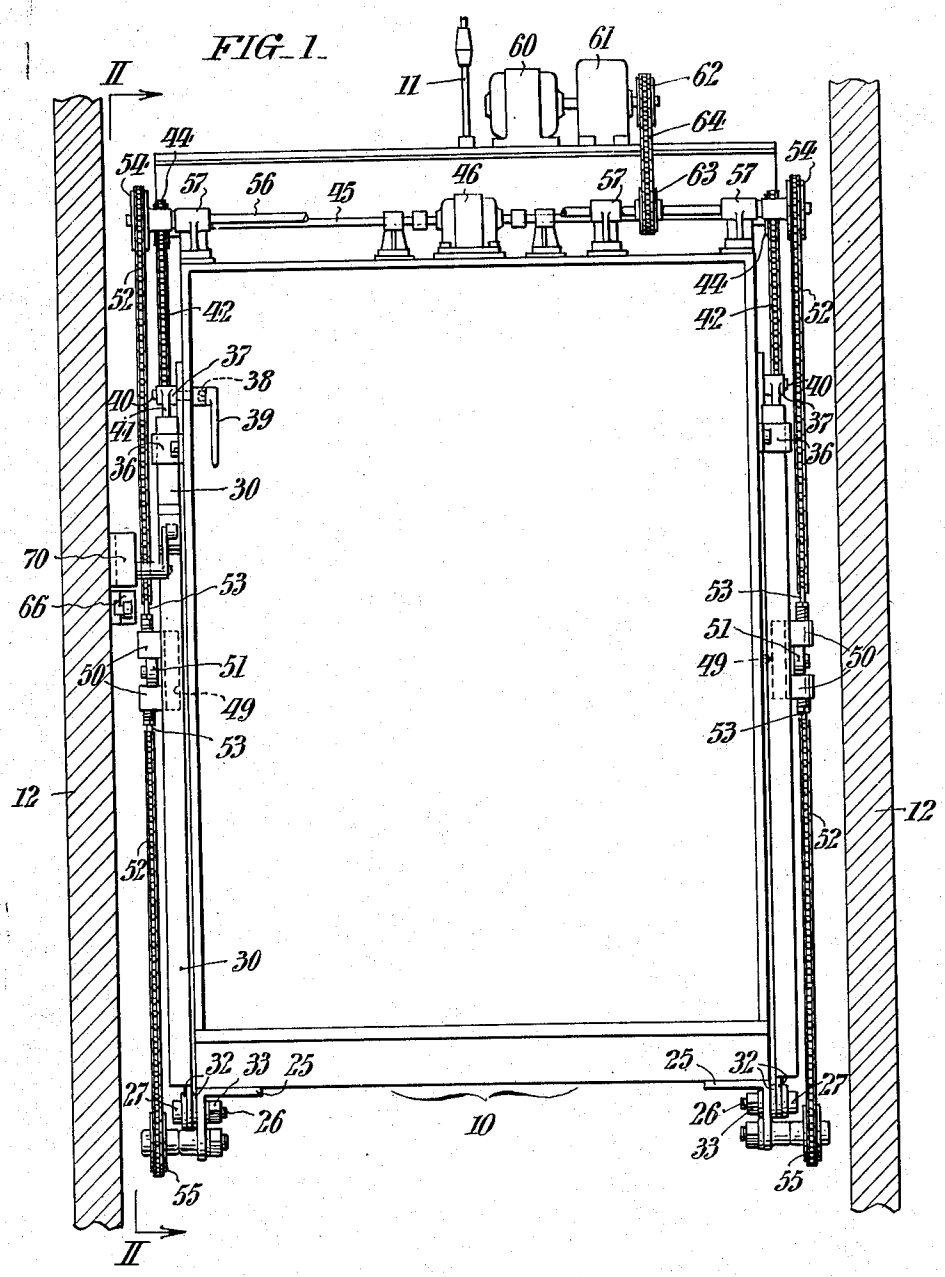
April 7, 1953 W. C. CLIFT 2,633,932

ELEVATOR DOOR OPERATOR MECHANISM

Filed Feb. 21, 1951 4 Sheets-Sheet 1

FIG. 1.



INVENTOR:
William C. Clift,

BY Paul & Paul

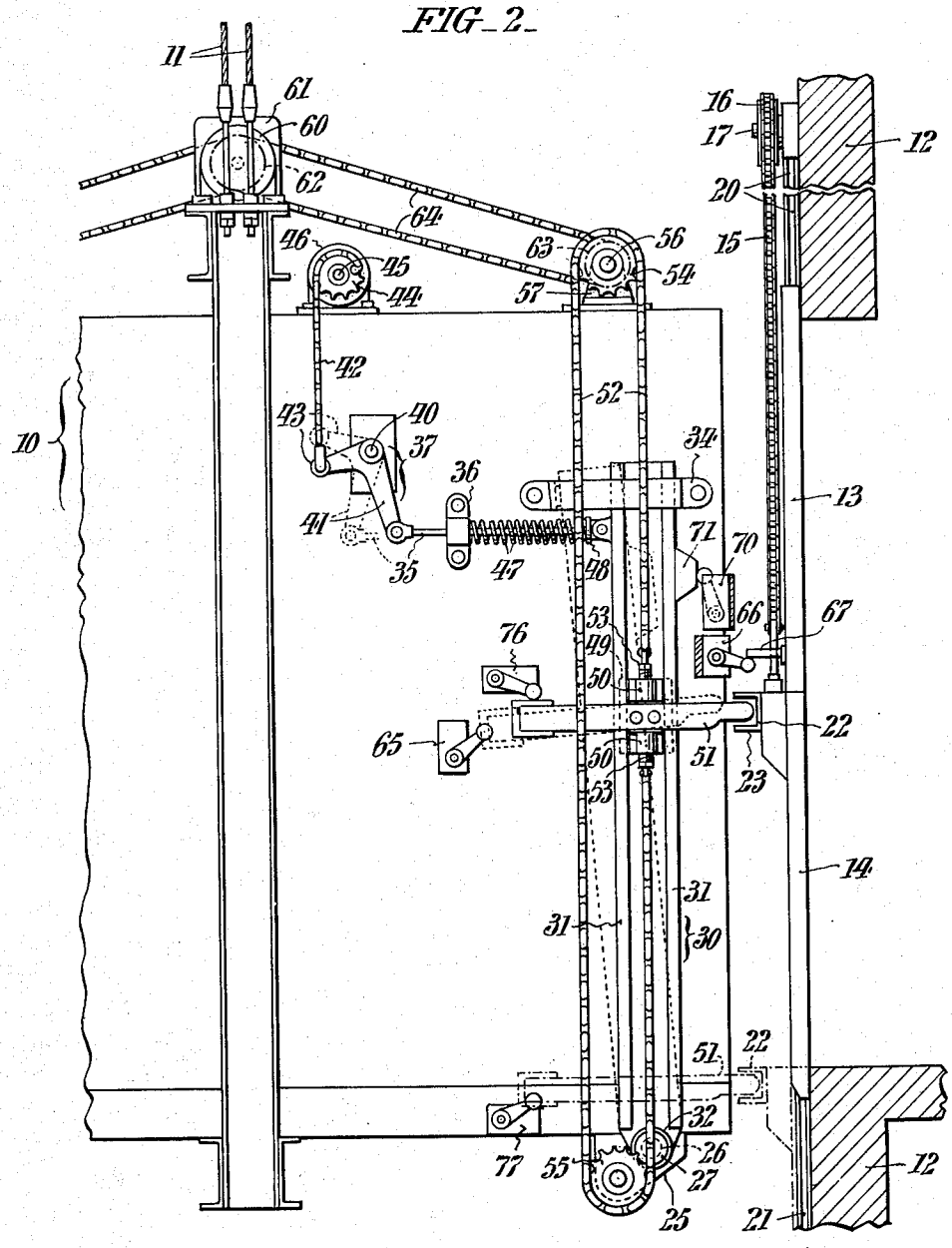
ATTORNEYS.

April 7, 1953 W. C. CLIFT 2,633,932

ELEVATOR DOOR OPERATOR MECHANISM

Filed Feb. 21, 1951 4 Sheets-Sheet 2

FIG. 2.



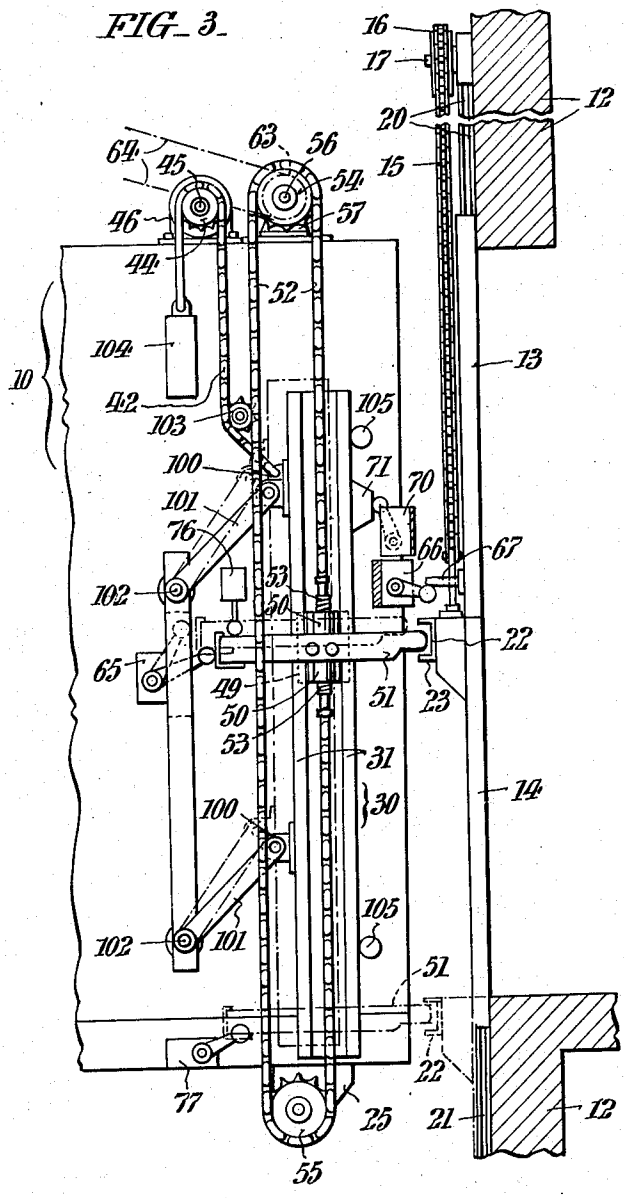
INVENTOR:
William C. Clift,
BY Paul & Paul
ATTORNEYS.

April 7, 1953 W. C. CLIFT 2,633,932

ELEVATOR DOOR OPERATOR MECHANISM

Filed Feb. 21, 1951 4 Sheets-Sheet 3

FIG. 3.



INVENTOR:
William C. Clift,

BY Paul & Paul

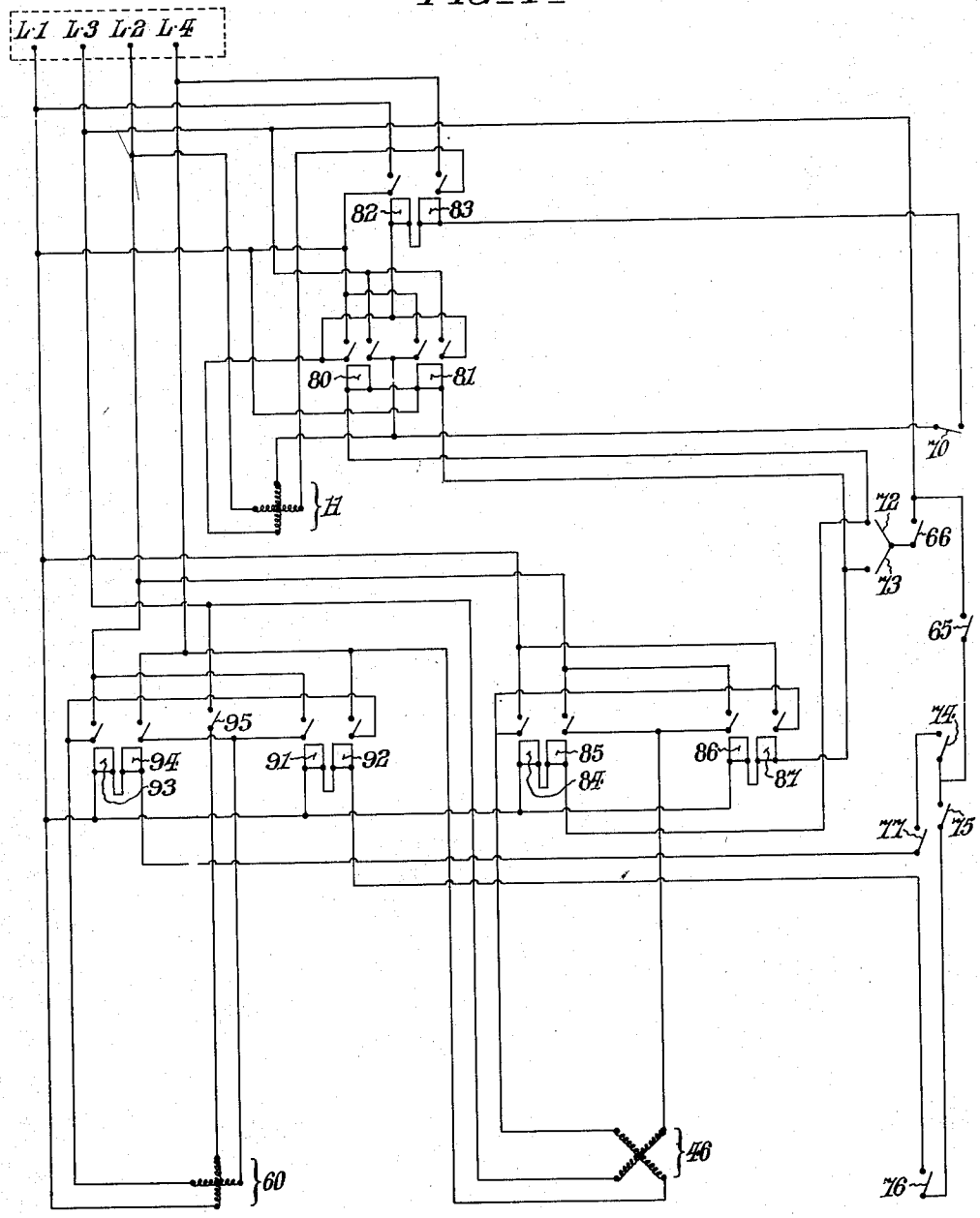
ATTORNEYS.

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ELEVATOR DOOR OPERATOR MECHANISM

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FIG_4_



INVENTOR:
William C. Clift,
BY Paul & Paul
ATTORNEYS.

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UNITED STATES PATENT OFFICE

2,633,932

ELEVATOR DOOR OPERATOR MECHANISM

William C. Clift, Philadelphia, Pa.

Application February 21, 1951, Serial No. 211,993

11 Claims. (Cl. 187—52)

1

This invention relates to apparatus for operating elevator shaft doors, and more particularly concerns a door operating device adapted to be mounted on the cab of an elevator to operate the elevator shaft doors on the different floors of a building.

Elevator door operating mechanisms are conventionally installed on each individual floor of the building in which the elevator operates, and are generally in the form of separate motor-operated mechanisms permanently connected to the elevator shaft doors which they serve to open and close. Thus in buildings having a multiplicity of floors large numbers of separate door operating mechanisms are required. This requires a rather considerable capital investment in machinery and also raises the maintenance charges for opening and closing the shaft doors to a considerable extent. While it has previously been proposed broadly to mount a motor on the elevator cab to connect with operating mechanisms attached to the doors on each floor, no such mechanism has ever been entirely satisfactory or dependable. Some of the devices previously proposed depend upon frictional engagement for effecting door operation, and these are objectionable in that positive action is not attained, and the friction parts require excessive maintenance. It is accordingly one object of the invention to provide an efficient, reliable mechanism capable of being mounted on the elevator cab itself with capacity to operate by direct mechanical connection the elevator shaft doors of a plurality of different floors.

Another disadvantage inherent in conventional door operating devices is that they are ordinarily very heavy and could not effectively be mounted on an elevator cab without materially decreasing the load carrying capacity of the elevator. It is accordingly another object of the invention to provide a relatively simple, light weight elevator door operating mechanism.

Frequently individual electric power circuits for operating elevator mechanisms fail by reason of defects in fuses or circuit breakers, or mechanical difficulties in the elevator operating mechanism. In many conventional installations such power failure interrupts elevator service for excessive periods of time. Therefore it is a still further object of this invention to provide an elevator door operating mechanism including readily accessible mechanical means for operating the elevator shaft doors in the event of power failure.

It has previously been proposed to provide door

2

operating devices which may be mounted on the cab of an elevator and connected to drive means located within the elevator shaft. However such devices have not proved commercially successful in that the natural sway of the elevator as it moves up and down the shaft tends to disengage the connections which are essential to the operation of the door operating mechanism. It is therefore another object of this invention to provide a door operating mechanism substantially unaffected by sway of the elevator.

Still further objects of the invention are to provide a door operating device which may be installed with minimum labor and material, which may be applied as an attachment to existing elevator equipment with minimum alterations, and which is economical to operate.

The foregoing and other objects of the invention will appear in further detail hereinafter, and in the drawings, whereof:

Fig. 1 represents a front elevation of an elevator cab carrying a door operating mechanism which constitutes one embodiment of this invention;

Fig. 2 represents a fragmentary side elevation, partly in section, of the door operating mechanism which appears in Fig. 1, taken as indicated by the lines and arrows II—II, which appear in Fig. 1;

Fig. 3 represents a side elevation similar to Fig. 2 showing a modified form of the invention; and

Fig. 4 represents an electric wiring diagram indicating the electric connections for the door operating mechanisms shown in Figs. 1–3.

In summary, the foregoing and other objects of the invention are attained by the present invention, wherein the elevator door operating device is adapted to be mounted in an elevator cab and comprises door engaging means on said cab, means for moving the door engaging means up and down, and means for advancing and retracting said door engaging means toward and away from the door to effect engagement with and disengagement from said door.

The two embodiments of the invention selected for illustration in the drawings are representative of preferred structures in accordance with the invention, and may be modified in many particulars without departing from the spirit and scope of the invention.

Referring now to Figs. 1 and 2 of the drawings, the illustrated embodiment of the invention is mounted on the elevator cab 10 which is suspended by the cab hoist cables 11 for movement

up and down within the shaft walls 12. At each floor of the building openings are provided in the shaft walls 12, such openings being normally closed by the upper and lower elevator shaft doors 13, 14 which move vertically away from one another in the tracks 20, 21 to open the door aperture to permit loading and unloading the elevator. The doors 13, 14 are conventionally connected together, as by the door chain 15 and door chain sprocket 16 which is pivotally mounted for free rotation on the shaft 17 imbedded in the shaft wall 12. At one end the chain 15 is attached to lower door 14 while the other end of chain 15 is attached to door 13. Thus the movement of one door in one direction actuates the movement of the other door in the opposite direction, effectively opening or closing the entire shaft aperture.

One door, here illustrated as the lower door 14, carries a horizontal keeper 22. The keeper 22 is in the form of a channel having horizontal flanges 23, such channel opening toward the elevator shaft.

Attached to the bottom of the cab 10 are a pair of corner angle irons 25 through each of which is projected a riser pivot shaft 26 which has an enlarged end 27. Pivotally mounted on the riser pivot shaft 26 is riser track 30, which is in the form of a substantially upright channel having inturned flanges 31. Each riser track 30 is maintained laterally in position on riser pivot shaft 26 by a pair of spaced washers 32 and nut 33 (Fig. 1). Bracket 34, fixed to the elevator cab near the top of each riser track 30, surrounds and serves as a guide for the riser track 30 as it pivots about shaft 26. A riser track pull rod 35, pivotally attached to each riser track 30 near its upper end, serves to swing the riser track 30 in and out about its pivot, causing it to tilt toward and away from the keeper 22. Each pull rod 35 is guided by pull rod guide bracket 36. A crank lever 37 is pivotally mounted on each shaft 40 fixed to the wall of cab 10. Shafts 40 each extend through the cab wall and have hexagonal recesses 38 which engage with a corresponding hexagonal projection on removable crank 39, which may be moved manually to advance and retract the riser track 30. One arm 41 of each crank lever 37 is pivotally attached to the end of each pull rod 35 while a chain 42 is attached to the free end of the other arm 43 of crank lever 37. Each chain 42 is trained around and attached to the sprocket pinion 44 mounted on drive shaft 45 of torque motor 46 which is mounted on top of cab 10. Spring 47 bears against each guide bracket 36 and against the enlarged end 48 of the corresponding pull rod 35, and is maintained under compression to urge the pull rod 35 continuously toward the position represented in solid lines in Fig. 2 of the drawings. Upon energization of torque motor 46 the chains 42 are immediately drawn upwardly against the resistance of spring 47, moving crank lever arms 41, pull rods 35, and riser tracks 30 to the positions shown in dash lines in Fig. 2.

A follower block 49 is slidably mounted within the channel of each riser track 30, and confined therein by the inturned flanges 31. A door operator arm 51 is rigidly attached to each follower 49, between auxiliary blocks 50 which are slidably disposed against the outside surfaces of the inturned flanges 31. A continuous chain 52 is attached by means of adjustable chain links 53 to the upper and lower ends of each block 50, and trained with moderate slack about the drive gear 54 and idler gear 55. Each drive gear 54 is mounted on drive shaft 56 rotatably supported above the top of the cab 10 by drive shaft bearings 57. Drive shaft 56 is rotated by electric motor 60 operating through reduction gear 61, sprocket 62, 63, and drive chain 64. Motor 60 is reversible and serves to move the door operator arm 51 up and down to close and open the elevator shaft doors when door operator arm 51 is engaged within keeper 22. The movement of riser track 30 about its pivot advances and retracts the door operator arm 51 toward and away from keeper channel 22 to effect engagement and disengagement thereof.

Electric means are provided for controlling the automatic operation of the device. The number 65 represents a normally closed switch mounted on the cab side in the path of movement of the rear end of arm 51. Switch 65 is maintained open by arm 51 when riser track 30 is tilted rearwardly. Switch 66 is mounted at a fixed point in the elevator shaft, as on wall 12 to the side of the elevator cab, and is normally open. It is closed by projection 67 which is fixed to the door 13 and serves to close switch 66 when doors 13, 14 are closed. The reference number 70 designates a normally closed switch mounted on shaft wall 12 in the plane of movement of cam 71 fixed on riser track 30. Switch 70 is opened by cam 71 when riser track 30 is shifted forwardly, to the position represented in solid lines in Fig. 2. Switches 72, 73 (Fig. 4) represent car operator switches actuated by a car operator lever of the character conventionally mounted for manual operation within the cab. As will appear hereinafter, switches 72, 73 are also connected to torque motor 46 to shift the riser track 30 about its pivot. Switch 72 is closed by movement of the car operator lever in one direction and serves to energize the elevator hoist motor to move the elevator cab 10 up the shaft, while switch 73 is closed by movement of the car operator lever in the opposite direction and also connects to the hoist motor for movement of the cab 10 down the shaft. Switches 74, 75 (Fig. 4) represent switches manually operable from within cab 10. Switch 74 closes a circuit moving arm 51 downwardly to open doors 13, 14, while switch 75 returns arm 51 upwardly to close the doors.

Normally closed switch 76 is mounted on the side of cab 10 in the path of movement of arm 51 and is opened by contact with arm 51 when doors 13, 14 are closed. Normally closed limit switch 77 is also mounted on the side of cab 10 at a level corresponding to the position of arm 51 when doors 13, 14 are open. Switch 77 is actuated by arm 51 and opened thereby when doors 13, 14 are fully open.

Referring more particularly to Fig. 4 of the drawings, L1, L2, L3, L4 represent individual load lines or wires. Switch 66 is connected directly to load line L3 and to the switches 72, 73. Switches 72, 73 are in turn respectively wired through the coils of relays 80, 81 to load line L1. Hoist motor H is energized through the switch of relay 80 and through the switch of relay 82 to move the elevator cab upwardly, and is similarly energized through relays 81, 83 for movement downwardly. Switch 70 is included in the circuit energizing the coils of relays 82, 83 to prevent the energization of the hoist motor H until riser track 51 is retracted.

Car operator switches 72, 73 are also each connected electrically through the coils of relays 84, 85 and 86, 87, respectively which are mounted on

cab 10 and arranged in series, to the line L3 through the coil of relay 81. The switches of relays 84, 85, 86, 87 are connected to load lines L1, L2, L2, and L1 respectively and also to corresponding terminals of torque motor 46. Load line L3 is connected through switch 73 and the coils of relays 86, 87 to load line L1 and is also connected through switch 72 and the coils of relays 84, 85 to load line L1. Thus the closure of either switch 72 or 73 energizes the corresponding relay coils energizing torque motor 46, when switch 66 is closed, automatically swinging riser shaft 30 rearwardly when the doors 13, 14 are closed and the elevator is set into operation.

Switch 74 is connected through switch 77 and the coils of cab-mounted relays 93, 94 to load line L1, thus closing the switches of cab-mounted relays 93, 94 to energize motor 60 in one direction, moving arm 51 downwardly to open doors 13, 14. Switch 75 is similarly connected through switch 76 and the coils of relays 91, 92 to load line L1 to energize motor 60 in reverse direction through the switches of relays 91, 92, raising arm 51 and closing the doors 13, 14. Switch 95 is mechanically linked with the switches of relays 94 and 91 to close when either of said switches is closed.

From the foregoing the operation of the apparatus will be apparent. The cab 10, driven up and down the elevator shaft by the conventional hoist motor means H, is stopped at the level of any selected floor of the building, riser track 30 then being retracted as shown in dash lines in Fig. 2 by torque motor 46. To stop the car the operator places car operator switches 72 and 73 in open position deenergizing the applicable solenoid sets 86, 87 or 84, 85, thus deenergizing torque motor 46 rendering spring 47 effective to swing riser track 30 forwardly about riser pivot shaft 26. This movement causes engagement of the forward end of arm 51 in keeper channel 22 and also permits switch 65 to close, opens switch 76, and opens switch 70. The opening of switch 70 prevents the energization of the hoist motor operating circuit, inactivating the hoist motor apparatus H, thereby protecting the elevator door operating apparatus from damage that might otherwise result if switch 72 or 73 were closed and the cab 10 were raised or lowered while arm 51 is engaged within keeper channel 22. The operator then closes switch 74 which acts through switch 77 to energize solenoids 93, 94, rotating motor 60 and moving arm 51 downwardly along the riser track 30 thus permitting switch 76 to close. Switch 66 is also opened as the doors 13, 14 are opened. Arm 51 eventually contacts and opens switch 77, opening the circuit and stopping the arm 51. The elevator is then loaded or unloaded and the doors 13, 14 are closed in similar manner by closing switch 75 which operates motor 60 in reverse, eventually bringing arm 51 into contact with, and closing, switch 76. The doors 13, 14 are then completely closed, closing switch 66.

The operator may then move the car operator lever closing either switch 72 or 73, depending upon whether it is desired to move the cab 10 up or down in the elevator shaft. In either event torque motor 46 will be energized through the switches of solenoids 84, 85 or 86, 87 retracting arm 51 immediately from keeper channel 22, chain 52 having sufficient slack to permit such movement. This permits switch 70 to close, permits switch 76 to close, and opens switch 65 which prevents further movement of arm 51 along riser track 30 while riser track 30 is retracted. Cab 10 is then free to move up and down the shaft under the influence of hoist operating apparatus H, actuated through relays 80, 81 operated from switches 72, 73.

A modified form of apparatus appears in Fig. 3 of the drawings. Many of the parts of such apparatus are similar to the apparatus of Fig. 2, are similarly numbered, and are not further described. However it will be observed that riser track 30 carries a pair of spaced upper and lower brackets 100 to each of which is pivotally attached a swinging arm 101. Swinging arms 101 are each pivoted to shafts 102 fixed to the side wall of cab 10, and are disposed at an angle to the horizontal flanges of keeper channel 22. The chain 42 is attached to the upper bracket 100 and trained around idler sprocket 103 and drive sprocket 44 of torque motor 46. A counterweight 104 is attached to the free end of chain 42. The weight of counterweight 104 is slightly less than the weight of riser track 30, providing minimum weight to be lifted by torque motor 46 in lifting riser shaft 30 from the position represented in solid lines in Fig. 3 to the corresponding dot-dash line position. The extent of forward swinging movement of riser track 30 is limited by limit pegs 105 fixed to cab 10.

The operation of the apparatus of Fig. 3 is substantially similar to that of Fig. 2. However in Fig. 3 the riser track is constantly maintained substantially vertical and is swung bodily through an arc to effect advancement and retraction of arm 51 toward and away from the keeper channel 22. It is lifted and thereby retracted under the influence of torque motor 46, and permitted to drop and thereby advanced by reason of its own weight. The electric control apparatus of the two forms of the invention may be identical. The torque motor 46 of Fig. 3 may be relatively small since it overcomes the counterbalanced weight of riser track 30 and is not required to overcome the relatively large resilient opposition of coil spring 47, Fig. 2.

By reason of the substantial angle of swinging arms 101 relative to the horizontal flanges of keeper channel 22, the arm 51 has capacity to swing through a very short arc, at the proper angle for engaging and disengaging the keeper channel 22.

It will be appreciated that, while I have shown and described vertically movable operator means for operating vertically movable doors, the same apparatus is readily applied to other conventional doors which slide horizontally or otherwise, and to conventional swinging doors. Moreover other modifications, such as reversals of parts, substitution of equivalent parts, and the use of certain features independently of the use of others, all fall within the spirit and scope of the invention as defined in the appended claims.

Having thus described my invention, I claim:

1. An elevator door operating device adapted to be mounted on an elevator cab, comprising a track member movably mounted on said cab with capacity to move toward and away from said door, door-engaging means movable along said track member, means for concurrently moving said track member and door-engaging means to effect direct mechanical engagement between said door and said door-engaging means, and means in the form of a direct mechanical linkage for moving said door engaging means along said track member to open and close the door when so engaged.

2. An elevator door operating device for use in

an elevator cab, comprising a riser track pivotally mounted on said cab with capacity to move about its pivot toward and away from said door, a door-engaging arm mounted for movement along said riser track to open and close said door, and means for swinging said riser track about its pivot to advance and retract said arm toward and away from said door, thereby effecting engagement of said arm with and disengagement of said arm from said door.

3. Door operating mechanism for opening and closing a door mounted in the opening of an elevator shaft, comprising a keeper fixed to the door, said keeper facing said shaft, a guide track pivotally mounted on the elevator cab with capacity to swing toward and away from said keeper, a door operator arm mounted on said guide track with capacity for movement longitudinally thereof, and for bodily movement with said guide track as it swings about its pivot, moving means attached to said guide track to swing it toward and away from the keeper thereby engaging and disengaging the door operator arm and the keeper, and power means for moving the door operator arm longitudinally of said guide track when engaged with said keeper, thereby moving said door.

4. Door operating mechanism for opening and closing a door mounted in the opening of an elevator shaft, comprising a keeper fixed to the door, said keeper facing said shaft, a guide track pivotally mounted on the elevator cab with capacity to swing toward and away from said keeper, a door operator arm mounted on said guide track with capacity for movement longitudinally thereof, and for bodily movement with said guide track as it swings about its pivot, resilient means continuously urged against said guide track to swing it toward said keeper to effect engagement of the door operator arm upon the keeper, and prime mover means attached to said guide track with capacity to swing it in opposition to said resilient means to disengage said door operator arm from said keeper, and means for moving the door operator arm longitudinally of said guide track when engaged with said keeper, thereby moving said door.

5. An elevator door operating device for operating a door in an elevator shaft aperture, comprising a keeper in the form of a channel mounted on said door and opening inwardly toward said elevator shaft, a guide track mounted on said elevator cab with capacity to shift toward and away from said channel, a mechanical linkage accessible from within the cab attached to said guide track, power operated means mounted on said elevator cab attached to said mechanical linkage to shift the guide track toward and away from said channel, a door operator arm mounted on said guide track with capacity to move longitudinally thereof, said door operator arm extending toward said channel, and means for moving the door engaging arm longitudinally of said guide track.

6. An elevator door operating device for operating a door in an elevator shaft aperture, comprising a keeper in the form of a channel mounted on said door and opening inwardly toward said elevator shaft, a guide track mounted on said elvator cab with capacity to shift toward and away from said channel, a mechanical linkage accessible from within the cab attached to said guide track, power operated means mounted on said elevator cab and attached to said mechanical linkage to shift the guide track toward and away from said channel, crank means within the elevator cab detachably engageable with said mechanical linkage for advancing and retracting said guide track, a door operator arm mounted on said guide track with capacity to move longitudinally thereof, said door operator arm extending toward said channel, and means for moving the door engaging arm longitudinally of said guide track.

7. Door operating mechanism for opening and closing a door mounted in the opening of an elevator shaft, comprising a keper fixed to the door, said keeper facing said shaft, a guide track pivotally mounted on the elevator cab with capacity to swing bodily upwardly through an arc away from said keeper and bodily downwardly through the same arc toward said keeper, a door operator arm mounted on said guide track with capacity for movement longitudinally thereof, and for bodily movement with the track as it swings through said arc, means for moving said door operator arm longitudinally of said guide track, power means attached to said guide track to lift it upwardly retracting said door operator arm from said keeper, and releasing means inactivating said power means, whereby the guide track is released to fall through said arc by reason of its own weight toward said keeper, effecting engagement of the door operator arm with said keeper.

8. Elevator door operating mechanism comprising a keeper on the elevator door, a pair of spaced pivots fixed to the elevator cab, swinging arms attached to each of said pivots, a riser track pivoted at spaced points to each of said swinging arms with capacity to reciprocate bodily through a limited arc about said fixed pivots, keeper engaging means mounted for movement along said riser track, means for moving said keeper engaging means along said riser track, a motor on said elevator cab, flexible connecting means connecting said motor to said riser track with capacity to lift it through said arc, releasing means inactivating said motor, said riser track having capacity to fall by gravity through said arc when said motor is inactivated, and counterbalancing means attached to said flexible connecting means effective to reduce the torque on said motor.

9. Door operating mechanism for opening and closing a door mounted in the opening of an elevator shaft, comprising a keeper fixed to the door, said keeper facing said shaft, a guide track pivotally mounted on the elevator cab with capacity to swing toward and away from said keeper, a door operator arm mounted on said guide track with capacity for movement longitudinally thereof, and for bodily movement with said guide track as it swings about its pivot, moving means attached to said guide track to swing it toward and away from the keeper thereby engaging and disengaging the door operator arm and the keeper, power means for moving the door operator arm longitudinally of said guide track when engaged with said keeper, thereby moving said door, hoisting means for moving said elevator cab up and down said shaft, and switch means connected to energize said hoisting means, said switch means also being connected to said guide track moving means with capacity automatically to retract said guide track upon energization of said hoist means.

10. Door operating mechanism for opening and closing a door mounted in the opening of an elevator shaft, comprising a keeper fixed to the door,

said keeper facing said shaft, a guide track pivotally mounted on the elevator cab with capacity to swing toward and away from said keeper, a door operator arm mounted on said guide track with capacity for movement longitudinally thereof, and for bodily movement with said guide track as it swings about its pivot, moving means attached to said guide track to swing it toward and away from the keeper thereby engaging and disengaging the door operator arm and the keeper, power means for moving the door operator arm longitudinally of said guide track when engaged with said keeper, thereby moving said door, and switch means disposed in the path of movement of said door operator arm to inactivate said power means when said guide track is retracted from said keeper.

11. Door operating mechanism for opening and closing a door mounted in the opening of an elevator shaft, comprising a keeper fixed to the door, said keeper facing said shaft, a guide track pivotally mounted on the elevator cab with capacity to swing toward and away from said keeper, a door operator arm mounted on said guide track with capacity for movement longitudinally thereof, and for bodily movement with said guide track as it swings about its pivot, moving means attached to said guide track to swing it toward and away from the keeper thereby engaging and disengaging the door operator arm and the keeper, power means for moving the door operator arm longitudinally of said guide track when engaged with said keeper, thereby moving said door, hoisting means for said elevator cab, cam means fixed to said riser track, and switch means mounted in the path of movement of said cam means and connected to said hoisting means, said switch means being effective when contacted by said cam means to prevent energization of said hoisting means.

WILLIAM C. CLIFT.

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