

May 24, 1960

M. A. SCHWEIG
ELEVATOR DOOR CONTROL

2,937,867

Filed Jan. 28, 1958

3 Sheets-Sheet 1

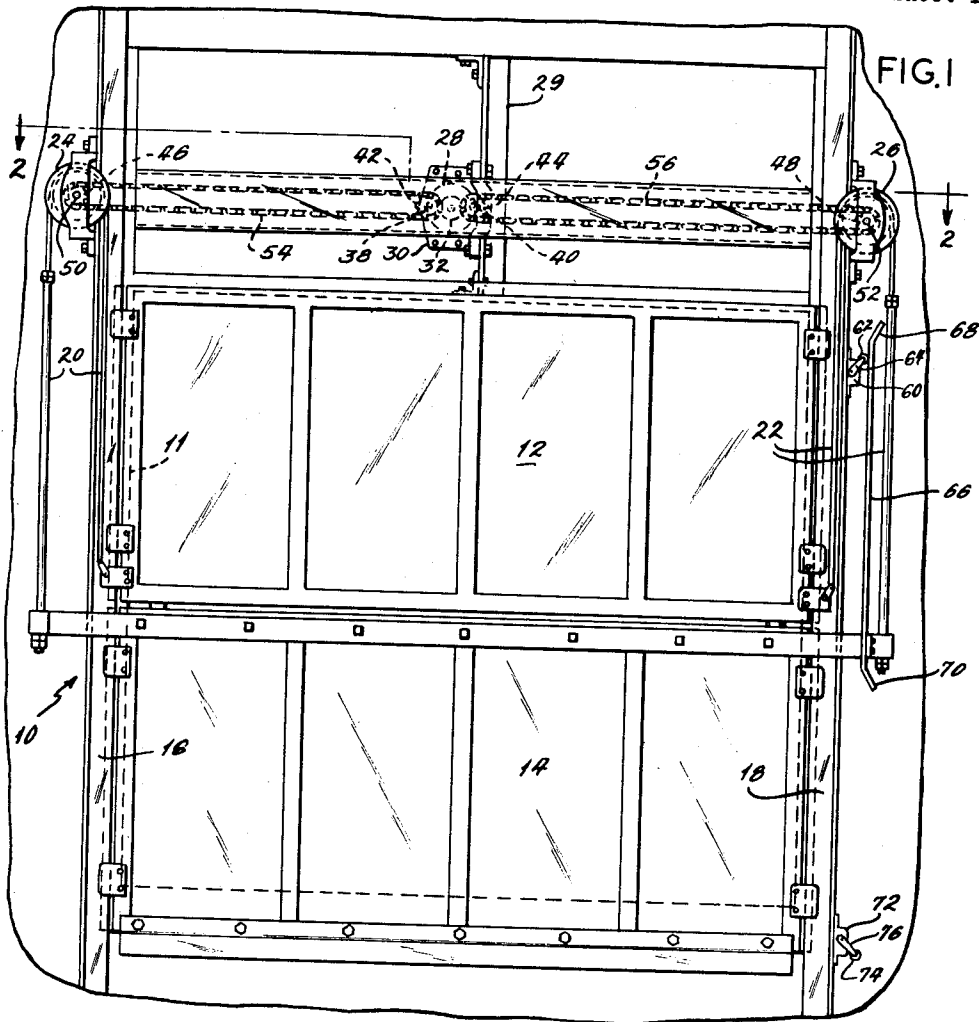
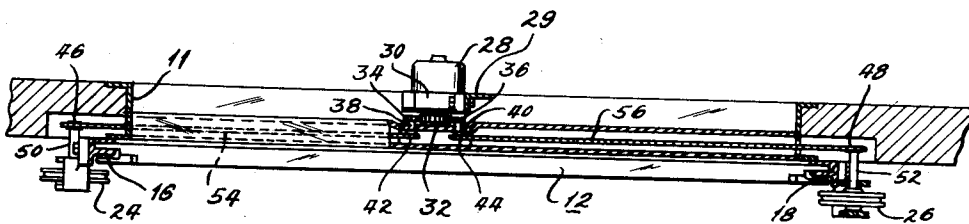


FIG. 2



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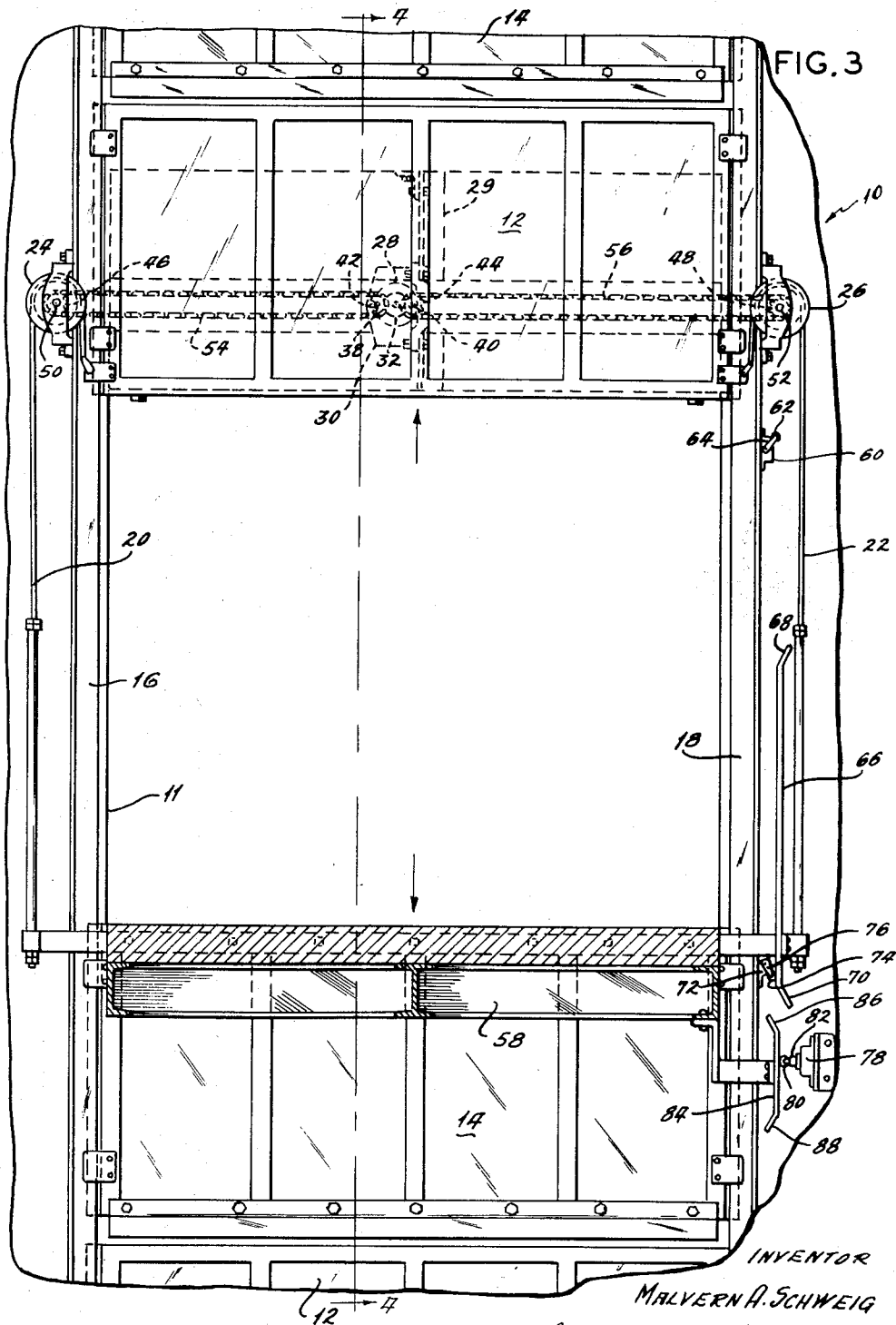
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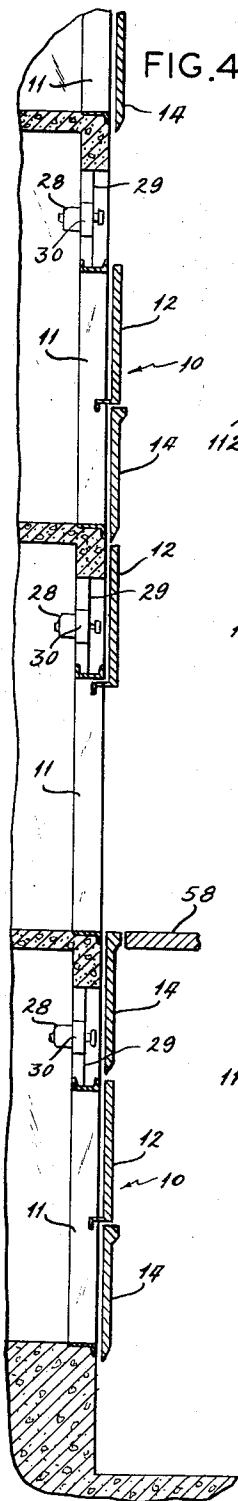


FIG. 4

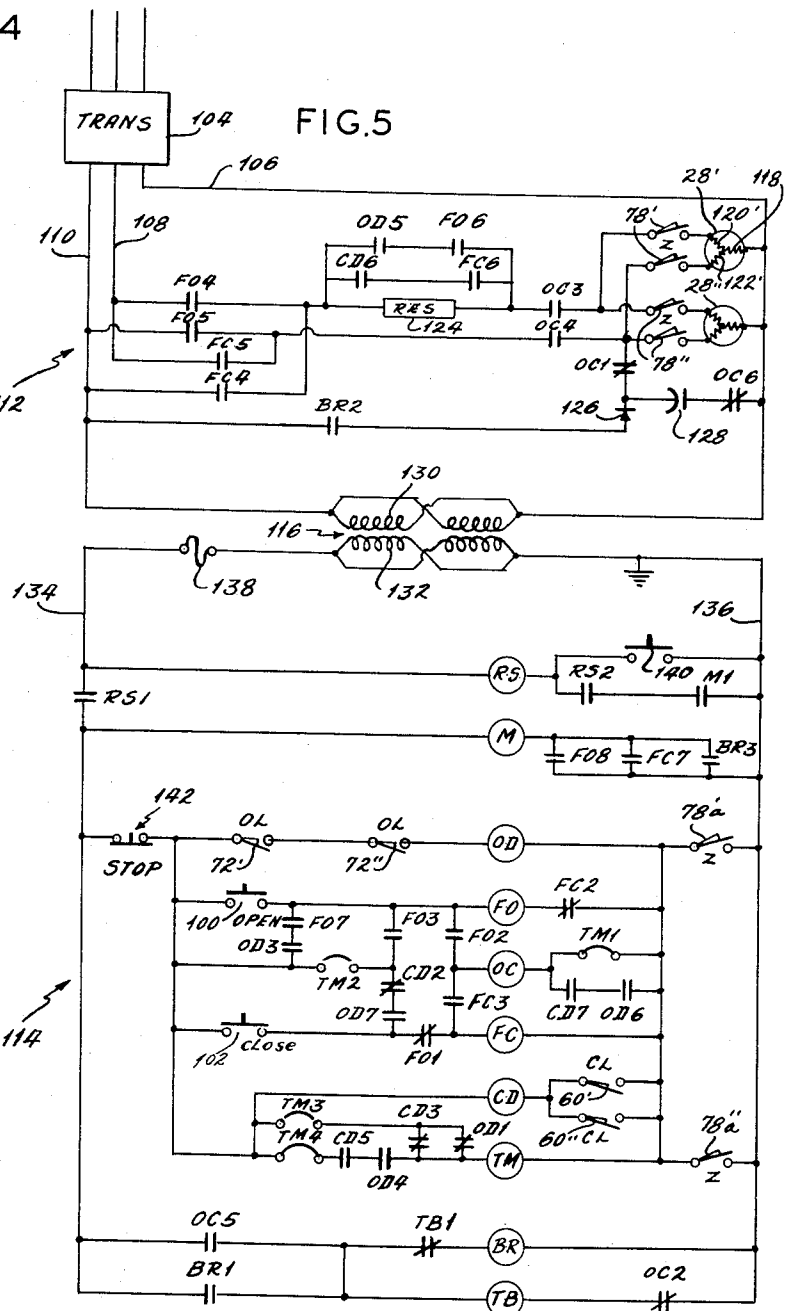


FIG. 5

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2,937,867

ELEVATOR DOOR CONTROL

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Filed Jan. 28, 1958, Ser. No. 711,726

12 Claims. (Cl. 268—59)

The present invention relates generally to control devices, and more particularly to control devices for elevator doors and the like.

Various means for controlling the opening and closing of elevator doors, and particularly bi-parting elevator doors, have been devised in the past. The known means, however, have been relatively expensive to construct and maintain, they have not been capable of satisfactory operation over a wide range of operating conditions and torque requirements, they have not provided means to compensate for shifts of the range of movement of the doors so as to fully open and fully close the doors every operating cycle, they have been noisy, and they have been relatively slow operating. Another difficulty that has not been solved heretofore by any known door control is that of providing a control that will rapidly decelerate the door movement during opening and closing and yet will insure that the door will always stop in the fully open and closed position without bouncing and jarring the door, the door operating mechanism, the door controls, and the latching mechanism if such is provided. These and other disadvantages of known elevator door control means are overcome by the present device.

The present control device is provided in one of its important embodiments to control the movement of counterbalanced bi-parting elevator doors and the like which are slidably mounted in a shaft opening. It is anticipated, however, that the present device could also be used to control other types of devices, such as other types of doors, conveyors and similar devices. The embodiment of the invention shown and described herein comprises electric motor means operatively connected to counterbalanced bi-parting elevator door portions for moving the door portions simultaneously in opposite directions to open and close a shaft opening, and control means connected to the motor means for controlling the operation thereof, said control means including an A.C. voltage source adapted to be connected to the motor means for exciting the motor means, to initiate movement of the door portions, means interposed between the A.C. source and the motor means for selectively reversibly connecting the motor to the A.C. source to change the direction of rotation thereof and thereby change the direction of movement of the door portions, a D.C. voltage source, first switching means for disconnecting the A.C. source from the motor and in the same operation connecting the D.C. source thereto to decelerate the motor and retard the movement of the door portions, and second switching means for subsequently disconnecting the D.C. source from the motor means and in the same operation reconnecting the A.C. source thereto to insure complete opening and closing of the door.

A principal object of the present invention is to provide a control device for opening and closing elevator doors.

Another object of the invention is to provide control means that insure complete opening and closing of an

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elevator door regardless of external conditions which may effect the door operation.

Another object is to reduce to a minimum the noise and vibration associated with opening and closing bi-parting doors and to reduce maintenance costs associated therewith.

Another object of the invention is to reduce lost time opening and closing elevator doors, particularly elevator doors of the bi-parting type and to speed up the movement of personnel and equipment in multiple floor buildings.

Another object is to provide control means for elevator doors and the like which are adaptable to automatic and manual operations.

Another object is to provide reliable, maintenance free, electrically operated elevator door control means which control the operating speed of elevator doors within limits even though the delivered torque may vary widely due to friction, wear, and other natural conditions.

Another object of the invention is to provide means for smoothly and quickly decelerating elevator doors.

Still another object is to provide an elevator door control which is adaptable for installation as original equipment and as an improvement to existing equipment.

These and other objects and advantages of the present invention will become apparent after considering the following detailed description of a preferred embodiment in conjunction with the accompanying drawings.

In the drawings:

Fig. 1 is a front elevational view showing an elevator shaft opening closed by a bi-parting elevator door,

Fig. 2 is a horizontal sectional view taken on line 2—2 of Fig. 1,

Fig. 3 is a front elevational view similar to Fig. 1 but showing the bi-parting door in the open position.

Fig. 4 is a cross-sectional elevational view taken vertically along the line 4—4 in Fig. 3 and extended to show the adjacent openings in the elevator shaft, and

Fig. 5 is a schematic wiring diagram of a device for controlling the operation of the bi-parting elevator door of Figs. 1—4.

Referring to the drawings by reference numbers, number 10 (Figs. 1, 3 and 4) refers generally to a bi-parting elevator door positioned to open and close a shaft opening 11. The bi-parting door 10 has an upper panel 12 and a lower panel 14 which are slidably positioned in spaced vertical track members or channels 16 and 18. The upper panel 12 is counterbalanced with the lower panel 14 by chains 20 and 22 which are connected between the panels as shown and extend therefrom upwardly over sheaves 24 and 26 located adjacent to the upper corners of the shaft opening 11. It is now apparent that when the upper panel 12 moves upwardly the chain connections to the lower panel 14 will cause the lower panel 14 to move downwardly and vice versa. It is also apparent that when the upper panel 12 is in the lower position the lower panel 14 is in the upper position and the door 10 is closed (Fig. 1); and vice versa when the upper panel 12 is in the upper position the lower panel 14 is down and the door is open (Fig. 3).

A motor 28 is mounted in the wall or on a cross member 29 above the door opening 11 and when energized, as will be described hereinafter, opens and closes the door 10. The motor 28 is connected to a gearbox 30 which carries a gear 32, and the gear 32 is meshed on opposite sides thereof with gears 34 and 36. The gears 34 and 36 are mounted on shafts 38 and 40 respectively with sprocket gears 42 and 44 respectively. The sprockets 42 and 44 are connected with similar sprockets 46 and 48 respectively on shafts 50 and 52 by link chains 54 and 56. The shafts 50 and 52 also carry the sheaves 24 and 26 respectively over which the door counterbalancing

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chains 20 and 22 are suspended. When the motor 28 rotates in one direction, the sheaves 24 and 26 are rotated to open the door 10, and when the motor 28 rotates in the opposite direction the sheaves 24 and 26 rotate to close the door 10.

The control means for the motor 28 are important to the present invention and a preferred embodiment will be described in detail in connection with Fig. 5 of the drawings. In the description reference will be made from time to time to mechanically operated limit switches which are mounted in the shaft and actuated by the movement of the elevator car 58 and the door 10 during specified pre-selected spans of the car and door movement respectively. The mechanically operated limit switches are shown in Figs. 1 and 3.

Limit switch 60 is mounted on the wall of the shaft adjacent to an upper corner of the shaft opening, and has an actuating roller 62 mounted on a sidewise extending arm 64. The switch 60 indicates the closed condition of the door 10 and a similar switch is provided for each shaft opening 11. In Fig. 5 the switch 60 is identified by the letters CL and also by the numbers 60' and 60'' for two floor locations. When the door 10 is closed a vertically extending cam actuator 66 which is mounted on the lower door portion 14 engages the roller 62 and actuates the switch 60. When switch 60 is actuated its contacts are in the open condition (Fig. 5). The ends of the actuator 66 are beveled at 68 and 70 to provide smooth engagement with the associated limit switch rollers.

Another limit switch 72 is mounted on the wall of the shaft adjacent to the bottom of the shaft opening 11 and is actuated by the cam actuator 66 when the door 10 is open with the lower door portion 14 down (Fig. 3). The switch 72 has an actuating roller 74 connected thereto by an arm 76. In Fig. 5 the switch 72 is identified by letters OL and numbers 72' and 72''.

Another limit switch 78 is also mounted to the wall of the shaft and has a roller 80 connected thereto by an operating arm 82. A cam actuator 84 with beveled end portions 86 and 88 is mounted on the elevator car and engages the roller 80 to actuate the switch 78 when the elevator car 58 is in the leveling zone adjacent to the shaft opening 11. The switch 78 is referred to as the zone switch and indicates when the car is in the leveling zone for the particular shaft opening. A similar zone switch is associated with each shaft opening. Each zone switch 78 has a plurality of switching contacts associated therewith. In Fig. 5 two sets of zone contacts are shown to illustrate the connections for two floors in a building. The zone switch contacts are identified in Fig. 5 by the letter Z and are further identified at one floor as 78' and 78_a' and the corresponding switches at the other floor are indicated as 78'' and 78_a''.

In order to more fully understand the electrical controls it will be advantageous to first briefly describe what is to be accomplished thereby. Briefly, the present control is constructed to initially apply an A.C. voltage to the windings of the motor 28, which motor is shown having three phases and is preferably a squirrel cage induction motor having a relatively high resistance winding to be able to withstand full load conditions for a considerable time interval without damage. The motor is also selected to have the desired speed torque characteristics.

With the initial A.C. applied, the motor accelerates the door 10 from an at rest condition (in the open or closed direction depending on the condition of the door) at a fairly high rate of speed but not so fast as to endanger the safety of those in the area or strain the door mechanism. When the door has traveled a substantial portion of the total distance required, the A.C. is removed from the motor and a D.C. voltage is applied to decelerate the motor and the door. The range of door movement over which the D.C. is applied, and the strength of the D.C. source, are selected to stop the door at approximately the

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fully open or fully closed position depending on the direction in which it is moving.

If, however, the door has not moved all of the way to the fully closed or fully opened position, the motor 28 is again energized, this time by a reduced A.C. source, and completes the operation at reduced torque and speed.

Initiation of the opening and closing cycles is through open and close spring restored switches 100 and 102 respectively which are usually mounted in the wall of the elevator car 58. As will be noted hereinafter, actuation of the open switch 100 results in a full cycle of operation in which the door is fully opened, while actuation of the close switch 102 maintains a closing cycle only while the switch 102 is depressed and release of the switch (during the greater part of the cycle) will cause the operation to stop. The principal reason for not making the closing operation self sustaining is to overcome a potential safety hazard, and it is anticipated that both operations could be made self sustaining if desired.

Referring now to Fig. 5, number 104 refers to a three phase A.C. power source or transformer which supplies power to the door control by leads 106, 108 and 110. The upper portion of the circuit identified generally by number 112 is the power portion of the circuit and the lower portion identified by number 114 is the control portion. An isolation transformer 116 is connected between the upper and lower portions 112 and 114 although this is not necessary to the operation and may be omitted if desired.

The power portion 112 of the circuit is controlled by the control portion 114 and includes the motors 28', 28'' and so on (one being provided for each door in the shaft). The door controls can be installed at a remote location such as in a control room over the elevator shaft or they can be carried by the elevator car 58. The limit switches which are controlled by movement of the car and the door, however, are usually mounted on the shaft wall and one set is required to operate each door in the shaft.

The motors 28', 28'' and so on depending on the number of floors, are connected in parallel through the zone switches 78' and 78'', and since only one zone switch can be actuated at any one floor, only the motor at that particular floor can be energized when the car 58 is there. In this description the controls will be considered only at one floor (indicated by the single primes following the number) and it will be understood that a similar control is available at every other floor.

One phase winding 118' of the motor 28' is connected to the A.C. source by the lead 106. The other two motor phase windings 120' and 122' are alternatively connected to the other A.C. source leads 108 and 110 depending on the direction of motor rotation. For example, lead 108 is connected to the motor winding 120' through normally open relay contacts FO-4, through one of three parallel branches consisting respectively of normally open relay contacts OD-5 and FO-6, normally open relay contacts CD-6 and FC-6, and resistor 124; through normally open relay contacts OC-3, and through zone contacts 78' which are closed when the elevator is at that floor.

Lead 110 is connected by a similar circuit to the same motor phase winding 120' through normally open relay contacts FC-4 instead of through the contacts FO-4.

The motor phase winding 122' is connected to lead 110 through normally open relay contacts FO-5 and OC-4 and through the zone contacts 78' associated therewith. The winding 122' is also connected by a similar circuit to the lead 108 through normally open relay contacts FC-5 instead of through the contacts FO-5.

The motor winding 122' is also alternatively connected to the lead 110 through a circuit consisting of normally open relay contacts BR-2, rectifier 126, and normally closed relay contacts OC-1. A circuit consisting of

capacitor 128 and normally closed relay contacts OC-6 is connected between the motor side of the rectifier 126 and the lead 106.

Primary winding 130 of the isolation transformer 116 is also connected between the leads 106 and 110, and the secondary 132 is connected across leads 134 and 136 which supply power to the control portion 114 of the circuit. The lead 134 is provided with a fuse 138, and the lead 136 is grounded.

A reset circuit is connected across the leads 134 and 136 and consists of a reset relay RS (of a known type) in series with a parallel circuit, one branch consisting of a normally open spring restored reset switch 140 and the other branch of normally open reset relay contacts RS-2 in series with normally closed timing relay contacts M-1. When the reset switch 140 is depressed, the reset relay RS energizes and closes its RS-2 contacts establishing a self-holding circuit therefor. At the same time reset relay contacts RS-1 close and establish a power connection from lead 134 to the rest of the control circuit 114.

The various relays shown in Fig. 5 are identified by descriptive letters thereon and the contacts which are operated by the relays are identified by the same descriptive lettering followed by the appropriate number. In order to further simplify the description the relay contacts are all shown in the position that they are in when the associated relay is deenergized. For example, two parallel spaced lines indicate a set of normally open contacts and spaced parallel lines with a line angularly extended therebetween indicates a set of normally closed contacts.

A timer relay (or motor) M is shown connected across the leads 134 and 136 below the reset relay RS and is in series with three parallel normally open branches, one consisting of relay contacts FO-8, one of relay contacts FC-7, and the third relay contacts BR-3. The timer relay, when energized, takes a certain predetermined amount of time before its contacts transfer. This time is adjusted to exceed the operating period of the door so that if the door is binding excessively or blocked the reset relay RS will drop out and the motor contacts will open to deenergize the motor 28' before it is damaged.

Below the timer relay M circuit are a plurality of parallel control circuits, all under control of a normally closed spring restored stop switch 142 which when actuated deenergizes the control circuits. The control circuits also depend for energization on one of the zone switches, such as the switches 78_a' and 78_b'', being closed indicating that the elevator car 58 is in a landing zone.

The upper control circuit dependent on the stop switch 142 consists of a plurality of the normally closed limit switches 72', 72'' (one being provided for each door 10) connected in series with an open sequence relay OD. The switches 72', 72'', and so on, are closed when the door 10 is closed and open when the door 10 is open (Figs. 1 and 3). Therefore, whenever the elevator car 58 is in a leveling zone with the door 10 closed, the relay OD is energized.

Immediately below the OD relay circuit is a parallel circuit consisting of the spring restored open switch 100 connected in series with an open direction relay FO and relay contacts FC-2. The open switch 100 is by-passed by a circuit consisting of relay contacts OD-3 and FO-7. Therefore, when the open switch is actuated and the door 10 closed, the relay FO will be energized and will be held energized when the switch 100 is released by contacts OD-3 and FO-7.

Another circuit is connected in parallel with the hold circuit for relay FO and consists of a normally open timing motor contact TM-2 and relay contacts FO-3. This circuit is provided to hold the relay FO energized for a predetermined time which may be adjusted to extend until after the relay OD has been deenergized by the

opening movement of the door opening the limit switch 72'.

A circuit is also provided across the series combination of the relay FO and the contacts FC-2. This circuit consists of relay contacts FO-2 which is connected to the series circuit of door sequence relay OC and parallel branches, one consisting of timer relay contacts TM-1 and the other of relay contacts CD-7 and OD-6 in series.

Below and connected to the circuits last described is a door closing circuit consisting of the series combination of the spring restored close switch 102, relay contacts FO-1 and door closing relay FC. The closing circuit is connected to the opening circuit by a circuit consisting of series connected relay contacts CD-2 and OD-7 which circuit is connected between the common sides of contacts TM-2 and FO-3 and the common sides of the close switch 102 and contacts FO-1. The closing circuit also consists of relay contacts FC-3 connected between the common sides of contacts FO-2 and relay OC and the common sides of FO-1 and relay FC.

Since the contacts FO-1 in the circuit of the close relay FC are normally closed, actuation of the close switch 102 directly energizes the close relay FC. It should be noted, however, that no hold circuit is provided for the close relay FC as there is for the open relay FO until the door is nearly closed. When the door is partly closed the open limit switch associated therewith closes to energize the open sequence relay OD and a hold circuit is then established for the close relay FC to complete the closing operation. This hold circuit is through the normally open timer contacts TM-2 which are closed, through the normally closed contacts CD-2 which are closed because of the limit switch 60', and through the normally open contacts OD-7 which are closed when relay OD is energized by the limit switch 72'.

Below the above circuits is a closed sequence circuit consisting of a closed sequence relay CD connected in series with the parallel connected close limit switches 60', 60'' and so on. The limit switches 60', 60'' and so on are all normally open and each closes when the door 10 associated therewith is opened a predetermined amount.

A timing motor circuit is shown connected below the closed sequence circuit and consists of a timing motor TM connected in series with two parallel branches, one consisting of timing motor contacts TM-3 in series with parallel connected relay contacts CD-3 and OD-1; and the other consisting of timing motor contacts TM-4 in series with relay contacts CD-5 and OD-4. Since the timing motor contacts TM-4 are closed prior to the initiation of an open or close cycle, the timing motor TM will be energized through the TM-4 contacts when the closed sequence relay CD and the open sequence relay OD are simultaneously energized. Relays OD and CD are simultaneously energized after the door has moved partially open or partially closed. Therefore, the timing motor TM is active during opening and closing operations.

The timer motor TM rotates a shaft (not shown) that carries a plurality of timed cams thereon. One such cam is provided to operate each of the timing motor contacts TM-1, TM-2, TM-3 and TM-4. After the timing motor has been energized, the TM-4 contacts (which are initially closed) open, and the TM-3 contacts (which are initially open) close. The timing of these contacts is adjusted to provide a hold circuit for the timer motor TM which extends even after one of the limit switches 60' or 72' has again been actuated by movement of the door.

It should also be noted that timing motor contacts TM-1 are initially closed to provide an energizing circuit for the door sequence relay OC. This energizing circuit is broken when the timing motor is energized and is by-passed by a parallel hold circuit of relay contacts CD-7 and OD-6 as previously described which holds until the door operation is substantially completed and switch 60' or 72' is actuated.

A braking relay BR is connected across the secondary 132 of the transformer 116 in series with relay contacts OC-5 and TB-1. As was previously noted in connection with the power portion of the circuit, the braking relay BR has contacts BR-2 connected in series with the rectifier 126, and this circuit is provided for decelerating the motor. When the braking relay BR is energized by the closing of the OC-5 contacts, the BR-1 contacts also close to establish a self-holding circuit therefor.

The BR-1 contacts also close a circuit consisting of a brake limiting relay TB and relay contacts OC-2. This energizes the relay TB, which is a delayed operation timing relay or timing motor. When the relay TB finally does act it ends the time interval during which braking D.C. voltage is applied because the contacts TB-1 open and deenergize the braking relay BR. It should also be noted that when the OC-5 contacts close to energize the braking relay BR, the OC-2 contacts open and prevent energizing the TB relay. Therefore, the relay TB cannot be energized until after door sequence relay OC is deenergized.

The time interval from when the door sequence relay OC is deenergized by the opening of the contacts OD-6 (on an opening operation) to the time when the relay OC is reenergized through TM-1 is set at less than the time necessary for the relay TB to open the TB-1 contacts. Even if this were not so and the contacts TB-1 opened the original braking cycle after the door opened the limit switch 72', the relay BR would be reenergized through the contacts OC-5 when the relay OC reenergized.

During most of an opening cycle, the contacts TM-2 are closed and the open direction relay FO is held energized through a circuit consisting of the contacts TM-2 and FO-3. The same circuit provides a hold and a reenergizing circuit for the door sequence relay OC through the contacts FO-2, CD-7 and OD-6 and also through the timing motor contacts TM-1 respectively.

On a door closing cycle the close sequence relay FC is not provided with a self-holding circuit until the door has closed enough for the cam operator 66 to actuate the close limit switch 60'. When this happens the close sequence relay CD is deenergized and closes the contacts CD-2. Only then is a circuit established to hold the close sequence relay FC and complete the closing operation. This circuit is through the timing motor contacts TM-2, and relay contacts CD-2, OD-7, and FO-1. Up until the time that the close limit switch 60' opens, which covers most of the door movement, there is no hold circuit for the close sequence relay FC as there is during an open operation for the open sequence relay FO and the operator must keep the close switch 102 depressed. This feature is provided for safety reasons and obviously is not essential to the operation.

Another function that is important to the operation of the present control involves reenergizing the motor 28' at low speed and torque after a braking operation to assure complete opening or closing of the door in the event that the door is not fully opened or closed after being decelerated. The reenergization of the motor 28' takes place with reduced A.C. voltage and is accomplished by connecting the resistor 124 in series with one of the motor phase windings. To understand this operation the motor circuit operation will be briefly reviewed. When the open switch 100 is actuated, the open direction relay FO is energized and at the same time the open sequence relay OD is actuated. The energizing of both relays FO and OD closes the contacts OD-5 and FO-6 and connects a short across the resistor 124.

Similarly when the close switch 102 is actuated and the door is open, the close direction relay FC is energized, and the close sequence relay CD is also energized through the appropriate closed limit switch 60'. Therefore, when initiating a closing cycle the contacts CD-6 and FC-6

short the resistor 124 and apply full A.C. power to the motor 28'.

When the door 10 is closed the timing motor contacts TM-3 are open, TM-4 are closed, and contacts CD-5 are open, and contacts OD-4 are closed. After the circuit to open the door is initiated and the door opens sufficiently to close the limit switch 60', the close sequence relay CD energizes and the relay contacts CD-5 close to start the timing motor TM. After a relatively short time interval contacts TM-3 close and TM-4 open stopping the timing motor TM. At this point relay contacts CD-3 and OD-1 are open and contacts TM-2 and TM-3 are closed.

Recalling now that the braking relay BR is energized by the OC-5 contacts and is held by its own contacts BR-1, it is also noted that D.C. power is prevented from being fed to the motor 28' by the relay contacts OC-1. Also D.C. power is prevented from reaching the capacitor 128 by contacts OC-6. As the door opens, relay contacts CD-7 and OD-6 are closed and provide a hold circuit for the door sequence relay OC and the timing motor contacts TM-1 open. As the door approaches the fully open position the limit switch 72' opens and deenergizes the open sequence relay OD causing the contacts OD-6 to open and deenergize relay OC. As soon as the relay OC is deenergized, the contacts OC-3 and OC-4 open and remove A.C. power from the motor 28', the contacts OD-5 remove the short around resistor 124, contacts OC-1 and OC-6 connect the D.C. power braking circuit to the motor 28' and capacitor 128, contacts OD-1 close and start the timing motor TM, and contacts OC-2 close and energize the brake limit relay TB.

After a preselected interval, the timing contacts TM-1 again close and reenergize the relay OC. This disconnects the D.C. power from the motor 28' and reconnects A.C. power thereto. However, with relay OD deenergized the A.C. power to the motor 28' must pass through the resistor 124 thereby reducing the power to the motor so that it operates at reduced torque (and reduced speed) and makes sure that the door moves or has moved to the fully open position and is held there momentarily.

The timing motor TM continues to function during the door operation until the contacts TM-3 open and deenergize the timing motor TM. Simultaneously, the holding circuit for the relay FO (through FO-3 and TM-2) is open, deenergizing relays FO and OC. When relay OC is again deenergized the D.C. braking current is again fed to the motor 28' and will continue to be fed until the braking limit relay TB completes its delay cycle and opens the contacts TB-1. When this occurs the brake relay BR is deenergized. The deenergizing of brake relay BR opens the contacts BR-1 and deenergizes the relay TB.

If during the opening cycle the operator decides to press the stop switch 142, a circuit will be immediately established to decelerate the motor and door. When the stop switch is depressed, the relay OC is deenergized and closes the contacts OC-1 and OC-6 to apply D.C. to the motor 28' and simultaneously opening contacts OC-3 and OC-4 to remove the A.C. therefrom. However, before the relay OC is deenergized the contacts OC-5 will have energized the braking relay BR which is self-holding and established a circuit through the contacts BR-2 for the D.C. braking current.

With the exceptions already noted the door closing cycle is similar to the opening cycle, the principal difference being that the close switch 102 must be held in at least until the door has closed enough to open the closed limit switch 60'. This is the case because the relay FC is not self-holding but depends on the closed switch 102 being depressed.

It should also be noted that during the closing cycle power to the motor 28' is fed through contacts FC-5 and FC-4 instead of through contacts FO-4 and FO-5

and in this way the direction of motor rotation is reversed by interchanging the phases.

The motor protection relay M is energized by the closing of any one of the contacts FO-8, FC-7 or BR-3, and is a delayed action timing device which operates to transfer its contacts only after it has been energized for a preselected interval of time. If the door fails to complete its cycle or takes longer than the time necessary to transfer the contacts of the relay M, the contacts M-1 will open and deenergize the reset relay RS. When this happens the reset relay contacts RS-1 open and remove power from the control portion 114 of the circuit.

A further function of the instant control is to enable an operator to apply power to the motor 28' after the door has been fully opened or closed, by pressing the appropriate switch 100 or 102. This function is designed to keep the equipment in operation in spite of the most adverse conditions such as might be caused by faulty adjustment.

It should also be noted that the physical location of the limit switches 60', 72' and 78 can be varied by moving them on their mountings. By so doing, a wide latitude of adjustment is provided to produce a desired operating condition and these adjustments are simple enough that they can be made by relatively unskilled personnel using simple hand tools.

Thus, a control device has been shown and described which fulfills all of the objections and advantages sought therefor. Obviously, however, many variations, alterations, modifications, and changes can be made in the particular embodiment of the invention which has been chosen for purposes of description. All such variations, alterations, modifications, and changes which will be readily apparent to one skilled in the art are contemplated as being covered by the present disclosure which is limited only by the claims which follow.

What is claimed is:

1. A control device for elevator doors that are movably mounted in a shaft opening comprising an elevator door movably mounted in a shaft opening, motor means operatively connected to said elevator door, means connected to the motor means for controlling the operation thereof, said means including a door opening switch and a door closing switch, a first source of power adapted to be connected to the motor means by said opening and closing switches for initially effecting opening and closing movement of the elevator door respectively, a second source of power, electric control means including timer means set in motion by the opening and closing switches for disconnecting said first source of power from the motor means when the door has moved a preselected distance and simultaneously connecting said second source of power thereto to decelerate said motor means, and means for disconnecting the second source of power from the motor means and thereafter reconnect a portion of the first source of power thereto for moving the door to the fully open or fully closed position.

2. A control device for a door slidably mounted to open and close an opening in a shaft comprising a source of A.C. voltage, a source of D.C. voltage, a door slidably mounted in a shaft opening, motor means operatively connected to said sliding door for moving said door, a door open switch and a door close switch, and electric door control means including first and second time delay switch means operatively connected to the motor means and initiated by actuation of said door open switch and said door close switch, said control means upon being initially actuated connecting the A.C. source to the motor means for energizing the motor means in a direction to move the door and thereafter under control of said first time delay switch means simultaneously disconnecting the A.C. source from the motor means and connecting the D.C. source thereto to decelerate the motor, and still later under control of said second time delay switch means simultaneously disconnecting the D.C.

source from the motor means and reconnecting the A.C. source thereto.

3. A control device for a door slidably mounted to open and close an opening in a shaft comprising a source of A.C. voltage, a source of D.C. voltage, a door slidably mounted in a shaft opening, motor means operatively connected to said sliding door for moving said door, a door open switch and a door close switch, and electric door control means including first and second time delay switch means operatively connected to the motor means and initiated by actuation of said door open switch and said door close switch, said second time delay switch means including means for tapping off a portion only of the A.C. source, said control means upon being initially actuated connecting the A.C. source to the motor means for energizing the motor means in a direction to move the door and thereafter under control of said first time delay switch means simultaneously disconnecting the A.C. source from the motor means and connecting the D.C. source thereto to decelerate the motor, and still later under control of said second time delay switch means simultaneously disconnecting the D.C. source from the motor means and reconnecting a portion only of the A.C. source thereto.

4. A control device for a bi-parting elevator door slidably mounted in a shaft opening comprising an A.C. source of power, a D.C. source of power, a bi-parting elevator shaft door, motor means operatively connected to said door for moving said door between an open and closed condition in a shaft opening, and electric control means for energizing the motor means including a door open switch for energizing the motor means in a direction to slide the door toward an open position, a door close switch for energizing the motor means in a direction to slide the door toward a closed position, said open and close switches upon initially being actuated connecting the motor means to the A.C. source of power, and limit switch means actuated by the door when moved to an advanced position during opening and closing thereof for simultaneously disconnecting the A.C. source from the motor and connecting the D.C. source thereto to decelerate the motor, said limit switch means including timed means for still later disconnecting the D.C. source from the motor and reconnecting the A.C. source thereto.

5. A control device for a bi-parting elevator door movably mounted in a shaft opening comprising an A.C. source of power, a D.C. source of power, a bi-parting elevator shaft door movably mounted in a shaft opening, motor means operatively connected to said door for moving said door between an open and closed position in the shaft opening, and electric control means for energizing the motor means including a door open switch for energizing the motor means in a direction to move the door toward an open position, a door close switch for energizing the motor means in a direction to move the door toward a closed position, said open and close switches upon being initially actuated connecting the motor means to the A.C. source of power, and timed delay switching means energized by actuation of the open and close switches for disconnecting the A.C. source from the motor means at a preselected position of door movement and simultaneously connecting the D.C. source thereto to decelerate the motor means and the door movement, said time delay switching means including means for timing the application of said D.C. source to stop the door at substantially the fully open and closed positions depending upon whether the open or closed switch was actuated and for disconnecting the D.C. and simultaneously reconnecting the A.C. source to the motor means to assure complete opening and closing of the door.

6. A control for counterbalanced sliding doors mounted in a track and movable for opening and closing a shaft opening comprising an induction motor operatively connected to said door for moving the door in the track,

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a limit switch mounted adjacent to said door and operated by the door at a preselected position of door movement, and electric control means including an A.C. power source, a D.C. power source, and an open and close switch for selectively effecting movement of the door in a desired direction, said control means upon being actuated by said open or close switch connecting the A.C. power source to the motor to effect movement of the door in the track, and thereafter said control means being effected by said limit switch to disconnect the A.C. power from the motor and to connect the D.C. power thereto for decelerating the motor to stop the door, and time delay control means included in said electric control means and set in motion during the movement of the door for disconnecting the D.C. power from the motor and thereafter reconnecting the A.C. power thereto to assure that the door reaches the fully open and closed position for every operating cycle thereof.

7. The control for a counterbalanced sliding door defined in claim 6 wherein a stop switch is provided to advance the decelerating operation of the door and motor upon actuation thereof.

8. The control device for counterbalanced sliding doors defined in claim 6 wherein said electric control means includes a timer device for disconnecting the A.C. and D.C. sources from the motor whenever a door operation exceeds the timing of said device.

9. A control device for a bi-parting elevator door slidably mounted in a shaft opening comprising an A.C. source of power, a D.C. source of power, a bi-parting elevator shaft door mounted in a shaft opening, motor means operatively connected to said door for moving said door between an open and closed condition in the shaft opening, and electric control means for energizing the motor means including a door open switch for energizing the motor means in a direction to slide the door toward an open position, said door open switch including self-holding means for maintaining the electric control means energized to complete a door opening operation, a door close switch for energizing the motor means in a direction to slide the door toward a closed position, said open and close switches upon initially being actuated connecting the motor means to the A.C. source of power, and limit switch means actuated by the door when moved to an advanced position during opening and closing thereof for simultaneously disconnecting the A.C. source from the motor and connecting the D.C. source thereto to decelerate the motor, said limit switch means including timed means for still later disconnecting the D.C. source from the motor and reconnecting the A.C. source thereto.

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10. Control means for elevator doors opening and closing the landing openings in an elevator shaft, comprising a landing opening door, motor means connected to said door to move the same to open and close the landing opening, door opening control switch means, door closing control switch means, and an electric circuit system connected to said motor means and said door opening and closing switch means, said circuit system including a first power source for said motor connected through said control switch means, a second source of power for said motor, and power shifting means in said circuit system adapted upon predetermined door movement in opening and in closing the landing opening to shift the motor over to said second source of power to decelerate the motor means and bring the landing door towards a stop, said power shifting means including means for reconnecting the motor to said first power means whenever the door has stopped before being fully opened or closed.

11. The control means for elevator doors defined in claim 10 wherein a timed overload switch is provided for de-energizing the electric circuit system when the opening and closing of the door exceeds a preselected timing interval.

12. The control means for elevator doors defined in claim 10 wherein said electric circuit system includes stop switch means adaptable upon actuation thereof to advance the shifting of the motor to said second source of power to prematurely decelerate the motor means and stop the door.

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