

Aug. 28, 1928.

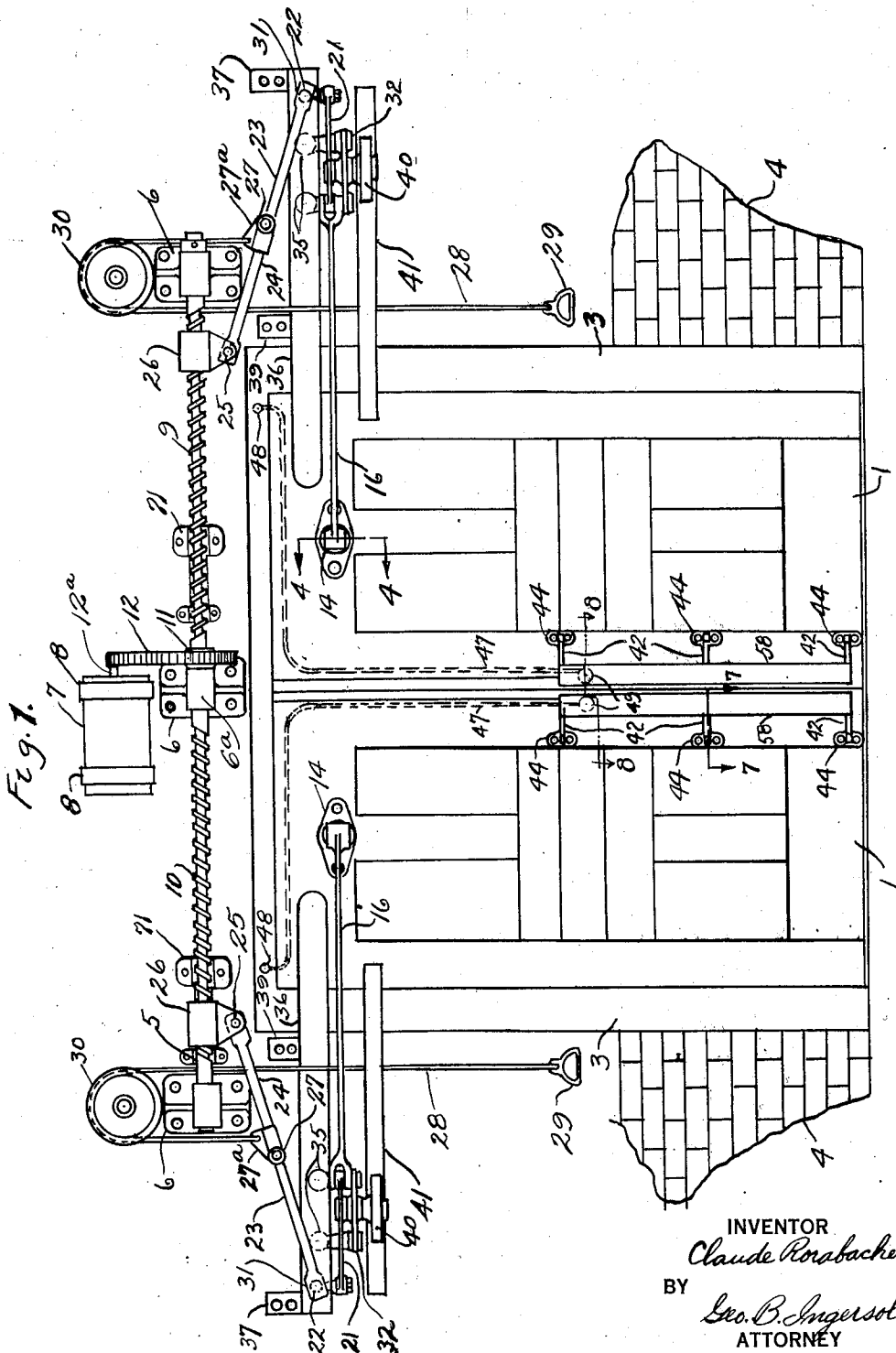
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C. RORABACHER

AUTOMATIC ELECTRICALLY OPERATED DOOR

Filed July 15, 1925

3 Sheets-Sheet 1



Aug. 28, 1928.

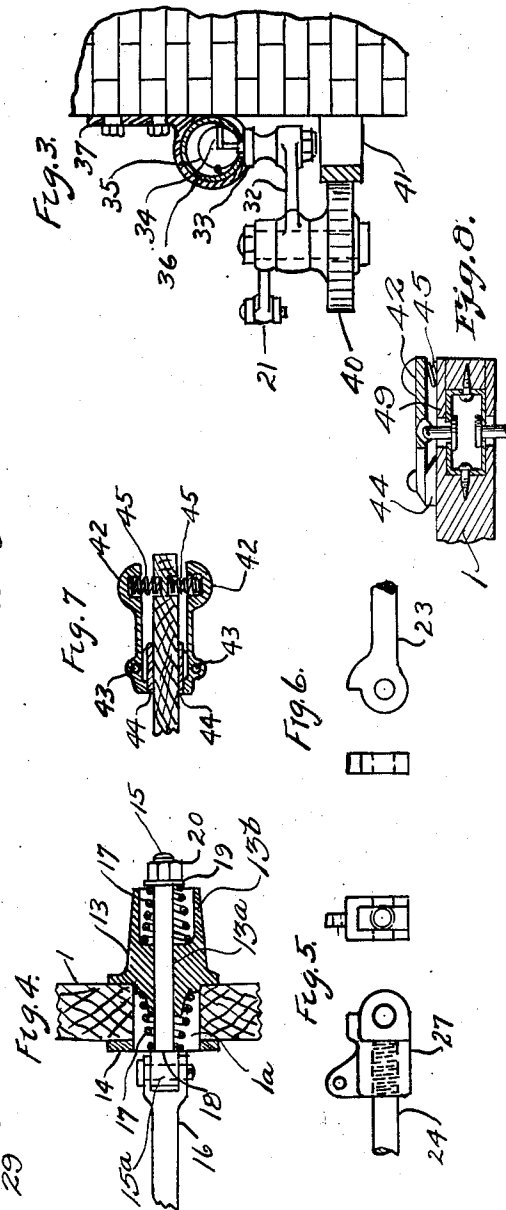
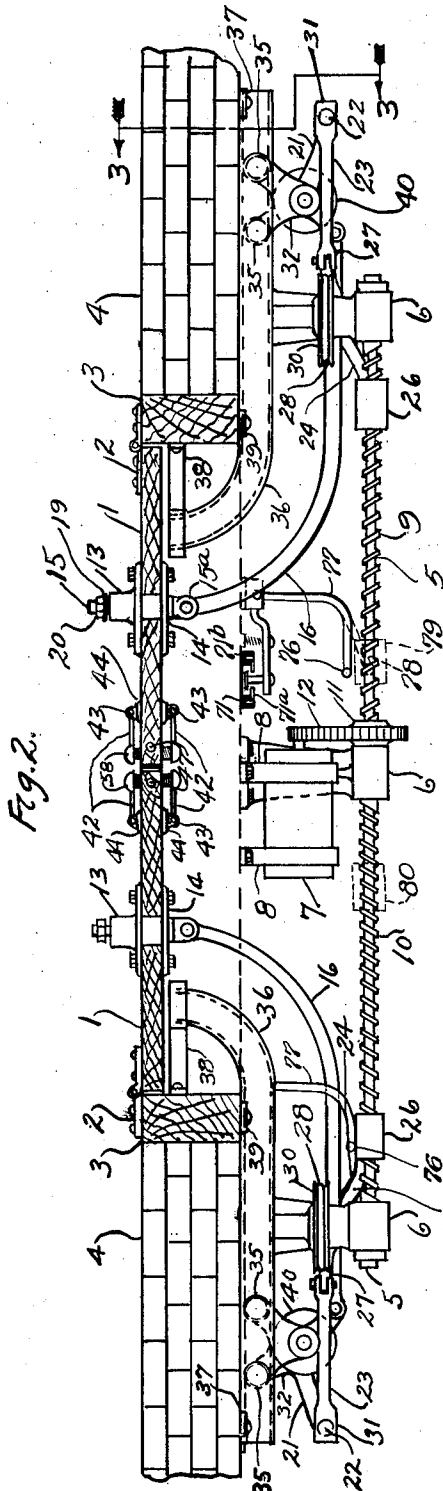
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AUTOMATIC ELECTRICALLY OPERATED DOOR

Filed July 15, 1925

3 Sheets-Sheet 2



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Aug. 28, 1928.

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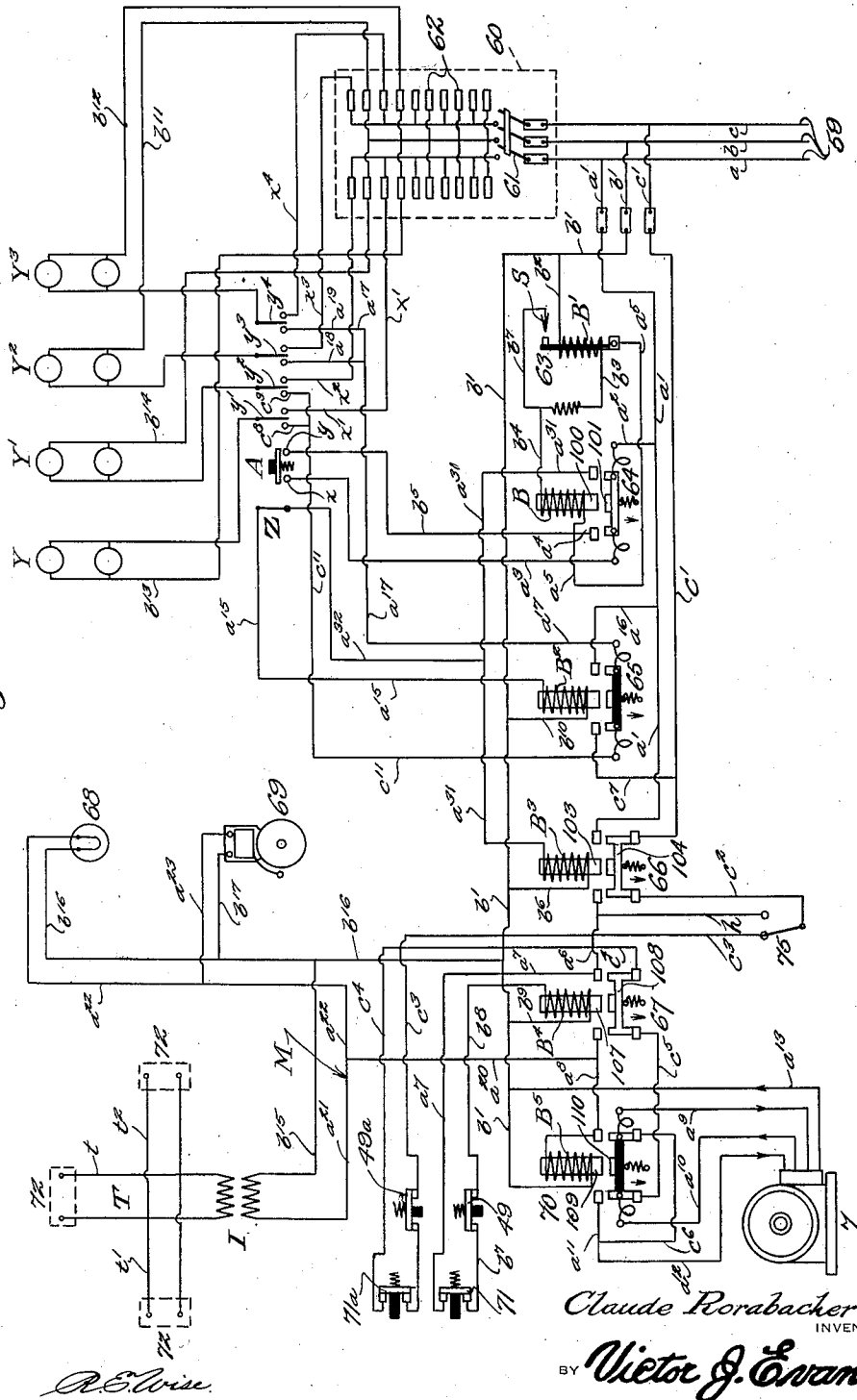
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AUTOMATIC ELECTRICALLY OPERATED DOOR

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Fig. 9.



WITNESS:

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UNITED STATES PATENT OFFICE.

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AUTOMATIC ELECTRICALLY-OPERATED DOOR.

Application filed July 15, 1925. Serial No. 43,840.

My invention relates to improvements in doors which in their operation are automatically and electrically controlled. The objects of my improvement are, first, to provide a door that will automatically open by merely operating an electrical switch; second, to provide for the automatic closing of the door after having remained in an open position for a predetermined length of time; third, to provide an automatically operated door with an electrical safety device; and, fourth, to provide an automatically operated door with an alternative manual control for emergency use.

I attain these objects by the mechanism illustrated in the accompanying drawings, in which:

Figure 1 is a front view of the door and its operating mechanism.

Figure 2 is a plan view of the door and its operating mechanism.

Figure 3 is an enlarged vertical section on the line 3—3 of Figure 2.

Figure 4 is an enlarged sectional view on the line 4—4 of Figure 1.

Figure 5 is an enlarged view of the upper drag link.

Figure 6 is an enlarged view of the lower drag link.

Figure 7 is an enlarged sectional view on the line 7—7 of Figure 1, showing the relation of the safety switch to the buffer mechanism and of the buffer mechanism to the door.

Figure 8 is a view similar to Figure 7 on a somewhat enlarged scale and on the line 8—8 of Figure 1, showing the relation of buffers to the switch controlling the movement of the door when striking an object, the buffer and switch on one side of the door being omitted.

Figure 9 is a diagrammatic view of the electric circuit and connections for controlling the operative mechanism.

Similar numerals refer to similar parts throughout the several views.

The door 1 is of the fire engine house type and is supported by the hinge 2 suitably fastened to the casing 3 set in the brick foundation 4. 6 designates brackets which are suitably secured to the wall 4 above the doors and are provided with bearings 6^a in which the worm shaft 5 is journaled. Above the worm shaft 5 is an electric motor 7, preferably of the impulsion starting and induc-

tion running type, which is supported in brackets 8 also suitably fastened to the brick wall 4. The worm shaft 5 has a right hand thread 9 at one end and a left hand thread 10 at the opposite end and a sprocket 11 secured thereto close to the center bracket 6, said sprocket being driven by a chain 12 trained about the sprocket 11 and a sprocket on a shaft 12^a of the electric motor 7.

The doors 1 are provided with brackets 13 suitably fastened to the outside and with bracket 14 fastened to the inside thereof. The bracket 13 is frusto-conical in shape having a central bore 13^a provided with a counter-sunk portion 13^b at its outer end, forming a socket in which a plunger rod 15 operates, the rod having sliding connection with the bore 13^a. The action of the plunger is cushioned in both inward and outward movements thereof by helical springs 17, one of which rests in the socket 13^b, the other being housed in a hole 1^a in the door, said springs having their opposite ends respectively resting against shoulders on the member 13 and against shoulders 18 and 19 on the ends of the rod 15, the latter consisting of a washer held by a nut 20 on the outer end of the plunger 15. In this manner the shock due both to opening and closing of the door is broken. The plunger 15 has an eye 15^a at its inner end to which is attached the bent end of an arm 16, the opposite end being attached to one arm of a bell crank lever 21. A drag member comprising links 23 and 24 is provided, the lower link 23 being pivotally secured to one arm of the bell crank lever 21 by means of a ball stud 22. The drag link 23 at its ball end is of the type generally used in the steering drag links of automotive vehicles and contains a spring mounted ball seat which is not shown in my drawings. The upper drag link 24 is fastened at its upper end to another ball stud 25 which is suitably fastened to a threaded nut 26 which travels lengthwise of the worm shaft 5 when the latter is revolving. The upper drag link 24 and the lower drag link 23 are connected to a point approximately midway between the ball studs 22 and 25 by a joint 27, adjacent which is a bracket 27^a to which a cable 28 having a handle 29 is secured, the said cable 28 operating over a pulley 30 journaled in a suitable bracket above the door. This is for use only when the automatic mechanism is for

any reason out of service. It is to be understood that in such an event the driving chain 12 may be disconnected from its sprockets. Also the position of the pulley 30 and the ball stud 22 must be suitably located relative to each door installation so they will permit the lower end 31 of the lower drag link 23 to swing clear of the ball stud 22 and also the cable 28 to exert an advantageous pull on the threaded nut 26 through the upper drag link 24. It should be noted also that the joint 27 will permit of a direct pull or push lengthwise of the upper and lower drag links 23 and 24, and at the same time will permit the cable 28 to break the joint to allow for misalignment in manually closing the doors by means of the cable 28 after the doors have been manually opened in the usual way.

The bell crank 21 is suitably mounted to oscillate on a double arm bracket 32 which has a ball stud 33 on each arm provided with a ball retainer 34 on each ball stud 33 and in which is carried a ball 35 which rolls within a tubular guide 36 suitably fastened to the foundation brick 4 by brackets 37, 38 and 39. To keep the ball 35 from binding in its raceway within the tubular guide 36, a roller 40 is rotatably mounted on a stud or shaft suitably supported from the double arm bracket 32, the said roller bearing against a guide bar 41 which is fastened on the foundation brick 4 below the tubular guide 36. It is to be noted that the guide bar 41, tubular guide 40, and the bent arm 16 are all curved from the inside of the foundation brick 4 to the inside of the door 1, the amount of the curvature being dependent on the individual door installation.

In order to prevent any injury to the door operating mechanism should the door strike an object in its swinging travel outward, or any injury to the object itself, it is of great importance that the door be provided with a safety device. In the present embodiment this takes the form of levers 42 which are mounted on shafts 43 in a bracket 44 in such a manner as to swing inwardly toward the door 1 from the position as shown in Figure 2 and Figure 7, the levers 42 being retained in the said position by springs 45 until an object is struck, when the springs 45 will compress, thus allowing the levers to swing inwardly toward the door 1. Within the door itself are installed electrical conductors 47, connection between which is made by switches 49, the connections being broken when the levers 42 are forced inwardly by striking an object (see Figure 7). The wires 47 extend to a point such as 48, where a connection may be made to a fixed point on the building itself, the conductors being connected with a controlling switch. The safety switches 49 are placed on the stile of the door 1 and are operated by the levers 42,

thereby stopping the door 1 upon its striking an object when opening, in a manner which will be hereinafter described, and stopping the door upon its striking an object in closing. The doors when opened by the electrical control hereinafter described will remain stationary for a predetermined length of time, say two minutes, and will then start closing again and will repeat this operation whenever any object is struck during its travel.

A bar 58 connects the levers 42 and forms a bumper for each side of each door and actuates the levers 42 when contact is made with any object in the path of the opening door 1. It is to be noted that the levers 42 may be made of any desired length and the bar 58 may be made of any desired size to provide complete protection to any desired area of the doors 1.

In Figure 9 is shown a diagrammatic view of the electrical wiring system and various electrical units employed to open, close and control the door 1.

The wires 59 represent the main service cables which may supply all light and power to any building and are connected with the distributing cabinet 60 and the fuses 62. To these wires 59, which may be designated in the order of their potentials as *a*, *c* and *b*, *b* being that of lowest potential, are connected lead in wires *a'* and *c'* and return *b'*, comprising a system for operating the doors 1 and including electromagnetically controlled switches 64, 65, 66, 67 and 70; limit opening and limit closing switches 71 and 71^a; buffer safety switch 49 and 49^a, visible and audible signals 68 and 69'; a "master circuit" including a non-locking push switch A, switch 64 and a thermostatic control switch 63, made up of a plurality of layers of metal having differing coefficients of expansion; a light relay cutout circuit controlled by a switch Z; and a trap operating system T. The electromagnetic switches 64, 65, 66, 67 and 70 may be known as "relay switches" and will be so called hereinafter. The relay 64 may be known as the "master" relay; relay 65 as the "light" relay; relays 66 and 67 as the "two circuit" relays; and relay 70 as the "pole changing" relay.

The thermostatic time control switch 63 determines the length of time that the doors 1 may remain open and may be adjusted to any time length from two to twenty minutes. This time control is very important, particularly in fire engine house installations, in that it allows the firemen to leave without closing the doors 1, the doors 1 automatically closing after the predetermined length of time has elapsed, as will hereinafter appear.

The relay 64 is energized by either a manually operated non-locking push switch A or an electrically operated switch and when so energized closes the circuit to the light con-

trolling relay or contactor 65 which controls and operates all the lights used for this emergency arrangement. It is to be noted that this is a very important control in that in case of fire engine house service it will immediately turn on all lights by the switch energizing the relay 64 and then will turn them out again after a predetermined and controlled length of time has elapsed.

The two circuit relay 66 is controlled by the relay 64 and is used to open and close controlling automatic door contactors.

The two circuit relay 67 is used to operate the signal light or electric sign 68 and the audible signal 69 which are to be used to warn of the possible danger from the automatic opening of the door 1. The audible signal 69 may be a gong, bell, or similar device. In fire engine house installations this will also be used to operate the trap door (not shown) through which the firemen pass to the lower floors.

The relay 67 also operates another two circuit relay or contactor 70 which is used as a pole changer. The switch 71 is of the limit control type and is used to open and close the circuit for controlling the action of the motor shaft.

In opening the door electrically the operation is as follows: Switch A, which may be in the nature of a non-locking push switch, is manually pressed into contact with the contact points x and y closing a circuit through conductors a' , and a^2 , armature 101, a^3 (a' being connected with a source of electric energy as line wire a), and b^5 , through the electromagnetic coil B of the switch 64, conductors b^4 , b^3 , through thermostatic switch coil B', conductors b^2 and b' , back to the line return b . The closing of this circuit, which I choose to call the "master circuit," energizes the magnet 100, drawing the armature 101 upward and forming a circuit through conductors a , a' , a^2 , a^{31} , solenoid B³, conductors b^6 , b' and b ; while at the same time starting operation of the thermostatic coil B'. The switch 64 is held closed by current passing through conductors a' , a^2 , 101, a^4 , coil B, and conductors b^4 , b^3 and b until the coil B is shunted out by the thermostatic control, as will later appear.

In the meantime armature 104 of switch 66 is drawn up by an electromagnet 103 forming a circuit through conductors a , a' , armature 104, conductors a^6 , a^7 , through the opening limit switch 71, conductor b^7 , buffer safety switch 49, conductors b^8 , solenoid B⁴, conductors b^9 , b' and b , actuating electromagnet 107 and causing armature 108 to be drawn up forming a circuit through conductors a , a' , armature 104, conductor a^6 , armature 108, conductor a^8 , solenoid B⁵ of switch 70, known as the pole changing switch, and conductors b' and b , causing the magnet 109 to draw armature 110 upward,

closing a circuit through a , a' , 104, a^6 , 108, a^8 , a^9 , motor 7, a^{10} , a^{11} , a^{12} , motor 7, a^{13} , b' and b , opening the doors.

When the switch 64 is closed in addition to operating the above described mechanism for closing the doors, a circuit will be formed through a , a' , a^2 , a^{31} , a^{32} , cutout switch Z, a^{15} , solenoid B² of switch 65, and conductors b^{10} , b' , b , which closes switch 65, throwing into circuit lights Y² and Y³ through a circuit a , a' , a^{16} , a^{17} , branches a^{18} and a^{19} and returns b^{11} and b^{12} and b . Similarly, lights Y and Y' are thrown into circuit through c , c' , c^7 , c^{11} and branches c^8 and c^9 , and returns b^{13} and b^{14} . These lights will remain on until the circuit through armature 101 is broken by the de-energizing of coil B, as will be hereinafter described.

When switch 67 has been closed current will flow through conductor a^{20} to the trap and signal system M consisting of branches a^{21} and a^{22} leading respectively to the trap controlling induction coil I and to the visible signal 68, the audible signal 69 being located on a branch a^{23} of the latter. From each of these elements the respective leads b^{15} , b^{16} and b^{17} form returns, b^{15} and b^{17} connecting with b^{16} which in turn connects with b' leading to b of the line wires. The traps 72 are connected in the branch circuits t , t' , t^2 and are operable simultaneously with the signal.

When the motor 7 is actuated in the door opening operation described above, the nuts 26 will travel toward the center of the worm shaft 5, pushing the doors 1 open through the arms 16 connected therewith through the bell crank 21 and drag link 23. Should the door strike an object the levers 42 will be moved inward against the influence of springs 45, opening the switch 49 and stopping the door in its movement, opening switches 70 and 67 and stopping the motor 7 and, in consequence, the operation of the doors. The doors are provided with similar switches and levers on their inner face which operate in the same manner should the door strike an object in closing. When the doors have opened to their extreme limit, switch 71 will be opened by the striking of nut 26 against an arm of the lever 77 on which the switch is mounted, the switch being held against the contact 71^a by means of spring 71^b.

After the doors have remained open for the predetermined time for which the thermostatic control switch 63 has been adjusted, the switch 63 contacts with point S, forming a circuit through a , a' , a^2 , 101, a^4 , a^5 , time switch 63, S, b^7 , b^8 , B', b^2 , b' , b , shunting the solenoid B out of circuit and opening the switch 64, which results in the opening of switches 65 and 66, 67, 70. Current flows now through circuit c , c' , armature 104, c^2 , switch 75, when set as shown, c^3 , buffer

switch 49^a, "closing limit" switch 71^a, conductor c⁴, armature 108, conductor c⁵, a contact on 110, a¹⁰, through the motor 7 in reverse direction through another contact on 110, c⁸, a¹¹, a¹², through motor 7, as indicated by the arrows, a¹³, b⁷, b, operating the motor in a reverse direction and closing the doors. When the doors reach the closing limit, switch 71^a will open, breaking the circuit and stopping the motor.

When it is desired to open the doors independently of the master circuit, the switch 75 is moved from the contact at the end of conductor c³ to the contact at the end of conductor h, whereupon a circuit will be formed through c, c', 75, h, a⁶, a⁷, switch 71, b⁷, switch 49, conductor b⁸, coil B⁴, b⁹, b', b, closing switch 67 and 70 in the manner described above and actuating the motor in the door opening direction. When it is desired to turn the lights Y, Y', Y², Y³ on independently of the master circuit, as for night lighting, switches y', y², y³ and y⁴ are turned from contact with conductors c⁸, c⁹, a¹⁸, a¹⁹ to contact with conductors x', x², x³, x⁴, the switch 61 to the fuse box 62 remaining closed. The doors may be closed independently of the electrical means by means of the cable 28, as hereinbefore described.

It is readily apparent from my invention as shown and described that it is adapted for use in connection with a great many various kinds of door installations where automatic control coupled with safety are absolutely necessary.

It is also especially adapted for use in fire engine house installations and has been developed in this particular service.

I claim:

1. In a door operating mechanism, the combination of a door, an electric motor, a screw threaded shaft suitably mounted above the door, driving means connecting the said electric motor and the said screw threaded shaft, a threaded nut adapted to travel longitudinally on the said screw threaded shaft, a tubular guide suitably mounted adjacent the said door, the said tubular guide having a longitudinal slot, a plurality of balls adapted to roll within the said tubular guide, a ball retainer suitably mounted around each of the said balls, a depending stud suitably attached to the said ball retainer, the said depending stud extending through the longitudinal slot in the said tubular guide, a bracket suitably attached to the said depending studs, a stud suitably mounted in the said bracket, a roller suitably mounted on the said stud and adapted to rotate thereon, a guide bar suitably mounted adjacent the door, the said guide bar being adapted to contact with and form a track for the said roller, a bell crank suitably mounted on the said stud and adapted to oscillate thereon, ball studs suitably

mounted on the said threaded nut and said bell crank, a drag link mounted on the said ball studs and adapted to swivel thereon, a bearing bracket suitably attached to the said door, a shaft slidably mounted in the said bearing bracket, oppositely disposed springs suitably mounted on the said shaft, a connecting arm suitably attached to the said bell crank and the said shaft, slidably mounted, and means for automatically controlling the opening and closing of the door operating mechanism.

2. In an automatic electrically controlled door mechanism, the combination of a door, an electric motor, a screw threaded shaft suitably mounted above the door, driving means connecting the said electric motor and the said screw threaded shaft, a threaded nut adapted to travel longitudinally on the said screw threaded shaft, a tubular guide suitably mounted adjacent the said door, the said tubular guide having a longitudinal slot, a plurality of balls adapted to roll within the said tubular guide, a ball retainer suitably mounted around each of the said balls, a depending stud suitably attached to the said ball retainer, the said depending stud extending through the longitudinal slot in the said tubular guide, a bracket suitably attached to the said depending studs, a stud suitably mounted in the said bracket, a roller suitably mounted on the said stud and adapted to rotate thereon, a guide bar suitably mounted adjacent the door, the said guide bar being adapted to contact with and form a track for the said roller, a bell crank suitably mounted on the said stud and adapted to oscillate thereon, ball studs suitably mounted on the said threaded nut and said bell crank, a drag link mounted on the said ball studs and adapted to swivel thereon, a bearing bracket suitably attached to the said door, a shaft slidably mounted in the said bearing bracket oppositely disposed springs suitably mounted on the said shaft, a connecting arm suitably attached to the said bell crank and the said shaft, slidably mounted, means for automatically controlling the opening and closing of the door mechanism simultaneously, means for electrically controlling the said door in an open position for a predetermined length of time, and means for electrically operating the door closing mechanism.

3. In an automatic electrically controlled door, a plurality of brackets, suitably mounted on the said door, levers suitably mounted on the said brackets and adapted to oscillate thereon, the said levers having stops to provide for a maximum outward position, springs suitably mounted on the said door, and adapted to always force the said levers to the maximum outward position, bumper bars suitably mounted on the said levers, and an electrical safety switch

suitably mounted on the said door, the said electrical safety switch being connected with the electrically operated door mechanism, and adapted to be controlled by the movement of the said oscillating levers when the said oscillating levers are actuated by any object contacting with the said bumper bars mounted on the said levers.

4. In an electrically controlled door mechanism, the combination of a screw threaded shaft mounted, a threaded nut adapted to travel on the said screw threaded shaft, a tubular guide mounted adjacent the said door, the said tubular guide having a longitudinal slot, a plurality of balls adapted to roll within the said tubular guide, a ball retainer mounted around each of the said balls, a depending stud attached to the said ball retainer, the said depending stud extending through the longitudinal slot in the said tubular guide, a bracket attached to the said depending studs, a second stud mounted in the said bracket, a roller mounted on the said second stud and adapted to rotate thereon, a guide bar mounted adjacent the door, the said guide bar being adapted to contact with and form a track for the said roller, a bell crank mounted on the said second stud and adapted to oscillate thereon, a connecting arm, the said connecting arm being attached to the door and to the said bell crank, a ball-end stud mounted in the said bell crank, a ball-end stud mounted in the said threaded nut, an upper drag link mounted over the ball-end stud in the said threaded nut, a yoke mounted on the lower end of said upper drag link, a lower drag link pivotally mounted at its upper end, in the said yoke, and mounted at its lower end, on the said ball stud in the said bell crank, the said lower drag link having, at its upper end, a projecting lug, the said projecting lug being adapted to contact with the said yoke and thereby limit the downward pivotal movement of the said upper and lower drag links, a pulley mounted above the door, and a cable, the said cable, being connected to the said yoke and operating over the said pulley.

5. In a door operating mechanism, the combination of a tubular guide mounted on the frame of the door, the said tubular guide having a longitudinal slot, a plurality of balls adapted to roll within the said tubular guide, a ball retainer mounted around each of the said balls, a depending stud attached to the said ball retainer, the said depending studs extending through the longitudinal slot in the said tubular guide, a bracket suitably attached to the said depending studs, a second stud mounted in the said bracket, a roller mounted on the said second stud and adapted to rotate thereon, a guide bar mounted on the door frame, the said guide bar having a thrust surface adapted to contact with and form a track

for the said roller, a bell crank mounted on the said second stud and adapted to oscillate thereon, means for connecting the said bell crank to the door, driving mechanism for the doors and means for connecting the said bell crank to the driving mechanism.

6. In an electrically controlled door mechanism, the combination of a door, a screw threaded shaft suitably mounted above the door, a threaded nut adapted to travel longitudinally on the said screw threaded shaft, means for connecting the said threaded nut to the said door, the said means utilizing the longitudinal travel of the said threaded nut to open and close the said door, an electric motor operatively connected with the said threaded shaft, a double pole reversing contactor with front and back contacts, the said double pole reversing contactor being electrically connected to the said motor, a plurality of single pole contactors with front and back contacts, the said single pole contactors being electrically connected to the said double pole reversing contactor a warning signal, the said warning signal being electrically connected to one of the said plurality of single pole contactors, a single pole switch located adjacent the said screw threaded shaft and having a lever arm adapted to contact with and be operated by the said threaded nut, the said single pole switch being electrically connected to the said single pole contactors, a single pole contactor having front and back contacts and being electrically connected to the said single pole switch located adjacent the said screw threaded shaft, a single pole contactor, having front contacts only, and being electrically connected to one of the said single pole contactors having front and back contacts, a push switch electrically connected to the said single pole contactor having front contacts only, a thermostatic time control switch, the said thermostatic switch being electrically connected to the single pole contactor having front contacts only, a thermostatic time control switch, the said thermostatic switch being electrically connected to the single pole contactor having front contacts only, and a push switch located on the said door, the said push switch being electrically connected to and capable of cutting off the electrical current to one of the plurality of single pole contactors which are connected to the said double pole reversing contactor.

7. In an electrically controlled door mechanism, the combination of a door, a screw threaded shaft suitably mounted above the door, a threaded nut adapted to travel longitudinally on the said screw threaded shaft, means for connecting the said threaded nut to the said door, the said means utilizing the longitudinal travel of the said threaded nut

to open and close the said door, an electric motor operatively connected with the said threaded shaft, a double pole reversing contactor with front and back contacts, the said double pole reversing contactor being electrically connected to the said motor, a single pole contactor with front and back contacts, the said single pole contactor being electrically connected to the said double pole reversing contactor, safety switches located in the said door, oscillating levers suitably mounted on the said door, the said oscillating levers being used to open and close the said safety switches, a single pole switch located adjacent the said screw threaded shaft and having a lever arm adapted to contact with and be operated by the said threaded nut, a single pole contactor with front and back contacts, the said single pole contactor being electrically connected to the said safety switches on the said door, the said single pole switch adjacent the said screw threaded shaft and the said single pole contactor which is connected to the said double pole reversing switch, a thermostatic time control switch, the said thermostatic switch being electrically connected to the said safety switches in the said door, and a plurality of single pole contactors with front contacts only, the said single pole contactors being electrically connected in series between the said thermostatic switch and the said single pole switch adjacent the said screw threaded shaft.

8. In an automatically controlled electrically operated door, a motor for operating said door, buffers mounted on opposite sides of said door, electric switches on said

door, in circuit with said motor and operable to stop said motor when said buffers strike an object.

9. In combination with a door, a system of conductors, a motor for operating said door in circuit with said conductors, a polarity reversing switch in said circuit, a master circuit including an electromagnetic controlled switch controlling said reversing switch, and a thermostatic time control switch in said master circuit.

10. In combination with a door, electrical means for opening and closing said door comprising a motor, conductors in circuit with said motor, a control for said circuit comprising an automatically electrically operated switch and a manually operable switch in circuit therewith, a plurality of electrically operable switches in circuit with the motor for controlling the direction of flow of the current through said motor, and means operably connecting the motor with said door.

11. In combination with a door, electric means for operating said door, a circuit including said means, means in said circuit for reversing the operation of said means, and thermostatic time controlled means for controlling the reversing of said reversing means.

12. In an electric circuit, a door opening and closing means, a plurality of electromagnetic switches in said circuit for controlling the flow of current through the opening and closing means, and means for timing the closing relative to the opening of said door.

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