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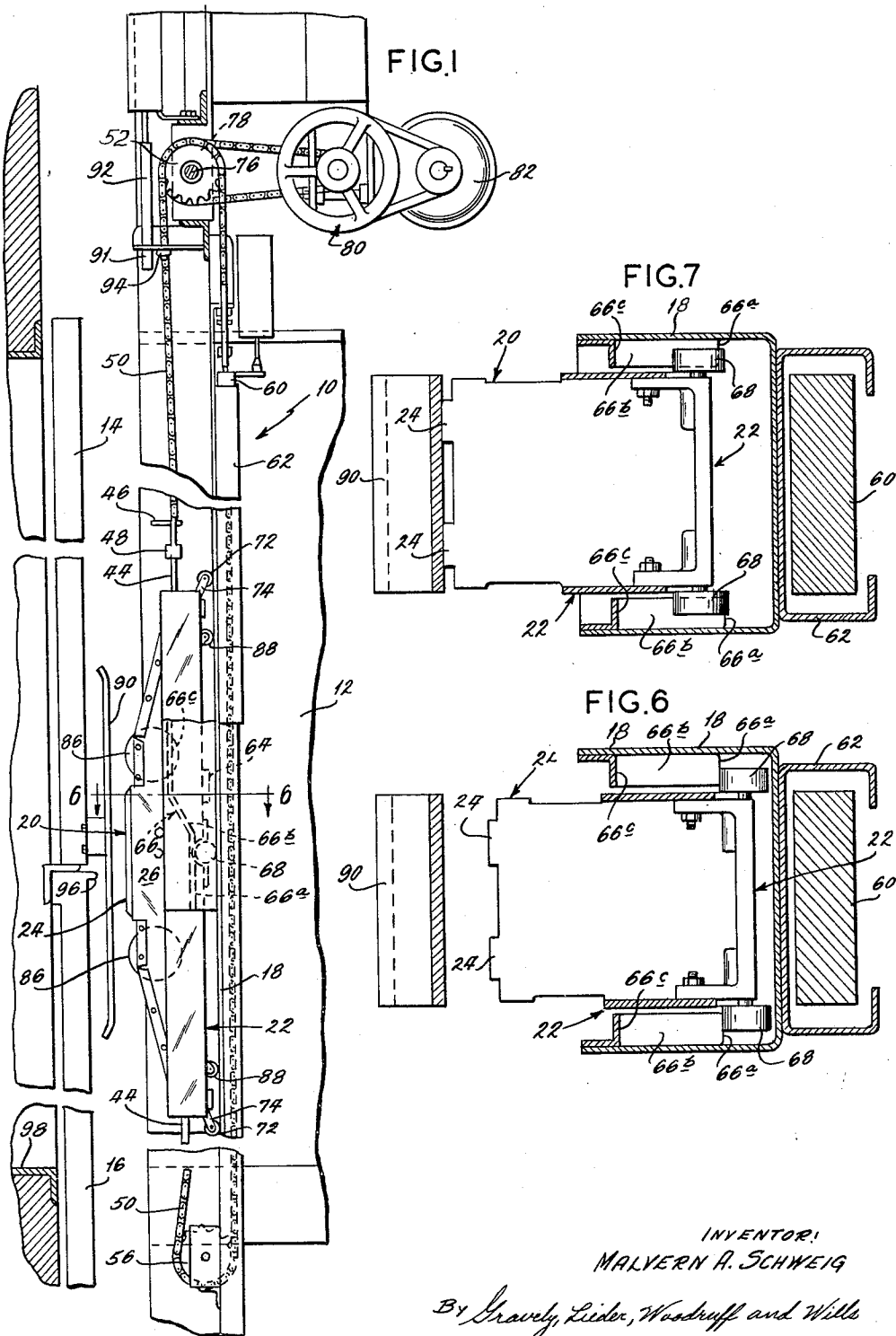
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2,960,188

ELEVATOR DOOR CONTROL MECHANISM

Filed March 11, 1957

3 Sheets-Sheet 1



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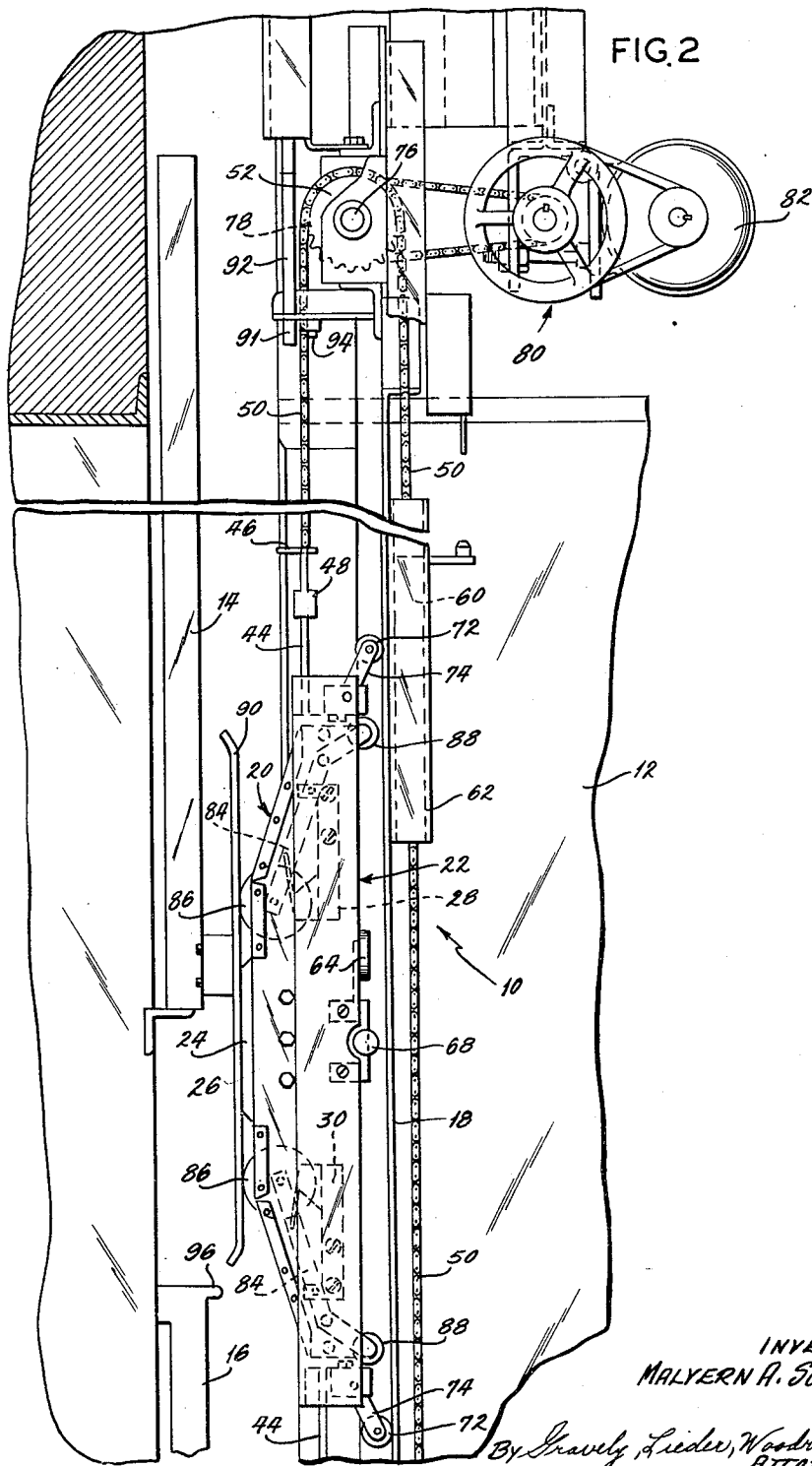
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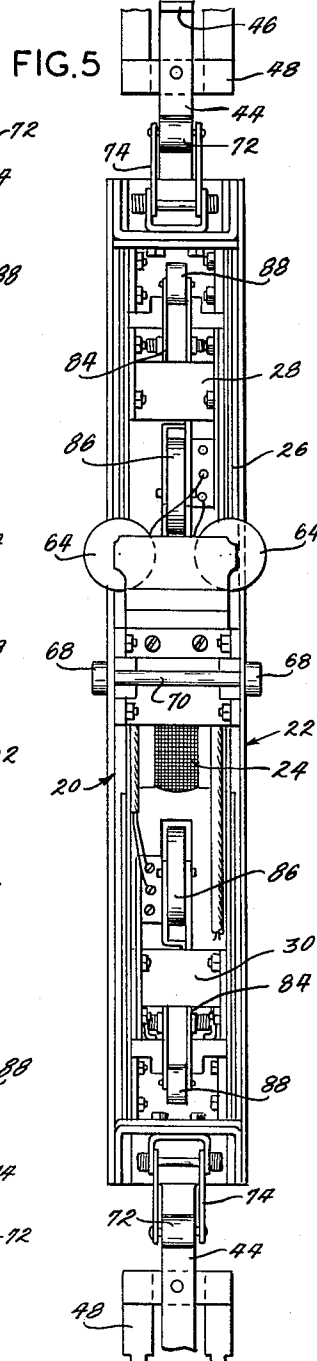
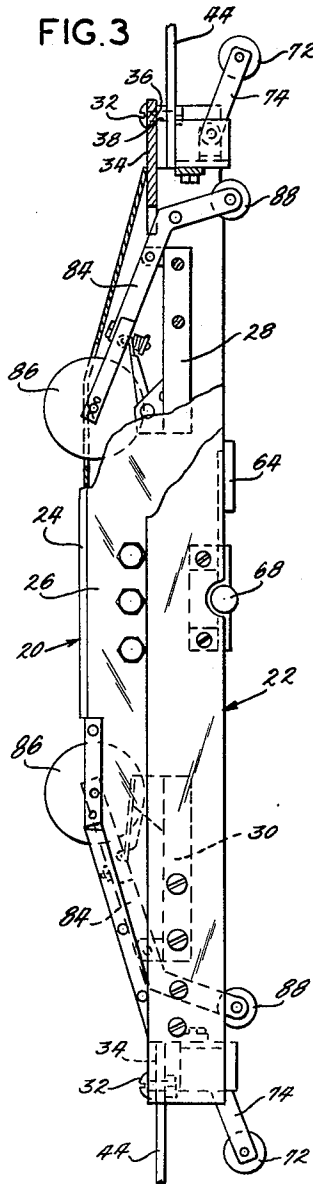
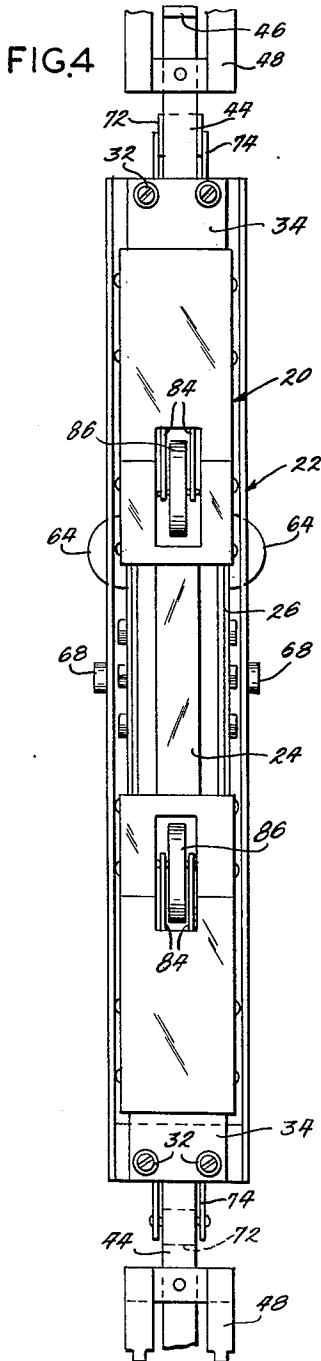
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2,960,188

ELEVATOR DOOR CONTROL MECHANISM

Filed March 11, 1957

3 Sheets-Sheet 3



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2,960,188

ELEVATOR DOOR CONTROL MECHANISM

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Filed Mar. 11, 1957, Ser. No. 645,098

4 Claims. (Cl. 187—52)

This invention relates to operating means for elevator shaft closures or doors and more particularly is directed to improved magnetically operated means for gripping and moving a sliding elevator door when the elevator car is stopped or is moving in a leveling zone; and is an improvement over the prior Patent No. 2,579,017, issued to Julius A. Schweig on December 18, 1951.

A principal object of the invention is to provide electromagnetic means for operating an elevator door such as a bi-parting counterbalanced elevator shaft door when the elevator car is stopped or is moving in the leveling zone.

Another object is to provide an electromagnetic operator for counterbalanced elevator doors which reduces wear and maintenance by operating in a plumb position when moving the door and yet which allows for greater lateral movement of the elevator car such as happens when the car track or guide means does not retain its initial setting.

Another object of the invention is to provide electromagnetic elevator door operator means which are maintained in a retracted position away from the elevator door and permit the elevator car to be operated at high speeds past the door.

Another object of the invention is to delay the operation of elevator doors until the elevator car is properly positioned relative thereto.

Another object of the invention is to reduce stress in elevator door operator chains caused by lateral movement of the elevator car.

Another object of the present invention is to enable an elevator car to move laterally toward and away from a shaft opening without excessively stretching the support chains for the elevator door operator.

Another object of the present invention is to provide an overhead drive for the chains on elevator cars that operate the doors in order to minimize malfunction and wear caused by chain stretch.

Yet another object of the present invention is to lock the controls for the elevator car against further car movement whenever the door operator is actuated.

This invention resides in an operator for counterbalanced elevator shaft doors in which vertically movable magnetic gripping means mounted on the elevator car are energized when the car is opposite the selected shaft door, the energized magnetic gripping means magnetically gripping an armature on one of the doors and opening and closing the doors. The invention further resides in the construction and operation of the magnetic gripping means, the manner in which it is mounted on the car, and in the drive means associated therewith.

Other objects and advantages of the present invention will become apparent after considering the following detailed description and the accompanying drawings.

Fig. 1 is a side elevational view of an operator for an elevator shaft door constructed according to the teachings of the present invention, the operator being shown in de-energized and retracted position,

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Fig. 2 is an enlarged fragmentary side elevational view of the operator shown in Fig. 1, the operator being shown in the energized and extended position, with the doors partly open,

Fig. 3 is a side elevational view of the magnet assembly,

Fig. 4 is an elevational view of the magnet assembly as seen from the left in Fig. 3,

Fig. 5 is an elevational view of the magnet assembly as seen from the right in Fig. 3,

Fig. 6 is a horizontal cross-sectional view through the door operator taken along line 6—6 in Fig. 1, and

Fig. 7 is a horizontal cross-sectional view similar to Fig. 6 showing the energized and extended position of the magnet assembly.

Referring now to the drawings by reference numbers, number 10 in Figs. 1 and 2 refers to a structure for operating counterbalanced elevator shaft doors and embodies the teachings of the present invention. The structure 10 is mounted on one side of an elevator car 12 adjacent to the doors and provides means for opening and closing the usual counterbalancing type of bi-parting elevator shaft doors. The bi-parting doors have an upper door portion 14 and a lower door portion 16.

The structure 10 has a channel-shaped column 18 (Figs. 1, 2, 6 and 7) mounted vertically along the side of the elevator car 12, and the column 18 extends substantially the full height of the car and is open along the side adjacent to the elevator doors 14 and 16.

A magnet assembly 20 and a carrier 22 therefor are slidably positioned in the column 18. The magnet assembly 20 consists of an electromagnet 24 centrally positioned in a housing 26 and two switches 28 and 30 including operating means therefor mounted in the housing 26 on opposite sides of the magnet 24.

The carrier 22 is in the form of box with opposed side and end walls. The magnet assembly 20 is positioned in the carrier 22 and chain connector members 44 extend endwardly from the ends of the carrier 22. The upper connector member 44 has an abutment member 46 attached thereto, and equalizer members 48 are pivotally mounted on the connector members 44 intermediate the ends thereof. The equalizer members 48 are U shaped and are centrally pivoted so that the side portions thereof extend endwardly and are fastened to parallel flexible chains 50. The chains 50 connected to the upper equalizer members 48 extend upwardly therefrom and around sprockets 52 located at the top of the structure 10, and the chains 50 connected to the lower equalizer member 48 extend downwardly therefrom and around sprockets 56 located at the bottom end of the structure 10 (Fig. 1). The opposite ends of the upper and lower chains 50 are connected to opposite ends of a counterbalance weight 60 which is positioned for vertical movement in a column 62 (Figs. 1, 2, 6 and 7) mounted on the rear side of the column 18.

The carrier 22 is movable vertically along the column 18 and the magnet assembly 20 is mounted in the carrier 22 so that the magnet 24 is exposed and extends outwardly from the open side of the column 18. To facilitate ease of movement and to centralize the position of the carrier 22 in the column 18, sidewise extending rollers 64 are mounted on the carrier 22 as shown in Figs. 3 and 5. The sidewise extending rollers 64 provide sufficient clearance between the sides of the carrier 22 and the opposite internal walls of column 18 so that cams 66 mounted on the opposite internal walls of the column 18 do not rub against the sides of the carrier.

The cams 66 are engaged by cam follower rollers 68 which extend axially out from the sides of the carrier 22. The rollers 68 are mounted on opposite ends of shaft 70 which extends across the carrier 22.

Spring biased rollers 72 are mounted at opposite ends of the carrier 22. The rollers 72 are mounted to the carrier 22 on arms 74 and bear against the inner surface of the column 18 and urge the carrier 22 and the magnet assembly 20 outwardly of the column 18 so that the cam follower rollers 68 remain engaged with the cams 66.

The cams 66 (Figs. 1, 6 and 7) have inner portions 66a (which are nearest the inner wall of the column 18), inclined portions 66b connected thereto, and outer portions 66c. When the cam follower rollers 68 are engaged with inner portions 66a as shown in Fig. 6, the carrier 22 and the magnet assembly 20 are in the retracted position relative to the column 18 and are away from the elevator doors 14 and 16. When, however, the carrier 22 (and the magnet assembly 20) move upwardly in the column 18, the rollers 68 move off of the cam portions 66a onto cam portions 66b and finally are opposite cam portions 66c. In the upper position, with the rollers 68 opposite cam portions 66c, the carrier 22 and the magnet assembly 20 are in the extended position relative to the column 18 and have moved nearer to the doors 14 and 16.

In the movement of the assembly 20 to its extended positions just described, the chains 50 which are connected to the opposite ends of the carrier 20 move from an out-of-plumb position (Fig. 1) to a plumb position as in Fig. 2. The extended or plumb position of the carrier 22 and the magnet assembly 20 is the operative or energized position thereof for opening and closing the counterbalanced doors 14 and 16, and the retracted position thereof is the inoperative position which is obtained when the elevator is moving between floors.

The upper sprockets 52 over which the chains 50 pass are mounted on a horizontal shaft 76 with a drive sheave 78. The drive sheave 78 is chain driven from a pulley assembly 80 which is operatively connected to drive motor 82. When the motor 82 rotates in one direction, the carrier 22 and the magnet assembly 20 move upwardly in the column 18, and when the motor 82 rotates in the opposite direction, the carrier 22 and the magnet assembly 20 move downwardly therein.

By mounting the motor 82 and the associated drive members for chains 50 at the upper end of the structure 10, the magnet assembly 20 and the counterbalance weight 60 therefor, hold the upper portions of the chains 50 in tension at all times even though the lower parts of the chains 50 are slack. This eliminates the possibility of faulty chain operation and loss of adjustment caused by chain stretch.

In the retracted or de-energized position, the magnet assembly 20 is positioned nearer the center of the car 12, and the chains 50 are bowed inwardly relative to the column 18 and away from the doors 14 and 16. Therefore, when the magnet assembly 20 moves from the de-energized to the energized position, the chains 50 move from the bowed position to the plumb position.

The switches 28 and 30 which are located in opposite ends of the magnet assembly 20 are actuated by pivoted arms 84 (Fig. 3) which have large rollers 86 attached to the ends thereof adjacent to the exposed surface of the magnet 24 and have small rollers 88 attached to the opposite ends thereof adjacent to the inner wall of the column 18. When the carrier 22 and the magnet assembly 20 are in the retracted position, the rollers 88 engage the inner wall of the column 18 and move the larger rollers 86 inwardly relative to the magnet assembly 20 to positions approximately flush with the exposed surface of the magnet 24 (Fig. 1). When the magnet assembly 20 is in the extended position, the rollers 88 move away from the inner wall of the column 18 and the larger outer rollers 86 move outwardly toward the elevator doors 14 and 16. As will be shown hereinafter, the outer rollers 86 actuate the switches 28 and 30 when the magnet assembly 20 is extended so as to energize the magnet 24.

The upper portion 14 of each elevator shaft door carries an armature 90 which is positioned thereon to be adjacent

to the magnet assembly 20 when the elevator car stops at a floor or is moving in a leveling zone. As the elevator car approaches or stops at a floor, the drive motor 82 is energized and moves the carrier 22 and the magnet assembly 20 upwardly in the column 18. In so doing, the magnet assembly 20 moves from the retracted to the extended position and the switch rollers 86 are depressed against the armature 90 and actuate their associated switches 28 and 30. Depression of both rollers 86 on the armature 90 closes a circuit and permits the energizing of the magnet 24 which then magnetically grips the armature 90. As the motor 82 continues to move the magnet assembly 20 upwardly, the magnet 24 moves the upper door portion 14 upwardly and separates the bi-parting door portions 14 and 16. The motor 82 continues moving the carrier 22, the magnet assembly 20, and the door portion 14 upwardly until the crosswise extending abutment 46 operates a switch lever 91 which controls limit switch 92, or until relays and limit switches which form no part of this invention and which are controlled by the position of the door portions 14 and 16, de-energize the magnet 24. The upward movement is finally stopped when the abutment 46 engages the bumper stop 94. The drive motor 82 continues to operate for a short interval after magnet 24 is de-energized and until the crosswise extending abutment 46 engages the bumper stop 94 to provide overtravel of the magnet assembly 20 that insures that the door portions 14 and 16 fully open and that the magnet assembly 20, including the switch rollers 86, is in position to properly grip the armature 90 for closing the door portions 14 and 16. It is important that the elevator doors 14 and 16 open fully because ledge 96 on top of the lower door portion 16 must be flush with the landing floor 98 to facilitate loading and unloading of the elevator car.

The armature 90 attached to the upper door portion 14 consists of a vertical plate with beveled upper and lower portions. The armature 90 is longer vertically than the magnet assembly 20 so that there is plenty of space thereon against which the magnet assembly 20 including the switch rollers 86 can operate, and it is important that both of the switch rollers 86 be depressed against the armature 90 in order that the magnet 24 be energized.

After the elevator car has completed its stop at a floor, the motor 82 is again energized to close the door portions 14 and 16. The motor 82 operates in the opposite direction for closing the door portions 14 and 16 and moves the magnet assembly 20 downwardly instead of upwardly. As the magnet assembly 20 moves downwardly, the magnet 24 is energized by the switches 28 and 30 and by limit switches and relays which form no part of the present invention, and the magnet 24 grips the armature 90 and closes the door.

It is important to this invention that the chains 50 operate in a plumb position when opening and closing the doors and that the power to the chains 50 be supplied from an overhead connection. By operating the means 10 with the chains 50 in a plumb position, side-wise chain stresses, chain distortion, and chain stretch are minimized, and by supplying the driving force for the chains 50 from overhead, the counterbalancing effect of the magnet assembly 20 and the counterbalance weight 60 maintain the chains 50 in a taut position and minimize malfunction due to chain stretch and wear which require frequent maintenance and adjustment.

It should also be noted that the cam portions 66c are positioned in column 18 to provide play or free lateral movement for the magnet assembly 20 when the assembly is in the operative position. By so providing, the magnet assembly 20 is able to move laterally inwardly and outwardly in the column 18 when energized to compensate for lateral movement of the elevator car 12.

It is now apparent that there has been provided a novel operator for elevator shaft doors which fulfills all

of the advantages and objects sought therefor. It is to be understood, however, that the foregoing description and the accompanying drawings have been presented only by way of illustration and example and that changes and alterations in the present disclosure which will be readily apparent to one skilled in the art are contemplated as being within the scope of the present invention which is limited only by the claims which follow.

What I claim is:

1. Door operator means for a vertically sliding elevator door that opens and closes an opening in a shaft, the door being slidably mounted adjacent to the shaft opening and having a magnetic member thereon, and an elevator car movable in the shaft, said car having improved door operator means mounted thereon, said improved door operator means comprising, an overhead sprocket mounted on the car, a magnetic assembly including a magnet, a counterbalance weight, a flexible member connected to said magnetic assembly and extending up over said sprocket and being connected to said counterbalance weight, said counterbalance weight and said magnetic assembly being disposed on opposite sides of a vertical plane extending through the axis of rotation of said sprocket when the flexible member is in plumb position on both sides of the sprocket such that the portion of the flexible member in engagement with said sprocket is under a continuous substantially constant tension, drive means operatively connected to said sprocket for moving said flexible member and magnetic assembly in reverse directions, said magnetic assembly and flexible member being in plumb suspension when the magnetic assembly is operatively associated with a magnetic member on a door such that movements under load when moving the door vertically occur with the magnetic assembly and flexible member in plumb position, guide means supported by said elevator car and including cam means operatively engaged with a portion of said magnetic assembly, said cam means including first and second offset upstanding cam portions and a sloping connecting cam portion, means associated with said magnetic assembly urging the magnetic assembly outwardly, said first upstanding cam portion permitting outward movement of the magnetic assembly such that the magnet can engage a magnetic member on a door and further serving to limit outward movement of the magnetic assembly, said sloping connecting cam portion automatically urging said magnetic assembly inwardly away from a door upon vertical movement of the magnetic assembly by said drive means when moving in an operating direction to close the door thereby moving the flexible member and magnetic assembly into and out of plumb position, said second upstanding cam portion maintaining said flexible member and magnetic assembly in out-of-plumb inoperative position, and means connected with the magnetic assembly for energizing the magnet when the magnet is in operative position adjacent to a magnetic member on a door.

2. Apparatus as defined in claim 1 wherein said drive means is frictionally connected to said sprocket to permit slippage between said sprocket and said drive means.

3. Apparatus as defined in claim 1, including means providing vertical overtravel of said magnetic assembly to provide for the proper relative positioning of the mag-

net and magnetic member on a door and to ensure full opening and closing of a door.

4. In an elevator shaft, a plurality of vertically spaced doors for said shaft and an elevator car movable in said shaft between said doors, an improved operator for said doors movably mounted on said car, said operator comprising, an overhead sprocket mounted on the car, a magnetic assembly including a magnet, a counterbalance weight, a flexible member connected to said magnetic assembly and extending up over said sprocket and being connected to said counterbalance weight, said counterbalance weight and said magnetic assembly being disposed on opposite sides of a vertical plane extending through the axis of rotation of said sprocket when the flexible member is in plumb position on both sides of the sprocket such that the portion of the flexible member in engagement with said sprocket is under a continuous substantially constant tension, drive means operatively connected to said sprocket for moving said flexible member and magnetic assembly in reverse directions, said magnetic assembly and flexible member being in plumb suspension when the magnetic assembly is operatively associated with a magnetic member on a door, such that movements under load when moving the door vertically occur with the magnetic assembly and flexible member in plumb position, guide means supported by said elevator car and including cam means operatively engaged with a portion of said magnetic assembly, said cam means including first and second offset upstanding cam portions and a sloping connecting cam portion, means associated with said magnetic assembly urging the magnetic assembly outwardly, said first upstanding cam portion permitting outward movement of the magnetic assembly such that the magnet can engage a magnetic member on a door and further serving to limit outward movement of the magnetic assembly, said sloping connecting cam portion automatically urging said magnetic assembly inwardly away from a door upon vertical movement of the magnetic assembly by said drive means when moving in an operating direction to close the door thereby moving the flexible member and magnetic assembly into and out of plumb position, said second upstanding cam portion maintaining said flexible member and magnetic assembly in out-of-plumb inoperative position, and means connected with the magnetic assembly for energizing the magnet when the magnet is in operative position adjacent to a magnetic member on a door, and control means associated with the drive means for overdriving said magnetic assembly in either direction of its movement, said control means moving said magnetic assembly while engaged with a magnetic member on a door beyond the normal open and closed positions of said doors to compensate for stretch of said flexible member and to ensure full opening and closing of the doors regardless of the size of the doors.

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