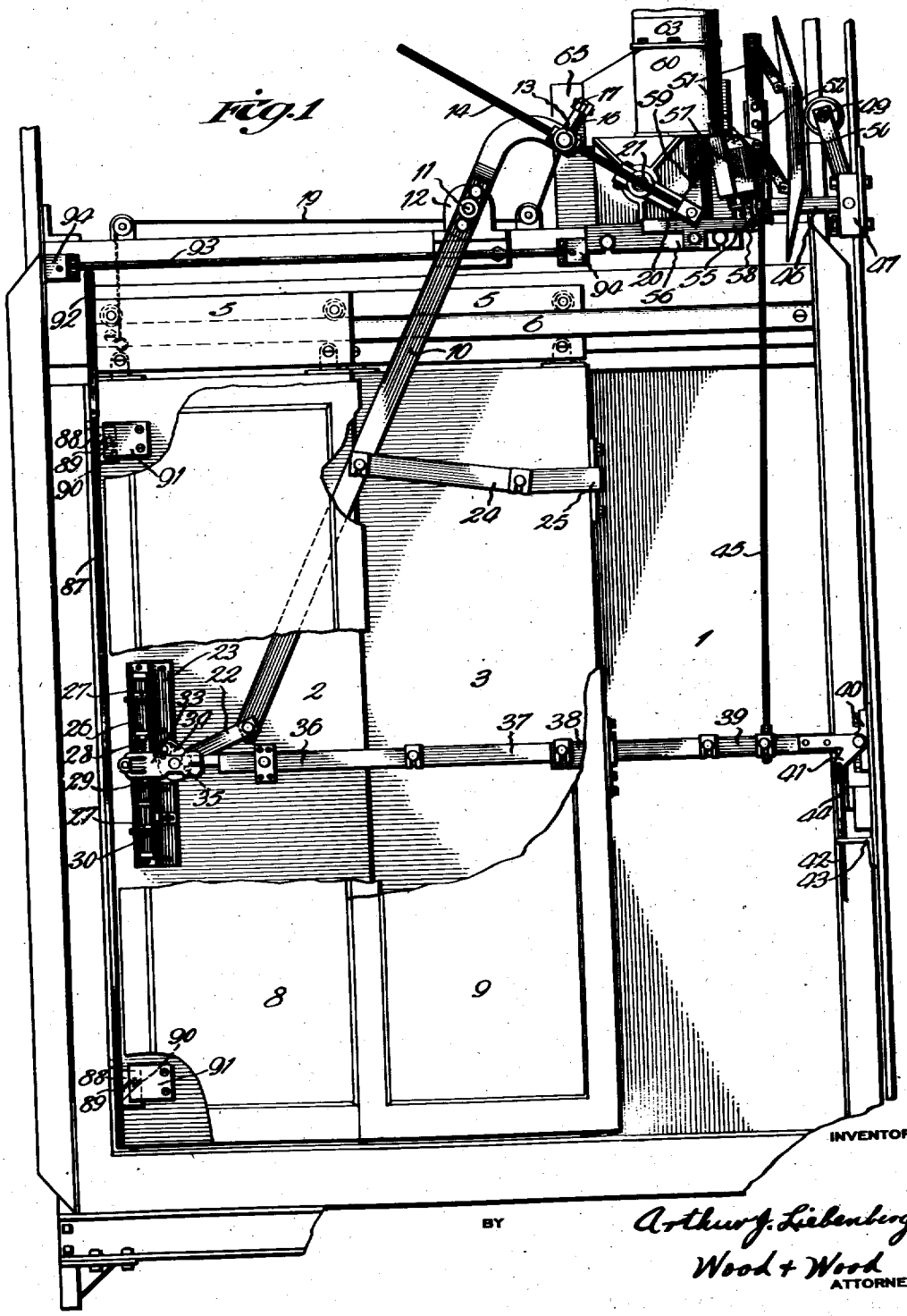
Oct. 29, 1935. A. J. LIEBENBERG 2,019,456

POWER OPERATED ELEVATOR DOOR

Filed Feb. 13, 1934 6 Sheets-Sheet 1

Fig. 1



INVENTOR

BY Arthur J. Liebenberg

Wood + Wood

ATTORNEYS

Oct. 29, 1935. A. J. LIEBENBERG 2,019,456

POWER OPERATED ELEVATOR DOOR

Filed Feb. 13, 1934 6 Sheets-Sheet 2

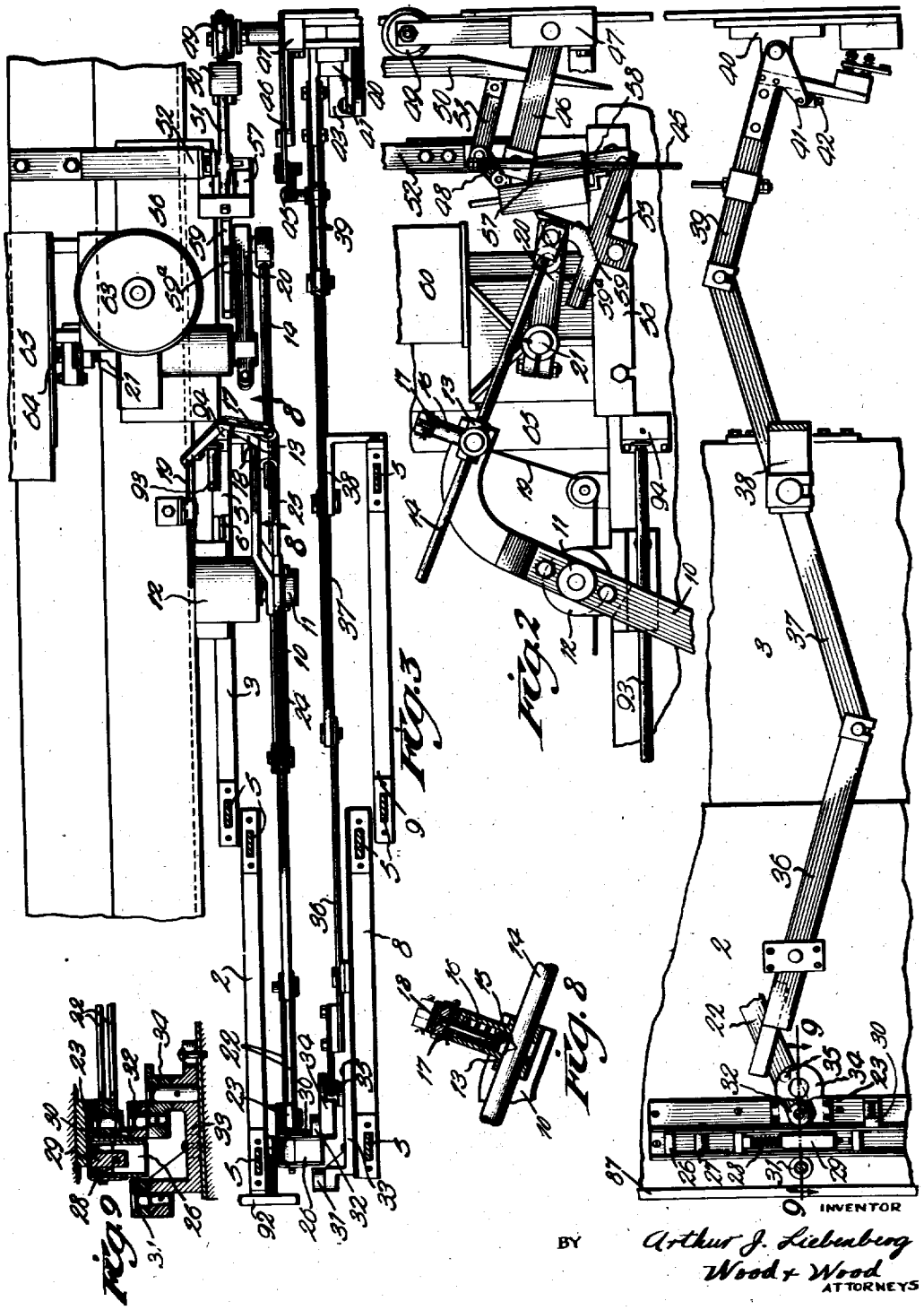


Fig. 3

Fig. 2

Fig. 8

Fig. 9

INVENTOR

BY Arthur J. Liebenberg

Wood & Wood

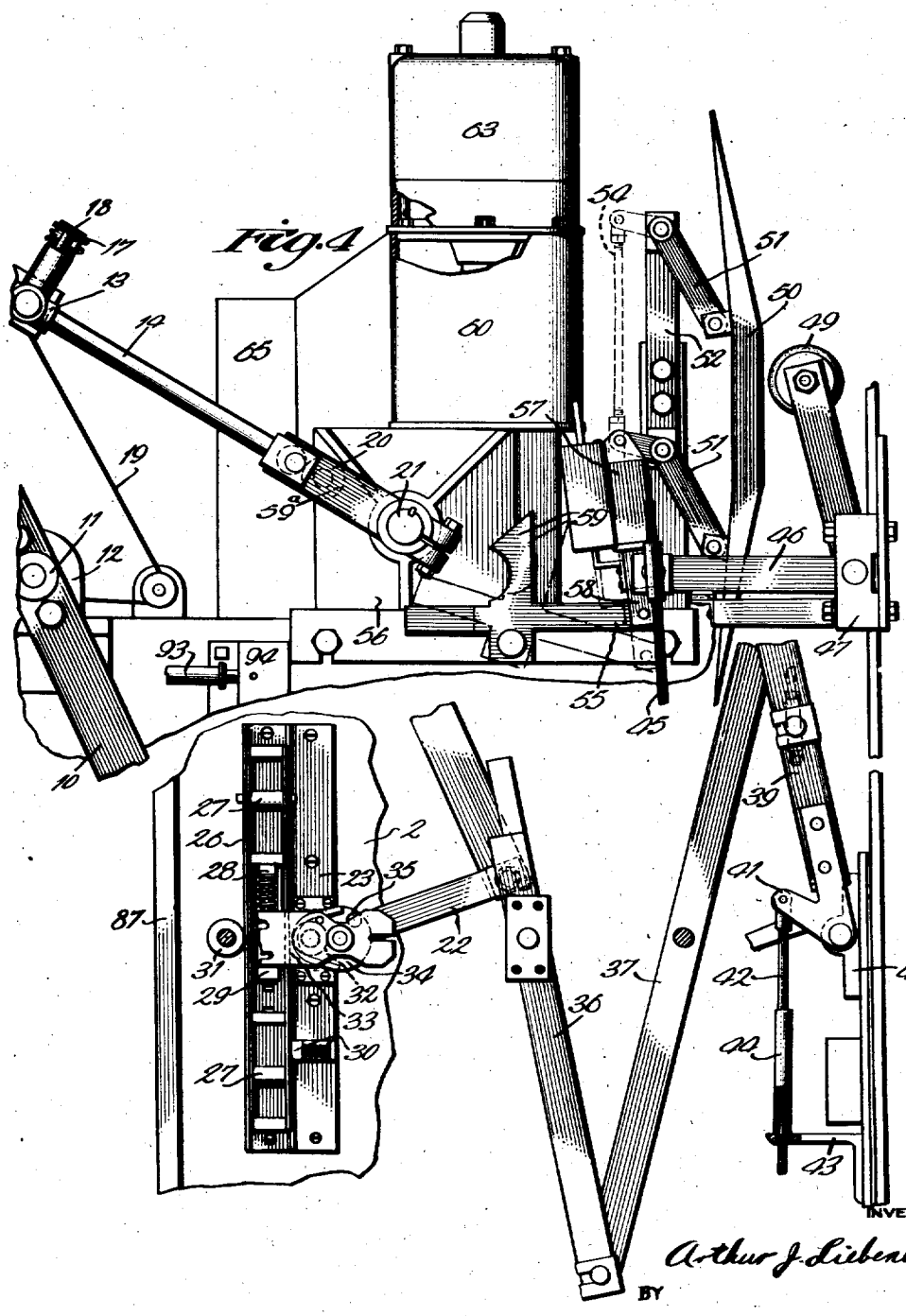
ATTORNEYS

Oct. 29, 1935. A. J. LIEBENBERG 2,019,456

POWER OPERATED ELEVATOR DOOR

Filed Feb. 13, 1934 6 Sheets-Sheet 3

Fig. 1



INVENTOR

Arthur J. Liebenberg

BY

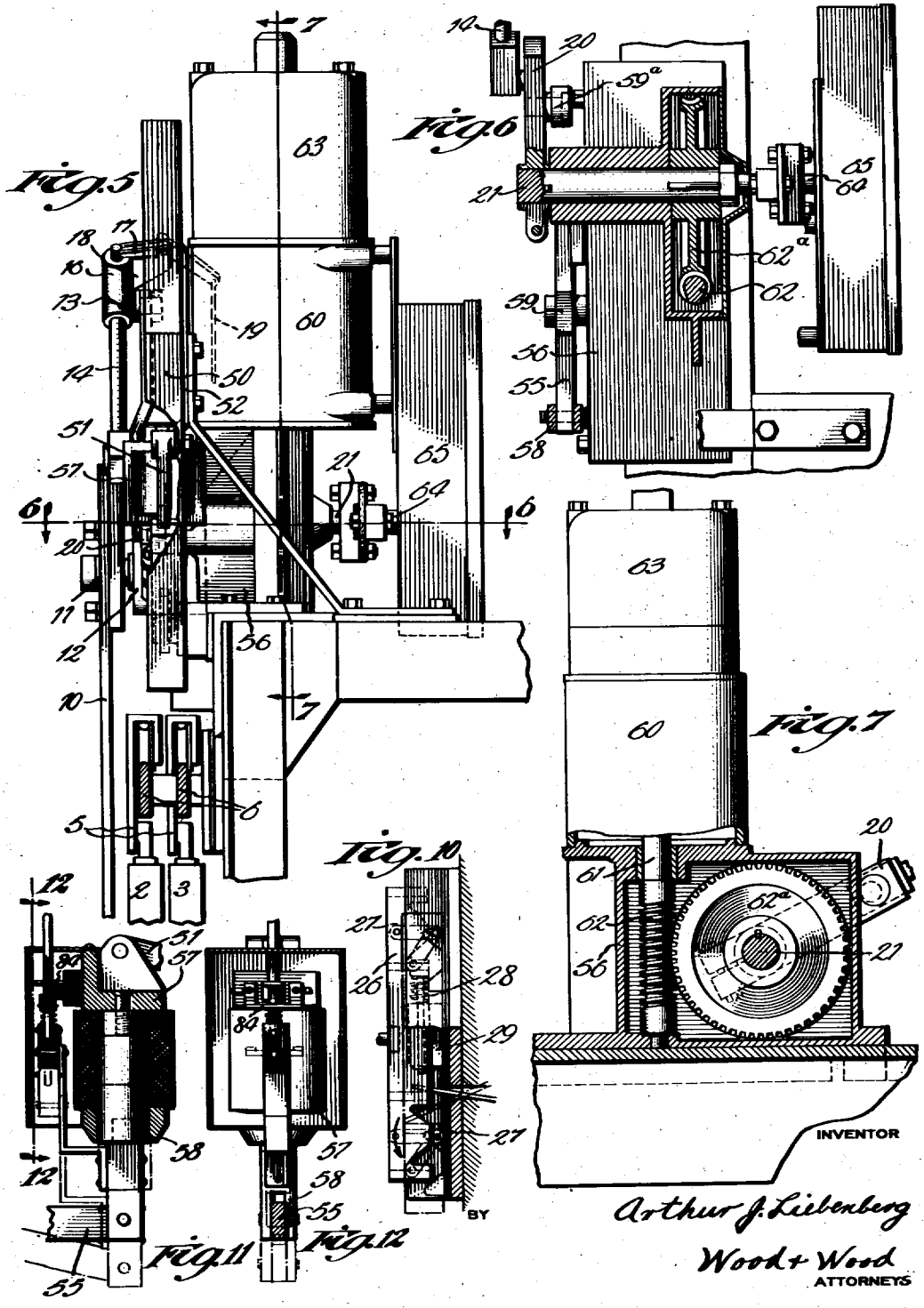
Wood & Wood

ATTORNEYS

Oct. 29, 1935. A. J. LIEBENBERG 2,019,456

POWER OPERATED ELEVATOR DOOR

Filed Feb. 13, 1934 6 Sheets-Sheet 4



Oct. 29, 1935. A. J. LIEBENBERG 2,019,456

POWER OPERATED ELEVATOR DOOR

Filed Feb. 13, 1934 6 Sheets-Sheet 5

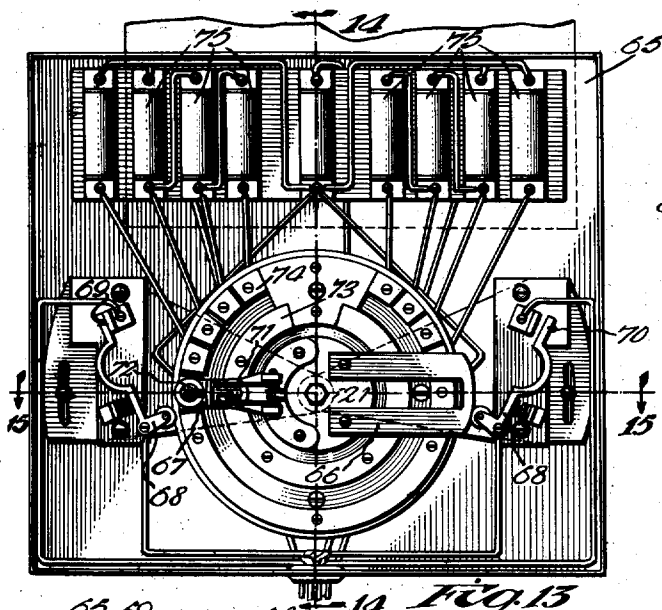


Fig. 13

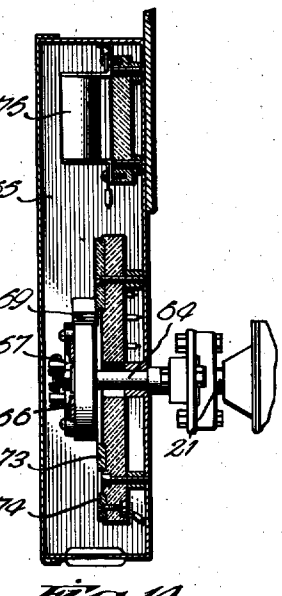


Fig. 14

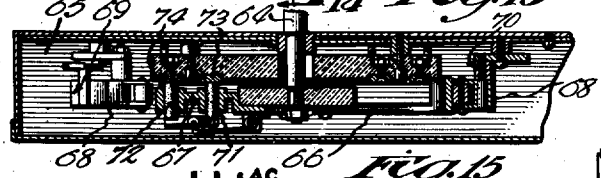


Fig. 15

Fig. 16

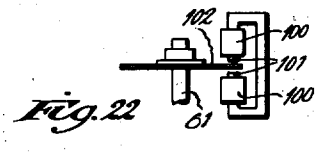


Fig. 22

INVENTOR

Arthur J. Liebenberg

Wood & Wood ATTORNEYS

Oct. 29, 1935. A. J. LIEBENBERG 2,019,456

POWER OPERATED ELEVATOR DOOR

Filed Feb. 13, 1934 6 Sheets-Sheet 6

Fig. 17

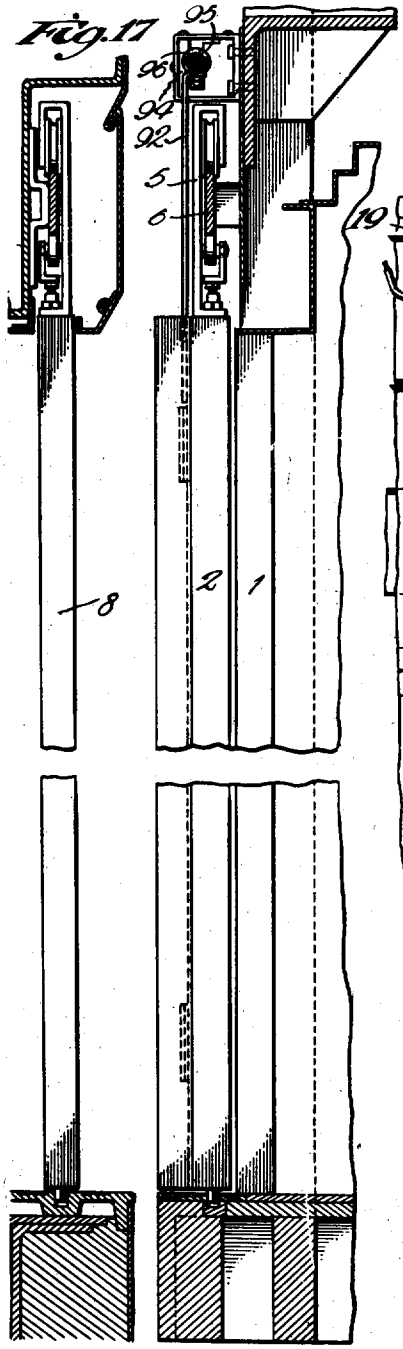


Fig. 18

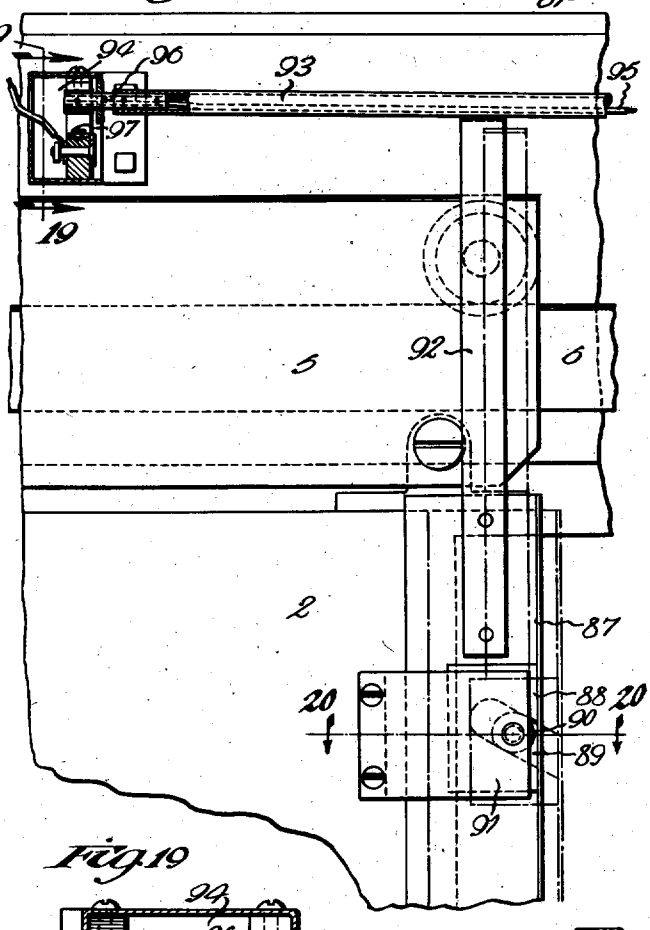


Fig. 20

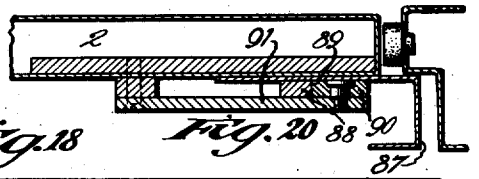


Fig. 19

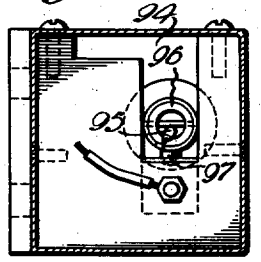
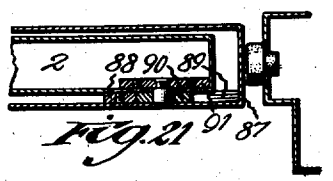


Fig. 21



INVENTOR

Arthur J. Liebenberg

BY

Wood & Wood

ATTORNEYS

Patented Oct. 29, 1935

2,019,456

UNITED STATES PATENT OFFICE

2,019,456

POWER OPERATED ELEVATOR DOOR

Arthur J. Liebenberg, Cincinnati, Ohio, assignor to The Warner Elevator Company, Cincinnati, Ohio, a corporation of Ohio

Application February 13, 1934, Serial No. 711,701

10 Claims. (Cl. 187—52)

This invention relates to elevators and particularly to power driven closures for the elevator cab and landing or floor openings of the hatchway.

An object of the invention is to provide an elevator cab with a power operated door, the door operating mechanism driven by an electric motor mounted upon the cab with the door travel decelerated toward the opening and closing limits through motor retardation.

Another object of the invention is to provide an elevator cab with electric motor driven door operated mechanism, the door travel gradually slowed down toward its limits of travel in either opening or closing directions through retardation of the motor rotation by an electrically influenced stator under sequential and regulatable control by a controller operated by the motor, and therewith under corresponding electric circuit control.

Another object of the invention is to provide an elevator cab with a power operated door driven by an electric motor, the door travel gradually slowed down towards its opening and closing limits, the retardation gradually introduced and cut out when the circuit of the motor is cut off and reinstated therewith at the same capacity prevailing at the time of cut off.

Another object of the invention is to provide an elevator cab with a power operated closure, the cab closure automatically coupling with the landing or latch doors as the cab moves into relation thereto and when stationed thereat the coupling elements for both doors relatively having ample clearance for freedom of passage as the cab moves by a hatch door and snugly interfitting in a unitary opening or closing operation thereof.

Another object of the invention is to provide a sliding elevator hatch door with a linkage for locking the door in its closed position, the linkage controlled and actuated from the cab for interlocking.

Another object of the invention is to provide the leading edge of electric motive power operated hatch or cab door with means for controlling the motor circuit should the door encounter any obstruction in its travel for either stopping or reversing the door travel, and to continue in a closing direction as soon as the obstruction is removed.

Another object of the invention is to provide a power operated elevator cab door with means for manually disconnecting the power operating mechanism from the door for operating the door by hand in the event of any disability of the power mechanism.

Various other features and advantages of the invention will be more fully set forth in a description of the accompanying drawings, in which:

Figure 1 is a front elevation of an elevator cab stationed at a hatch or landing opening, illustrating the improved power door operating mechanism with portions of the sliding door for the hatch or landing broken away and the doors in a closed position.

Figure 2 is an enlarged fragmentary view of the door operating mechanism as disclosed in Figure 1, with the parts in the preliminary stage for door opening.

Figure 3 is a top plan view thereof.

Figure 4 is an enlarged fragmentary front elevation of the door operating mechanism with the door in fully opened position.

Figure 5 is an end elevation of the motor and door operating mechanism carried by the elevator cab.

Figure 6 is a section on line 6—6, Figure 5.

Figure 7 is a central vertical section through the motor driven transmission.

Figure 8 is an enlarged detailed section through the trip coupling of the elevator door operating linkage between the main door operating lever and power driven connecting rod.

Figure 9 is a section on line 9—9, Figure 2.

Figure 10 is a detailed side elevation of a coupling shoe carried by the cab for connecting car and hatch doors.

Figure 11 is an enlarged central vertical section of a magnetic coupling, an electric switch device actuated by the coupling connecting a retiring cam mounted upon the top of the elevator for tripping the hatch door linkage by power.

Figure 12 is a section on line 12—12, Figure 11.

Figure 13 is a front elevation of rheostat for controlling the motor rotation retarding stator.

Figure 14 is a section on line 14—14, Figure 13.

Figure 15 is a section on line 15—15, Figure 13.

Figure 16 is a diagrammatic view of a wiring scheme for door operating motor and motor rotation retarding stator control.

Figure 17 is a central vertical section through elevator and hatch doors.

Figure 18 is a front elevation of an upper section of a cab leading door and a door operating motor control safety switch.

Figure 19 is a section on line 19—19, Figure 18.

Figure 20 is an enlarged section on line 20—20, Figure 18.

Figure 21 is a section similar to Figure 20 of a modified construction.

Figure 22 is an elevation of a modified construction of motor rotation retarding stator.

In the specific embodiment shown herein, the elevator cab is provided with a plural panel sliding door closure constituting a stationary panel 1 and double sliding panels 2 and 3. The sliding panels 2 and 3, each, are suspended by hangers 5 respectively from the rails 6, 6, enabling the panels to move side by side to open position alongside the stationary panel.

Likewise, a plural panel sliding door closure is provided for each of the landings at which the elevator cab stops, the car closure and landing closure at which the elevator is stopped cooperating for simultaneous and unitary operation. Therefore, each landing closure correspondingly constitutes a stationary panel and double sliding panels 8 and 9, the sliding panels suspended by hangers from rails mounted upon the head wall of the hatchway opening for the landing in any well known manner. The sliding panels of both car and landing closures are guided at their lower ends by engagement with guide grooves or rails.

The door operating mechanism to which the present invention is primarily directed is not limited to the particular type of sliding doors herein preferably incorporated as to the number of panels operated, or whether opening from one end or center parting and provides for high speed operation opening and closing with the motion checked or retarded toward the end of door travel, in either direction, to avoid door slam or injury and to give a smooth and noiseless operation. It may be utilized for power operating only the car closure with the landing doors operated manually, mechanically automatically unlocked when the elevator is stationed at the landing.

The cab door sliding panels are connected by link mechanism for adapting the panels to be moved simultaneously and at relatively differential rates to accommodate or compensate for their relatively different distances of travel in bringing them to a side by side open position. The linkage preferably employed constitutes a main link 10, toward one end pivotally mounted at 11, upon a bracket 12, fixed to the top framework of the elevator cab. (See Figures 1, 2, and 3.)

The upper end of the link is bent to an angle and at the free end and one side thereof has a guide or sleeve coupling 13 swiveled thereon, to which a pitman rod 14 is connected and capable of slidingly traversing the coupling when unlocked therefrom and by a spring urged detent or latch 15 carried by said sleeve coupling 13 (see Figure 8).

The detent or latch 15 is slidably housed within a tubular boss 16 extending laterally from the sleeve coupling with the end of the stem of the detent or latch pivotally connecting with one end of a lever 17 pivotally mounted on a bracket arm 18 extending from the coupling 13. The opposite end of the lever 17 connects with a cable or cord 19 for remotely actuating said lever as manually from within the car or cab.

The pitman rod 14 normally when actuating the doors or panels by power is rigidly locked to the coupling 13 and when unlatched therefrom enables the doors to be operated manually, in which instance the pitman rod slides within the coupling. The pitman at its forward end is pivotally connected to a crank arm 20 fixed to and extending laterally from a shaft 21 of the power driven transmission.

The lower end of the main link 10 pivotally connects with one end of a pair of companion connection links, 22, 22, the opposite ends of said links as a unit pivotally connecting to a channel bracket or plate 23 rigidly fixed to the outer side and forward end of the leading or first panel 2 of the cab door closure.

The second sliding panel 3 of the cab door closure connects with the panel 2 by a connecting link 24, the link at one end, pivotally connected to the main link 10 at approximately intermediate of its lower end and fulcrum. The opposite end of said connecting link pivotally connects with a link extension of a stationary bracket 25 fixed to the rear end or edge of the second sliding panel 3. Thus when the doors are closed, upon swinging the crank arm 20 in a counterclockwise direction, the lower end of the main link 10 will be swung rearwardly therewith, coordinately moving the first door panel and through its connection with the main link by the connecting links 22, 22, and the second sliding panel 3 through its connection with the main link by the connecting link 24.

The connection of the sliding panels with the main link 10, being at relatively different points thereof from the fulcrum of the main link, the panels are moved simultaneously but at different rates for the respective different distances of travel required for bringing the door side by side in an open position.

The car doors are automatically coupled to the hatch or landing doors respectively as the car moves within a landing zone, to be connected with the landing door when the car is stopped at a selected landing. The channel bracket 23 has a longitudinal shoe 26 hingedly mounted thereon to be engaged within the channel of the bracket when out of commission and alternately to laterally extend therefrom in an operative position as shown in Figure 10.

The shoe 26 hingedly connects with the channel bracket 23 by a pair of links 27, 27, respectively, at one end pivotally connected to the shoe which is preferably of hollow or skeleton form while the opposite ends of the links connect with the bracket 23 within and at the base of the channel thereof. The shoe is engaged by a spring pressed plunger 28 slidably mounted within a bearing 29 formed upon the channel bracket 23 and longitudinally centrally within the channel thereof for yieldingly urging and maintaining the shoe outward or in an extended position from the channel bracket for coupling with a landing door when the cab is stationed at such landing door.

The shoe can be swung inwardly, out of commission and out of the path of any extending obstruction it should meet during the travel of the cab in either up or down direction and can be locked in its inactive position by swinging the same inwardly through the aid of a hand tool brought into connection therewith from the interior of the cab, by a spring latch 30 mounted upon said channel bracket 23.

In Figure 10 the shoe, in full line, is shown in its extended or active position and in dotted line in its inactive position housed within the channel of the channel bracket 23.

To lock the shoe 26 out of commission, it is depressed downwardly, as shown in dotted lines Figure 10, through the aid of a hand tool engaged through a slot in the

elevator door or channel 2, and the base of the channel bracket 23 accessible from the inner side of the door channel 2. As soon as the outer edge of the shoe is brought below the plane of the outer edge of the channel bracket 23 the bolt of the spring latch 30 is free to snap over the edge of the shoe holding it in a depressed position within the channel. The latch 30 is mainly accessible from the inner side of the elevator cab door.

The shoe 26, when the cab is passing through or stationed at a landing zone, extends between a pair of spaced rollers 31, 32, mounted upon a bracket 33 fixed to the inner side of the leading or first panel 8 of a landing or hatchway door connecting said landing and cab doors for unitary operation.

The structure of the landing doors for the various floors served by the elevator are of duplicate construction so that a description of one serves for all, and the rollers for the several landing doors are arranged in alignment allowing the shoe to freely traverse therebetween and automatically connect with the door of a selected landing at which the cab is stopped and disconnected therefrom as the cab moves beyond the landing zone.

The roller 32 is journalled upon a swinging quadrant or cam 34 pivotally mounted upon the bracket 33 having a limited arc of movement for normally increasing the roller spacing when the landing or hatchway door is closed, offering greater clearance for the shoe to pass therebetween without contact as the cab is passing the landing zone. The quadrant is held or moved to retract the roller 32 by a pin 35 laterally extending from the quadrant for engagement by a forwardly extending end of the linkage connecting and actuating the sliding door panels.

In the preferred arrangement as shown in Figures 1 and 2, when the landing door is closed the door panel actuating links are in a dead central or horizontally aligned position, locking the panels against opening from the exterior side, from which they are not manually accessible. The forward panel 8 pivotally carries a link 36 having its forward end extended to engage the pin 35 of the cam or quadrant 34 for swinging and maintaining the quadrant in a retracted position to increase the gap or spacing of the rollers 31 and 32.

The link as it swings to its complete door closing or horizontal position has its forward end engaged with the pin 35 of the quadrant, swinging the quadrant upward and holding the same in such position. As soon as the link alignment is broken by disposing the several links of the combination at an angle to one another as shown in Figure 2, which action is timed to slightly precede movements of the doors, the quadrant is released allowing the same to drop by gravity swinging the roller 32 downward toward and against the shoe. This action reduces or minimizes the play between the shoe and rollers, making a more rigid coupling connection.

Exerting a spring pressure to the quadrant, and also lowering the pivot center of the quadrant slightly below the horizontal central line through the journal axis of the roller when the roller is in its lowermost position, lessens the shoe play between the rollers and insures a quicker more positive action. The car when moving in an upward direction approaching a floor where a stop is to be made travels at a fairly high speed and should it engage with the roller it would have a tendency to throw the same outwardly, but under the tension of the spring is quickly returned in place and holds it in its locked position against the shoe, thereby eliminating as far as possible any vibrating play between the contacting parts, and enables two sets of doors to start simultaneously, eliminating any hammering or bumping noise.

The shoe on the cab door and the swingingly mounted roller on the landing door provide for either one or the other to yield sufficiently for shoe traverse should any lateral shifting of the car cause the parts to strike one another avoiding breakage of the parts or undue noise.

The freedom of passage of the shoe without scraping or contacting the rollers for a rapidly travelling elevator in passing the landings at which no stop is made is essential to eliminate noise as a car is passing through a door coupling zone, and when stopping at the landing it is very desirable to have a coupling made between the two sets of doors without play. This latter feature eliminates slamming of the parts due to lost motion in the coupling should a quick reversal of the door be made. These functions are very efficiently accomplished by the mechanism herein disclosed.

The landing doors are connected by a series of links. A link 36 pivotally connected to the first or leading slide panel 8 pivotally connects at one end with one end of a link 37 pivotally mounted upon a bracket 38 fixed to the rear edge of the second sliding panel 9. The opposite end of said link 37 pivotally connects with one end of a link 39 pivotally mounted upon a stationary bracket 40 fixed upon the framing for the landing opening, or to a wall of the hatchway. The link 39 at its end connecting with the bracket 40 is of bell crank form, providing an arm 41 pivotally connecting with a stop rod 42, vertically depending therefrom and guidingly engaged through a bracket 43 fixed to a wall of the hatchway.

A sectional tube 44 is concentrically engaged over the stop rod 42 with its lower end resting upon a bracket 43 and its upper end adapted to engage with the head end of the stop rod for limiting the movement of the links when the door is in its closed position to prevent any sagging of the links below a dead central line, as well as taking the weight load off of the connecting links or connecting pivots thereof to avoid any bind. The tube 44 can be readily interchanged to accommodate for any wear or adjustment that may be required.

The dead central or door locking position of the actuating links for the landing doors is initially automatically broken, after the elevator has stopped for a landing, by a vertically disposed connecting rod 45 having its lower end pivotally connected to the end link 39 of the series, and its opposite upper end pivotally and slidably connected with the laterally extending arm of a bell crank lever 46. The bell crank lever is pivotally mounted on a bracket 47 fixed to a wall of the hatchway.

A spring cushion 48 is introduced between the upper end of the connecting rod 45 and the arm of the bell crank lever 46 to provide a yielding connection to take up for any resistance between the parts which may be encountered by any excessive movement of one part over the other and obviate the necessity of making the very delicate adjustments which cannot be conveniently made.

The spring prevents unduly straining the parts and saves the same from being bent or broken.

The free end of a second arm of the bell crank lever **46** journals a roller **49** for engagement with a hingedly mounted shoe or retiring cam **50** carried by the elevator cab. The retiring cam is power operated by the motor driven transmission which operates the car and landing doors, and when the electric motor thereof is energized, the retiring cam is maintained in an extended position for actuating the bell crank lever. When the cam is in the retired position, the motor is deenergized and the cam clears the roller of the bell crank lever **46** for non-contacting passage of the shoe or retiring cam during the travel of the elevator cab and passing through any landing zone, and also for taking a part in a door and elevator operating control to insure a complete closing of the doors before elevator starting.

When the car arrives at a floor for stopping, and after the car elevating power is cut off, the motor becomes energized for causing the cam to be moved into its extended position in which engagement with the roller of the bell crank lever actuating said lever causing the connecting link or rod **45** to be moved upwardly breaking the horizontal locking alignment of the door actuating links. With the breaking of the locking position of said links, or moving said links relatively to a slightly inclined position releases the quadrant and brings the roller carried thereby into connection with the coupling shoe so that the doors are coupled with practically no clearance and immediately move as a unit when the operating motion is imparted thereto by the link **10** receiving its motion from the door operating power transmission.

The link **22** connecting the link **10** with the leading door of the cab closure provides for a slight idle motion of the link **10** before imparting any conveying motion to the doors furnishes the sequence in the door operation to allow the linkage for the landing doors to be initially actuated to an unlocked position before any opening motion is imparted to the doors.

The retiring cam or shoe **50** is pivotally connected to one end of each of a pair of parallel links or levers **51**, **51**, having their opposite ends pivotally mounted upon and extending from a vertical bracket or support **52** fixed to the top framing of the elevator cab.

As shown in Figure 4, the levers are connected by an equalizing bar or rod **54** for unitary operation of the levers when moved to extend the cam or shoe **50** in an outward direction against the roller upon the end of the bell crank lever **46** for actuating said lever and unlocking the landing door connecting links. The levers as a unit pivotally connect to one end of a two-part or sectional coupling which in turn pivotally connects with a bell crank lever **55** mounted upon the top framing of the elevator cab or to the base of a transmission casing **56** supported upon the top of the elevator cab. The two-part or sectional coupling consists of a solenoid **57** having its head end pivotally connected to the lower lever **51** of the retiring cam or shoe and a rod or plunger **58** slidably engaged within the core of the solenoid and pivotally connecting with the bell crank lever **55**.

The sectional coupling, being shown in detail in Figures 11 and 12, provides for positively connecting or coupling the sections upon energizing the solenoid and permitting the section **58** to be moved idly within the solenoid when the solenoid is deenergized. The crank arm **20** in its arc of movement and in the initial portion thereof, connects with the bell crank lever **55**, depressing or pulling the coupling downward for extending the retiring cam to a position for effecting an unlocking of the door actuating links and as the coupling operates to transmit motion to the retiring cam in a downward or pull direction it is necessary to have the solenoid energized to establish a coupling connection between the sections. Thus when the solenoid is deenergized the coupling connection is broken and offers no interference against locking the links when the landing door is closed after the elevator has served such landing.

As shown in Figures 2 and 4, the arm **59** of the bell crank lever **55** is notched or has a cam-shaped edge for co-operating with a roller **59a** laterally extending from the crank arm **20** for positively connecting the crank arm and bell crank lever **55** with the starting or initial motion of the crank arm for positively moving the retiring cam to an extended position. After the crank arm has moved a predetermined arc of degree the bell crank lever is released, allowing the parts operated thereby to automatically return to their normal position.

The coupling solenoid **57** in the present instance according to the relation of the parts must be energized before a transmitting connection with the armature section **58** can be effected and is preferably in circuit connection with the elevator door control system, as shown in diagram, Figure 16, thus serving as a safety means, requiring the elevator to be at rest at a selected landing before automatic power operation of the landing door is possible. Likewise, in the retreat stroke of the cam arm **59** the bell crank lever **55** can be idly operated without in any wise influencing the retiring cam **50** so that there is no interference against locking the links in their door-closing position which might prevent a full door closing and interrupt the operation of the elevator control which usually requires the doors to be fully closed before an elevator starting control can be made.

An electric motor **60**, supported upon the transmission casing **56** mounted upon the top framing of the elevator cab, constitutes the power means for operating the car door and a landing door at which the elevator is stopped, the retiring cam or shoe and an electric switch device or controller.

As shown in Figures 6 and 7, the motor shaft **61** is provided with a worm **62** in mesh with a worm wheel **62a** fixed upon the shaft **21** journaled in the transmission casing **56**. The shaft **21** carries the crank arm **20** of the cab door operating mechanism.

A second motor **63** has its armature shaft coaxial with the shaft of the main drive motor **60** either coupled thereto or integral therewith. The second motor **63** is used for retarding or breaking the rotation of the door drive motor **60** to check the speed of the doors at the ends of their travel either opening or closing.

In the present instance, the drive motor is of alternating current type and the second motor used for retardation is of direct current type. The retardation motor can be connected in several ways. One method is to keep the shunt field energized all the time and alter the resistance parallel to the armature through a segment rheostat operated by the shaft of the main motor or transmission gearing thereof.

A second method is to short-circuit the armature brushes and vary the amount of resistance in series with the shunt field. This latter method is the most desirable owing to the fact that high voltage, such as 220 volts, is used which eliminates heavy currents and variations due to contact resistance. By the use of several rheostat points it is possible to introduce retardation gradually, which gives smooth operation. When the doors are in the retardation zones and for some reason or other they should be stopped, the retardation automatically disappears as cutting out the circuit to the drive motor correspondingly cuts out the circuit to the retardation motor.

When the main or drive motor is at rest, retardation is at nil, and as soon as rotation starts, retardation comes into play. This makes it possible to always have the full starting torque of the drive motor available to close and open the doors regardless at what point in their travel the doors have been stopped.

Referring to the Figures 13 to 16, the transmission shaft 21 extends through the rear side of the transmission casing 56 and is coupled to a shaft 64 of a rheostat device enclosed within a casing 65 mounted upon the top framing of the elevator cab. The shaft 64 carries a switch actuating arm or plate 66 and a contact arm 67 relatively diametric to the switch actuating arm 66. The arm 66 at opposite or alternate ends of its arc of rotation engages with and actuates a switch lever 68 respectively of a pair of electric circuit controlling switches 69 and 70. Switch 69 is effective or closed when the door is open for a specific circuit control and switch 70 operates reversely for a door closing position. The switch 70 during the operation of the cab with the doors closed is in open position through its engagement with the arm 66, as shown in Figure 16, the rheostat in such instance being in its neutral position.

The contact arm 67 carries a pair of contacts 71, 72, contact 71 engaging with a contact ring 73 mounted concentric with the axis or controller rheostat shaft 64 and contact 72 engaging with a segmental ring 74 concentric with the ring 73. The various segments of the ring 74 are respectively in circuit connection with resistance or rheostat coils 75.

In Figure 16, a wiring diagram for the control of the door operating motor circuits is illustrated in which 76 is a magnetically operated multipole or contact electric circuit controlling switch for starting and controlling the direction of motor rotation, say for door opening operation, and 77 is a similar electric circuit controlling switch for operating the door driving motor in a reverse direction for door closing. 78 is a magnetically operated electric circuit controlling switch in the controlling circuit of the elevator motor and has its coil continuously energized upon starting the elevator motor and while the elevator motor is energized. The switches 76 and 77 control the main line circuits, alternately to the drive motor 60 and correspondingly to the retardation motor 63, with the rheostat control interposed in the circuit lines from said switches 76, 77, to the shunt field of the retardation motion. The rheostat cutting-in resistance toward the end of door travel in either direction, the rheostat contact and switch actuating arms moving alternately in an arc of approximately 180° or as may be necessary to synchronize the same with the period of drive motor operation in either direction of rotation for conveying the door its full length or distance of travel in either direction, the retardation control, however, being toward the end of door travel in either direction.

When the elevator comes to a stop at a floor landing, magnet switch 78 is deenergized and correspondingly motor direction switch 77 being deenergized and the rheostat in a position for elevator door opening, a control circuit is completed from switch 78 by wire 80 to and through direction switch 77, wire 81 to solenoid coil of the sectional coupling of the landing door link unlocking mechanism, wire 82 to rheostat switch 69 which is normally closed, and by wire 83 to field line or supply source. As soon as the solenoid coil of the sectional coupling is energized, connecting the coupling sections, a switch 84 is actuated, being in connection with the movable section of the sectional coupling, completes a controlling circuit to the door motor switch 76 actuating the same and thereby completing the power circuit for the drive motor 60 operating the drive motor in an appropriate direction for door opening. The rheostat operating with the door drive motor rotates the contact arm 67 and switch actuating arm 66, say in a clock-wise direction, and toward the end of its arc of travel the contact arm progressively engages the segments of the ring 74 gradually introducing the resistance to the shunt field of the retardation motor 63. The arm 66 of the rheostat correspondingly at the end of its stroke actuates the rheostat switch 69 breaking the circuit to the magnet coil of the motor control switch 76 whereupon the motor is stopped and correspondingly the circuit to the retardation motor is likewise cut off.

With the starting of the elevator control, switch 78 is energized, completing the control circuit to the magnet coil of the door motor control switch 77 by a wire 85 through the motor control switch 76 which is deenergized, thence through wire 86 to the rheostat switch 70 which during such period is closed to the supply source, whereupon a reverse operation of the motor 60 for door closing takes place with the retardation gradually introduced toward the end of the return stroke of the rheostat moving elements.

It of course is recognized that the control system could be variously modified, the system herein introduced being primarily to disclose a preferred method of a very efficient type.

To safeguard against the door closing or continuing in its closing direction of travel upon striking an obstruction in its travel, the forward end of the leading panel of the car door is provided with an extensible edge or movable shield 87, as a channel form of strip, either engaged over the forward edge of the door as shown in Figure 21 or upon the inside thereof as shown in Figures 18 and 20. The extensible edge or shield 87 is arranged to move inwardly and upwardly when depressed and is provided with a plurality of lugs 88 each having an upwardly inclined slot 89 formed therein into and through which a roller 90 engages. The roller is journalled upon a plate 91 fixed to or within the door panel.

The shield at its upper end is provided with a vertical extension 92 for engaging with a cross rod or tube 93, the rod extending across the door opening for at least the full length of the leading door travel. Each of the opposite ends of the rod are engaged respectively within switch boxes 94 fixed to the top of the elevator car. In the present

instance, the rod is of tubular form and internally carries a wire 95 having its opposite ends connected with a contact sleeve 96. The structures for the opposite ends of the rod being duplicated, the description will be confined to the singular.

The contact sleeve 96 engages with a stationary contact 97 mounted within a switch box 94 and to which a control circuit line is connected. The ends of the rods are loosely confined within the switch boxes and upon the slightest raising or elevating of either or both ends of the rod the circuit controlled thereby will be broken.

Therefore, upon bringing or exerting the slightest pressure against the extensible edge 87 of the leading door panel it will be moved inwardly and upwardly, elevating the rod and thereby breaking the hoist motor controlling circuit.

As shown in the wiring diagram, Figure 16, the safety rod 93 is interposed with the magnetic switch 78 to hoist motor circuit controlling the circuit to the magnet coil of said switch for deenergizing the same and when deenergized after a door closing traverse has started the drive motor 60 will be immediately cut out, stopping the travel of the door.

As the rheostat under such condition has moved sufficiently to be disengaged from the rheostat switch 69 and the alternate companion switch 70 being closed, a reverse control for the door is effected, causing the motor to start and continue for a door opening operation if the obstruction is not removed, as for instance, should the extensible edge be depressed by the hand of a person while passing through the door opening. Immediately upon release of the obstruction the control parts will be reconditioned and the door will again continue in its closing direction of travel.

In Figure 22, an exceedingly simplified and cheap form of motor rotation repulsion device is disclosed, consisting of a stator, of a pair of magnet coils 100, 100, having one end of their metallic cores 101 relatively opposed and spaced apart and their opposing ends in metallic connection, with a rotor disk 102 marginally traversing between the cores of the magnets. The disk is fixed upon an end of the motor shaft 61, thus rotating with the shaft, so that when the magnets are energized and the disk is in motion, an inhibiting or repulsive force is set up, retarding disk rotation, and this action is variable by electric current regulation and velocity of the rotor. The greater the velocity, the greater the repulsion; and also increasing with an increase in electric current strength, automatically reducing with the slowing down of the rotor. This makes it possible to always have a full starting torque of the door-operating motor available to close or open the door regardless of at what point in its travel the doors have been stopped, insuring a full closure should the door be stopped for any reason in its travel when retardation is effective. Cutting off of the current to the motor correspondingly cuts off the current to the retardation stator, and when again starting is not materially effective until after the motor velocity has increased to an appreciable extent.

Having described my invention, I claim:

1. An elevator door operating mechanism comprising, a sliding hatchway door, a link structure pivotally connected with said door and to a stationary support, the elements thereof, when the door is closed, in a relative posture for locking the door against opening, means in the hatchway in connection with said link structure, a shoe carried by the elevator car normally in a retired position and when expressed during the car approach of and stationed in relation to the hatchway door opening actuating said means for breaking the locking posture of said link structure for door opening, a door operating motor carried by the elevator car, and means for transmitting power from said motor to said shoe to express the same, said means including separable coupling elements magnetically coupled by remote electric circuit control for effecting the door unlocking control when the car is at the floor landing of said hatchway door.

2. An elevator door operating mechanism comprising, a sliding hatchway door, a link structure pivotally connected with said door and to a stationary support, the elements thereof, when the door is closed, in a relative posture for locking the door against opening, means in the hatchway in connection with said link structure, a shoe carried by the elevator car normally in a retired position and when expressed during the car approach of and stationed in relation to the hatchway door opening actuating said means for breaking the locking posture of said link structure for door opening, a motor carried by the elevator car, and means for transmitting power from said motor to said shoe to express the same, said means including separable coupling elements magnetically coupled by remote electric circuit control for effecting an unlocking control when the car is at the floor landing of said hatchway door, and an electric switch actuated by one of said coupling elements for completing a controlling circuit with said motor.

3. An elevator door operating mechanism comprising, a sliding hatchway door, a link structure pivotally connected with said door and to a stationary support, the elements thereof, when the door is closed, in a relative posture for locking the door against opening, means in the hatchway in connection with said link structure, a shoe carried by the elevator car normally in a retired position and when expressed during the car approach of and stationed in relation to the hatchway door opening actuating said means for breaking the locking posture of said link structure for door opening, a motor carried by the elevator car, and means for transmitting power from said motor to said shoe to express the same, said means including separable coupling elements magnetically coupled by remote electric circuit control for effecting an unlocking control when the car is at the floor landing of said hatchway door, an electric switch actuated by one of said coupling elements for initiating a controlling circuit with said motor, and said power transmitting means between the motor and shoe effective only in the initial motor operating period for door unlocking operation.

4. An elevator door operating mechanism comprising, a sliding hatchway door, a link structure pivotally connected with said door and to a stationary support, the elements thereof, when the door is closed, in a relative posture for locking the door against opening, means in the hatchway in connection with said link structure, a shoe carried by the elevator car normally in a retired position and when expressed during the car approach of and stationed in relation to the hatchway door opening actuating said means for breaking the locking posture of said link structure for door opening, and power operated means for transmitting power to express the shoe, said

means including separable coupling elements magnetically coupled by remote electric circuit control for effecting an unlocking control when the car is at the floor landing of said hatchway door.

5. In combination with an elevator door, and a door at the landing served by the elevator, means on the elevator for opening said elevator door, means for automatically coupling said elevator and landing doors constituting a shoe carried by said car door traveling between jaw elements extending from said landing door, one of said jaw elements movable for engagement with the shoe, and control means carried by said landing door for jaw control upon actuating said control means for door opening.

6. In combination with an elevator door, and a door at the landing served by the elevator, means on the elevator for opening said elevator door, means for automatically coupling said elevator and landing doors constituting a retrieving shoe carried by said car door traveling between jaw elements extending from said landing door, one of said jaw elements movable for engagement with the shoe, and control means carried by said landing door for jaw control upon actuating said control means for door opening.

7. In combination with an elevator door, and a door at the landing served by the elevator, means on the elevator for opening said elevator door, means for automatically coupling said elevator and landing doors constituting a shoe carried by said car door traveling between jaw elements extending from said landing door, one of said jaw elements pivotally mounted for engagement with the shoe, a link structure pivotally connected to said landing door and to a stationary support for locking said door against opening, and holding said movable jaw in a retreated position and releasable therefrom when the link structure is moved for door opening.

8. An elevator door operating mechanism, comprising, an electric motor including reduction gear transmission connecting with the armature shaft of the motor, a crank arm fixed to a driven shaft of the gear transmission oscillating in an arc of revolution for transmitting motion to an elevator door operating mechanism in alternate opening and closing directions, an electric motor field having an armature shaft rotatively connecting with the armature shaft of said motor, the field when energized influencing its armature shaft for impeding the rotation of the motor armature shaft, a rheostat in circuit connection with said field effective toward the limits of arc of motion of said crank arm for gradually impeding the rotation of said motor, and a rheostat and electric circuit controlling member connecting the said driven shaft of the gear transmission and in synchronism with said crank arm for controlling the energizing circuits for said motor and field.

9. An improved arrangement of control for a motor particularly adapted for driving an elevator door in alternate opening and closing directions, comprising, an electric motor, an electric motor field having a rotative armature coupled to the armature shaft of said motor for impeding the armature shaft rotation when said field is energized, and a rheostat in circuit connection with said field for energizing and influencing the same to gradually vary the degree of impedance of said motor armature shaft toward the end of an operating period in either of reverse directions of rotation, said rheostat having a control member in driven connection with the motor armature shaft.

10. An improved arrangement of control for a motor particularly adapted for driving an elevator door in alternate opening and closing directions, comprising, an electric motor, an electric motor field having a rotative armature coupled to the armature shaft of said motor for impeding the armature shaft rotation when said field is energized, a rheostat in circuit connection with said field for energizing and influencing the same to gradually vary the degree of impedance of said motor armature shaft toward the end of an operating period in either of reverse directions of rotation, said rheostat having a control member in driven connection with the motor armature shaft, and an electric circuit controlling device, simultaneously controlling the energizing circuits for said motor and field, the latter through said rheostat.

ARTHUR J. LIEBENBERG.