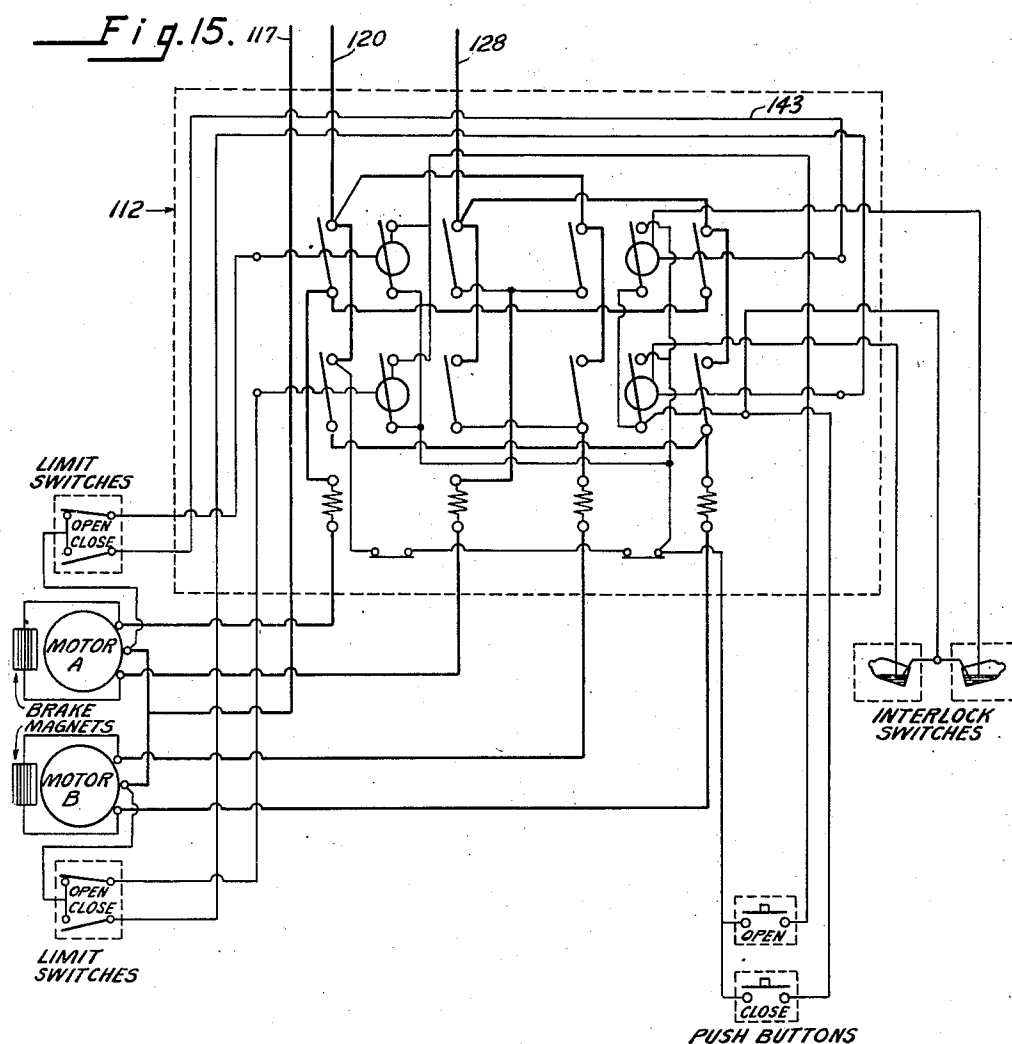
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SWINGING DOOR OPERATOR

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7 Sheets-Sheet 7



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UNITED STATES PATENT OFFICE

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SWINGING DOOR OPERATOR

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Application December 31, 1934, Serial No. 759,877

19 Claims. (Cl. 268—63)

This invention relates to improvements in swinging doors, and has for its object to provide, in connection with such doors, means for opening and closing the doors mounted on the doors.

5 It is an object of this invention to provide, in connection with a swinging door, means on the door for swinging it, said means cooperating with the mechanism on the wall, which has therein an opening adapted to be closed by the door.

10 It is an object of this invention to provide, in connection with a wall having a passageway therein, a swinging door for closing and closing the passageway, and means on the door and the wall for swinging the door, said means being so
15 connected that the door may be opened independently of the operation of the door opening means.

It is also an object to provide, in connection with a swinging door, means for swinging the door, and means on the door for putting the door-swinging means out of operating condition.

It is a further object of this invention to provide, in connection with doors, means for operating the doors to open them actuated by the approach of tractors, hand trucks or a train of trailers of varying lengths passing through a sensitive field, in which the vehicle will interrupt the beam of light for actuating the instrumentalities for opening the doors. The doors also may be opened
30 by in any manner cutting out the source from which the beam of light originates.

The operation of these doors may be accomplished by a push button or similar switches, which selectively energize the magnets of the contactors, thereby supplying current to the motors, causing the rotor to rotate in the proper direction to open or close doors, as shown by wiring diagram Figure 15.

These and other advantages will appear from the following description taken in connection with the drawings.

This application deals primarily with the door mechanism, the motors and brakes for operating the door mechanism, with the spring-cushioning device for use as bumpers, and the light mechanisms.

The copending application, Ser. No. 88, of January 2, 1935, deals with the electrical circuit and photo-electric cell controls and the primary and
50 secondary sensitive fields.

Referring to the drawings:

Figure 1 shows in elevation a pair of doors and the wall of the building adjacent thereto.

Figure 2 is a section on the line 2—2 of Figure 1.

Figure 3 is a section on the line 3—3 of Figure 1.

Figure 4 is a section on the line 4—4 of Figure 1.

Figure 5 is a horizontal section through one of the doors, showing the bumper thereon for releasing the door-operating mechanism.

Figure 6 is an elevation of the bumper structure shown in Figure 5.

Figure 7 is a vertical section through part of a door, an adjacent part of a building wall, and the door-operating mechanism.

Figure 8 is a detail view showing the means whereby the door-operating mechanism may be released and an electrical circuit broken.

Figure 9 is a sectional view of the door releasing mechanism and the circuit breaking means operated thereby.

Figure 10 shows the interior of one of the power units, with part of the casing removed and a part of the internal structure in section.

Fig. 10a is a view taken on the line 10a—10a of Figure 10, extending from top to bottom of the door, so as to disclose the means connecting the bumpers disclosed in Figs. 2, 5, and 6 with the tube-tripping mechanism shown in Figure 10.

Figure 11 is a top plan view of the power unit shown in Figure 10, with part of the casing broken away to show a part of the internal mechanism.

Figure 12 is a section on the line 12—12 of Figure 10.

Figure 13 shows a layout of the equipment for sensitive field control of the doors.

Figure 14 shows a wiring diagram for operating the doors, in which there is a photo-electric controller.

Figure 15 shows a wiring diagram for operating the doors by means of push buttons or similar switches.

The present door structure and operating mechanism are adapted to be used with various forms of buildings and for various purposes. These operators are primarily for use on doors for openings through which vehicles such as tractors, hand trucks and trains of trailers of varying lengths pass. The doors will open as soon as the vehicle enters a sensitive field and will not close until the vehicle has passed a safe distance beyond the door.

The sensitive field method of operating doors differs from the standard opening beam and closing beam method as follows: Where there is a separate opening beam and closing beam, the interruption of the opening beam would cause the doors to open and breaking the closing beam

would cause the doors to close. This method makes no distinction as to the length of the tractor, truck or train. The sensitive field method may be used with all lengths of vehicles.

5 In the time delay method the interruption of the beam causes the doors to open, and after the beam has been restored for a definite time, the doors close. In this method no distinction is made as to the length of the truck or train
10 and it is possible for a truck, after having passed the beam, to be caused to stop in the opening. Since the light beam has been restored, as soon as the time interval has elapsed, the doors will start to close and may close against the vehicle,
15 which is not possible with the sensitive field method.

In the present instance the door is shown in use in connection with a building structure, which has a wall 1, with an opening therein forming a
20 doorway, which has about it and attached to the wall a frame 2, which forms the door facing. The doors for closing this opening are two in number, indicated by the numeral 3, and supported by hinges 4 attached to the frame adjacent opposite
25 sides of the doorway.

Each perpendicular part of the frame 2 and the horizontal part above the doorway are provided with a stop member 5 against which the door fits when closed. The upper end of each door is cut
30 away to provide space for a power unit, which is inclosed in a casing composed of sides 6 and 7, held in spaced relationship by channel-shaped edge members 8 and an angle iron bottom 8a. The sides are attached to the door, the edge mem-
35 bers and the bottom member by means of bolts 9. Resting upon the bottom 8a is a cup member 10 which supports the lower end of a shaft 11 by means of bearings 12 (Fig. 7). The upper end of this shaft is supported by means of bearings 13
40 provided in a gear box 14 mounted upon the upper end of a motor casing 15. The rotor of the motor is on the shaft 11.

On the shaft 11 adjacent and above the bearings 12 is a brake drum 16. On opposite sides of
45 this drum are braking means, including an arcuate arm 17 (Figs. 7, 10, and 12) pivoted at one end to a pivot 18 provided in the lower part of the casing, and a second arcuate arm 23 pivoted at one end to a pivot member 24, similarly sup-
50 ported in the lower end of the casing. The arm 17 is provided with a brake shoe 19 and the arm 23 is provided with a brake shoe 19a for engagement with the periphery of the brake drum. The end of the arm 17 remote from the pivot 18 has
55 thereon an extension 20, provided with a screw 21 which engages an arm 22. The other arcuate brake arm 23 has on its end remote from the pivot 24 an extension 25 through which extends an adjustable screw 26 for engagement with an arm
60 27 oppositely disposed to the arm 22.

Through the extensions 20 and 25 is a bolt 28 which has on one end, between its head and the extension 20, a spring 29, and on its other end, between the nut thereon and the extension 25, a
65 spring 30. The tensions of these springs may be adjusted by adjusting the nut on the end of the bolt. These springs serve to hold the brake shoes in engagement with the brake drum. The shoes are released from the brake drum through the
70 operation of a brake lever 31, which has at one end a pivot 31a. On the pivoted end of this brake lever are the arms 22 and 27, which are moved and operated by the brake lever 31 for moving the arcuate arms 17 and 23 for releasing the brake
75 drum 16.

The end of the brake lever 31 remote from the pivot 31a has attached thereto a plunger 32 operated by means of a brake magnet 33. On the lower end of the motor casing is a sleeve 34, which has extending therefrom a lug 35 provided
5 with a screw 36 adapted to engage an arm 37 for operating a contact member 38. On the sleeve 34 opposite the lug 35 is a lug 39, which has therein a screw 40 for engagement with an arm 41 for
10 operating a contact member 42. The contact members 38 and 42 are held in engagement with cooperating contact members by means of a spring 43.

The gear box 14 is closed by means of a lid 44, which has on its upper surface a stud 45 project-
15 ing into a bearing 46 located on the under side of a top plate 47. This top plate is in line with the top surface of the door. The stud 45 and bearing 46 permit a limited swinging movement of the gear box and an outwardly extending tube 55
20 supported by the gear box, with relation to the unit casing and door. The upper end of the unit casing is protected by means of an inwardly projecting part 6a of the side 6 and by means of a skirt 48 supported on the lid 44 by arms 48a at-
25 tached to the lid and the gear casing by means of screws. Other suitable means may be used.

In the gear box and on the upper end of the shaft 11 is a gear 49 in mesh with a gear 50 fixed
30 to one end of a shaft 51, supported by bearings 52 in a sleeve 53 projecting from one side of the gear box and supporting the tube 55 mounted thereon at one end. This tube extends through a hole 54 provided therefor in the skirt 48. On the inside of the tube and around the sleeve 53
35 is a ring 56 suitably attached to the tube 55 as by welding, or other means (Fig. 7).

Threaded over the outer end of the sleeve 53 is a cap 57, which serves to retain the ring in proper position to prevent longitudinal move-
40 ment of the tube 55, but permitting a rotary movement thereof. This cap also serves to retain packing 58 about the shaft 51. The cap is provided with a hole 59 through which the shaft 51 extends. The shaft 51 is elongated and extends
45 through the tube 55 in the form of a screw shaft 60, which has threaded thereon a nut 61 located within the cylinder 62 for sliding movement therein but rotating with the cylinder by means of a spline 64 on the nut extending into a slot 63
50 in the cylinder.

In the end of the cylinder adjacent the unit casing is fixed a ring 65, against which one end of a spring 66 abuts, while the other end of this spring abuts one end of the nut 61. In the other
55 end of the cylinder 62 is fixed a ring 67, and there is between this ring and the adjacent end of the nut 61 a spring 68. These springs 66 and 68 allow a certain amount of movement of the nut independently of any movement of the cylinder, and prevents shocks due to the sudden closing or opening of the door. Extending from the cylinder 62 is a key 69, which projects through a slot
70 70 in the tube 55.

For the purpose of supporting the tube 55 and holding the nut 61 against movement with rela-
65 tion to the wall of the building, there is provided a cylindrical housing 71, which surrounds the tube 55. In this cylindrical housing is a V-shaped notch 72 adapted to receive the key 69. This V-shaped notch 72 has in one side thereof, in the body of the housing, a shoulder
70 73 for forming a seat for retaining the key 69 in a definite position for operating the door
75

through the mechanical mechanism inclosed within the unit casing.

Integral with the housing 71 is a switch box 74 pivotally attached to a bracket 75 so that the housing 71 may rotate to accommodate the swinging of the tube 55, due to the opening and closing of the door. The part of the switch box 74 extending through the bracket 75 is cylindrical and terminates at its upper end in a cap 76 fitting over the upper surface of the bracket 75. In the switch box 74 is a mercury or interlock switch 77 operated by means of a cam lever 78 adapted to be contacted by the key 69. Extending from the mercury switch is a pair of conducting wires, such as 136 and 137 (Figs. 7, 8 and 9).

When the key 69 leaves the shoulder 73 the cam lever 78, which operates the mercury switch 77, is caused to drop so that the switch opens, thereby opening the circuit. The opening of the circuit prevents the motor from rotating in a direction to close the door, but the motor may rotate for opening the door provided the contact operated by the arm 37 has not been broken (Figs. 11 and 12).

On the end of the tube 55 remote from the gear box is a collar 79 adapted to engage a spring 80 located in one end of the housing 71 to absorb shock. On the end of the tube 55 within the skirt 48 is attached one end of a trip lever 81 (Fig. 10). Acting upon this trip lever for holding the tube in such a position that the key 69 will lie in the notch 73 is a spring 82 (Fig. 10). This key 69 is retained in the notch 73 during all periods of normal operation, but may be removed therefrom by suitable instrumentalities operating upon the trip lever 81 to slightly rotate the tube 55 against the action of the spring 82. For the purpose of operating the trip lever there is provided a plunger 83 supported at its upper end by means of a guide 84 (see Figs. 10 and 10a).

On the door, near the bottom thereof, is a bumper member 85 supported at one end on a pivot pin 86 (Figs. 2, 5, and 6). There is also a second bumper member 87 pivoted at one end by means of a pin 88 on the other end of the first-named bumper member. The other end of the bumper member 87 has a slot 89 therein to receive a pin 90. The pins 86 and 90 are supported in a frame member 91, suitably attached to the door for supporting the bumper members. With reference particularly to Figs. 5, 10, and 10a, mechanism is shown for converting swinging movement of bumper member 85 into swinging movement of trip lever 81 which, by means of the rigid attachment of trip lever 81 to the tube 55, results in a swinging of the tube 55 on its axis and the release of key 69 from shoulder 73 in notch 72 of the housing 71. As shown in Fig. 10a, the connecting means comprises a vertically-disposed tubular trip-rod 83, slidable in spaced bearings 84, having integrally attached to its upper end a reduced portion 83a (Fig. 10), for engagement with the lower of two channels 81a of the trip lever 81; the lower end of member 83 is suitably flattened and has a hole therein whereby it is pivotally connected to the bifurcations 92a of the link 92, by means of such suitable means as a pin or bolt 92b (Figs. 5, 10a). The opposite end of link 92 is flattened and bored, so that it may be pivotally connected to the bumper member 85 by such suitable means as a pin or bolt 85b, which extends through

suitable holes in parallel spaced L-shaped brackets 85a and through the hole in the flattened end surface of link 92, which surface is thus pivotally secured between the spaced L-shaped brackets 85a which are integrally secured to the inner or back surface (Figs. 5, 10a) of bumper member 85 by welds, rivets, or other suitable means. It will thus be clear that, as seen in Fig. 10a, backward movement of bumper member 85 will act through double pivot link 92 to slide trip rod 83 upwardly through bearings 84 whereby the upper or reduced portion 83a of trip rod 83 will engage the lower channel 81a of trip lever 81, whereby the trip lever 81 and the integrally-connected tube 55 will be rotated about their coincident axes and the key 69, which is guided in slot 70 in tube 55, will be released from the notch 73 and will actuate the interlock switch 77 by swinging the cam lever 78 upward about its axis as shown in Fig. 8. It is to be noted that the trip rod 83, and bearings 84 lie wholly within the doors 3, and are therefore fully protected from the elements as only a part of the double pivoted link 92 lies outside of the door in an exposed position.

The doors are located in a passageway formed by walls or side members 94 (Fig. 13). Between these walls is the sensitive field 95, one part of which is designated the main field 96, while the other part is designated the secondary field 101. For the main field there is a source of light 97 and a plurality of mirrors 98 for reflecting the light 100 upon a photo-electric cell 99. The main field is on one side of the door while the secondary field is on the other side of the door and provided with a light source 102, the light beam 105 from which is reflected by a mirror 103 upon a photo-electric cell 104.

In Figure 13 there is shown a photo-electric control 106 connected to the source of light 102 by means of conductors 107. This photo-electric control is connected to the source of light 97 by means of conductors 108. The photo-electric cell 99 is connected to the photo-electric control by means of conductors 109, while the photo-electric cell 104 is connected to the control by means of conductors 110. The numeral 111 indicates a push button switch for making and breaking a circuit formed by the conductors 108.

The door movements are determined by a magnetic control 112 connected by means of conductors 115 to the photo-electric control 106. The magnetic control 112 is connected to the motors that operate the doors by means of conductors 113 and to the interlock switches 77 by means of conductors 114.

The numeral 116 (Figs. 13 and 14) is used to designate, as a whole, the conductors for supplying current from a source for operating the various mechanism, and includes main conductors 117, 120, and 128. The conductor 117 has branches 118 and 119, leading to the motors in the casings 15. The conductor 120 terminates in a contact 121, which has extending therefrom a conductor 121a, terminating in a contact 122, from which a conductor 123 extends to a transformer 123a. This conductor 123 continues from one side of the transformer into a conductor 124, which terminates in a contact 125, which is connected by means of a conductor 126 to a contact 127 forming the terminal of the main conductor 128.

Extending from the contact 121, at the end of the main conductor 120, is a conductor 129, which terminates in a contact 130. The contact 130 is

connected by means of a conductor 131 and overload relays 132, to two contacts 133 and 134. Adjacent the contact 133 is a cooperating contact 135, which is connected by means of a conductor 136 to the interlock or mercury switches 77. There are two of these interlock switches, one for each door. One of these switches is connected by means of a conductor 137, through a coil 138, through a second conductor 139, to a close limit switch 140. This close limit switch is connected by means of a conductor 141 to the branch 119.

Extending from the other of the interlock or mercury switches is a conductor 141a, which passes through a coil 142 and continues by a conductor 143 to a close limit switch 144. Opposite the contact 134 is a cooperating contact 145, which is connected by means of a conductor 146, a coil 147 and a conductor 148 to the open limit switch 149. This switch and switch 144 are connected by conductors 150 and the branch 118 to the main conductor 117. A branch 146a of the conductor 146 passes through a coil 151, and by means of a conductor 152, is connected to an open limit switch 153. This switch 153 serves to connect the conductor 152 to the conductor 141.

The coil 147 serves to operate three switches, 147a, 147b, and 147c. The switch 147a serves to connect the contact 121 by means of a conductor 154 to the motor in one of the motor casings. The coil 151 serves to operate switches 151a, 151b, and 151c. The coil 138 serves to operate switches 138a and 138b, while the coil 142 serves to operate switches 142a and 142b.

The switch 151a serves to connect the contact 130 to a motor in the other of the motor casings. This connection is effected by means of two conductors 155 and 156. The conductor 156, in addition to serving as a connection between the contact 130 and the motor serves, in connection with the switch 138b, to connect the contact 125 to the motor. The conductor 157 and the switch 138a serve to connect the contact 122 with the motor to which the conductor 156 is connected. The conductor 158 serves to connect the switches 147c and 142a to the motor to which the conductor 154 is connected. The circuit for energizing one of the magnets 33 is indicated by the numeral 159 and is connected to the conductors 154 and 158. The other magnet is energized by a circuit 160 connected to the conductors 157 and 156.

The photo-electric control may be of any suitable kind, and includes a grid glow tube 161 and a solenoid 162 for operating a switch 163. This switch normally connects the contacts 133 and 135, but when the solenoid is energized it is moved from the contacts 133 and 135 to engagement with the contacts 134 and 145. The grid glow tube has three electrodes, namely, the anode, the cathode and the grid. When the phase of the potential between the grid and the cathode is varied the tube will or will not pass current, depending upon the phase relation between the grid to cathode voltage and the anode to cathode voltage. The initial phase relation of the grid voltage is selected by means of a potentiometer 164.

When either beam of light 100 or 105 is broken the grid glow tube passes current and energizes the solenoid 162, which operates to bridge the contacts 134 and 145, thereby closing a circuit from the conductor 120, through the conductor 131, through the conductor 145, through the coil 147 and conductor 148 to the open limit switch 149 of one of the motors, and from this switch through the branch 118 to the conductor 117.

There is also a circuit including the conductor 146, the coil 151, conductor 152 to the open limit switch 153 of the other motor.

As long as these circuits are closed the motors operate to open the doors and continue to operate until the open limit switches are broken through the swinging of the tubes due to the movement of the doors. These circuits are control circuits and serve to operate the switches for completing circuit through the motors. The switches operated by the coils 147 and 151 are closed, thereby forming a circuit including the conductors 120, 154, the motor, the branch 118 and the main conductor 117, and the circuit including the conductor 120, conductor 155, conductor 156, the other motor, the branch 119 and the conductor 117, thereby operating the motors for opening the doors.

At the same time there is formed a circuit comprising a conductor 128, the switch 151c, the conductor 157, one of the magnets 33, the conductor 156, the conductor 155, switches 151a, and the conductor 120. This circuit releases the brake for one of the motors. At the same time there is a circuit including the conductor 128, the switch 147c, the conductor 158, the other magnet 33, the conductor 154, the switch 147a and the conductor 120. This circuit serves to release the brake from the other motor. The brakes are applied by the springs 29 and 30.

When the open limit switches are broken the coils 147 and 151 are deenergized, thereby permitting the various switches operated thereby to open and cut off the current to the motors. As soon as the light beams 100 and 105 are restored, the switch 163 bridges the space between the contacts 133 and 135. When the light beam is broken, the solenoid pulls the bridge 163 down, bridging contacts 134 and 135, completing the circuits necessary to open the doors. When the opening operation is completed, the limit switches stop the doors. As long as the sensitive field is interrupted; i. e., the beams 100 or 105 are broken, the solenoid 162 holds the bridge 163 on the contacts 134 and 145 and the door remains open. When the sensitive field, or beams 100 and 105 are re-established, the bridge 163 completes the circuit from contact 133 to 135, thereby completing the circuit to the motor for closing the doors. The motor operates and the door closes; whereupon the limit switches operate, thereby stopping the motor. When the contacts 133 and 135 are connected the following circuit is provided, which includes the conductors 120, 129, 131, 136 the interlock switches, the conductor 137, the coil 138, the conductor 139 and the close limit switch 140, the conductor 141, branch 119 and the conductor 117. At the same time and as a branch of this circuit there is a circuit beginning with the interlock switches, including the conductor 141a, the coil 142, the conductor 143, the close limit switch 144, the conductor 150, the branch 118 and the conductor 117.

When these circuits are made the switches 142a and 142b, 138a and 138b close, creating circuits whereby the motors operate in a direction contrary to that in the operation of opening the doors. This operation continues until the close limit switches are moved to break the circuits. This completes the opening and closing operations of the doors. In the event that the doors do not open fast enough to accommodate a moving vehicle, the vehicle will strike the bumpers, thereby causing the tubes 55 to rotate and release the keys 69. These keys being released the doors

can open independently of the motor operations, and will continue to open until the open interlock switches are moved to break the circuits, but this merely serves to break the circuits that energize the coils 138 and 142. If the doors are pushed entirely open manually, and the open limit switches' contacts are broken, it is necessary to push the doors manually in the closing direction until the open limit switches remake their contacts; whereupon, if either of the sensitive field beams are broken, the motors will rotate in the proper direction to open the doors, thereby causing the nuts 61 to be driven down the slots in tube 55 until they re-engage 62 in notch 73. As soon as keys 69 are re-seated in notches 73, the interlock switches make their circuits, thereby making the circuits to coils 138 and 142, so that as soon as the light beams are restored to the photo cells, the doors will close. As soon as the doors are open the closing operation may become effective.

By means of the switch 111 the current may be cut off from the light 97. This cutting off of the light will have the same effect as breaking the beam of light, and will result in the production of a current through the grid glow tube for energizing the solenoid by which the switch 163 is moved to close the space between the contacts 134 and 145, thus creating a circuit for energizing the coils 147 and 151 and closing the switches operated thereby for so connecting the motors to the conductors connected to the source of power for operating the motors for opening the doors. At the same time circuits are produced through the coils that operate the brakes for releasing the brakes so the motors can rotate.

Opening operation

The various circuits are normally in the position shown in Figure 14. In this position the switch 163 connects the contacts 133 and 135 and the various coil energizing circuits are broken, due to the closed condition of the doors, whereby the close limit switches are open.

If a vehicle should pass through the main field 96 the zigzag beam of light will be broken so that no light will fall upon the photo-electric cell 99. Under this condition a current of electricity will be caused to pass through the grid glow tube to energize the solenoid 162, which will cause the switch 163 to leave the contacts 133 and 135 and connect the contacts 134 and 145.

This shifting of the switch 163 will produce electric circuits through the coils 147 and 151 for operating switches to connect the conductors 120 and 128 to the motors and to the brakes so that the motors may rotate in a direction for opening the doors. This operation will continue until the doors are fully open, at which point the open limit switches are operated to break the circuits, thereby releasing the switches, breaking the circuits 120 and 128 so that the motors have no current and the brakes are applied to the motors. The contact member 38, shown in Figure 12, is mechanically the same as the open limit switches 149 and 153, and the contact member 42 of Figure 12 is the same as the close limit switches 144 and 148 shown in Figure 14.

The doors will remain open so long as a vehicle is within the sensitive field, which includes both the main field and the secondary field. As soon as the vehicle passes out of the field the beam of light is again admitted to the photo-electric cell, whereby there is no current through the grid glow tube. Hence, the solenoid 162 is

deenergized and the switch 163 again connects the contacts 133 and 135, and the door closes.

Emergency operation

In case the doors should not open sufficiently fast to permit the passing of an oncoming vehicle the bumpers will be operated to release the keys 69 from the notches 73. This releasing of the keys 69 from these notches will permit the tubes 55 to freely move in the cylindrical housings 71 so that the doors may be opened independently of the motors by which the doors are normally opened. The rotation of the tubes 55 will cause a break in the circuits for energizing the coils 138 and 142. These circuits will remain broken until the keys seat themselves in the notches 73.

If the doors be opened manually through the operation of the bumpers they will remain in that position until pushed toward the closed position by hand, and as soon as the arms 37 (Figs. 7 and 12) are moved to make contact the keys 69 will automatically travel along the notches 72 in the housings 71 until they reengage and are re-seated in the notches 73. When the keys are re-seated in the notches 73 the doors are operated by the motors to a full open position. From this position the mechanism will function normally, closing the doors as soon as the beam of light is restored.

If, however, the doors are thrown only partially open, due to collision of a truck with the bumpers, the keys 69 will continue to travel along the slots 70 in the tubes 55 until they reengage the housings 71, and will continue the opening of the doors provided the current is not off. When the keys 69 leave the housings they allow the cam levers on which the mercury switches are mounted to drop, causing the mercury switches to open the control circuit. The opening of this circuit prevents the motors from rotating in a closing direction only, but the power can be applied for opening provided the limit switches operated by the arms 37 have not been opened, and then the keys 69 travel along the slots 70 in the tubes 55 until they reengage the housings and raise the mercury switch levers to the position shown in Figure 7, thereby remaking the closing control circuit. The doors are then ready for complete motor operation.

The operation of the spring-cushioning devices is for two purposes in the relieving of the mechanism from sudden shocks, as follows:

(1) In the beginning of the opening operation of the door one of the springs is compressed, thus absorbing the shock of overcoming the inertia of the stationary mass of the door.

(2) At the completion of the opening operation, the inertia of the moving mass of the door is absorbed by compressing the opposite spring.

These springs function similarly in closing the door, and in addition, one of them serves another purpose. It will be understood that both the door and the door structure and the door stops on the jambs, against which the door closes, are of unyielding material and that the stopping of the motor operator would have to be precise and definite at the instant of complete closure; otherwise, the door mechanism would be placed under a great stress if the motor should overrun slightly, or on the other hand, the door would stand slightly open if the motor should underrun. By providing the cushioning elements, a tolerance is obtained which takes care of these variations. When the doors are pushed

fully open manually; i. e. due to being struck by truck bumper, the collar 79 on tube 55 engages spring 80 in housing 71, thereby bringing the doors to rest easily, the impact being absorbed by spring 80.

It will be understood that I desire to comprehend within my invention such modifications as come within the scope of my claims and my invention.

10 Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In combination with a wall having a doorway therein, a door for closing the doorway, a casing comprising two partly-cylindrical plates integrally secured on opposite sides of the door, a motor pivotally mounted in the casing having its axis contained within the door and normal to the upper edge thereof, a connection between the motor and the wall including a thrust member swingable about the axis of the motor whereby on operation of the motor the door will open or close, and means to stop the operation of the motor when the door reaches either its open position or its closed position, said last named-means comprising a switch mounted in the casing and actuated by stop means on the motor upon swinging of the motor with respect to the casing.

2. In combination with a wall having a doorway and a door for closing the doorway, a gear box rotatably mounted on the door, a motor supported on the box, a screw shaft supported at one end by the box, a gear connection in the box between the motor and the screw shaft, a cylindrical housing pivotally mounted on the wall, a nut threaded on the shaft, means connected to the nut to engage the housing to hold the nut from rotation while the shaft rotates to open or close the door, and means on the door to release said means whereby the door may be opened independently of the motor.

3. In combination with a wall having a doorway and a door for closing the doorway, power operated means including a shaft connected at one end to a motor mounted to pivot about an axis in the door, to swing about the axis of the motor, a bracket on the wall, an interengaging resilient instrumentality on the bracket and a cooperating instrumentality on the shaft to hold the door in a fixed position, and means on the door for releasing said instrumentalities whereby the door may be manually moved independently of the power operated means.

4. In combination with a wall having a doorway therein and a door for closing said doorway, a gear box pivotally mounted on the door, a motor on the gear box, a housing pivotally supported by the wall, a tube connected at one end to the gear box and extending into the housing, said tube having a slot therein, a mechanism including a nut in the tube having a key extending through the slot, a screw shaft supported at one end by the gear box extending into the tube and threaded into the nut, a gear connection in the box between the motor and the screw shaft, means to connect the key to the housing, and a bumper on the door to release the connecting means whereby the door may be manually operated independently of the power operated means.

5. In combination with a wall having a doorway therein and a door for closing said doorway, a gear box pivotally mounted on the door, a motor on the gear box, a housing pivotally supported by the wall, a tube connected at one end

to the gear box and extending into the housing, said tube having a slot therein, mechanism including a nut in the tube having a key extending through the slot, a screw shaft supported at one end by the gear box extending into the tube and threaded into the nut, a gear connection in the box between the motor and the screw shaft, means to connect the key to the housing, and a bumper on the door operatively connected to the tube to rock the tube to release the connecting means whereby the door may be manually operated independently of the power operating means.

6. In combination with a wall having a doorway therein and a door for closing the doorway, a casing on the door, a gear box and motor supported in the casing so that they may rotate, a tube supported at one end by the gear box, a screw shaft operatively connected to the motor and extending into the tube, mechanism including a nut on the screw shaft in the tube, a bracket on the wall, a housing pivotally supported on the bracket, said tube extending through the housing, a key on said mechanism to engage the housing whereby the mechanism is fixed with relation to the housing and the operation of the motor will move the door, and means adjacent the bottom of the door to release said key, whereby the tube can move in the housing and the door may be moved independently of the power operating means.

7. In combination with a wall having a doorway therein and a door for closing the doorway, a casing on the door, a gear box and motor supported in the casing so that they may rotate, a tube supported at one end by the gear box, a screw shaft operatively connected to the motor and extending into the tube, a nut on the shaft in the tube, a bracket on the wall, a housing pivotally supported on the bracket, said tube extending through the housing, a key connected to the nut to engage the housing whereby the nut is fixed with relation to the housing and the operation of the motor will move the door, and means adjacent the bottom of the door to release said key, whereby the tube can move in the housing, said means comprising a bumper operatively connected to the key.

8. In combination with a wall having a doorway therein and a door for closing the doorway, a casing on the door, a rotatably supported motor in the casing, a tube rotatably supported at one end by the motor, a screw shaft mounted in the tube and operatively connected to the motor for rotation thereby, said tube having a slot therein, a cylinder in the tube, a key on the cylinder projecting through the slot, a nut on the screw shaft yieldingly supported in the cylinder whereby it has a limited longitudinal movement but no rotary movement with respect to the cylinder, means on the wall to engage the key to hold the cylinder in a fixed position whereby the motor may move the door, and means on the door for rotating the tube to release the key from said means.

9. In combination with a wall having a doorway therein and a door for closing the doorway, a casing on the door, a rotatably supported motor in the casing, a tube rotatably supported at one end by the motor, a screw shaft mounted in the tube and operatively connected to the motor for rotation thereby, said tube having a slot therein, a cylinder in the tube, a key on the cylinder projecting through the slot, a nut on the screw shaft yieldingly supported in the cylinder whereby it has a limited longitudinal movement but no ro-

tary movement with respect to the cylinder, means on the wall to engage the key to hold the cylinder in a fixed position whereby the motor may move the door, and means on the door for rocking the tube to release the key from said means, said last-named means comprising a bumper composed of a pair of connected bumper members operatively connected to means adapted to rock the tube, one of said members having at one end a fixed pivotal connection with the door and the other member having at one end a sliding connection with the door.

10. In combination with a wall having a doorway therein and a door for closing the doorway, a casing on the door, a rotatably supported motor in the casing, a tube rotatably supported at one end by the motor, a screw shaft mounted in the tube and operatively connected to the motor for rotation thereby, said tube having a slot therein, a cylinder in the tube, a key on the cylinder projecting through the slot, a nut on the screw shaft yieldingly supported in the cylinder whereby it has a limited longitudinal movement but no rotary movement with respect to the cylinder, a cylindrical housing around the tube and supported by the wall, said housing having therein a V-shaped notch and means at one side of the notch to hold the key whereby the cylinder is held fixed and the operation of the motor will move the door, and means on the door to rock the tube about its axis to release the key from said holding means, whereby the door may be opened independently of the operation of the motor.

11. In combination with a wall having a doorway therein and a door for closing the doorway, a casing on the door, a rotatably supported motor in the casing, a tube rotatably supported at one end by the motor, a screw shaft mounted in the tube and operatively connected to the motor for rotation thereby, said tube having a slot therein, a cylinder in the tube, a key on the cylinder projecting through the slot, a nut on the screw shaft yieldingly supported in the cylinder whereby it has a limited longitudinal movement but no rotary movement with respect to the cylinder, a cylindrical housing around the tube and supported by the wall, said housing having therein a V-shaped notch and means at one side of the notch to hold the key whereby the cylinder is held fixed and the operation of the motor will move the door, and pressure-operated means on the door to rotate the tube to release the key from said key holding means, whereby the door may be opened independently of the operation of the motor.

12. In combination with a wall having a doorway therein and a door for closing the doorway, a motor on the door, an operative connection between the motor and the wall whereby the operation of the motor will open the door, and means on the door to break said connection, said means comprising a bumper mounted on a vertical pivot on the door and having a bracket thereon connected by means of a double pivoted link to a vertically-slidable trip rod having a reduced upper end portion engageable with a trip lever, whereby when the bumper is pressed toward the door the trip rod is urged upwardly into engagement with the trip lever and the connection between the motor and wall is broken and the door may be manually operated independently of the power operating means.

13. In combination with a wall having a doorway therein and a door for closing the doorway, an electric motor on the door, a brake for the

motor, electric means in circuit with the motor for releasing the brake, an operative connection between the motor and the wall whereby the operation of the motor will open the door, and means on the door operative to break said connection and said circuit, whereby the brake is caused to operate and the door may be operated manually.

14. In combination with a wall having a doorway therein and a door for closing the doorway, an electric motor on the door, a brake for the motor, electric means in circuit with the motor for releasing the brake, an operative connection between the motor and the wall whereby the operation of the motor will open the door, and pressure-operated means on the door operative to break said connection and said circuit, whereby the brake is caused to operate and the door may be operated manually.

15. In a door swinging apparatus, a door pivoted to swing, a fixed support, a motor casing having a gear box at its upper end attached to the door to pivot about a vertical axis and supporting a tubular member pivoted about a horizontal axis in the gear box and means in the tubular member operating against the fixed support to open and to close the door, said member including a motor and motor circuit, and switch means operated by the pivotal movement of said motor casing to break the circuit whereby the motor stops.

16. In an operating apparatus for a swinging door, a door having a motor mounted therein, a motor-driven screw shaft adapted to swing about the axis of the motor within the door and adjacent one end of the shaft, a housing pivoted to the door-supporting structure, and thrust means resiliently connected to the screw shaft for reciprocation thereby and selectively engageable with the pivoted housing, whereby rotation of the screw shaft swingably operates the door when the thrust means is engaged with the pivoted housing and the door may be operated manually when the thrust member is disengaged from the pivoted housing.

17. In an operating apparatus for a swinging door, a door, a motor-driven screw shaft adapted to swing about an axis within the door and adjacent one end of the shaft, a housing pivoted to the door-supporting structure, and thrust means resiliently connected to the screw shaft for reciprocation thereby, normally engageable with the pivoted housing and manually-operable means on the door for disengaging the thrust member from the pivoted housing whereby upon the operation of said manually-operable means, the normally operative power-operating means is made inoperative and the door may be moved manually independently thereof.

18. In a door-operating mechanism, a power-operated screw shaft having one end rotatably journaled in a support, a tubular member rockably journaled in the support surrounding the screw shaft and having its axis coincident therewith, a slot in the tubular member, a cylinder member within the tubular member and surrounding the screw shaft, having splined therein a nut operably engaging the screw shaft, a thrust ring rigidly secured inside each end of the cylinder, a compression spring on each side of the nut inside the cylinder and retained therein by the thrust rings, a key attached to the cylinder and extending through the slot in the tubular member whereby it is rockable therewith, a housing mounted on a second support and having a bore

therein in which the sliding member is slidably and rockably received, a V-shaped notch in the housing having a shoulder thereon adapted to retain the key in the notch, and a manually-operated trip lever rigidly secured to the tubular member whereby the tubular member may be rocked about its axis and the key freed from the V-shaped notch in the housing, thus breaking the connection between the screw shaft and the housing.

19. In a door-operating mechanism, a power-operated screw shaft having one end rotatably journaled in a support, a tubular member rockably journaled in the support surrounding the screw shaft and having its axis coincident therewith, a slot in the tubular member, a cylinder member within the tubular member and surrounding the screw shaft, having splined therein a nut operably engaging the screw shaft, a thrust ring rigidly secured inside each end of the cylinder, a compression spring on each side of the nut inside the cylinder and retained therein

by the thrust rings, a key attached to the cylinder and extending through the slot in the tubular member whereby it is rockable therewith, a housing mounted on a second support and having a bore therein in which the sliding member is slidably and rockably received, a V-shaped notch in the housing having a shoulder thereon adapted to retain the key in the notch, a motor circuit switch operating cam swingably mounted in said second support with its face adjacent the shoulder in the notch and engageable by the key when the tubular member is rocked, and a manually-operated trip lever attached to the tubular member whereby, when the tubular member is rocked by operation of the trip lever, the key is freed from the shoulder in the notch and the motor circuit switch is operated, thus breaking the operative connection between the screw shaft and the housing and simultaneously stopping the operation of the screw shaft operating motor.

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