Feb. 25, 1969

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3,429,073

COMPACT DOOR OPERATOR

Filed Oct. 27, 1966

Sheet 1 of 3

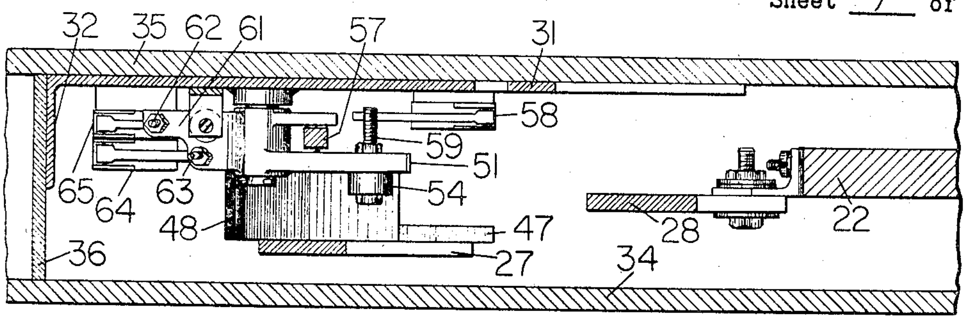
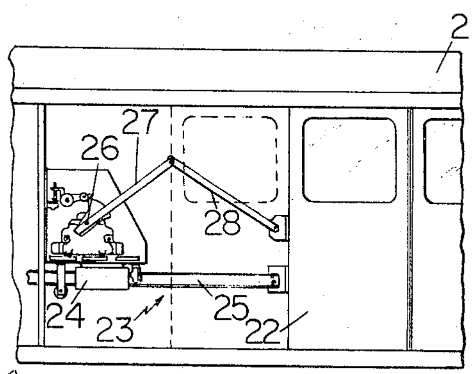


FIG. 3

FIG. 1



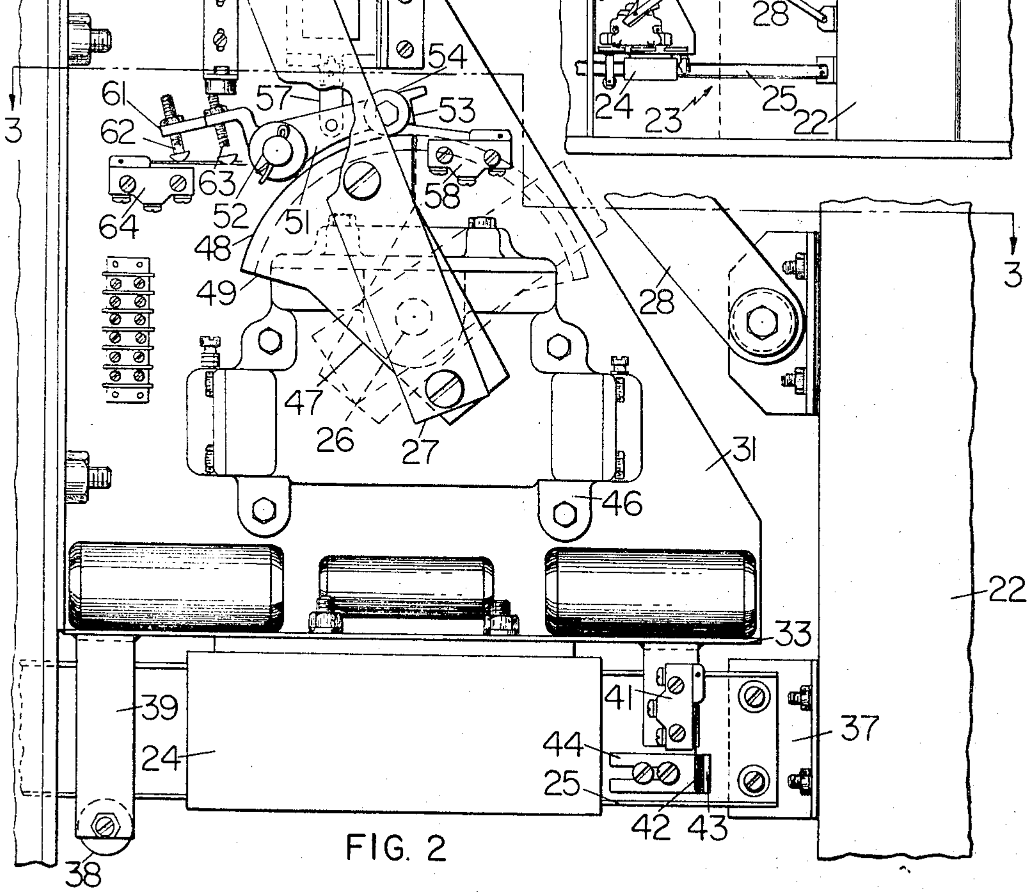


FIG. 2

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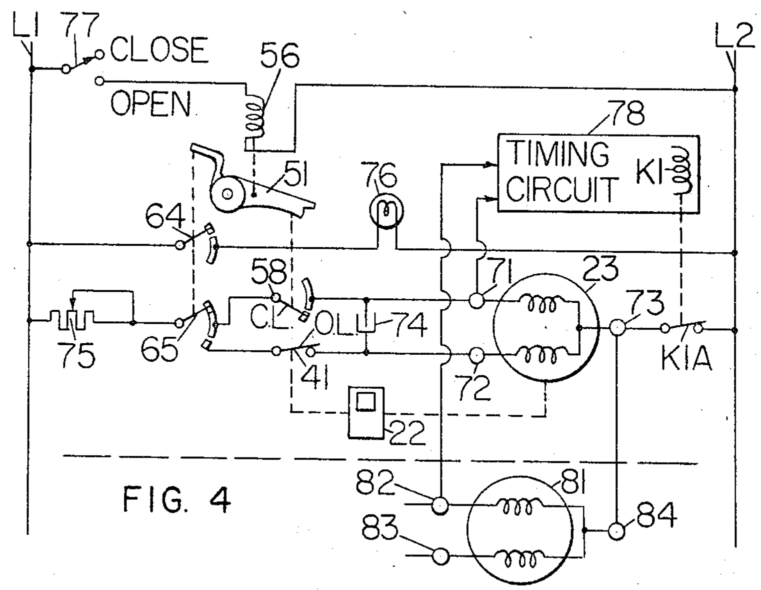

FIG. 4

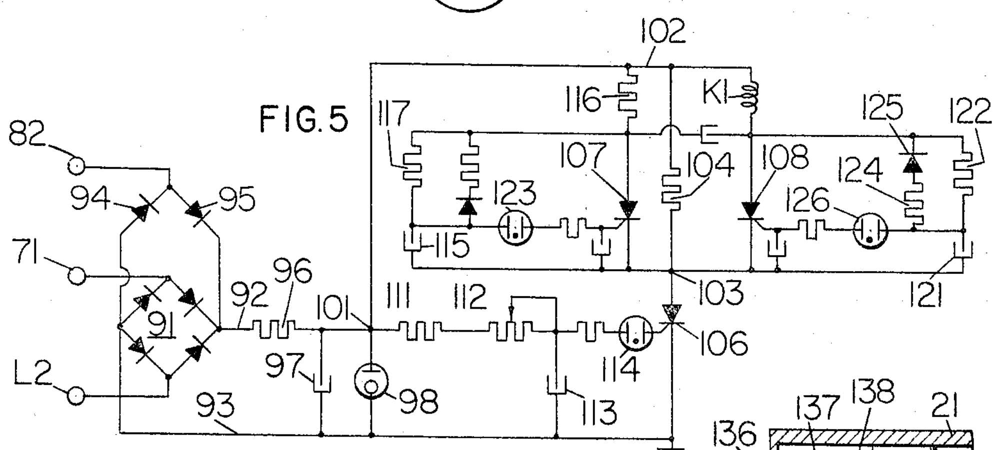

FIG. 5

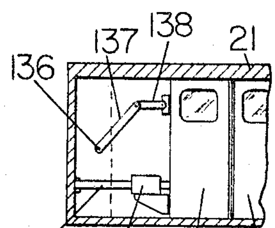

FIG. 6

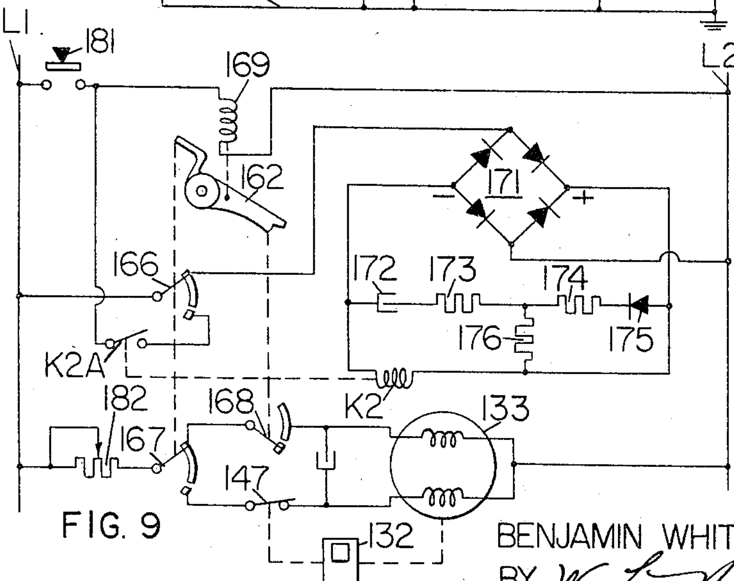

FIG. 9

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COMPACT DOOR OPERATOR

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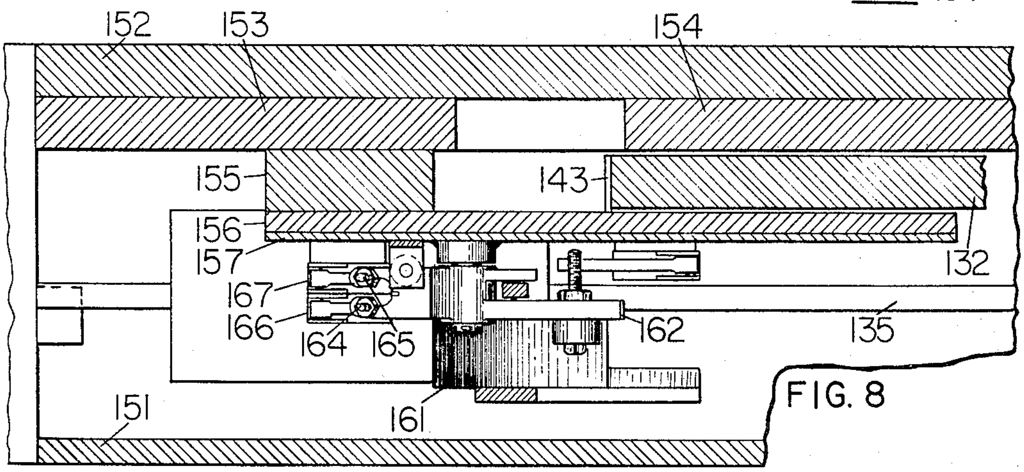

FIG. 8

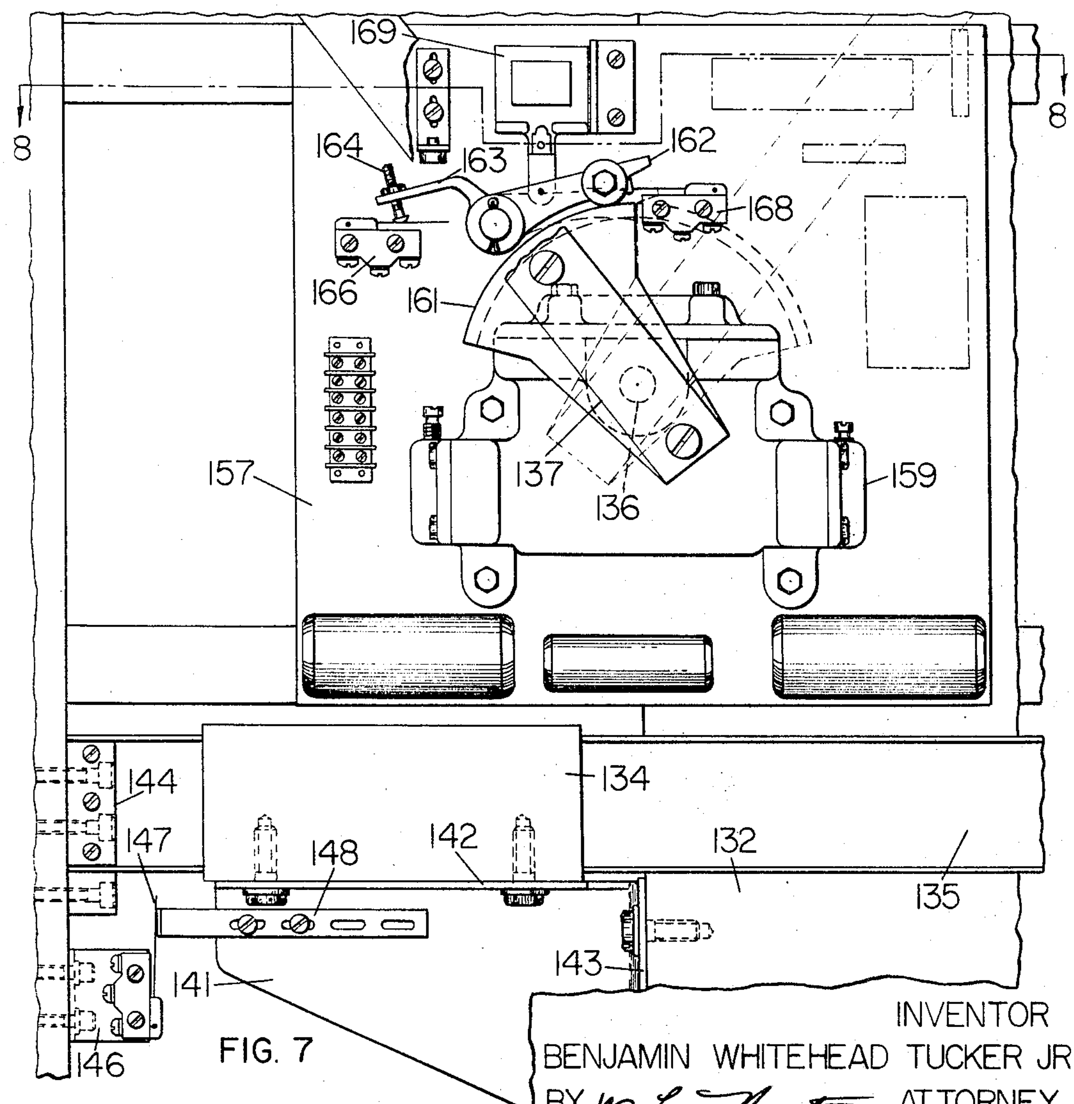

FIG. 7

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COMPACT DOOR OPERATOR

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U.S. Cl. 49—280 13 Claims
Int. Cl. E05f 15/4

ABSTRACT OF THE DISCLOSURE

A closure apparatus including a support structure, a sliding door mounted on the structure for lateral movement between open and closed positions, a motor for operating the door, switch means for controlling the motor, a locking plate rotatably mounted on the structure, a linkage interconnecting the door and the locking plate for rotating the locking plate in response to lateral movement of the door, and a locking arm pivotally mounted on the structure and angularly displaceable relative thereto to three selected positions to operate the switch means for respectively unlocking and opening, unlocking and closing and locking and closing the door.

This invention relates generally to operators for sliding doors and particularly to a novel operator suitable for use where space is at a premium as it is in rapid transit cars.

A so-called "sliding" door, as the expression is usually used, denotes a door which is opened or closed by a lateral motion, as contrasted with a swinging motion, whether the door actually "slides" or whether it travels on wheels, balls, or rollers. The cars of railway rapid transit lines are usually equipped with several such doors on each side to permit quick passenger transfer at each station and also with one at each end to allow passage between cars. The end doors are normally arranged for manual operation, while the side doors are usually provided with power actuated mechanisms, called "operators," for opening and closing them either automatically or under the control of an attendant. In service, the doors and operators should have certain characteristics. Efficient operation requires that the doors open and close quickly. They should operate smoothly without jarring or banging when fully opened or the fully closed position is reached. Provision must be made for preventing injury to a passenger in the pathway of a closing door. The mechanism must not be damaged if door closing is prevented by the presence of an obstruction. When fully closed, the door should be mechanically locked and a signal indicative of this condition should be generated, which signal should persist only as long as the door remains mechanically locked. The operator should be compact because there is no room above the door for bulky machinery. It is preferred that the operator be located entirely within the walls of the car so as to leave the interior free for the use of passengers. And, of course, the operator should be simple and inexpensive.

Many kinds of operators have been proposed in the past. Some have been operated by fluid pressure, others by electricity. None has been entirely satisfactory.

It is a general object of the present invention to provide an improved operator for a sliding door.

Another object is to provide an operator having the desirable characteristics previously mentioned.

A more specific object is to provide a compact operator which can be mounted readily within the wall of the structure carrying the door.

Briefly stated, a preferred embodiment of the invention includes a sliding door which is opened and closed by a linear electric motor acting directly between the door and its supporting structure. A shaft mounted on the structure is mechanically interconnected with the door so as to be rotated back and forth by the opening and closing of the door. This shaft serves as the operating shaft for a fluid cushioning device and also carries a locking plate which cooperates with a pivoted locking arm to lock the door in its closed position. The door may be unlocked by energizing an electromagnet which raises the locking arm out of locking position. The motion of the arm actuates suitable signal and control switches.

For a clearer understanding of the invention, reference may be made to the following detailed description and the accompanying drawing, in which:

FIGURE 1 is a fragmentary elevation view of one side wall of a rapid transit car taken from within the car with the interior panel removed and showing a sliding door equipped with an operator in accordance with the present invention;

FIGURE 2 is an elevation view of the operator of FIGURE 1;

FIGURE 3 is a cross section view taken on the plane 3—3 of FIGURE 2;

FIGURE 4 is a schematic diagram of the electric control circuit;

FIGURE 5 is a schematic diagram of the timing circuit;

FIGURE 6 is a fragmentary elevation view of one end wall of a rapid transit car taken from within the car with the interior panel removed and showing a sliding door equipped with an operator in accordance with the present invention;

FIGURE 7 is an elevation view of the operator of FIGURE 6;

FIGURE 8 is a cross section view taken on line plane 8—8 of FIGURE 7; and

FIGURE 9 is a schematic diagram of the control circuit for the operator of FIGURES 6, 7 and 8.

Referring first to FIGURE 1 there is shown a rapid transit car **21**, the side of which is formed with an opening which is alternatively covered or exposed by one or more sliding doors such as the door **22**. These doors are mounted for lateral movement by a conventional hanger arrangement the details of which are not a part of the present invention.

A linear electric motor, designated generally by the reference character **23**, is provided for opening and closing the door **22**. The motor **23** comprises a magnetic assembly **24** fastened to the car and an elongated conductive element **25** fastened to the edge of the door **22**. The motor **23** may be any of various kinds but in the specific embodiment being described it is a two phase linear induction motor which operates in a manner analogous to that of the familiar squirrel cage motor. The magnetic assembly **24** includes appropriate energizing windings for generating a linearly moving magnetic field.

A shaft **26** is rotatably mounted on the car **21**. A crank arm **27** has one end rigidly fastened to the shaft **26** and the other end pivotally fastened to one end of a connecting rod **28** the other end of which is pivotally fastened to the door **22**. Accordingly, as the door is opened and closed by the motor **23**, the connecting rod **28** and the crank arm **27** cause the shaft **26** to rotate.

Referring now to FIGURES 2 and 3, there is shown a generally vertical mounting plate **31** which is formed with a vertically extending flange **32** and a horizontally extending flange **33**. The plate **31** is mounted within the wall of the car **21**. As best shown in FIGURE 3, the wall of the car includes an interior panel **34**, an exterior panel **35** and a number of cross pieces such as the cross piece **36**. The plate **31** is mounted along the inside surface of the exterior panel **35** and is bolted to the cross piece **36**.

The previously mentioned magnetic assembly **24** is fastened to the horizontal flange **33**. The conductive element **25** is fastened to an L-shaped bracket **37** which in turn is fastened to the door **22**. A roller **38** is fastened to a bracket **39** which in turn is also fastened to the horizontal flange **33** of the mounting plate **31**. The roller **38** is positoned to support and guide the conductive element **25**.

A switch **41**, sometimes referred to as the open limit switch (OL) is also fastened to the flange **33** and includes an actuator **42**. The switch is operated by an up-turned flange **43** of a bracket **44** which is fastened to the movable element **25** in such a position that the switch is actuated when the door **22** is in its fully open position as illustrated in FIGURE 2.

The previously mentioned shaft **26** is the operating shaft of a hydraulic cushioning device **46** which is mounted on the plate **31**. The device **46** operates in a well-known manner to cushion the door **22** as it reaches its fully open and fully closed positions. A locking plate **47** is rigidly fastened to the shaft **26** and to the crank arm **27**. The upper surface **48** of the plate **47** is arcuate in form and concentric with the shaft **26**. The arcuate surface **48** is broader than the remainder of the plate in a direction parallel to the axis of the shaft, as best shown in FIGURE 3. The plate **47** is also formed with a radial abutment **49**.

A locking arm **51** is pivotally mounted on the plate **31** by a shaft **52**. One end of this arm, the right hand end, as viewed in FIGURE 2, has a lower corner cutaway to form an abutment **53**. The arm **51** is positoned above the plate **47** so that gravity urges the right hand end downward towards engagement with the arcuate surface **48**. A small roller **54** is mounted near this end of the arm and is the portion of the arm which actually rests on the surface **48**.

An electromagnet **56** is mounted on the plate **31** just above the arm **51** and includes a movable element which is connected to a link **57** which in turn is pivotally connected to the arm **51** so that this arm is raised when the electromagnet **56** is energized. A switch **58**, sometimes referred to as the close limit switch (CL) is mounted on the plate **31** near the locking arm **51**. As best shown in FIGURE 3, the roller **54** is mounted on a stud **59** which projects in back of the arm **51** so as to engage the actuator of the switch **58**. The opposite end of the locking arm **51**, that is, the left hand end as viewed in FIGURE 2, is formed with an extension **61** which carries two machine screws **62** and **63** which are positioned to engage the actuators of switches **64** and **65** which are mounted on the plate **31**.

FIGURES 2 and 3 show the door **22** in its fully opened position. In order to close the door, the magnetic assembly **24** is energized by a circuit to be fully described subsequently. As the door closes, the connecting rod **28** and the crank **27** rotate the shaft **26** and the locking plate **47** clockwise. When the door is fully closed, the plate **47** will have rotated to the dotted line position which is just far enough to allow the locking arm **51** to drop down so that the two abutments **49** and **53** are juxtaposed. Rotation of the plate **47** in the counterclockwise direction is prevented, thereby locking the door closed. To open the door, the electromagnet **56** is energized thereby raising the locking arm **51** above the surface **48** to a position higher than the position shown in FIGURE 2. Then the motor **23** may be energized and the door opened.

It is to be noted that the arm **51** can assume any one of three positons. The first, or raised position, occurs during the door opening when the electromagnet **56** is energized to bring the arm **51** entirely out of contact with the surface **48**. The second, or intermediate position, occurs when the electromagnet **56** is de-energized and the door **22** is in any positon except its fully closed position. At this time, the roller **54** rests upon the surface **48** as shown in FIGURE 2. The third positon is a fully lowered position, which can occur only when the door **22** is fully closed and the electromagnet **56** is de-energized, so that the arm **51** can drop down to bring the abutment **53** opposite the abutment **49** so as to lock the door.

The switches **58**, **64** and **65** are each capable of assuming either a first or a second condition. The closed limit switch **58** is positioned and adjusted so that it assumes its first condition when and only when the arm **51** is in its third, lower position with the door locked. This switch is used in the control circuit as will be more fully explained.

The switch **64**, although operated by the extension **61**, is also positioned and adjusted so that it assumes its first condition when and only when the arm **51** is in its third position with the door locked. This switch is used as a signaling device and may be connected to either light or extinguish a lamp when the door is locked.

The switch **65** is positioned and adjusted so that it assumes its first condition when and only when the arm **51** is in its first or raised position. As soon as the electromagnet **56** is de-energized, dropping the arm **51** to its second position, the switch **65** assumes its second condition in which it remains as long as the arm **51** is in either its second or its third position.

Referring now to FIGURE 4, there is shown the electric circuit for opening and closing the door. Lines L1 and L2 are connected to a suitable alternating current source. The motor **23** is provided with terminals **71** and **72**, bridged by a capacitor **74**, and with a common terminal **73** which is connected through a normally closed contact K1A to the line L2. An adjustable resistor **75** is connected between line L1 and the arm of the switch **65** which is a single pole double throw switch. A warning lamp **76** has one terminal connected through the switch **64** to the line L1 and the other terminal connected to the line L2. A switch **77** is provided to open and close the door. This switch may be operated either manually or automatically but for purposes of explanation it will be assumed that the switch is manually operated. A timing circuit **78** includes the operating winding of a relay K1 which controls the previously mentioned contact K1A.

The remainder of the circuit can best be explained by considering its mode of operation. FIGURE 4 shows the position of the parts when the door **22** is closed. The locking arm **51** is in its third position; the switch **64** is in its first condition which is open and the lamp **76** is extinguished; the closed limit switch **58** is in its first condition which is open; the open limit switch **41** is closed; and the switch **65** is in its second condition which corresponds to its upper position as shown in the drawing. In order to open the door the switch **77** is moved to its "open" position thereby energizing the electromagnet **56** and raising the locking arm **51** to its first position. This closes the switches **58** and **64** and moves the switch **65** to its lower position. Accordingly, the terminal **72** is energized directly from the alternating current source while the terminal **71** is energized through the capacitor **74**. The door **22** is opened, the switch **41** is opened, and the motor is de-energized.

In order to close the door the switch **77** is moved to its "close" position thereby de-energizing the electromagnet **56**, thus allowing locking arm **51** to drop to its second position at which the roller **54** engages the surface **48** of the locking plate as shown in FIGURE 2. This movement of the arm **51** raises the switch **65** to its upper position and, since the switch **58** is closed at this time, the terminal **71** is energized directly while the terminal **72** is energized through the capacitor **74**. The door starts to close. If no obstructions are encountered the door closes allowing the arm **51** to drop to its third position and lock the door thereby opening the switch **58** and de-energizing the motor.

If an obstruction, such as a person, is in the path of the door it will be prevented from closing. The torque of the motor has been limited by resistor **75** so that no injury to the passenger can result. However, continued energization of the motor may cause it to overheat. To prevent such overheating, timer **78** is provided. If the door **22** does not completely close within a predetermined time after closing has been initiated, the timing circuit **78** operates to energize the relay winding K1 thereby opening the contact K1A and de-energizing the motor. After another predetermined time, the winding K1 is de-energized thereby closing the contact K1A, whereupon the motor **23** is again energized so as to close the door. This cycle of alternate energization and de-energization continues until the door is closed.

Rapid transit cars are usually provided with doors at each side but it is seldom that doors on both sides are opened simultaneously. Therefore a single timing circuit **78** can be used for the doors on both sides of the cars. Assuming, for example, that the motor **23** and door **22** are installed on the right hand side of the car, the left hand side is provided with a motor **81** including terminals **82, 83** and **84** similarly connected. However, the same timing circuit **78** is also connected to the terminal **82** while the terminal **84** is connected to the terminal **73** so that the timing circuit **78** is operative whenever either the right or the left door is closed.

The details of the timing circuit **78** are shown in FIGURE 5. The terminal **71** and the line conductor L2 are connected to the input terminals of a conventional full wave rectifier circuit **91** comprising four rectifying elements connected to the familiar bridge circuit. The positive output terminal is connected to a conductor **92** and the negative output terminal is connected to a conductor **93**. Two additional rectifying elements **94** and **95** are connected to form alternative upper legs of the bridge and provide a second input which is connected to the terminal **82**. Thus, when either the terminal **71** or the terminal **82** is energized with alternating current, a voltage appears on the conductor **92** which voltage is positive with respect to the conductor **93**.

The voltage on conductor **92** causes a current to flow through the low valve resistor **96** so as to charge a capacitor **97** quickly. A voltage regulating element such as a tube **98** is connected across the capacitor **97** so as to hold the potential of the junction **101** substantially constant. A conductor **102** is connected to the junction **101** and assumes a positive potential whenever either the terminal **71** or **82** is energized. Similarly, the junction **103**, which is connected to the junction **102** through a resistor **104**, becomes positive with respect to conductor **93**.

Three silicon controlled rectifiers **106, 107** and **108** are all non-conducting initially because their gate electrodes are at the same potential as their cathodes. The rectifiers **107** and **108** are connected in a conventional asymmetrical multivibrator circuit in which, when the circuit is enabled, the two rectifiers conduct alternately. The rectifier **106** is connected in a circuit which enables the multivibrator after a predetermined time.

Upon the appearance of a voltage at the junction **101**, a current flows through the resistors **111** and **112** and starts to charge the capacitor **113**. This circuit has a substantially longer time constant than the resistor **96** and capacitor **97** but eventually the potential of the capacitor **113** rises sufficiently to cause a current to flow through the neon tube **114** and to render the controlled rectifier **106** conductive. The junction **103** falls quickly to substantially ground potential. A capacitor **115** starts to charge through the resistors **116** and **117**. Likewise a capacitor **121** starts to charge through the relay winding K1 and a resistor **122**. The circuit of capacitor **115** has a shorter time constant so that presently the potential thereof rises sufficiently to cause the neon tube **123** to conduct thereby turning on the controlled rectifier **107**. The multivibrator action almost immediately removes any partial charge from the capacitor **121** through a resistor **124** and a rectifying element **125**. However, the capacitor **121** immediately starts to charge again through the resistor **122**.

Eventually the potential rises sufficiently to cause the neon tube **126** to conduct therefore turning on the controlled rectifier **108**. The relay winding K1 is energized, the contacts K1A (FIGURE 4) are opened, and the motor **23** is de-energized. At the same time the controlled rectifier **107** is cut off and the capacitor **115** starts to re-charge. Eventually, the controlled rectifier **107** is again turned on thereby turning off the rectifier **108**, de-energizing the relay K1 and closing the contact K1A. Thus the motor **23** is alternately de-energized and energized. The cycle repeats until the door closes.

Reviewing the operation of the timing circuit, the motor **23** is energized to close the door and if there is no obstruction it is de-energized by the opening of the closed limit switch **58**. If not so de-energized in a predetermined time, namely, the time required to charge the capacitors **113, 115** and **121** successively, the contact K1A is opened thereby de-energizing the motor. After another predetermined time, namely, the time required to charge the capacitor **115**, the motor is re-energized. Then, after another predetermined time, namely, the time required to charge the capacitor **122**, the motor is again de-energized and the cycle repeats until the door closes.

The operation has been described as occurring when the terminal **71** is energized to close the door and this is correct. The timing circuit **78** also starts to operate when the terminal **72** is energized to open the door. However, the door normally opens quickly and reaches its fully open position before the timing circuit **78** can operate. While it is not necessary that the timing circuit operate during the opening of the door, such operation does no harm and actually provides additional protection to the motor.

The invention may also be applied to the end doors of a rapid transit car, that is, to the doors through which one passes when going from one car to another. As shown in FIGURE 6, the car **21** is provided with sliding doors **131** and **132** at each end. A linear electric motor **133** comprising a magnetic assembly **134** including an energizing winding is fastened to the edge of the door **132**. An elongated conductive element **135** is fastened to the structure of the car. A shaft **136** is also mounted on the car structure and a crank arm **137** is rigidly fastened thereto. A connecting rod **138** has opposite ends pivotally fastened to the crank arm **137** and to the door **132**. Thus, the motor opens the door and the door rotates the shaft **136**.

As best shown in FIGURE 7, a bracket **141** is formed with a generally horizontally flange **142** which is fastened the bottom of the magnetic assembly **134**. The bracket **141** is also formed with a generally vertical flange **143** which is fastened to the door **132**. The conductive element **135** is fastened to the car structure by means of a rubber block **144** which also serves as a resilient stop for the assembly **134** in case it should overtravel. A switch **146**, also fastened to the car structure, includes an actuator **147** which is operated by a strap **148** fastened to the bracket **141** in such a position as to actuate the switch **146** when the door is in its fully opened position as shown in FIGURE 7.

As best shown in FIGURE 8, the end wall of the car **21** includes an interior panel **151**, an exterior panel **152** and two frame members or braces **153** and **154**. A rigid block **155** is fastened to the brace **153** and supports a strong rigid plate **156** which in turn supports a mounting plate **157**. As shown in FIGURE 7, a cushioning device **159** is fastened to the plate **157** and carries the previously mentioned operating shaft **136** to which the crank arm **137** is rigidly fastened. A locking plate **161** similar to the plate **47** of FIGURES 2 and 3, is fastened to the shaft **136** and the arm **137**. A locking arm **162** is similar to the arm **51** except that the extension **163** on the left side may be formed slightly differently so as to accept two machine screws **164** and **165** side by side, which screws operate switches **166** and **167** respectively. These switches are both actuated to their first condition when and only when the arm **162** is in its first, raised, position. A switch **168**, comparable to the switch **58** of FIGURE 2, is actuated to its first condition when and only when the arm **162** is in its third, lowered position with the door locked. An electromagnet **169** is operatively connected to the arm **162** so as to unlock the door when energized in the same way that the electromagnet **56** unlocks the door **22**.

The end door **132** is operated a little differently from the side door **22**. On the interior wall of the car, adjacent to the door, is a push button. When this button is depressed, the door opens and remains open for a predetermined time after which it closes. The circuit for accomplishing this is shown in FIGURE 9.

In FIGURE 9, the parts are shown in the positions they are in when the doors are fully closed. When power is first applied to the alternating current lines L1 and L2, current flows from L1 through the switch **166** and the rectifier **171** to the line L2. The relay winding K2, which is connected to the output terminals of the rectifier **171**, is energized thereby closing the contacts K2A. A capacitor **172** is charged by being connected in series with resistors **173** and **174** and a rectifying element **175** across the output of the rectifier circuit **171**. The two resistors **173** and **174** are of comparatively low value so that capacitor **172** can charge quickly. The relay winding K2 is connected from one terminal of the capacitor **172** through a large resistor **176** to the junction of the resistors **173** and **174**.

To open the door, the push button **181** is depressed momentarily thereby energizing the electromagnet **169** and raising the arm **162** to its first position which closes the switch **168** and moves the switches **166** and **167** to their first conidtion which is the opposite condition from that shown in FIGURE 9. The electromagnet **169** is maintained energized through a circuit including the switch **166** and the contacts K2A which are now closed. The operation of the switch **166** also removes the alternating voltage source from the rectifier **171**, tending to de-energize the relay winding K2. However, the capacitor **172** discharges through the resistors **173** and **176** and the winding K2 thereby holding it energized for a predetermined time. At the same time, the motor **133** is energized through an adjustable resistor **182** and the switch **147** so as to open the door. When the door is fully opened the switch **147** is opened thereby de-energizing the motor. Eventually the capacitor **172** becomes discharged to such an extent that the relay winding K2 becomes de-energized thereby opening the contacts K2A which de-energize the electromagnet **169**. The switch **167** is thereby moved to its upper position so that the motor **133** is energized through the switch **168**, which is now closed, thereby closing the door. The capacitor **172** recharges quickly through the rectifier **175** and the low value resistors **173** and **174**. The apparatus is now ready for another cycle of operation.

It is to be noted that in the embodiment described in connection with FIGURES 1, 2 and 3, the magnetic assembly of the motor is stationary while the conductive element moves. This arrangement is suitable when the hollow wall is very thin so that it is impossible to place the door and the conductive element side by side. However, this arrangement requires a substantial amount of clearance in the lateral direction. As is apparent from FIGURE 1, when the door opens, the element **25** moves a substantial distance to the left but the door does not reach the magnetic assembly **24** which is in substantially the same plane as the door. In contrast, in the embodiment of FIGURES 6, 7 and 8 there is more room between the panels of the end wall but much less room in the direction of door motion. These conditions lend themselves to the use of a stationary conductive element and a movable magnetic assembly. As shown in FIGURE 8, the door **132**, when open, is behind both the conductive element **135** and the mounting plate **157**.

From the foregoing description it is apparent that the present invention provides a simple operating mechanism for the doors of rapid transit cars which mechanism provides the necessary locking safeguards and which mechanism can be placed within the walls of the cars.

Although some preferred embodiments of the invention have been described in considerable detail for illustrative purposes, many modifications will occur to those skilled in the art.

What is claimed is:

1. Closure apparatus, comprising,
a structure,
a sliding door mounted on said structure for lateral movement between open and closed positions,
motive means for moving said door between said open and closed positions,
switch means for controlling said motive means,
a locking plate rotatably mounted on said structure,
means interconnecting said door and said locking plate for rotating said locking plate about an axis of rotation in response to lateral movement of said door,
a locking arm pivotally mounted on said structure and angularly displaceable relative to said structure about a pivot axis to first, second and third angularly spaced positions, said locking arm being operative at said first position to operate said switch means to control said motive means for opening said door and said locking arm being operative at said second position to operate said switch means to control said motive means for closing said door and said locking arm being operative at said third position to cooperate with said locking plate for locking said door when said door is fully closed, and
means for angularly displacing said locking arm.

2. Apparatus according to claim **1** in which
said locking plate is formed with an arcuate surface and is formed with a first abutment disposed at one end of said surface,
said locking arm is formed with a second abutment and said locking arm has a roller rotatably connected therto, said roller being disposed adjacent said second abutment, and
said locking arm is mounted in such position that the force of gravity acting thereon urges said second abutment toward a position opposite said first abutment when said door is closed and urges said roller into engagement with said arcuate surface while said door is being closed.

3. Apparatus according to claim **1** in which said means interconnecting said door and said locking plate includes a thrust member, and in which said door has a central portion disposed between the top and bottom edges of said door that is connected to said thrust member.

4. Apparatus according to claim **3** in which said means interconnecting said door and said locking plate includes
a crank arm rigidly fastened to said plate, and in which
said thrust member is a connecting rod pivotally connected at opposite ends to said crank arm and to the central portion of said door.

5. Apparatus according to claim **3** in which said motive means has a portion connected to and controlled by said switch means and a portion connected to said door for moving said door between open and closed positions.

6. Apparatus according to claim **5** in which said motive means is a linear electric motor including first and second relatively movable members, one of said members being connected to said door adjacent to said thrust member connection.

7. Apparatus according to claim **6** in which said first member is an assembly including energizing windings and said second member is an elongated conductive element, and in which said motive means has means for adjusting the driving force appled by said motive means to said door.

8. Apparatus according to claim **7** in which said first member is fastened to said door and said second member is fastened to said structure.

9. Apparatus according to claim **5** further comprising means jointly responsive to the elapse of a predetermined time after initiation of door closing and to the location of said locking arm in said second operative position and said door in at least a partly opened position for alternately deenergizing and re-energizing said motive means.

10. Apparatus according to claim **5** further comprising manually operable means for energizing said motive means to open said door, and

means jointly responsive to the elapse of a predetermined time after initiation of door opening and to the location of said locking arm in said second operative position for energizing said motive means to close said door.

11. Apparatus according to claim **6**, including a rotary fluid cushioning device which has a shaft fixedly connected to said locking plate coaxially therewith and which serves to bring said door to a smooth stop as it approaches its fully opened and fully closed positions, and including an electromagnet having a movable element operatively connected to said locking arm, and including a mounting plate which supports said locking arm and cushioning device and electromagnet on one side thereof and which is supported by said structure.

12. Apparatus according to claim **11** in which said structure includes a hollow wall formed with an interior and an exterior panel, said panels forming a space therebetween in which said mounting plate is disposed,

said wall being formed with an opening through both of said panels,

said door being mounted so as to at least partially cover said opening when in its closed position and so as to retract into said space between said panels and to be disposed adjacent to said mounting plate when in its open position.

13. Apparatus according to claim **6** in which said switch means includes first, second and third electric switches, all mounted on said structure, each capable of assuming either a first or a second condition, the condition of each being controlled by the position of said locking arm in each of the three operative positions of said locking arm.

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