

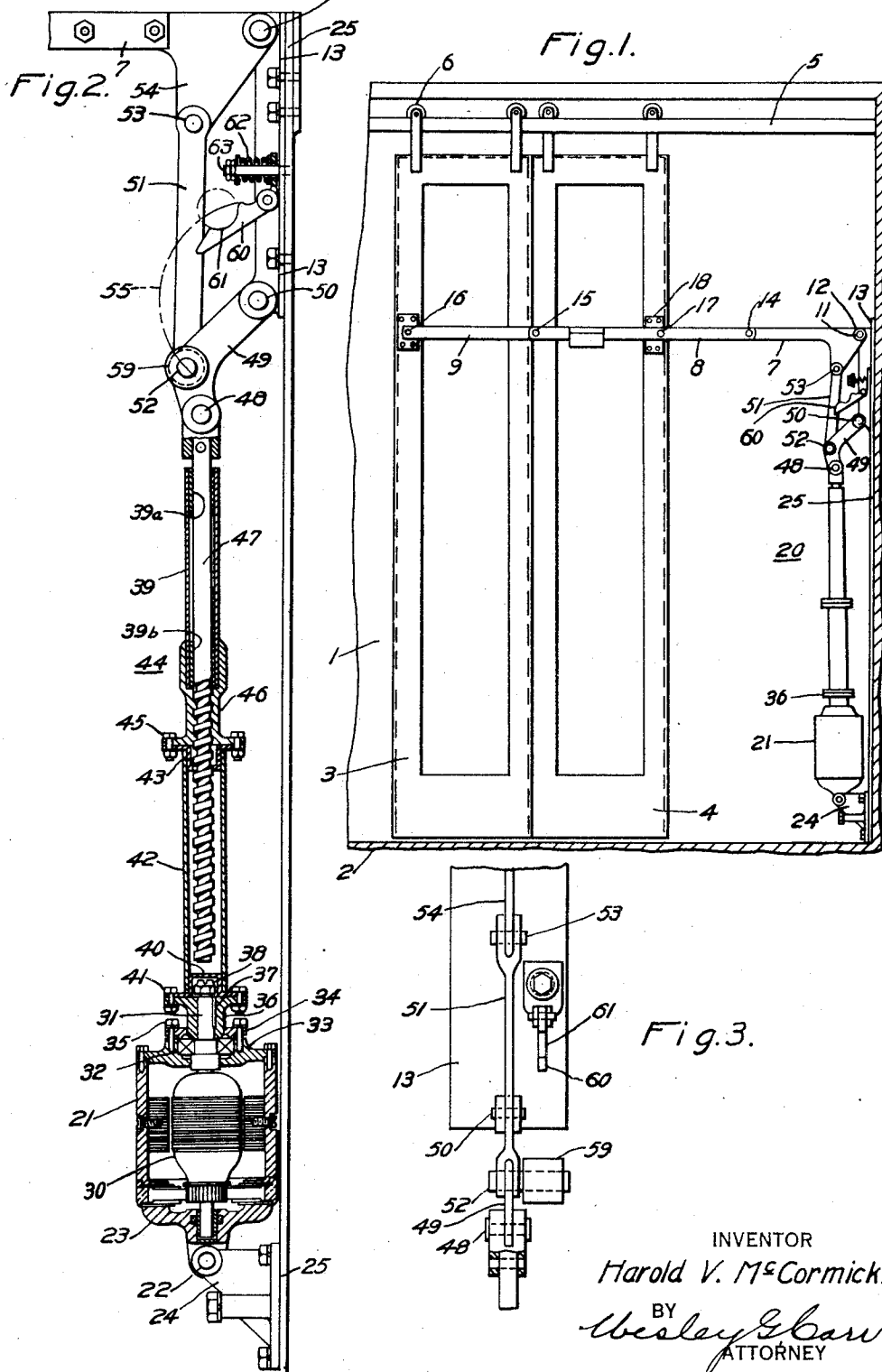
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ELEVATOR DOOR OPERATING DEVICE

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HAROLD V. McCORMICK, OF LONG BEACH, NEW YORK, ASSIGNOR, BY MESNE ASSIGNMENTS, TO WESTINGHOUSE ELECTRIC ELEVATOR COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS

ELEVATOR DOOR OPERATING DEVICE

Application filed August 8, 1930. Serial No. 473,851.

My invention relates to door-operating devices and more particularly to such power-operated devices as are employed for opening and closing elevator doors.

One object of my invention is to provide an individual operator for the corridor door at each floor landing of an elevator, which shall be capable of being easily and inexpensively manufactured, installed and maintained, and which shall be simple and efficient in operation.

Another object of my invention is to provide, for each door, an electric-motor-driven operating unit which may be disposed in an approximately vertical position at one side of the door where it will occupy a minimum amount of what is usually unoccupied space, and where it may be easily inspected and maintained in good operating condition.

A further object of my invention is to provide a door operator of such construction that a small electric motor may be employed to supply the power necessary to open and close the door with which the operator is connected.

A further object of my invention is to provide a door operator that will cause the door to start slowly, accelerate to a relatively high speed and then decelerate to a low speed, as it comes to a stop, when it is being moved to its open or to its closed position, so that it will start easily and will not slam at the end of its movement.

It is also an object of my invention to provide for holding a door-operating mechanism in its door-opened position so that the door will be maintained in its full-open position against the gravity effects of the door-operating mechanism.

Other objects of my invention will, in part, be obvious and will, in part, appear hereinafter.

For an illustration of one of the many forms in which my invention may be employed, reference may be had to the accompanying drawing, in which;

Figure 1 is a view, in elevation, as it appears from the interior of an elevator hatchway, of a side-opening door mounted in a

corridor opening and an operating mechanism therefor embodying my invention,

Fig. 2 is an enlarged view, partly in side elevation and partly in section, of the door operator shown as connected to the door-operating levers illustrated in Fig. 1; and,

Fig. 3 is a view, in front elevation, of a portion of the means for connecting the operator to the actuating levers, and the detent for maintaining it in a raised position, as illustrated in Fig. 2.

Referring more particularly to the drawing, I have illustrated a door frame 1 for a corridor door at a floor landing, as viewed from the interior of an elevator hatchway 2 (only a small portion of which is shown). In the door frame 1 is mounted a door comprising a high-speed panel 3 and a low-speed panel 4. The door panels are slidably supported upon tracks 5 by means of a plurality of hangers 6.

As a means for moving the door panels 3 and 4 along the tracks 5, in opening or in closing the door, I have provided a plurality of door toggle levers 7, 8 and 9. One end of the lever 7 is mounted, by a pin 11, in a bearing 12 on a back plate 13 which is secured to a base plate 25 mounted on one side of the door frame 1. The other end of the lever 7 is pivotally connected, by a bolt 14, to one end of the lever 8, the other end of which is pivotally connected, by a bolt 15, to one end of the lever 9. The other end of the lever 9 is pivotally connected, by a bolt 16, to the high-speed door panel 3, and the middle portion of the lever 8 is pivotally connected, by a bolt 17, to a bracket 18 on the door panel 4, so that movement of the levers to a straight-line position will close the door, and movement out of their straight-line position will open the door. The lengths and the positions of the levers are so selected that their operation will cause the door panel 3 to travel at a higher speed than the door panel 4, thereby causing the panels to reach their full-open or full-closed position at the same time.

A door operator, comprising a motor 21 and mechanism operated thereby for actuating the door toggle levers to open or to close the door, is disposed in an approximately

vertical position at one side of the door. The operator is pivotally or hingedly supported by a swivel joint 22 that connects an end bell 23 on the lower end of the motor 21 to a bracket 24 that is mounted on a base plate 25 secured to the side of the door frame 1.

The motor 21 is provided with a suitable rotor, such as an armature 30, which is mounted with the lower end of its shaft 31 disposed in a bearing in the lower end bell 23. The upper end of the armature shaft 31 is supported in a suitable ball-thrust bearing 32 mounted in an end bell 33 secured to the upper end of the motor. A cover-plate 34 is mounted upon the end bell 33 by means of a plurality of bolts 35 to hold the ball-thrust bearing in its correct position in the end-bell.

The upper end of the armature shaft 31 extends upwardly beyond the ball-thrust bearing and has mounted upon it a flanged collar 36. The flanged collar is keyed to the armature shaft by a key 37 and is firmly retained in its position thereon by means of a nut 38, so that it will rotate with the armature. The lower end of the flanged collar is disposed against the ball-thrust bearing which prevents axial displacement of the armature shaft or the collar mounted thereon during the operation of the motor and the mechanism actuated thereby.

A flanged cap 40 is firmly mounted upon the flanged collar 36 by a plurality of bolts 41. A driving tube 42 is firmly mounted upon and fixed to, the flanged cap 40 by a welding or other suitable means. Mounted upon the upper end of the driving tube and firmly secured thereto by a weld or some other suitable means, is a flanged collar 43 that serves to support a flanged driving nut 44 which is firmly attached to it by a plurality of bolts 45. Inasmuch as the driving nut 44, the driving tube 42, and the flanged collar 36 are firmly connected, through each other, to the shaft 31 of the armature, the driving nut 44 will rotate with the armature when the motor is operated.

The driving nut 44 is provided with a central screw-threaded aperture 46 in which is disposed the screw-threaded end of an operating shaft 47. The screw-threaded shaft 47 is hingedly connected at its upper end, by a bolt 48, to the lower end of a motion-converting lever 49, of approximately L shape, the other end of which is pivotally connected, by a bolt 50, to the bracket 13. The middle portion of the motion-converting lever 49 is connected, by a bolt or joint 52, to the lower end of a link 51, the upper end of which is connected, by a bolt 53, to a downwardly extending lug 54 on the door-actuating lever 7. As shown, the lever 49 and the link 51 constitute a pair of auxiliary toggle levers for operating the door toggle levers.

By reason of the fact that the operating shaft 47 is hingedly connected to the lever

49, the shaft cannot rotate around its axis. Therefore, when the driving screw 44 on the screw-threaded portion of the operating shaft is rotated by the operation of the driving motor, the operating shaft will be pushed upwardly or pulled downwardly in accordance with the direction of rotation of the motor, and the up or down movement of the shaft will be transmitted, through the auxiliary toggle levers 49 and 51, to the door toggle levers 7, 8 and 9 to effect the opening or the closing of the door.

Inasmuch as the upper end of the motion-converting lever 49 is fulcrumed on the bracket 13, the motion, transmitted by the drive shaft 47 through the joint 52, will not follow a straight-line but the joint will move from a straight-line position along a curved path and back to approximately a straight-line position, as indicated by the dotted line 55. Therefore, it will be seen that the movement of the pivot point (joint 52) of the auxiliary toggle levers 49 and 51 along the curved line 55 will, in conjunction with the door toggle levers, impart to the door a slow starting and stopping movement with a relatively rapid intervening movement.

The hinged connection between the motion-converting lever 49 and the operating shaft 47, and the swivel mounting of the motor on the bracket, permit the motor and the parts mounted thereon to swing outwardly and inwardly with reference to the base plate 25, as the motion-converting lever 49 is moved upwardly and downwardly, thereby preventing any binding action between the driving nut 44 and the screw-threaded shaft 47.

With the door toggle levers 7, 8 and 9 and the auxiliary toggle levers 49 and 51 disposed as shown, the pivot points (bolts 11, 14, 17, 15 and 16) of the door toggle levers will assume a straight-line position when the door is closed, and the pivot points (bolts 50, 52 and 53) of the auxiliary toggle levers will assume approximately a straight line when the door is open. However, it will be noted that the toggle levers are proportioned and mounted to prevent the pivot points of the auxiliary toggle levers 49 and 51 from assuming quite a full straight-line or locking position when the door is in its full-open position, thereby permitting the door to be closed by hand in case of power failure.

As shown, the driving tube 42 is seated upon, and welded to, the cap 40. This construction provides a closed chamber in which a suitable lubricant may be disposed to lubricate the engaging surfaces of the screw-threaded portion of the shaft 47 and the driving nut 44.

A sleeve 39 is firmly mounted in the upper end of the driving nut 44 in position to ex-

tend upwardly around the operating shaft 47 to cover the shaft and protect it from dirt or from losing any lubricant that may be on it. A pair of bushings 39a and 39b are also mounted in the end portions of the sleeve 39 to bear against the shaft 47 and assist in keeping it in a straight-line position in the driving nut 44.

In order that the door may be retained in its full-open position against the gravity effects of the toggle levers and operating parts when it is opened by the door-operating mechanism, a roller 59 is mounted at the side of the lever 49, upon an extended portion of the bolt 52, in such position as to be engaged by a detent 60, when the door-operating mechanism is in its full-open position. The detent 60 is pivotally mounted upon the bracket 13, and its outer end is provided with an inclined surface for leading the roller 59 to a notched portion 61 in which the roller rests when it is retained by the detent.

The inner end of the detent extends under a coiled spring 62 disposed upon a bolt 63. The spring presses against the inner end of the detent to apply a resilient force for biasing the detent upwardly and, at the same time, permit it to release the roller when the operating mechanism is actuated to return the door to its closed position.

Although the motor 41 may be electrically connected, for operation, to any suitable control system, it is particularly well suited to be employed in connection with the door-operating control system disclosed in the copending application of Charles E. Ellis, Jr., and myself, Serial No. 420,092, filed January 11, 1930, and assigned to Norton-Blair-Douglass, Inc.

The operation of the mechanism is as follows: assuming that the door is in its closed position and that its control system (not shown) is operated to cause it to open, supplying electric energy in one direction to the motor 21, then the motor will rotate in a counter-clockwise direction (as viewed from the lower end of the motor looking upward). The operation of the motor rotates the driving nut 44 in a counter-clockwise direction around the screw-threaded portion of the operating shaft 47. The operating shaft cannot rotate and, therefore, the rotation of the driving nut forces the shaft upwardly, thereby applying an upward push to the lower end of the lever 49. The force applied by the operating shaft 47 to the lever 49 causes the auxiliary toggle levers 49 and 51 to move from their open position to their closed position.

The movement of the auxiliary toggle levers toward their straight-line position forces the lever or link 51 upwardly, thereby moving the door toggle levers 7, 8 and 9 from their straight-line position to

their open position. Inasmuch as the lever 49 is fulcrumed upon the bolt 50, the joint or bolt 52 follows the circular path 55. Thus, it is seen that the effective value of the lever 49 increases during the first part of the movement but decreases rapidly during the latter half of the movement until it is nearly zero when the auxiliary toggle levers reach their approximately straight-line position in moving the door to its full-open position.

Therefore, it is seen that the operation of the auxiliary toggle levers, as shown, in conjunction with the door toggle levers, causes the door to start to open slowly, then to accelerate to a relatively high speed and finally to slow down and come to a stop in its full-open position without slamming.

As the door-operating mechanism nears its full-open position, the roller 59 engages the inclined face of the detent 60 and presses it downwardly against the force exerted by the biasing spring 62. As the roller continues, it enters the notch 61 in the detent 60. Thereupon, the spring 62 forces the detent upwardly and holds the roller in the notch, thereby providing a means for overcoming the gravity effects of the door-operating mechanism for the purpose of retaining the door in its full-open position until power is applied to the operating mechanism to return the door to its closed position. Inasmuch as the operation of closing the door is simply a reversal of the opening operation just described, its description will be omitted.

Therefore, it will be seen that I have provided an individual elevator door operator that may be conveniently disposed at the side of a corridor door and may be efficiently actuated by a small electric motor to open and to close the door without starting it suddenly or slamming it when it reaches the end of its movement.

While I have illustrated and described only one specific embodiment of my invention, I realize that it is susceptible of wide application, and I do not desire to be limited to the precise construction illustrated and described.

I claim as my invention:

1. A mechanism for operating a door in a door frame comprising an electric motor having a rotatable part, means for hingedly mounting said motor upon said door frame, a rotatable screw-threaded member mounted in an approximately vertical position on the rotatable part of said motor for rotation thereby, a non-rotatable screw-threaded member to be actuated longitudinally thereby, and a lever for connecting said non-rotatable screw-threaded member to said door, whereby operation of said motor will effect an opening or a closing movement of said door.

2. In a mechanism for operating a door

in a door frame, the combination with a plurality of toggle levers for opening and closing said door, of an operator therefor disposed in an approximately vertical position at one side of said door, said operator comprising a screw-threaded member connected to said toggle levers, a cooperating screw-threaded member for moving said first named screw-threaded member to operate the toggle levers, an electric motor having a rotatable part for rotating said second named screw-threaded member, and means for hingedly mounting said motor on said door frame to prevent binding of said screw-threaded members during their operation.

3. A mechanism for operating a door in a door frame comprising an electric motor having a rotatable part, means for hingedly mounting the motor on the door frame, a rotatable screw-threaded member mounted in an approximately vertical position on the rotatable part of the motor for rotation thereby, a non-rotatable screw-threaded member disposed to be moved longitudinally by said rotation of the rotatable screw-threaded member, a cover carried by the rotatable screw-threaded member for the non-rotatable screw-threaded member to prevent the escape of lubricant therefrom, and a lever for connecting the non-rotatable screw-threaded member to said door, whereby operation of said motor will effect an opening or a closing movement of said door.

4. In a mechanism for operating a door in a door frame, the combination with a lever for opening and closing the door, of an operator therefor disposed in an approximately vertical position at one side of said door, said operator comprising a screw-threaded shaft hingedly connected to said lever, a motor provided with a rotor mounted on said frame and a nut mounted on said rotor, said nut being disposed in engagement with the screw-threaded portion of said shaft, whereby operation of said motor effects a longitudinal movement of said shaft to operate said lever.

5. In a mechanism for operating a door in a door frame, the combination with a lever for opening and closing the door, of an operator therefor disposed in an approximately vertical position at one side of said door, said operator comprising a screw-threaded shaft hingedly connected to said lever, a motor provided with a rotor mounted on said door frame and a nut mounted on said rotor, said nut being disposed in engagement with the screw-threaded portion of said shaft, whereby operation of said motor effects a longitudinal movement of said shaft to operate said lever, and a cover carried by said nut for the screw-threaded portion of said shaft to prevent loss of lubricant therefrom.

6. In a mechanism for operating a door in a door frame, the combination with a plural-

ity of door toggle levers connected to said frame and to said door, of a plurality of auxiliary toggle levers connected to said frame and to said door toggle levers for operating the latter to open or to close the door, said levers being so disposed that the door toggle levers are in a broken position and the auxiliary toggle levers are in an approximately straight-line position when the door is in its full-open position.

7. In a mechanism for operating a door in a door frame, the combination with a plurality of door toggle levers connected to said frame and to said door for operating said door, of a plurality of auxiliary toggle levers connected to said frame and to said door toggle levers for operating the latter, a screw-threaded member for operating said auxiliary toggle levers, a second screw-threaded member for operating said first named screw-threaded member, and a motor mounted on said frame and connected to said second named screw-threaded member for operating that member to effect the opening and the closing of said door.

8. In a mechanism for operating a door in a door frame, the combination with a plurality of door toggle levers connected to said frame and to said door for operating said door, of a plurality of auxiliary toggle levers connected to said frame and to said door toggle levers, a screw-threaded member for operating said auxiliary toggle levers, a second screw-threaded member for operating said first named screw-threaded member, and a motor mounted on said frame and connected to said second named screw-threaded member for operating that member to effect the opening and the closing of said door, said auxiliary toggle levers being so disposed as to be moved into an approximately straight-line position in the final opening movement of the door, whereby the door will slow down and come to a stop in its full-open position without slamming.

9. In a mechanism for operating a door in a door frame, the combination with a lever for operating said door and an operator for actuating said lever, of means for connecting said operator to said lever comprising a link hingedly connected to said lever, and a motion-converting member having its one end pivotally mounted on said door frame, its other end hingedly connected to said operator and its intermediate portion hingedly connected to said link for controlling the force applied by the operator to cause a slow starting and a slow final movement of said door, as it is actuated by said operator.

10. In a mechanism for operating a door in a door frame, the combination with means for opening and closing said door, of a detent mounted on said door frame, and resilient means for biasing said detent to yieldingly engage a portion of said opening and

closing means, when in its full-open position, for yieldingly maintaining said door in its full-open position against the gravity effects of said opening and closing means.

5 11. In a mechanism for operating a door in a door frame, the combination with a plurality of toggle levers for opening and closing said door and an operator for actuating said toggle levers, of a detent mounted
10 on said door frame, and resilient means for biasing said detent to yieldingly engage a portion of said operator, when in its open position, to yieldingly maintain said door in its full-open position against the effect of
15 gravity on the toggle levers and the interconnected parts.

In testimony whereof, I have hereunto subscribed my name this twenty-fifth day of July, 1930.

20 HAROLD V. McCORMICK.

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