Dec. 18, 1951 J. A. SCHWEIG 2,579,017

ELEVATOR DOOR CONTROL MECHANISM

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FIG. 1.

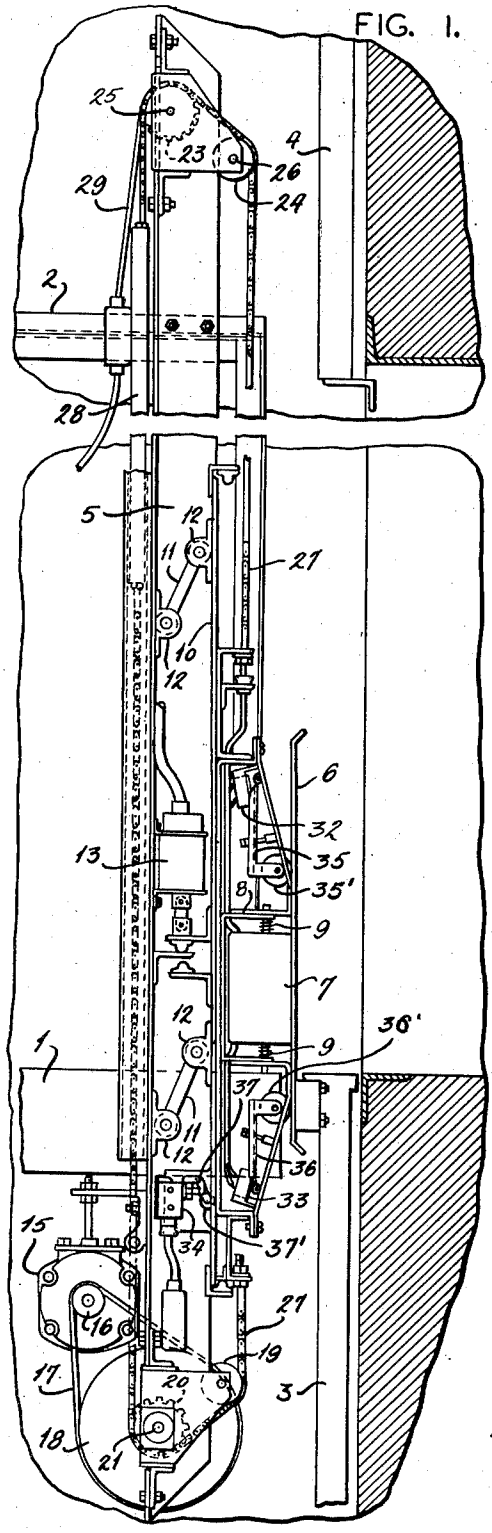

FIG. 2.

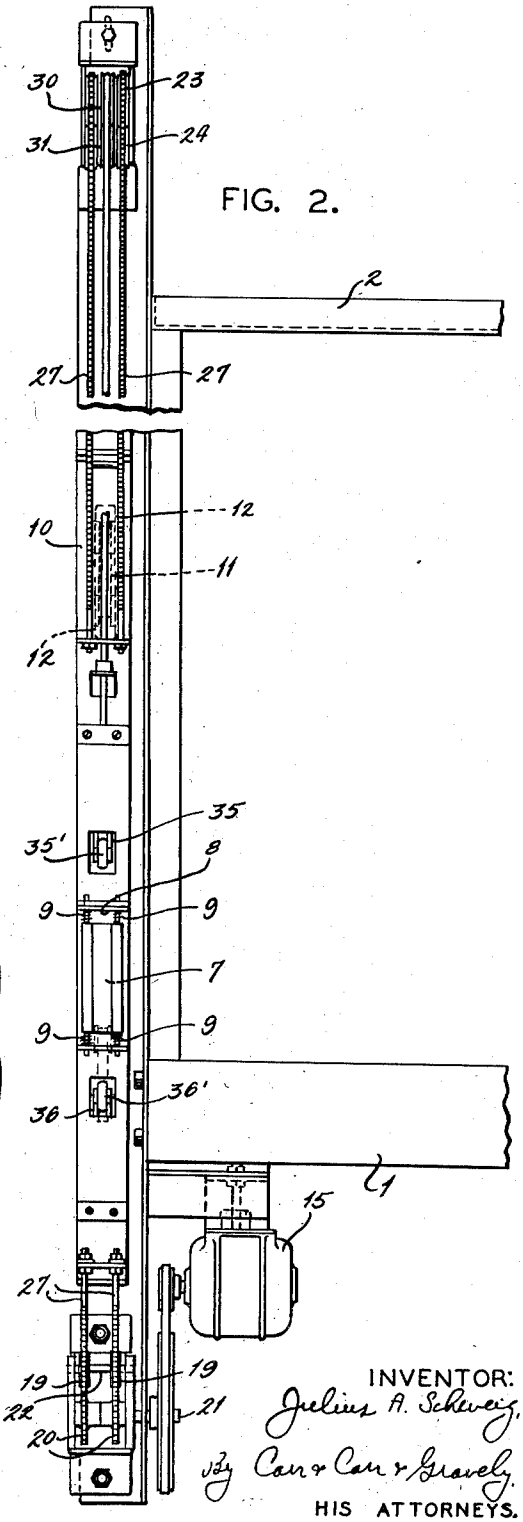

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FIG. 6.

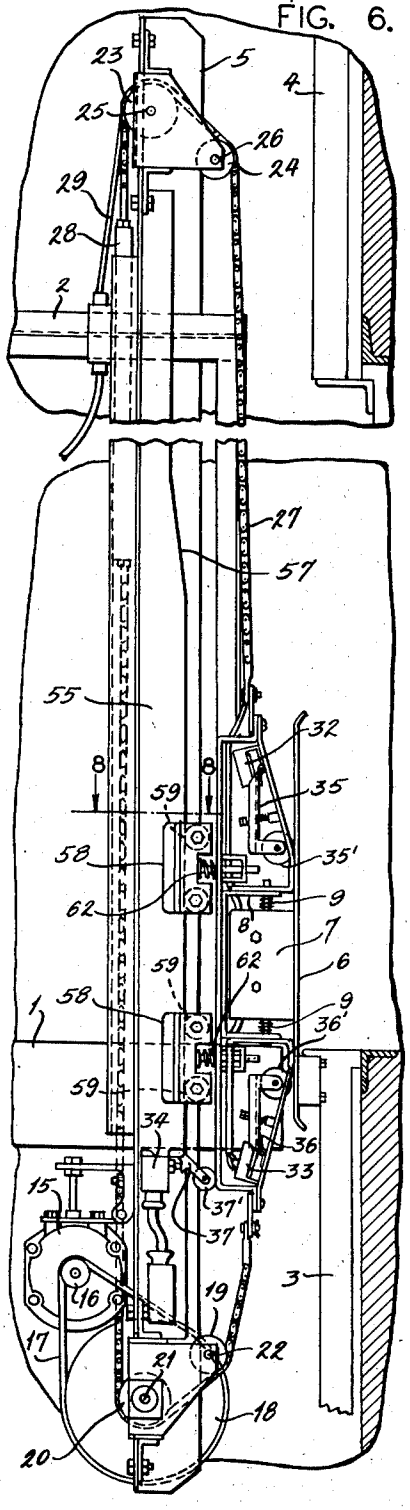

FIG. 7.

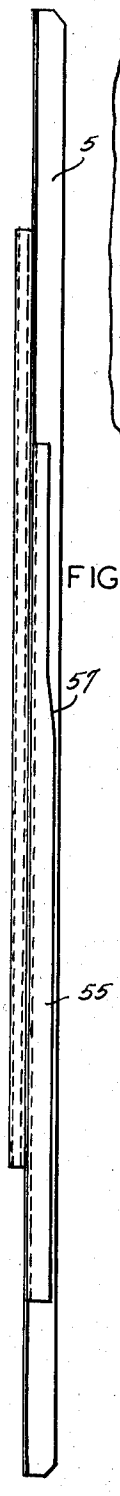

FIG. 3.

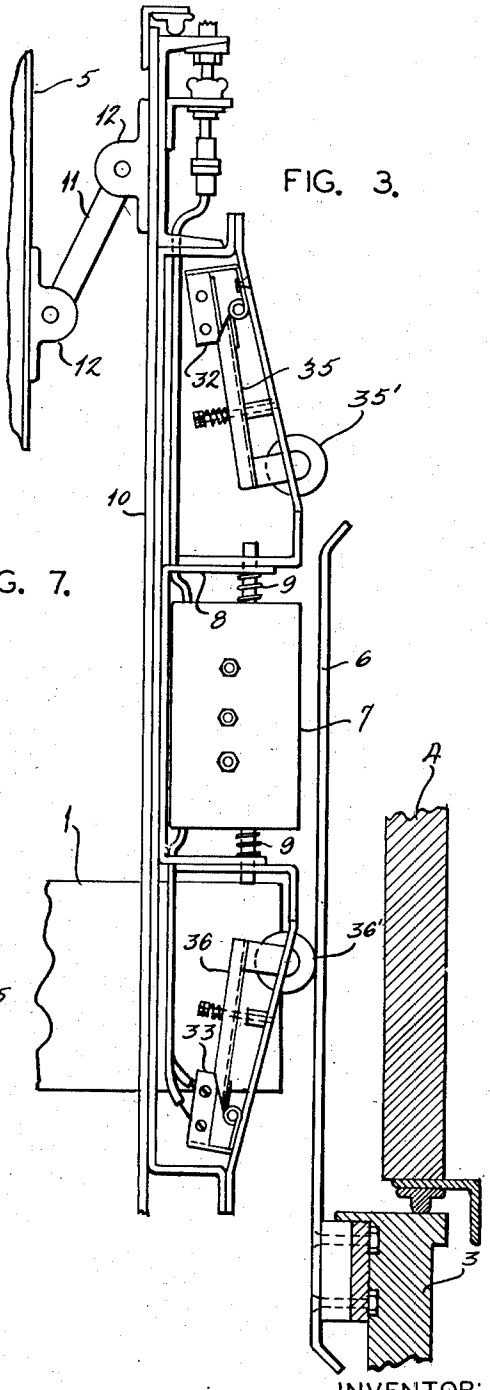

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FIG. 5.

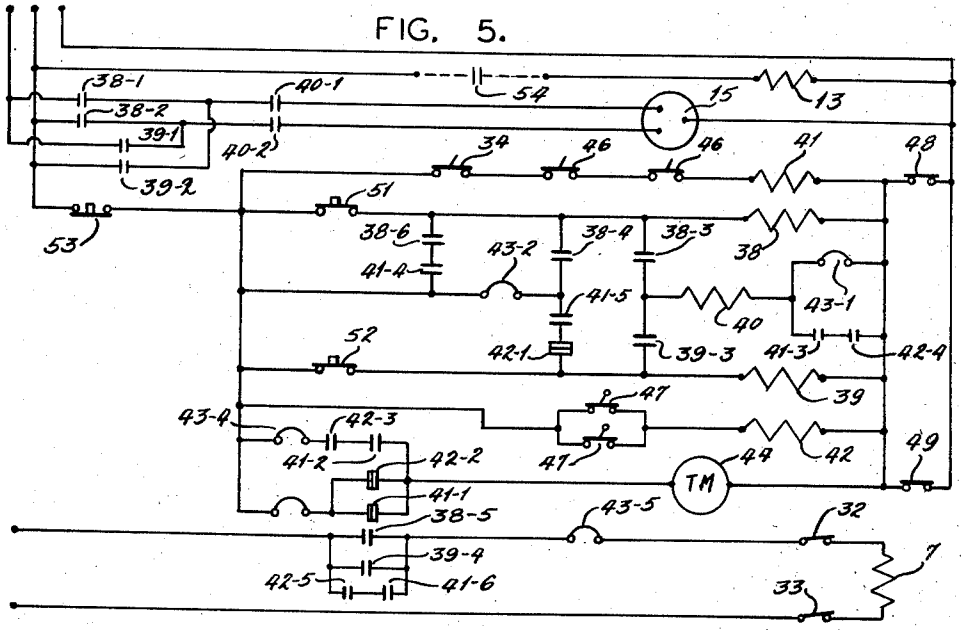


FIG. 4.

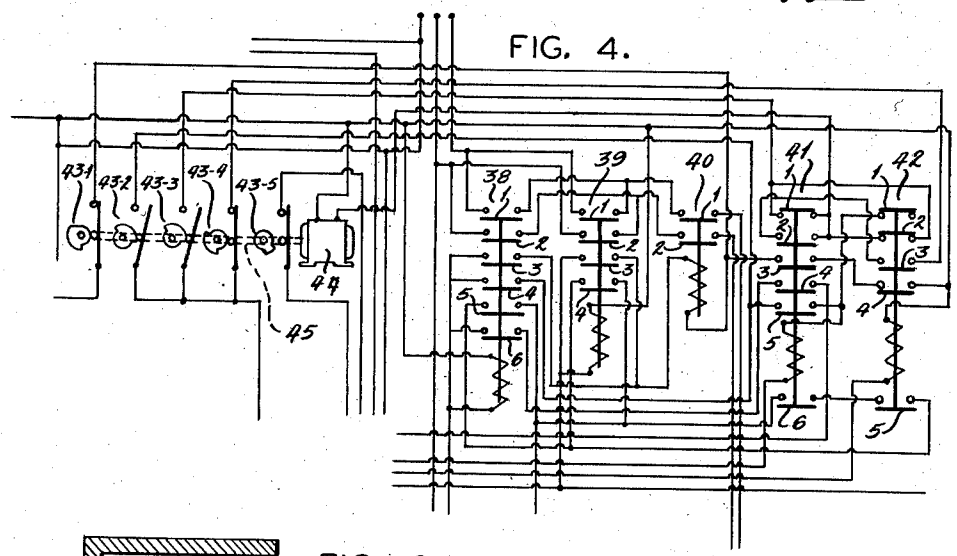
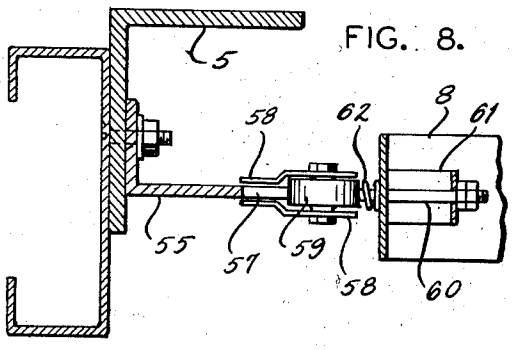


FIG. 8.



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UNITED STATES PATENT OFFICE

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ELEVATOR DOOR CONTROL MECHANISM

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Application December 30, 1949, Serial No. 136,029

14 Claims. (Cl. 187—51)

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This invention relates to operators for elevator shaft closures or doors and is more particularly directed to an improved magnetically operated means for gripping a sliding elevator shaft door as soon as the car is stopped or moving in the leveling zone.

One of the objects of the invention is to provide an electromagnetic operator for a counterbalanced elevator door that will become operative as soon as the car enters the leveling zone or has completely stopped.

Another object of the invention is to provide means for retracting the magnetic grip when it reaches the limit of travel for allowing the energizing switches therefor to clear the armature, thus permitting the operator to be used on high speed elevators.

A further object of the invention is to provide means for delaying the energization of the door gripping means until the latter, while moving up and down, is in position opposite the armature on the door.

A still further object of the invention is to permit over-travel of the gripping means in both directions of operation to thereby insure proper engagement during each operation of the gripping means with the armature on the door in both directions of operation.

This invention consists in an elevator shaft door operator in which vertically movable magnetic gripping means is provided and mounted on the car, the gripping means being energized as the car stops opposite the shaft door, or is in a leveling zone, the magnet gripping an armature secured to the door, the magnetic energization being delayed until the magnet is opposite the armature. The invention also consists in the provision of a pair of switches, associated with the assembly for the magnet, that are engageable with the armature and in which the magnetic energization is delayed until the magnet is opposite the armature and in which the magnet is deenergized after the door has been opened or closed.

In the drawings:

Fig. 1 is a side elevational view of an elevator door operator incorporating the invention,

Fig. 2 is a front elevational view thereof,

Fig. 3 is a view showing some of the parts illustrated in Fig. 1 but in a different operating position,

Fig. 4 is a single line diagram of the elevator door operator control,

Fig. 5 is a portion of the wiring diagram of the switching equipment for the elevator door operator control,

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Fig. 6 is a side elevational view of a modified form of the invention,

Fig. 7 is an elevational view of the magnet projecting means shown in Fig. 6; and

Fig. 8 is a sectional view taken along the line 8—8 of Fig. 6.

The invention is embodied in the structure and circuits set forth in the several views of the drawings in which the numeral 1 designates the floor or platform of an elevator car and 2 the roof of the car. A door comprising vertically sliding counterbalanced sections 3 and 4 closes the opening in the elevator shaft. A column 5 is mounted on the platform and secured to the roof of the elevator car. This column supports the mechanism for opening and closing the vertically movable door sections 3 and 4.

An armature 6 is suitably secured to the door section 3 and is engageable with an electromagnet 7. The electromagnet is vertically movable along column 5, raising and lowering the door section 3. The door section 4 moves oppositely to section 3, being suitably connected thereto by conventional mechanism (not shown). The electromagnet 7 is disposed in a substantially U-shaped frame 8 and resiliently mounted therein by means of springs 9 disposed between the magnet and the ends of the frame 8. The frame 8 bears on a guide plate 10 movable toward or away from the armature 6, the guide plate being pivotally supported on column 5 by links 11 which are pivotally mounted on the column 5 and guide plate 10, there being suitable brackets 12 provided to which the links are secured. A solenoid 13 secured to column 5 moves the guide plate vertically in one direction, gravity moving it in the opposite direction. The solenoid in Fig. 1 is shown in the deenergized position, having permitted the guide plate 10 to drop by gravity and project the electromagnet 7 into position for engagement with the armature 6.

Fig. 3 shows the position of the armature relative to the electromagnet assembly when the car is moving toward the landing zone. The trailing roller 35', arbitrarily selected as such, has not contacted the armature but the electromagnet has begun to move in door opening direction, after which the trailing roller contacts the armature. This action closes the switch actuated by the trailing roller, thus closing the circuit to the electromagnet which then goes into engagement with the armature. Since the electromagnet is already moving toward door open position, the door section is carried along with the traveling electromagnet, thus opening the door.

Vertical motion is imposed on the electromag-

net 7 and its supporting frame 8 by a reversible electric motor 15 having a pulley 16 mounted on the armature shaft, motor 15 being secured to column 5 on the elevator car platform 1. A pulley 18 and sheaves 19 are rotatably supported in a bracket mounted on the lower end of column 5, pulley 18 being driven from pulley 16 by means of a belt 17. The pulley 18 is secured to a shaft 21 on which driving sheaves 20 are mounted. Sheaves 19 are mounted on shaft 22, constituting combination idler and guide sheaves. Idler sheaves 23 and 24 are mounted on shafts 25 and 26, respectively, the latter being rotatably supported in a bracket mounted on the upper end of column 5. A pair of chains 27 are connected to the upper and lower ends of the frame 8, passing over sheaves 19, 20, 23 and 24, each having a weight 28 interposed between the ends of the chains which counter-balances the weight of the electromagnet 7 and its associated parts. The counterweights move in a suitable shield, thereby minimizing operational hazards. The sheaves 19 and 24 cause the plane in which the electromagnet assembly is moved, to shift laterally in closer proximity to the armature. Under certain conditions the guide plate may be omitted, in which event the electromagnet will be located in close proximity to armature 6 so that when the electromagnet is energized, it will be magnetically drawn into engagement with the armature.

Power is applied to the various operating mechanisms through a cable 29 which is led over sheaves 30 and 31 mounted on shafts 25 and 26. The various conductors in the cable are then connected to the electromagnet 7 and to switches 32 and 33. The switches for the electromagnet are mounted at the upper and lower ends of the frame 8. A motor stop switch 34 is mounted near the lower end of guide plate 10 that controls the stopping of motor 15 after the vertically sliding door sections have been opened. Suitable stops have been provided at each end of the guide plate for limiting the movement of the magnet frame and confining it to the door opening movement plus over-travel. The switches 32 and 33 are operated by levers 35 and 36 respectively, switch 34 being actuated by lever 37. The switches 32 and 33 prevent energization of the magnet until the magnet assembly is in position opposite armature 6. The door control circuit is prepared for operation by zone switch 48 or 49 shown on the single line diagram in Fig. 5. Control switch 51 energizes the opening switch 38 and motor 15 starts to rotate. On the normal position (door closed) the electromagnet assembly is above the position of armature 6 and must travel in the downward direction for engaging said armature. When opening switch 38 is energized and motor 15 moves the electromagnet assembly in the downward direction, said assembly will come into position with the armature 6. At this time switches 32 and 33 will be closed, completing the circuit to the electromagnet and causing energization of same. Energization of the electromagnet engages it with armature 6 and the door is thus moved to open position. Levers 35 and 36 have rollers 35' and 36' mounted thereon and engageable with armature 6. Both switches 32 and 33 must be closed before the electromagnet 7 can be energized. The roller 37' on lever 37 is engaged by frame 8 at the lower end of its travel so that motion will be stopped. The guide plate 10 may be omitted, in which event the switch 34 is moved to such a position that the frame 8 will contact roller 37' for moving lever 37 and operating said switch.

The control circuit for the door operator consists of reversing switches 38 and 39, sequence switch 40, sequence relays 41 and 42, and timing device or switch 43. The circuits in which the several contacts of each of these switches are placed, are shown in Fig. 4, while Fig. 5 shows the complete circuit organization thereof. Other single switches for the control circuits are included in Fig. 4 and not shown in Fig. 5.

The reversing switch 38 is provided with two contacts 38—1 and 38—2 connected in the circuits of motor 15. Two of its contacts 38—4 and 38—6 are connected in the holding circuit for the solenoid of the contactor, thus holding switch 38 in closed position for each operating position of limiting switches 34 and 46. When closed, contact 38—3 completes the circuit for the solenoid of switch 40, contact 38—5 being included in the circuit of the electromagnet 7. The latter circuit is preferably a direct current circuit.

The reversing switch 39 is provided with two contacts 39—1 and 39—2 connected in the circuit of motor 15. Contact 39—3 is included in the circuit for the solenoid switch 40, and contact 39—4 is included in the circuit for the electromagnet 7. The solenoid switch 40 has two contacts 40—1 and 40—2 connected in the circuit of motor 15. This switch is provided for the purpose of interrupting power to motor 15 when the elevator doors are approaching the closed or open position thereof, thus permitting the door sections 3 and 4 to coast to near their closed or open position and to re-apply power to the motor for completing the movement of the door sections.

The desired operation of solenoid switch 40 is controlled by sequence relays 41, 42 and timer contact 43—1 for the purpose of avoiding operation of the reversing switches 38 and 39. The directional movement of the door sections 3 and 4 is determined by the setting of switches 38 and 39 and maintained thereby, thus assuring the proper directional movement of the door sections regardless of the operation of solenoid switch 40.

Sequence relay 41 has a normally closed contact 41—1 and a normally open contact 41—2, each of which is connected in the timing motor 44 circuit. It also has one normally open contact 41—3 included in the circuit of the solenoid switch 40 and one normally open contact 41—4 in one of the holding circuits for reversing switch 38. The normally open contact 41—5 is included in the closing circuit of the solenoid for reversing switch 39. The normally open contact 41—6 is included in the circuit of the electromagnet 7.

Sequence relay 42 has a normally closed contact 42—1 connected in the circuit for the solenoid of reversing switch 39 and is provided with a normally closed contact 42—2 and one normally open contact 42—3 connected in the circuit of the timing motor 44. Contact 42—4 is normally open and is included in the circuit for the solenoid switch 40. A contact 42—5 is connected in series with contact 41—6, all of which is included in the circuit for the electromagnet 7.

The timing switch consists of not only motor 44 for driving same, but includes a cam shaft 45 on which a plurality of cams are mounted, each actuating one of the switches 43—1 through 5. The cam shaft 45 makes one complete revolution for each operation of the door sections 3 and 4. During a portion of each revolution, the timing device is reset, and during the balance of each

revolution, the final application of power is made to motor 15 for completing the closing or opening of the door sections 3 and 4. The timing device and the solenoid switch 40 operate during both directions of movement of the door sections, thereby obviating duplication of the equipment.

The timing device contact 43—1 is connected in the circuit for the solenoid switch and when the door sections are in their fully open or closed position, the contact is closed. It opens during the resetting movement of the timing device and closes during the final movement thereof, thus energizing the solenoid switch 40 and applying power to the door sections 3 and 4 for opening or closing thereof.

The timing device contact 43—2 is connected in the circuits common to the solenoids for reversing switches 38 and 39. The function of this contact is to maintain the circuits of either of the reversing switches 38 or 39, depending upon which is closed, for the final movement of the timing device, and then deenergize or open the circuits for the solenoids of reversing switches 38 and 39. This contact is open when the door sections are fully open or closed, and closes during the time the timing device resets. It again opens at the conclusion of the final movement of the timing device.

The timing device contact 43—3 is connected in the circuit of the timing motor 44, which contact is open when the door sections are fully opened or closed. It closes during the resetting movement of the timing device, remaining closed during the final movement thereof, and then opens to stop the timing motor 44.

The timing device contact 43—4 is connected in the circuit of the timing motor 44 and is closed when the door sections 3 and 4 are fully opened or closed. This contact completes the circuit to the timing motor 44 when relays 41 and 42 are energized by the door moving enough to close both limit switches 46 and 47 operable by the door sections when they reach the end of their travel, and completing the circuits through contacts 41—2 and 42—3. When the door sections are partly opened or closed and disengaged from both limit switches 46 and 47, the circuit of the timing motor 44 is closed, thereby enabling the timing device to reset. The reset travel stops when contact 43—4 opens.

The timing contact 43—5 is connected to the circuit of the electromagnet 7 and is closed during all but the final movement of the cam shaft 45. This contact opens the circuit for the electromagnet after the door sections 3 and 4 have been fully opened or closed, thus permitting the electromagnet to over-travel in the direction of movement of the door sections which insures complete engagement of the electromagnet 7 with armature 6 when the direction of travel of the electromagnet is reversed.

The zone switches 48 and 49 are provided for preventing energization of either of the reversing switches 38 or 39 unless the elevator car is in a landing zone and prior to energization of the electromagnet. These switches may be operated by a suitable cam mounted on the elevator car. The limit switch 34 located on the electromagnet unit, will disconnect contactor 38 in the event of failure of power to the electromagnet, thus allowing the electromagnet to pass up armature 6 on the door. Suitable switches 51 and 52 located in the elevator car are provided in the circuits for reversing switches 38 and 39 for the purpose of opening and closing the door. A manually operated switch 53 is included in the limit switch circuits for stopping the movement of the door at any time. This switch may be located either in the elevator car or at any other suitable location.

In installations where a guide plate 10 is employed, the solenoid 13 therefor is controlled by a switch 54 usually located on the control device for the elevator. This switch is arranged to open when the elevator stops or levels to a landing.

A modified form of the invention is illustrated in Figs. 6 through 8 of the drawings in which the same parts described in Fig. 1 are identified by the same reference numerals.

The electromagnet 7 and the frame 8 in which it is carried, is projected toward or away from the armature 6 by means of a bar 55 secured to column 5 mounted on the elevator car platform 1 and the roof 2. The bar 55 is preferably L-shaped, one leg of which has a cam surface 57 formed thereon. This cam surface is so positioned on bar 55 that during motion of the electromagnet 7 relative to the car for opening and closing the door sections 3 and 4, that it will be moved in close proximity to the armature 6. The lateral motion of the electromagnet 7, as viewed in Fig. 7, in response to the cam is directed by cam followers 58 mounted on frame 8. Each cam follower is provided with a pair of rollers 59, preferably antifriction bearings rotatably mounted therein. The sides of the followers 58 embrace the leg of the bar having the cam formed thereon. These rollers engage the cam surface and ride on the leg of the bar on which it is formed. Each guide has a bar 60 secured therein slidably mounted in the frame 8 and in a bracket 61 secured to the frame. A spring 62 is disposed on each of the bars between the followers 58 and frame 8 for the purpose of cushioning any shock between the cam bar and the frame.

What I claim is:

1. In an elevator shaft, a door for said shaft and an elevator car movable in said shaft, an operator for said door comprising an electromagnet assembly mounted on said car, an armature on said door for engagement with said electromagnet, means for reversely moving said electromagnet for opening and closing said door; and means for energizing said electromagnet when the car reaches a predetermined zone in said shaft.

2. In an elevator shaft, a door for said shaft and an elevator car movable in said shaft, an operator for said door comprising an electromagnet reversely movably mounted on said car, an armature on said door, an electromagnet on said car adapted for engagement with said armature for reversely moving said door, means for energizing said electromagnet after said car reaches a predetermined zone opposite said armature; and means for retarding and arresting the motion of said electromagnet as the door reaches the end of its movement.

3. In an elevator shaft, a door for said shaft and an elevator car movable in said shaft, an operator for said door comprising an electromagnet mounted on said car, an armature mounted on said door for engagement with said electromagnet, means for reversely moving said electromagnet for opening and closing said door, means for energizing said electromagnet when the car reaches a predetermined zone; and means for initiating movement of said electromagnet prior to energization thereof.

4. In an elevator shaft, a door for said shaft

and an elevator car movable in said shaft, an operator for said door comprising an electromagnet, means for supporting said electromagnet on said car for vertical movement, means for reversely vertically moving said electromagnet, an armature on said door engageable with said electromagnet, the electromagnet opening and closing said door as it is moved vertically, means for energizing said electromagnet when it is in position opposite said armature; and means for permitting over-travel of said electromagnet in either direction of its movement to thereby provide for the proper positioning of the electromagnet and armature during the return movement of said door.

5. In an elevator shaft, a door for said shaft and an elevator car movable in said shaft, an operator for said door comprising an electromagnet, means for supporting said electromagnet on said car for vertical movement, means for reversely vertically moving said electromagnet, an armature on said door engageable with said electromagnet, the electromagnet opening and closing said door as it is moved vertically, means for energizing said electromagnet when it is in position opposite said armature, means for deenergizing said reversely movable means prior to the door being fully open or closed and for reenergizing same for completing the motion of the door; and means for permitting over-travel of said electromagnet in either direction of its travel, thereby definitely providing for engagement of the electromagnet and armature on said door during the return movement thereof.

6. In an elevator shaft, a door for said shaft and an elevator car movable in said shaft, an operator for said door comprising an electromagnet, means for supporting said electromagnet on said car for vertical movement, means for reversely vertically moving said electromagnet, an armature on said door engageable with said electromagnet, the electromagnet opening and closing said door as it is moved vertically, means for energizing said electromagnet when it is in position opposite said armature, means for permitting over-travel of said electromagnet in either direction of its travel, thereby providing for the proper positioning of said armature and electromagnet during the return movement thereof; means for moving said electromagnet toward said armature prior to energization thereof; and means for retracting said electromagnet from said armature after said door has been opened or closed.

7. In an elevator shaft, a door for said shaft and an elevator car movable in said shaft, an operator for said door comprising means for supporting an electromagnet on said car for vertical movement, motor means on said car for reversely vertically moving said electromagnet, an armature on said door adapted to be engaged by said electromagnet, the door to be opened and closed by said motor means, reversing relay switches for controlling the movement of said motor means, relays for controlling the operation of said switches; and a timing device for controlling the operation of said relays and relay switches.

8. In an elevator shaft, a door for said shaft and an elevator car movable in said shaft, an operator for said door comprising an electromagnet mounted for vertical movement on said car, a reversible motor for moving said electromagnet, an armature mounted on said door and adapted for engagement with said electromagnet, thereby enabling said motor to open and close said door, reversing switches for controlling the direction of rotation of said motor, relay means for controlling the operation of said reversing switches, a timing device for controlling the operation of said relay means; and means for energizing said electromagnet when it is opposite said armature including means permitting over-travel of said electromagnet with respect to said armature to thereby assure the proper positioning of said armature opposite said electromagnet during the return movement of the door.

9. In an elevator shaft, a door for said shaft and an elevator car movable in said shaft, an operator for said door comprising an electromagnet mounted for vertical movement on said car, a reversible motor for moving said electromagnet, an armature mounted on said door and adapted for engagement with said electromagnet to thereby enable said motor to open and close said door, reversing switches for controlling the direction of rotation of said motor, relay means for controlling the operation of said reversing switches, a timing device for controlling the operation of said relay means; and means for holding said electromagnet in retracted position during movement of said car.

10. In an elevator shaft, a door for said shaft and an elevator car movable in said shaft, an operator for said door comprising an electromagnet and a frame therefor supported for vertical movement on said car, a guide plate for slidably receiving said electromagnet frame, a reversible motor for vertically moving said electromagnet frame, an armature mounted on said door and adapted for engagement with said electromagnet to thereby enable said motor to open and close said door, a pair of reversing relay switches for controlling the direction of rotation of said motor, a plurality of relays for controlling the operation of said reversing switches, a timing device for controlling the operation of said relay means for causing energization of said electromagnet when it is adjacent to said armature, other switch means for permitting over-travel of said electromagnet with respect to said armature while permitting the opening and closing of said door by said motor; and means for controlling the position of said electromagnet and guide plate relative to said armature.

11. In an elevator shaft, a door for said shaft and an elevator car movable in said shaft, an operator for said door comprising an electromagnet movably mounted on said car, an armature secured to said door and engageable with said electromagnet, means for energizing said electromagnet when it is opposite said armature, means for reversely moving said electromagnet to thereby open and close said door; and cam means for controlling the lateral movement of said electromagnet with respect to said armature.

12. In an elevator shaft, a door for said shaft and an elevator car movable in said shaft, an operator for said door comprising an electromagnet movably mounted on said car, an armature secured to said door and engageable with said electromagnet, means for reversely moving said electromagnet to thereby open and close said door, means for energizing said electromagnet when the car reaches a predetermined zone in said shaft, means for controlling the lateral movement of said electromagnet with respect to said armature; and means for deenergizing said electromagnet and for stopping the motion of said door after it has reached the limit of its travel.

13. In an elevator shaft, a door for said shaft and an elevator car movable in said shaft, an operator for said door comprising an electromagnet movably mounted on said car, an armature secured to said door and engageable with said electromagnet, means for energizing said electromagnet when it is opposite said armature, means for reversely moving said electromagnet to thereby open and close said door and initiating vertical motion prior to energization of said electromagnet, cam means for controlling the lateral movement of said electromagnet with respect to said armature, means for deenergizing said electromagnet and for stopping the motion of said door after it has reached the limit of its motion; and means for permitting said electromagnet to over-travel in any given direction of

door travel, thereby permitting said electromagnet to be correctly positioned relative to said armature for return movement of said door.

14. In an elevator shaft, a door for said shaft and an elevator car movable in said shaft, an operator for said door comprising an electromagnet assembly mounted on said car, an armature on said door for engagement with said electromagnet, means for reversely moving said electromagnet for opening and closing said door, means for energizing said electromagnet when the car reaches a predetermined zone in said shaft; and means for controlling the lateral movement of said electromagnet.

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No references cited.