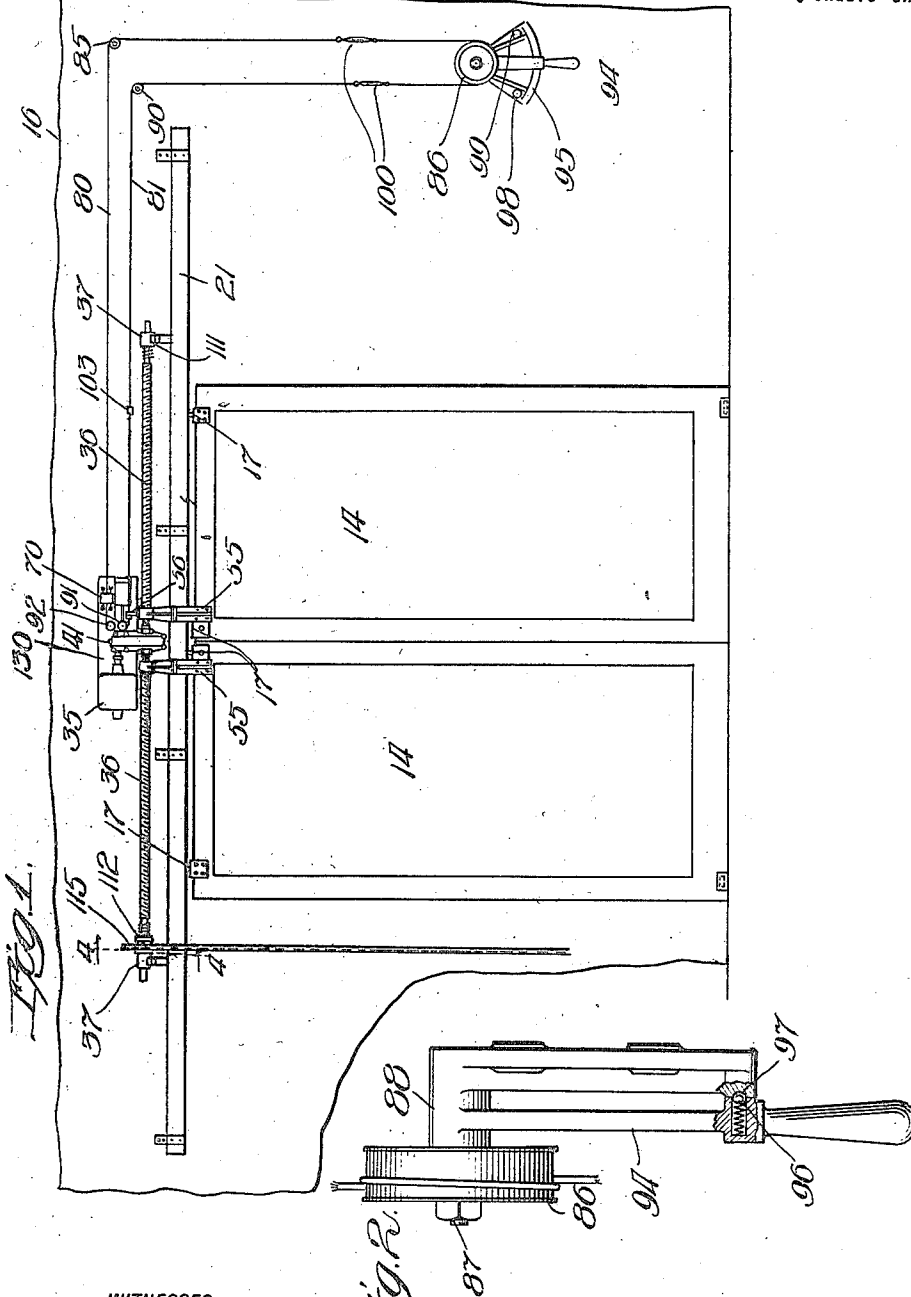


P. H. LACEY.
DOOR OPERATING MECHANISM.
APPLICATION FILED JUNE 5, 1918.

1,411,039.

Patented Mar. 28, 1922.

6 SHEETS—SHEET 1.



WITNESSES:
Harry S. Gaither

INVENTOR
Paul H. Lacey
BY *William H. Hale*
ATTORNEY

1,411,039.

6 SHEETS—SHEET 2.



Paul H. Igcey

R

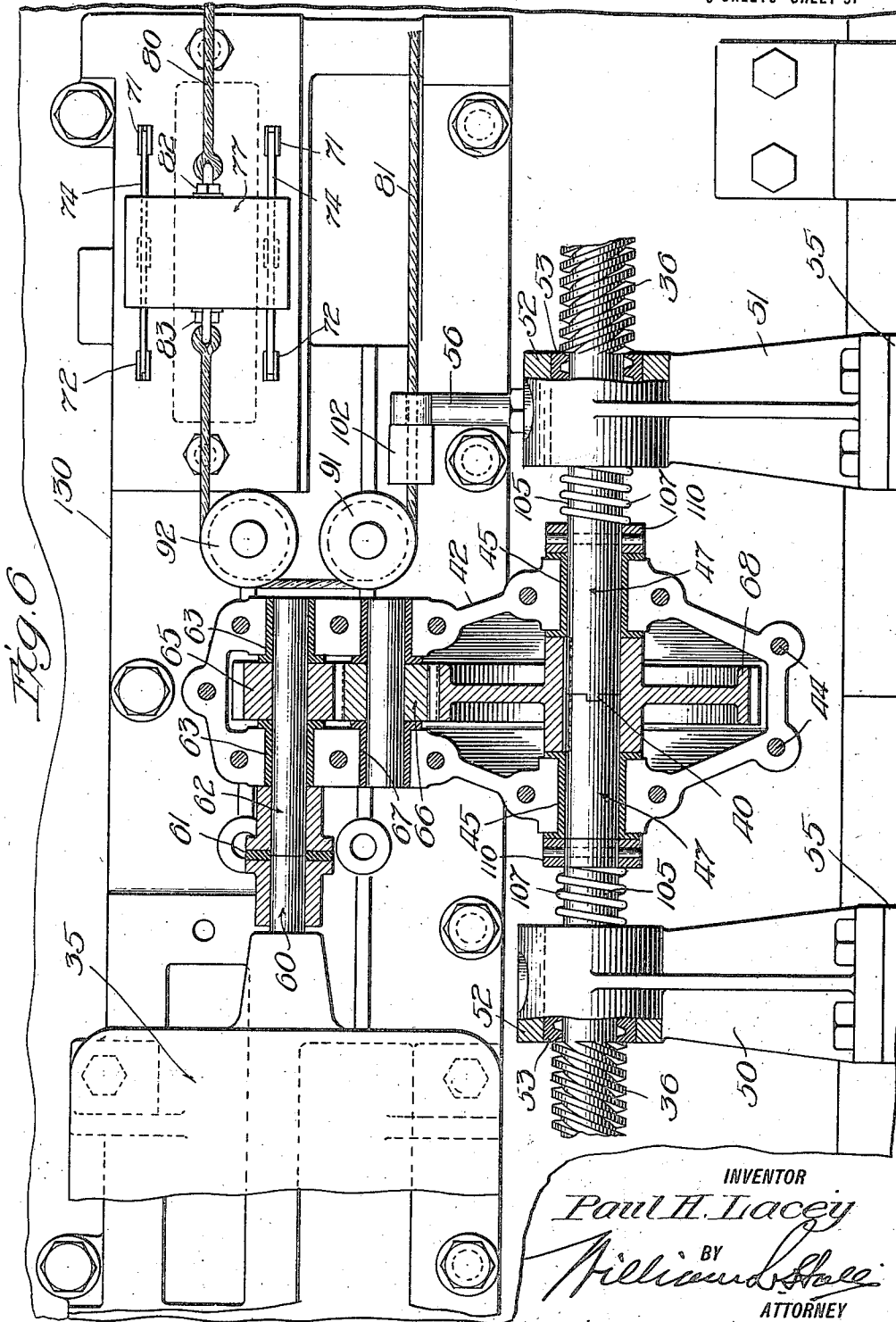
ATTORNEY

P. H. LACEY.
DOOR OPERATING MECHANISM.
APPLICATION FILED JUNE 5, 1918.

1,411,039.

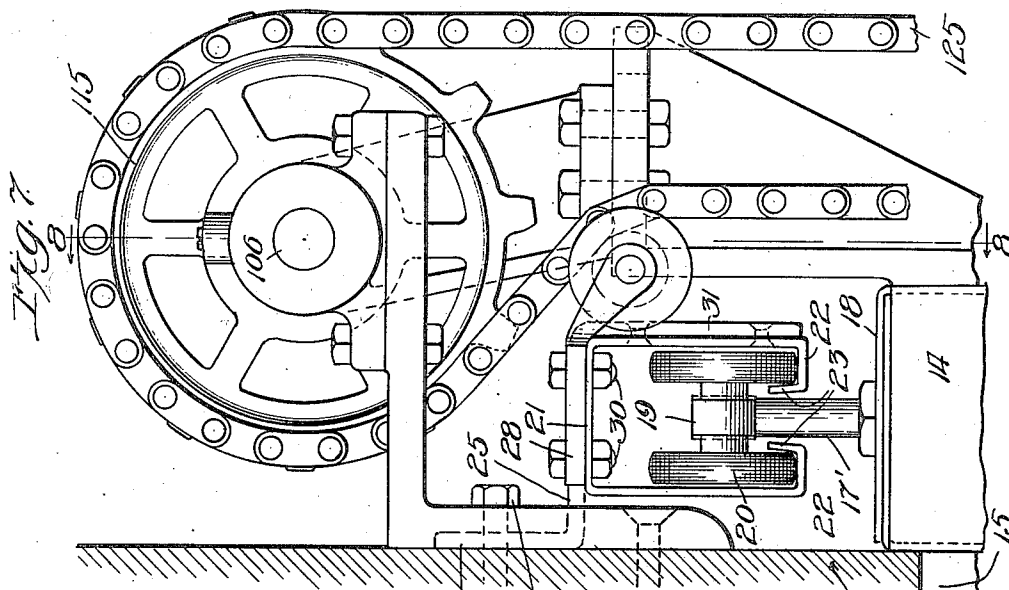
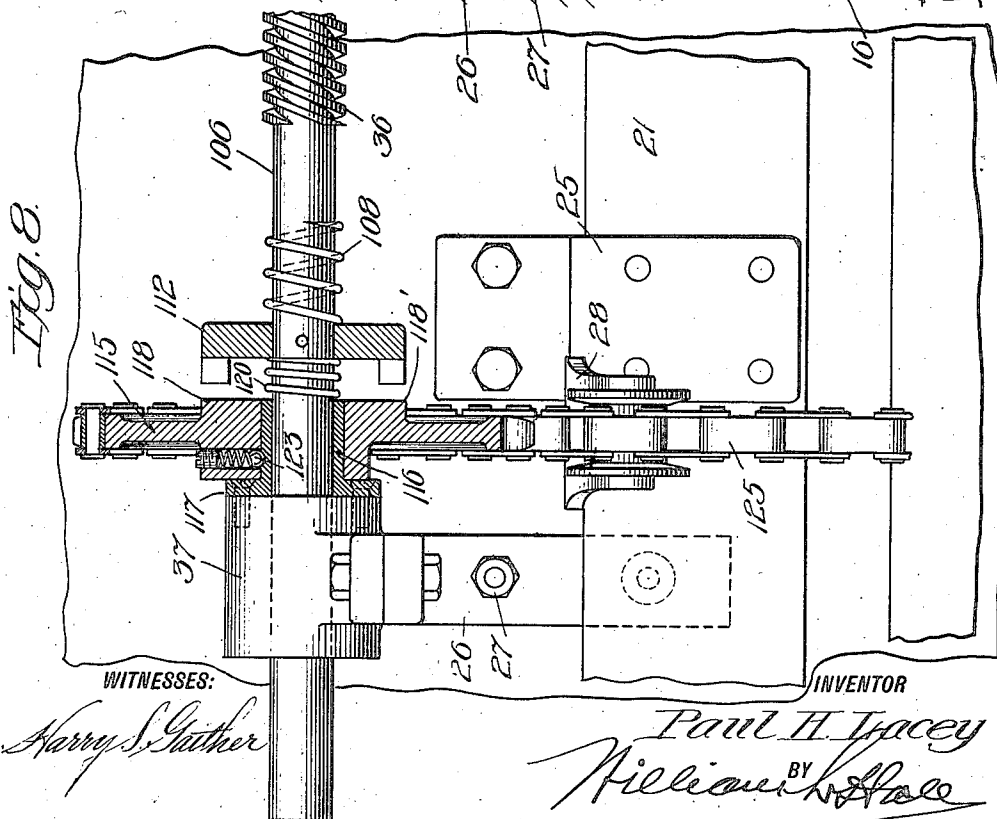
Patented Mar. 28, 1922.

6 SHEETS—SHEET 3.



1,411,039.

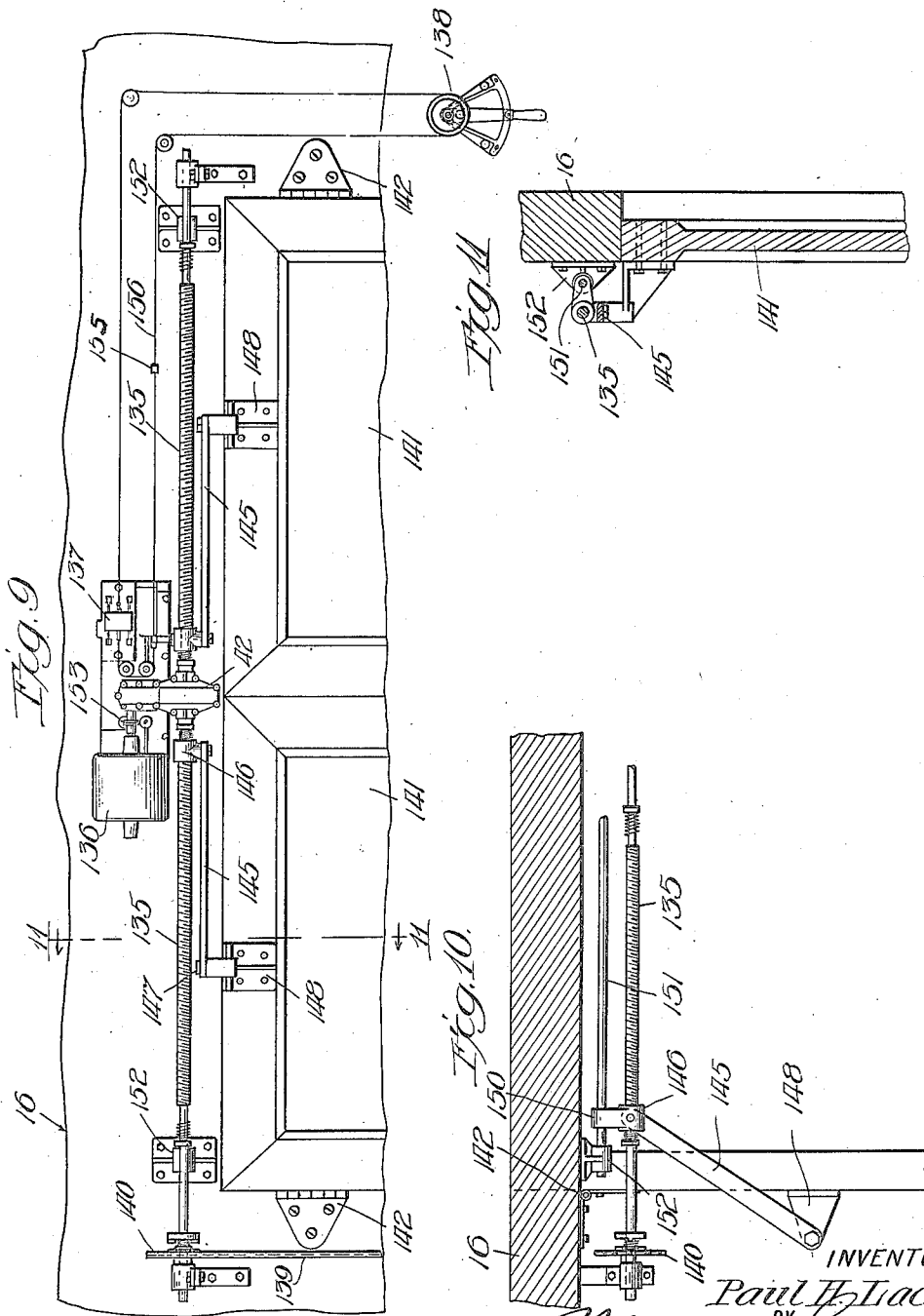
6 SHEETS—SHEET 4.



P. H. LACEY.
DOOR OPERATING MECHANISM.
APPLICATION FILED JUNE 5, 1918.

1,411,039.

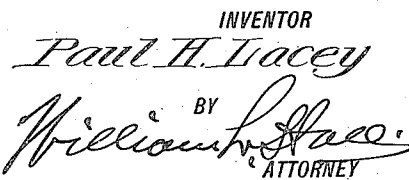
Patented Mar. 28, 1922.
6 SHEETS—SHEET 5.



INVENTOR:
Paul H. Lacey
BY
William L. Lacey
ATTORNEY

1,411,039.

6 SHEETS—SHEET 6.



UNITED STATES PATENT OFFICE.

PAUL H. LACEY, OF CHICAGO, ILLINOIS, ASSIGNOR TO PEERLESS DOOR CONTROL COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION.

DOOR-OPERATING MECHANISM.

1,411,039.

Specification of Letters Patent.

Patented Mar. 28, 1922.

Application filed June 5, 1918. Serial No. 238,265.

To all whom it may concern:

Be it known that I, PAUL H. LACEY, a citizen of the United States, and a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Door-Operating Mechanism; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the characters of reference marked thereon, which form a part of this specification.

This invention relates to a novel means for operating doors, windows, or other like closures, both swinging and sliding closures, and relates in part to novel operating mechanism for giving motion to the closure to open and close the same, either manually or by motor power, and in part to novel means for so controlling the closure opening and closing means from a distant point or points of control located at a suitable station or stations in the building.

In the embodiment which is here chosen to illustrate the principles of my invention, the invention is shown as applied to operate a horizontally sliding door or doors and a horizontally swinging door or doors, although it will be understood that the principles of the invention may be applied to operate doors which open and close in a direction other than horizontal.

The invention consists of the combination and arrangement of the parts shown in the drawings and described in the specification, and pointed out in the appended claims.

A useful application of the operating mechanism is to the doors of garages, freight houses, warehouses, and other buildings where it is convenient and desirable to open and close the doors from a distant point or points of control, and in the following detailed description of the embodiment of the invention herein disclosed, reference will be made specifically to the sliding and swinging doors shown. It is to be understood that such reference is for convenience of particular and explicit explanation of the form of the invention shown and is not intended to be restrictive as to the scope of the invention in its broader phase.

Among the objects of the invention is to

provide a novel door operating mechanism which is constructed and arranged to positively open and close the door or doors, the construction and arrangement being such as to avoid lost motion between the motor which operates the mechanism and the door or doors which are to be opened and closed.

Another object of the invention is to provide a novel apparatus for operating the door or doors which is constructed with means to disconnect the door from the operating mechanism at both the opening and closing limits of movement of the door or doors so as to thereby avoid throwing a heavy stress on the operating mechanism in the event that the motor which drives the operating mechanism should continue to operate either because of its momentum or because of the failure of the intended means to stop its operation; and in respect of this object of the invention a further and auxiliary object of the invention is to construct the disconnecting means so as to insure the proper connection of the operating mechanism with the door when the door or doors are to be moved from one extreme throw towards the other direction of its movement.

Another object of the invention is to provide means which are constructed to operate in the event that the movement of the door or doors is blocked intermediate its opening or closing movement so as to thereby avoid overloading the motor that drives the operating mechanism. For instance, should the door or doors upon closing clash with a vehicle or other object passing through or within the door-way, the safety device thus provided will render the motor inert to further press the door or doors towards the obstruction. This feature of the invention as disclosed in the illustrated embodiment consists of means between the motor and the operating mechanism which is so constructed as to effect a slippage of the driving connection therebetween, which slippage will be released when the obstruction has been removed. However, in respect of the broader aspect of this feature of the invention, the safety device for this purpose may be otherwise constructed and arranged.

Another object of the invention is to pro-

vide a novel control device that is connected to the motor or its starting or stopping equipment and extends therefrom to a distant control station or stations, as the case
 5 may be, whereby the motor may be started from said control station or stations and after the motor has been set in operation, the mechanism will continue to be automatically
 10 operated until the door reaches the limit of its travel towards which the motor is driving it; and the control means is preferably supplementally provided with automatic means whereby it is actuated at the limit
 15 of travel of the door or doors so as to render the motor inert to further operate the door or doors. When an electric motor is used to drive the door operating mechanism, the control device operated from the distant
 20 station or stations will be connected to and operate a switch to open and close the motor circuit, and means traveling with the door or doors will act on the control device to open or close the motor circuit, depending
 25 upon the direction of movement of the door or doors at the respective limits of said movement.

Another object of the invention, in connection with the motor driven operating mechanism referred to, is to provide a novel
 30 means for manually operating the door opening mechanism upon failure of power derived through the motor, and preferably such manually operated actuating mechanism will embrace a prime mover that is
 35 normally disconnected from the door operating mechanism and is adapted to be clutched or otherwise connected thereto when the manually actuated mechanism is to be employed.

Another object of the invention is to provide means for operating the door through the medium of a suitably located rotative screw shaft or shafts, a single screw shaft
 40 being employed with a single door and a double screw shaft with right and left hand threads being employed in connection with
 45 double doors. In respect of the safety means to disconnect the operating mechanism from the door or doors when a screw actuating shaft is used, travelers may be
 50 threaded thereover and the screw threads discontinued at the limits of movement of the doors to provide plain sections onto which the travelers pass, and springs may
 55 be provided which are placed under compression for forcing the travelers back onto the screw threads when the shaft rotates in an opposite direction.

A further object of the invention in respect of its application to sliding doors is to provide a novel door supporting rail or track suitably shaped for operative combination with the door operating mechanism
 60 and to enclose the hanger carriage and travelers, and preferably also the screw shaft

for the doors, the travelers being directly connected to the carriages with the track enclosure.

Other objects of the invention are to improve and simplify operating mechanisms
 70 for doors and like closures.

In said drawings,

Figure 1 is an inside elevation of two sliding doors with my improved operating mechanism applied thereto.

Figure 2 is a view partially in elevation and partially in section of a distant control device for the actuating motor of the operating device.

Figure 3 is a plan view of a portion of the operating mechanism and its motor.

Figure 4 is a section on the line 4—4 of Figure 1, looking in the direction indicated by the arrow.

Figure 5 is a side elevation thereof partly in section and partly in elevation.

Figure 6 is a partial vertical section on the line 6—6 of Figure 3.

Figure 7 is an end elevation of the operating mechanism taken from the end thereof to which the manually actuated device is connected.

Figure 8 is a section on the line 8—8 of Figure 7.

Figure 9 is an inside elevation of the upper ends of two swinging doors showing the door operating device applied thereto.

Figure 10 is a plan view of a portion of the latter construction showing the door in full lines in open position.

Figure 11 is a vertical section on the line 11—11 of Figure 9.

Figure 12 is an inside elevation of the upper ends of the sliding doors showing a modified arrangement of the operating mechanism and its door track and support.

Figure 13 is an end elevation of the structure shown in Figure 12.

First, referring to the sliding door construction shown in Figures 1 to 8, inclusive, 14, 14 designate two sliding doors which move towards and from a central closing position to close the door opening 15, and are located, as herein shown, just inside the wall 16 (Figures 1, 3, and 7) of the building so as to have clearance inside said wall. 17, 17 designate hangers, two being applied and connected to the top of each door. Each of said hangers, as best shown in Figure 7, embraces a shank 17' that is connected to a U-shaped fitting 18 that fits over and is attached in any suitable manner to the upper marginal portion of its corresponding door, and an eye 19 to receive a shaft on which bearing rollers 20, 20 are mounted.

21 designates as a whole a horizontal inverted U-shaped track structure that is located just inside the building wall 16 above the door opening 15. The lower marginal portions of the U-shaped structure are

formed to provide horizontal tracks 22 on which the rollers 20 travel and, inside said tracks, with upwardly extending guard flanges 23 to confine the rollers 20 in place.

5 Said track 21 is closed at its upper side and thereby constitutes an enclosed track structure which measurably protects the rollers 20 and the tracks 22 from the settlement of dust and dirt thereon.

10 The particular form of track, however, may be varied to suit different installations. When applied to doors already installed the old doors will be retained and the hangers and other elements constructed
15 to be adapted to the installation.

Said track structure is supported from the wall 16 by a horizontal, generally Z-shaped bracket 25 inside the wall 16, the upper member 26 of which is attached, as by
20 means of bolts 27, to said wall. The horizontal member 28 of said bracket is connected to the closed or intermediate portion of the track structure in any suitable manner, as by means of the bolts 30, and
25 the terminal portion 31 of said bracket lies inside of and may be attached in any suitable manner to the inner member of the track structure. The foregoing construction affords means whereby the doors 15 are sus-
30 pended from and are adapted to travel on the fixed track 21 horizontally towards and from each other.

The specific means herein shown for causing the doors to travel towards and from
35 each other embraces a horizontally threaded shaft which is driven by a motor 35, said motor being a reversible motor as herein shown. In the present instance, where two sliding doors are contemplated, the threaded
40 shaft embraces right and left hand screw threads so as to cause the doors to travel away from each other in opening and towards each other in closing the doors. If
45 a single door be contemplated, a single shaft having a thread of only one direction will be employed, in connection with the reversible motor, to cause the door to travel in opposite directions to open and close the same.

50 Referring now particularly to the double door construction and the right and left screw threaded shaft to operate the same, the construction herein disclosed is made as follows:

55 36, 36 designate two sections of a horizontal shaft having right and left hand screw threads, respectively. The sections of said shaft are rotatively mounted at their outer ends in brackets 37, suitably supported from
60 the wall structure 16, and extending inwardly therefrom. The inner or proximate ends of said shaft sections are connected by any suitable interlocking connection 40, best shown in Figure 6, and are rotatively sup-
65 ported in a suitable bearing bracket, desig-

nated as a whole in Figure 1 by 41. Said bearing bracket consists of two hollow, box-like members 42, 43, Figures 3 and 6, that are detachably fixed together by means of cap screws 44 to constitute a gear housing
70 for gears hereinafter described. The inner unthreaded portions 47 of said shaft sections rotate in bushings 45 that are suitably fixed in the bearing bracket 41. The screw shaft is thus made of two sections for con-
75 venience of manufacturing and assembling. If desirable, however, the right and left hand screw threads for double doors may be formed on a single length shaft section.

50, 51 designate travelers that are provided at their upper ends with heads 52,
80 52 to receive internally threaded fixed bushings 53, Figure 6, that engage the right and left hand threaded shaft sections 36, 36. Said travelers are separable from and are
85 bolted, or otherwise fixed, to brackets 55 that are attached to the upper margins of the doors near their meeting edges. One of the travelers, the traveler 51 as herein shown, is provided with an upstanding arm
90 56 that is adapted, at the limit of travel of the associated door, 15 to control the connection of the motor with the door operating mechanism in a manner hereinafter to be described.

95 The motor 35 is connected to the right and left hand threaded shaft through a gearing connection that is enclosed within the housing bracket 41 made as follows:

The shaft 60 of the motor 35 is connected
100 through a suitable form of slip clutch or connection, designated as a whole by 61, with a shaft 62 that is rotatively mounted in suitable bushings 63 carried by the bearing bracket 41. Fixed to said shaft 62 is a
105 pinion 65 which, through an idler gear 66 rotatively mounted in the bushing 67 carried by said bracket, is connected to and drives a gear wheel 68 that is keyed or other-
110 wise non-rotatively mounted on the meeting plane ends 47 of the shaft threaded sections. Through the gearing arrangement described, the speed of the motor to drive or rotate the shaft sections 36 is suitably reduced.

The circuit of the motor 35 is controlled
115 through the medium of a switch, designated as a whole in Figures 1 and 6 by 70, and illustrated in detail in Figures 3 and 6. Said switch, as illustrated in said last mentioned figures, embraces in its construction
120 two pairs of terminals 71, 72 suitably connected to the reversible motor and are supported on a base 73 of any suitable insulating material. These terminals are split terminals to receive the ends of rocking switch
125 blades 74 that are pivoted at 75 to brackets 76 mounted on the base 73. The said switch blades 74 are connected in any suitable manner to a switch actuating block 77, said blades 74 being herein shown as fixedly con-
130

nected to the block. The block is adapted for movement in directions parallel to the planes of the blades 74 so that when moved in one direction it and the blades 74 are
 5 oscillated to bring the ends of the blades 74 into contact with one of the pairs of terminals 71, and when moved in the other direction to bring the other ends of said
 10 terminals 72. The means herein shown for actuating the switch block are made as follows:

80, 81 designate the two leads of what may be considered an endless cable that are
 15 normally taut and connected, respectively, through the medium of eye bolts 82, 83 (Figure 6) to the opposite sides of the switch block 77. The lead 80 is trained directly from its attachment to the switch
 20 block 77 over a guide pulley 85 (Figure 1) to and about a drum 86 that is rockingly mounted on a shelf 87 (Figure 2) supported on a bearing 88 that is located at any suitable control station about the building. The
 25 said lead 80 is wound about the drum 86 and continues, as the lead 81, from said drum over guide pulleys 90, 91, 92 (Figures 1 and 6) to its connection with the attaching eye bolt 83 at one of the switch
 30 block 77. The drum 86 is rocked on the shaft 87 through the medium of an operating lever 94 (Figures 1 and 2) that is attached to or made integral with the bearing 88. The lever is adapted to be locked in
 35 one of a number of adjusted positions to a sector 95. The particular means of locking the lever 94 on the sector may be varied. It consists, as herein shown, of a spring pressed spherical pawl 96, Figure 2, that
 40 is adapted to enter concave sockets 97, 98, 99 formed on the sector 95. The intermediate locking position, or when the spherical pawl 96 is engaged with the control socket 97, is a neutral position, or a position in
 45 which the motor circuit is open; and the positions represented by the sockets 98, 99 are positions in which the motor circuit is closed for operating the motor to respectively open and close the doors.

50 When the lever 94 is swung to the left hand side of its neutral position to engage the spherical pawl with the socket 98, Figure 1, the right hand ends of the blades 74 are engaged with the split terminals 71
 55 to close the motor circuit to operate the latter to open the doors, and when the lever 94 is swung to the right from the position indicated in Figure 1 to engage the spherical pawl with the socket 99, the left hand ends
 60 of the blades 74 are engaged with the split terminals 72 to close the motor circuit to operate it in a direction to close the doors.

The strands or laps 80, 81 of the control cable are provided with turn-buckles, or

other suitable take-up devices 100 for the 65 purpose of adjustment, as will be apparent, and it will be understood that said strands are normally fixed or stationary.

It will be understood that the control lever 94 may be located in any part of the building 70 desired, and also that a number of such controlling devices connected to the same cable may be located in different parts of the building, so that the operating mechanism may be controlled to open or close 75 the doors by persons stationed at different parts of the building.

In connection with the manual control of the motor circuit described, means are provided whereby, through the cable connections 80 referred to, the motor circuit is automatically opened when the doors reach the limits of their travel in both their opening or closing positions. The means herein shown for effecting the automatic opening and closing 85 of the doors at the limits of their opening and closing movements are associated with the arm 56 of the traveler 51 before referred to and are made as follows:

The lead 81 of the controlling cable is provided with spaced blocks or enlargements 90 102, 103, (Figures 1 and 6). The said arm 56 is provided with an opening through which the lead 81 of the controlling cable is threaded, as best shown in Figure 6. The 95 blocks or enlargements 102, 103 are so spaced, longitudinally of said lead 81, that at about the time when the doors reach their closing position the arm 56 engages the block 102 to slightly shift the normally fixed cable and operate the motor switch to open the circuit 100 and at about the time when the doors reach their full open positions the arm 56 engages the normally fixed block 103 to effect a reverse movement of the cable and switch to 105 open the motor circuit, and the direction of the movement imparted to the operating cable through contact of said arm 56 with the respective blocks 102, 103 actuates the switch block 77 to open the motor circuit. 110

The engagement of the spring pressed pawl 96 with the sockets of the sector 95 is such that when the cable is automatically 115 actuated by engagement of the blocks or enlargements 102, 103 with the arm 56, the pulling stress on the cable will effect rocking movement of the manually actuated lever so as to throw it to its intermediate or neutral position.

In order that the doors may be arrested 120 at the limits of both their closing and opening movements without throwing an overload on the motor or throwing an objectionable stress on the operating mechanism, means are provided at said limits for temporarily disconnecting the doors from the 125 operating mechanism, but constructed with means to afford proper operative connection

between the doors and the operating mechanism when the doors are moved towards the other direction of their travel.

The means herein shown for effecting this temporary disconnection of the operating mechanism from the doors are made as follows:

The threads of the right and left hand threaded shaft sections terminate short of the inner and outer ends of the shaft sections 36 to provide plain or unthreaded portions 105 at the inner ends of said shaft sections and other plain, unthreaded portions 106 at the outer ends thereof (Figures 6 and 8). Surrounding the inner plain portions 105 of the shaft sections are spiral springs 107. Likewise surrounding the plain unthreaded outer ends of the shaft sections are other spiral springs 108. The spiral springs 107 co-operate with discs or collars 110 that are fixed to the plain portions 105 of the shaft sections and bear against the ends of the bushings 53 of the hangers 50, 51 in which the inner plain ends of said shaft sections may rotate or the threads 36 thereof may engage. The springs 108 are adapted to co-operate with the hangers 50, 51 and fixed abutments 111, 112 at the opposite ends of the shaft sections, the abutment 111 constituting a part of the adjacent bracket 37, and the abutment 112 constituting a disc that is fixed to and rotates with the associated shaft section 36. Said disc 112 constitutes a part of a clutch device, the construction and operation of which is hereinafter described.

The operation of the safety disconnecting device is as follows:

When the doors approach the limits of their movement in either direction, the hubs 52 of the travelers 50, 51 or their bushings 53, engage the springs 107, 108, depending upon which direction the doors are traveling, and place said springs under compression. The doors, with the travelers thus engaged with and compressing the springs, continue to travel as long as the threads of the bushings 53 are engaged with the threads of the shaft sections 36. The parts are so proportioned that the doors reach their full closed or open positions, depending upon the direction of their travel, at the time the threads of the bushings 53 reach the ends of the threads of the shaft sections 36, and when this occurs rotation of the shaft sections 36 will impart no traveling movement to the doors. Therefore, if the motor continues to rotate, either by its own momentum or because the switch control device has failed to operate, disconnection is effected between the door operating mechanism and the doors so that an overload is not thrown on the motor or an objectionable stress thrown on the operating mechanism.

The springs 107, 108, being under com-

pression when the safety device is brought into service, serve to hold the screw threaded bushings 53 against the ends of the threads of the shaft section 36, so that when said shaft sections are rotated in the opposite directions to give traveling movement to the doors, the expansion force of said springs will serve to bring the threads of the bushings into mesh with the threads of the shaft sections 36 and to effect a driving connection between said shaft sections and the travelers to cause the doors to move. It will be noted that the disconnection of the travelers with, and their connection to, the shaft sections is entirely automatic. So far as the broader phase of the invention is concerned, such disconnection and connection may be otherwise effected, within the spirit and scope of the claims herein.

The slip connection or clutch 61, shown best in Figures 3 and 6, is proportioned relatively to the load necessary to cause the doors to travel, that when said load is substantially increased, the shaft 60 will rotate relatively to the shaft 62 and until the load on the motor is reduced to the normal load to operate the doors, whereupon the shaft 62 will be again picked up and the doors will continue their travel.

The advantage of this slipping connection lies in the fact that it is primarily a safety means to avoid crushing a person or other object caught between closing doors, as well also as to avoid objectionable overload on the motor. With the construction described, it will not be necessary for the person operating the mechanism at a distant control station or stations to give further attention to the closing or opening movements of the doors after the manually actuated lever 94 has been once thrown into position to close the motor circuit, inasmuch as the doors will be automatically arrested when encountering an obstruction to throw an overload on the motor. As before stated, when this overload decreases to normal load, the slip or clutch connection 61 will again pick up the load and move the doors in the same direction towards which they were traveling before encountering the obstruction.

It may at times occur that, by reason of failure of the motive power or defects in the motor, the normal or intended power cannot be transmitted to the shaft sections 36 to open and close the doors. In this event, there is provided a manually actuated operating device which is made as follows:

One of the shaft sections 36 is provided at its outer end with a sprocket wheel 115 that is loosely mounted on a bushing 116 (Figure 8) which surrounds the plain end of the associated screw shaft section. Said bushing has a flange 117 that is fixedly at-

tached to the adjacent bearing 37. The hub 118 of said sprocket wheel is provided with notches or recesses 118' to co-act with lugs 119 on the disc 112, hereinbefore referred to and attached to and rotating with the shaft section 36. The said clutch elements are normally separated by a spiral expansion spring 120 that is interposed between the disc 112 and the hub 118 of the sprocket wheel 115.

The said bushing 116 is provided with a V-shaped slot 122, best shown in Figure 5. This slot is engaged by a spring pressed spherical pawl 123 that is mounted in a suitable socket in the hub of the sprocket wheel 115. An endless sprocket chain 125 or other like flexible device is trained over the sprocket wheel 115 so that, therethrough, the sprocket wheel may be rotated in either direction.

Normally, when the clutch elements associated with the sprocket wheel 115 and disc 112 are separated by the spring 120, the spherical pawl is located at the apex of the V-shaped slot 122. When, however, the sprocket wheel 115 is rotated in one direction or the other, through the medium of the chain 125 angular movement of the sprocket wheel about the axis of the bushing causes said pawl to travel inwardly through one leg of the V-shaped slot and thereby displace said sprocket wheel longitudinally of the shaft section 36 so as to engage the clutch elements in a manner to transmit relative movement of the sprocket wheel 115 to the right and left hand threaded shaft sections. When pulling stress is released from the chain 125 the expansive force of the spring 120 will separate the clutch elements of the disc 112 and the sprocket wheel 115 and will restore the pawl to the apex of the V-shaped slot 122.

The motor 35 and the bearing bracket for the inner ends of the shaft sections 36 and also for the shafts of the pinions 65, 66, are herein shown, and conveniently, will be located above the center of the doorway. Conveniently also said parts are supported on a mounting plate 130 that is fixed in any suitable manner to the wall 16. Said mounting plate 130 is so fashioned that the motor 35 may be attached to either end thereof, and so also that the switch base may be supported on either end of said mounting plate which is opposite to the end thereof which supports the motor. This arrangement affords the desirable flexibility to adjust the mechanism to suit different installation conditions.

It will be understood, however, that instead of connecting the motor centrally of the right and left hand screw shaft sections 36, said motor may, in some instances, be conveniently and desirably operably connected to one end of the two part shaft.

It will be furthermore understood that the hangers 17 and the travelers 50, 51 may also be modified to adapt them to varying conditions of door installations. That is to say, the construction herein shown has been devised as a preferable one for new installations. Where, however, the mechanism is to be applied to a door already installed, the hangers and travelers, as well also as the position of the right and left hand threaded shaft, in respect of its plane relatively to the plane of the doors, may be varied.

Referring now to the adaptation of the invention to swinging doors, illustrated in Figures 9, 10, and 11, the same is made as follows:

The right and left hand screw threaded shaft sections 135, their bearings, as well as the operative connections of the motor 136 thereto, and the motor circuit control switch 137 and the distant station control device 138 are generally similar to the like features illustrated in the previously described figures.

The doors 141, 141 are supported by hinges 142 on the jambs of the doorway. So also the means for manually actuating the screw shafts, consisting of the chain or belt 139 and sprocket 140, with its associated clutch devices are similar to those previously described.

The connections between the threaded shaft section and the swinging doors are made as follows:

145, 145 designate links, each of which is pivotally connected at one end to a traveler 146 that is screw threaded to engage over the threads of its associated shaft section 135. Said links are pivotally connected at their other ends at 147 to brackets 148 that are attached to the doors near their upper margins. The said travelers 146 are prevented from turning with the rotative threaded shaft sections 135 by any suitable interlocking connection with parts fixed relatively to their traveling movement. As herein shown, the travelers are provided with extensions 150 that are apertured to receive guide rods 151 that are supported at their ends by brackets 152 suitably attached to the wall 16.

Horizontal movement of the travelers 146, through the screw threaded shaft sections acts through the links 145 and the brackets 148, when moving outwardly or away from the center of the doorway to swing the doors, by a pushing movement, open. Said connections also act with a pulling stress, when the travelers move inwardly, to swing the doors toward their closing positions.

A slip connection 153 is provided between the motor 136 and the threaded shafts. Also one of the travelers 146 is provided with an arm 154 that coacts with the blocks or enlargements 155, 155 on one of the leads

156 of the operating cable to automatically open the motor circuit after it has been closed through the operation of the manually actuated device 138.

5 In the construction shown in Figures 12 and 13, the right and left hand threaded shaft sections 160 are enclosed within the track structure 161. Said track structure is formed to provide a housing for said shaft
10 sections and to provide also tracks 162 having guard flanges 167 for the wheels 163, 163 of the carriages for the hangers 164, 164 that are connected by fittings 166 to the doors. The housing track structure for the
15 shaft sections and carriage is omitted near the meeting line of the doors to provide space for the gearing and the bearing brackets therefor that connect the motor 170 to the right and left hand threaded shaft sections.
20 The details of the bearings for the inner ends of the shaft sections, the slip joint or connection 171, and double throw switch 172, together with its actuating mechanism as well also as the safety stops for the doors,
25 may be the same as the like parts hereinbefore described.

In the construction shown in Figures 12 and 13, the hangers 164 near the inner edges of the door carry upstanding travelers 175
30 also enclosed in the track housing that are threaded to engage the right and left hand threaded shaft sections 160, so that said shaft and said travelers are enclosed within the housing track structure 161. Said en-
35 closed track structure is attached to the wall 16 by means of a suitable number of straps or brackets 176. In the construction shown in said Figures 12 and 13, the operation of opening and closing the doors, in respect of
40 the actuation thereof by the motor 170, and in respect of the operation of the safety stop devices, is the same as hereinbefore described.

A traveling member 178 is attached to one
45 of the doors and threaded over one of the leads 179 of the switch actuating cable for contact with the blocks or enlargements 180 on said lead to shift the switch to stop the doors at both limits of their movement. The
50 modification to be observed in respect of the member 178 is that it is not attached to or carried by one of the threaded travelers, but is attached directly to and carried by one of the doors; and its shape is modified
55 to correspond to its changed relation to the other parts.

The hand actuated device for rotating the shaft 160 is also modified in the sense that the flexible hand actuated element 180' is
60 trained over a sprocket wheel 181 that is mounted on a short stub shaft 182 and which carries a gear wheel 183 that meshes with a pinion 185 which is fixed to and rotates with one of the right and left hand threaded
65 shaft sections 160. The construction de-

scribed permits the shaft 160 to be disposed within the housing track structure 161 and permits also the manually actuated device embracing the elements 180', 181, 182, and 183 to be located inside the plane of the
70 wall 16. In some instances, said wall may be recessed to receive a portion of the wheel 183, in which event the centers between the stub shaft 182 and the right and left hand threaded shaft section 160 may be brought
75 closer together. The bearing for said shaft 182 is carried by a bracket 186 that may be fixed to the track structure 161 or to the wall 16. In other respects, the construction shown in Figures 12 and 13 is substantially
80 the same as the structures illustrated in the previously described figures.

In all of the constructions shown the door operating screw shaft is a multi-threaded shaft, four threads being herein shown. It
85 has been demonstrated in practice that with a single thread shaft of the pitch required to give the proper travel to the door the threaded traveler, when passing from the threads of the shaft to the unthreaded sections of the
90 shaft, move so abruptly away from the threaded portion of the shaft as to tend to injure the door supports, as the hinges in a swinging door or the hangers in a sliding
95 door. In other words, the action of the travelers leaving the screw shafts of a single threaded shaft is a whip action, while with the multi-thread shown herein the action is smooth and without jar. The multi-thread is also advantageous inasmuch as the door
cannot be opened by force applied to the door, the door becoming self locking.

The multi-threaded shaft and carrier has the further advantage, when used in connection with the disconnecting device between
105 the carrier and shaft, including the plain sections of the shafts and compression springs on them, in that the threads of the carrier take in to the threads of the shaft more quickly and with less abruptness than
110 would be true with a single thread shaft and carrier.

It will, of course, be understood that my improvements may be applied to a single
115 sliding or a single swinging door by means which will be obvious from the foregoing description, taken in connection with the drawings, and that it is not necessary to illustrate the adaptation of the operating device to single swinging and sliding doors.
120

Furthermore, as before stated, the essential principles of the invention may be applied to doors or other closures which open
and close by other than horizontal movements. Furthermore, other means may be
125 applied to close the motor circuit at a control station or stations, as, for instance, a push button control, with or without relays. The invention is not intended to be limited, therefore, to the structural details shown,
130

except as to claims wherein such details are specifically set forth and as imposed by the prior art.

I claim as my invention:

5 1. A door operating mechanism comprising, in combination, a door, a screw shaft, a reversible motor for rotating said shaft, a traveler adapted for connection to the door and threaded on said shaft, means controlled
10 by a part which travels with the door for opening the motor circuit and for arresting the door at both limits of the door movement, and a manually operable emergency device normally disconnected from the shaft
15 and constructed with means to automatically connect it to and disconnect it from the said shaft to rotate the latter.

2. A door operating mechanism comprising, in combination, a door, supporting
20 means therefor during opening and closing movement thereof, a screw shaft, a motor to rotate the shaft in opposite directions, a traveler operatively connected to the door and threaded on said shaft, means controlled by a part which travels with the door
25 for opening the motor circuit and arresting the door at both limits of the door movement, said shaft being provided at both ends with unthreaded sections over which the traveler passes comprising means at the unthreaded sections of the shaft against which the traveler moves at each limit of the door movement, and a manually operated emergency device normally disconnected from
30 and adapted to be automatically connected to and disconnected from said shaft to operate the latter.

3. A door operating mechanism, in combination, a door, supporting means therefor
40 during opening and closing movement thereof, a multi-threaded screw shaft, a motor to rotate the shaft in opposite directions, a multi-threaded traveler operatively connected to the door and threaded on said shaft, means controlled by a part which travels
45 with the door for opening the motor circuit and arresting the door at both limits of the door movement, said shaft being provided at both ends with unthreaded sections over which the traveler passes comprising compression means at the unthreaded sections of the shaft against which the traveler moves at each limit of the door movement, and a manually operated emergency device normally
50 disconnected from and adapted to be automatically connected to and disconnected from said shaft to operate the latter, said compression means comprising spiral springs which surround the unthreaded sections of the shaft and of a length to be engaged by the traveler before it leaves the multi-threads of said shaft.

4. A door opening mechanism comprising, in combination with a reversible motor,
65 a screw shaft, operative connections be-

tween the motor and shaft to drive the latter, a feed circuit for the motor, a double throw switch for controlling said circuit comprising a connection, embracing a normally stationary, spring-held actuating and door position
70 indicating device having a manual control for closing the switch, means traveling with the door and cooperating with the switch connection for actuating said switch to open it at both limits of the door movement, and
75 means operative at the limits of the door movement for operatively disconnecting the screw shaft from the door.

5. A door operating mechanism comprising, in combination with a reversible motor, a screw shaft, operative connections between the motor and shaft to drive the latter, a traveler adapted for connection to the door and threaded on said shaft, a feed circuit for the motor, a double throw switch for controlling said circuit, means traveling with the door for operating said switch, embracing connections extending from said switch to a control station, with spring-held manual means at said station acting through said
80 connections to control said switch and to indicate the positions of the door, and means operative at the limits of the door movement for disconnecting the motor from the door, embracing unthreaded portions of the shaft
85 over which the traveler passes, and spring means for establishing connection between the threads of the traveler and shaft through rotation of said shaft.

6. A door operating mechanism comprising, in combination, a reversible motor, a screw shaft, operative connections between the motor and shaft to drive the latter, operative connections between the door and shaft, a feed circuit for the motor, a double throw
100 switch for controlling said circuit, embracing an oscillating operating member and fixed terminals, a cable operatively connected to said oscillating member, a rocking, hand actuated drum at a control station about which the cable is trained, a controlling lever therefor, spring held at its two extremes and neutral position and means carried by and movable with the door and cooperating with the cable at both limits of
105 movement of the door to open said switch and shift said controlling lever to neutral position.

7. Door operating mechanism comprising, in combination, two doors movable toward and from each other, a right and left hand threaded shaft adapted to be rotated in opposite directions, bearings for the ends and central portion of said shaft, respectively, travelers adapted to be connected to the doors and threaded on said shaft, and means at both ends and at the central portion of said shaft adapted to coact with parts which travel with the doors to effect disconnection of the doors from the shaft
120
125
130

through one direction of rotation of the shaft and to effect connection of the shaft with the doors through the opposite direction of rotation of the shaft.

8. Door operating mechanism comprising, in combination, two doors movable towards and from each other, a right and left hand threaded shaft, a reversible driving motor therefor and its operating switch, bearings for the ends and central portion of said shaft, respectively, travelers adapted to be connected to the doors and threaded on said shaft, means at both ends and at the central portion of said shaft adapted to coact with parts which travel with the doors to effect disconnection of the doors from the shaft through one direction of rotation of the shaft and for effecting connection of the shaft with the doors through the opposite direction of rotation of the shaft, and means traveling with one of the doors and operative at the opening and closing positions of the doors for controlling the starting switch.

9. A door operating mechanism comprising, in combination with a reversible motor a screw shaft adapted to be rotated in opposite directions, operative connections between the motor and shaft to drive the latter, a traveler adapted for connection to the door and threaded on said shaft, and manual automatically operable means normally disconnected from said shaft and adapted to be connected to the shaft for rotating the latter.

10. A door operating mechanism comprising, in combination, a reversible motor, a screw shaft adapted to be rotated in opposite directions, operative connections between the motor and shaft to drive the latter, a traveler adapted for connection to the door and threaded on said shaft, and manually operable means normally disconnected from said shaft and adapted to be automatically connected to and disconnected from the shaft for rotating the latter.

11. A door operating mechanism comprising, in combination with a reversible motor, a screw shaft, operative connections between the motor and shaft to drive the latter, a traveler adapted for connection to the door and threaded on said shaft, means controlled by a part which travels with the door for stopping rotation of the shaft at both limits of the door movement, a pulley normally loose on one end of said shaft, a flexible member trained over said pulley to rotate the same, and a clutch for connecting said pulley to the shaft, operative through rotation of the pulley.

12. A door operating mechanism comprising, in combination with a reversible motor, a screw shaft, operative connections between the motor and shaft to drive the latter, a traveler adapted for connection to the door and threaded on said shaft, means controlled

by a part which travels with the door for stopping rotation of the shaft at both limits of the door movement, a pulley normally loose on one end of said shaft, a flexible member trained over said pulley to rotate the same, and a clutch for connecting said pulley to the shaft embracing co-acting clutch elements fixed to the shaft and said pulley, the supporting member for the pulley being provided with a cam groove and a pawl carried by the pulley engaging said cam groove.

13. A door operating mechanism comprising, in combination with a reversible motor, a screw shaft, operative connections between the motor and shaft to drive the latter, a traveler adapted for connection to the door and threaded on said shaft, means controlled by a part which travels with the door for stopping rotation of the shaft at both limits of the door movement, a pulley normally loose on one end of said shaft, a flexible member trained over said pulley to rotate the same, and a clutch for connecting said pulley to the shaft embracing co-acting clutch elements fixed to the shaft and said pulley, the supporting member for the pulley being provided with a V-shaped groove and a spring held pawl carried by the pulley for engagement with said groove.

14. The combination with a door, a rotative shaft, operative connections between said shaft and the door to open and close the latter through rotation of the shaft, a driving member normally loose on said shaft, a flexible member trained over said driving member to rotate the same, and means for connecting said driving member to the shaft, operative through rotation of the driving member.

15. The combination with a door, a screw shaft, a traveler connected to the door and threaded to the shaft to open and close the door, a driving member normally loose on said shaft, means whereby the driving member may be rotated, and means for connecting the driving member to the shaft, operative through rotation of the driving member.

16. A door operating mechanism comprising, in combination, a threaded operating shaft, a door hanger, a carriage therefor having rollers at the sides of the hanger, laterally spaced tracks on which the said rollers travel, and a traveler extending upwardly from the carriage between the planes of said rollers and threaded on the shaft, said tracks being formed on the lower margins of a housing which continues upwardly at the sides of said carriage and traveler and around said shaft to enclose said parts.

17. A door operating mechanism comprising, in combination, a threaded operating shaft, a door hanger, a carriage therefor having laterally spaced rollers, a housing having means to attach it to the side of a

door frame about the door opening, in which said shaft is enclosed, said housing being closed at its top and open at its bottom, and provided at the lower margins of its side walls with inwardly directed tracks for the carriage rollers, and a traveler within the housing between said rollers extending upwardly from said carriage and threaded to said shaft.

5 In testimony whereof I claim the foregoing as my invention, I hereunto append my signature at Chicago, Illinois, this 31st day of May, 1918.

10

PAUL H. LACEY.