June 28, 1938. E. L. DUNN 2,121,906

CLOSURE OPERATING MECHANISM

Filed Aug. 21, 1937 3 Sheets-Sheet 1

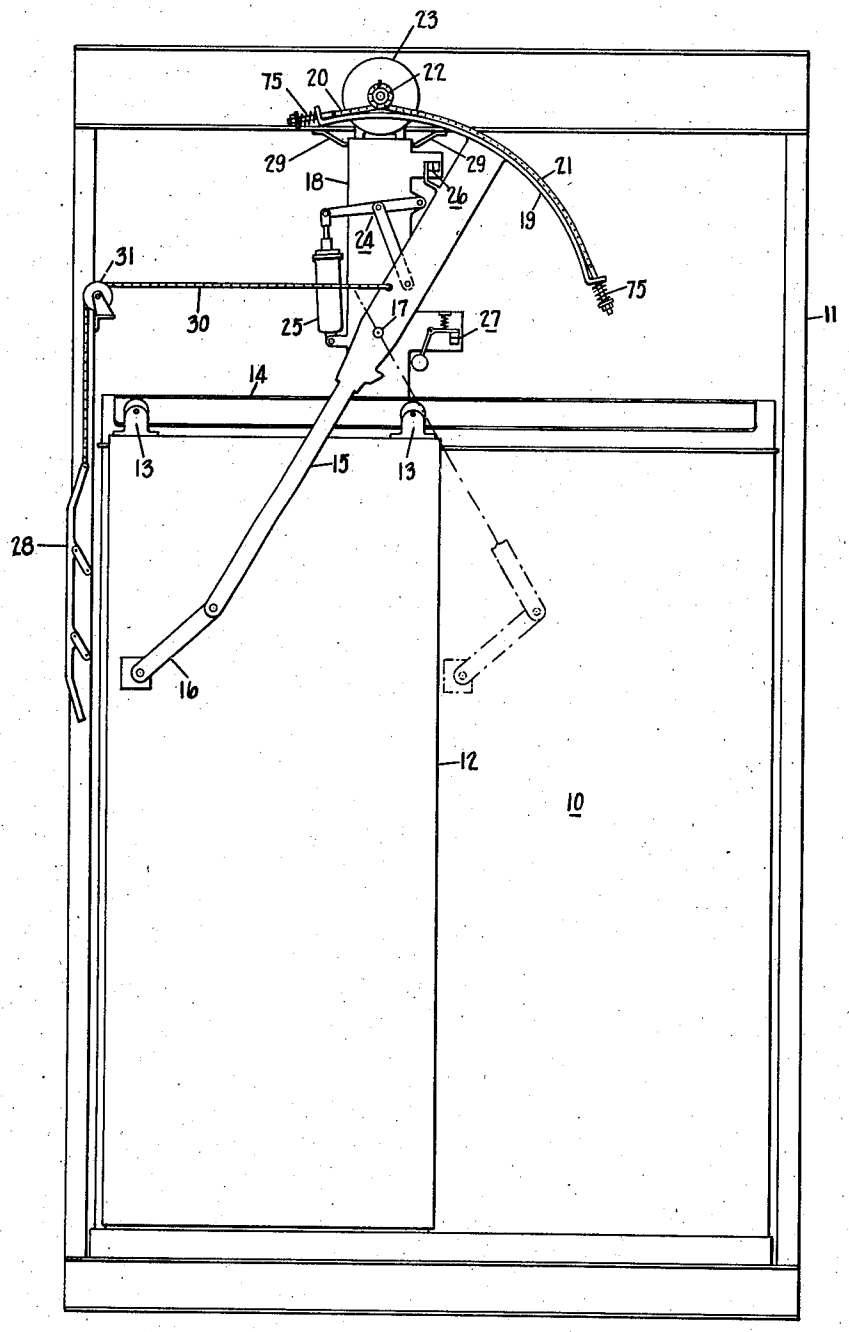


FIG. 1

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CLOSURE OPERATING MECHANISM

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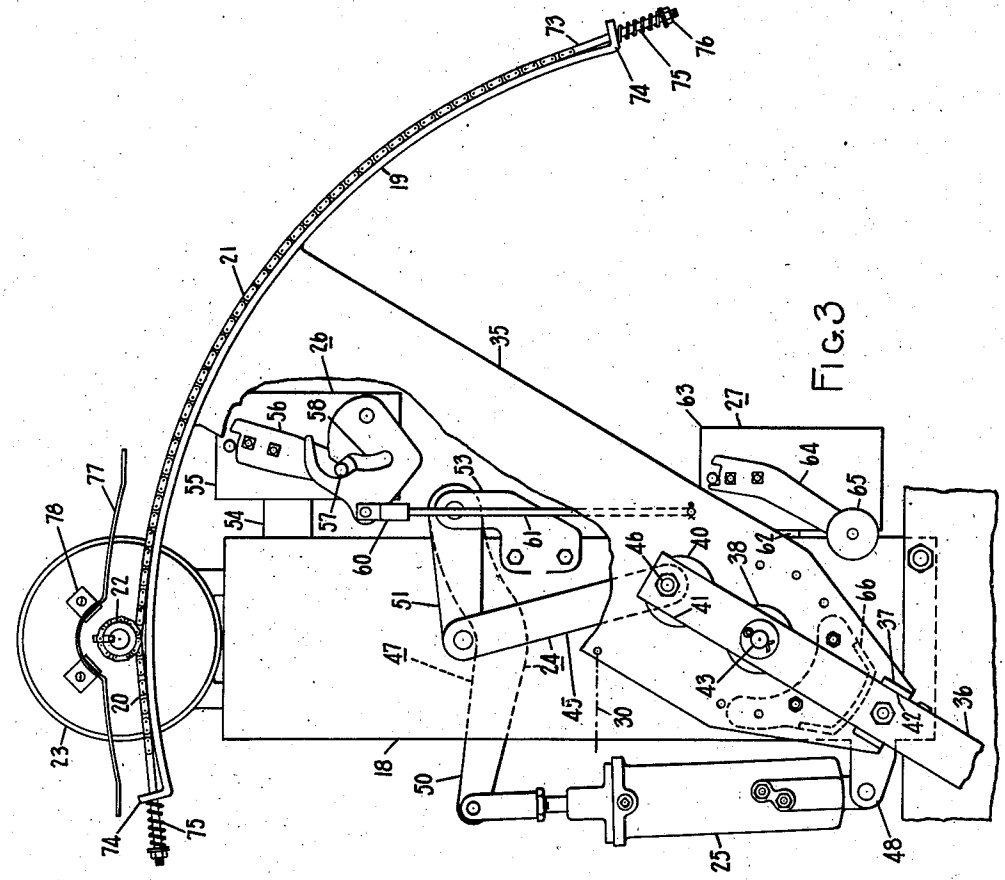


FIG. 3

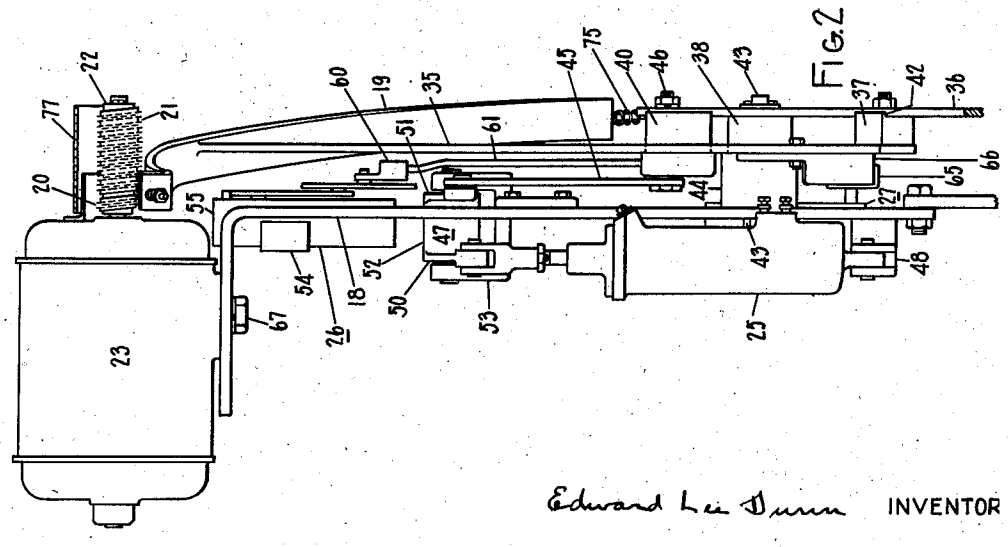


FIG. 2

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June 28, 1938. E. L. DUNN 2,121,906

CLOSURE OPERATING MECHANISM

Filed Aug. 21, 1937 3 Sheets-Sheet 3

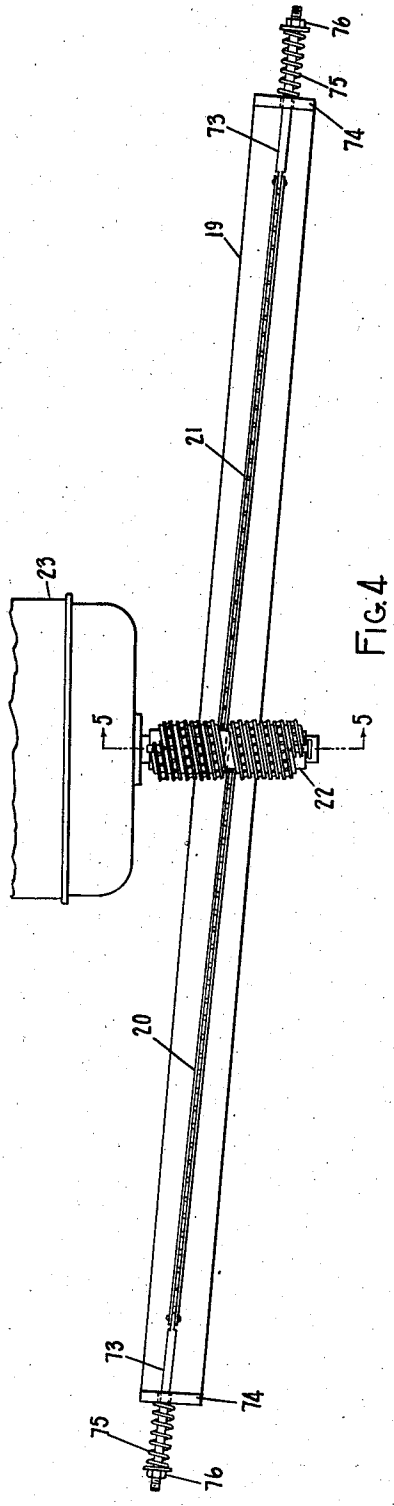


FIG. 4

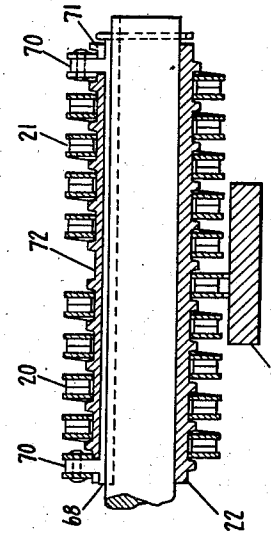


FIG. 5

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Patented June 28, 1938 2,121,906

UNITED STATES PATENT OFFICE

2,121,906

CLOSURE OPERATING MECHANISM

Edward Lee Dunn, Livingston, N. J., assignor to Otis Elevator Company, New York, N. Y., a corporation of New Jersey

Application August 21, 1937, Serial No. 160,204

6 Claims. (Cl. 268—53)

The invention relates to closure operating mechanism and especially to operating mechanism for elevator doors.

It is advantageous in elevators to utilize electric motors for operating car and hatchway doors. There are certain factors in the operation of such doors which limit the speed at which they may be operated. It is of advantage, in operating doors at a suitable speed, to utilize small, low torque motors in conjunction with speed reducing mechanism. The invention is directed to door operating mechanism of this character.

It is the object of the invention to provide door operating mechanism of the above character which is silent and positive in operation, of simple construction and inexpensive to manufacture.

In carrying out the invention, according to the preferred arrangement, flexible means is arranged in driving relationship with respect to the door. Opposite ends of the flexible driving means are secured to rotatable means driven by the door operating motor and are wound oppositely thereon so that one winds up and the other unwinds as rotation of the rotatable means takes place. The taking up and paying out of the flexible means causes movement of the door, this movement taking place at a speed reduction determined by the diameter of the rotatable means.

Features and advantages of the invention will be apparent from the following description and appended claims. The invention will be described as applied to operating mechanism for the door of an elevator car.

In the drawings:—

Figure 1 is a view in somewhat diagrammatic form of door operating mechanism embodying the invention, arranged for operating the door of an elevator car;

Figure 2 is an enlarged end view of the door operating mechanism shown in Figure 1;

Figure 3 is a front view of the mechanism shown in Figure 2, parts being broken away;

Figure 4 is a top view further enlarged, illustrating the connections of the driving chains; and

Figure 5 is a still further enlarged sectional view, taken along the line 5—5 of Figure 4 and turned at right angles.

Referring first to Figure 1, the elevator car 10 is arranged within the car framework 11 and is illustrated as provided with a gate 12 of the solid type usually referred to as a car door. The car door is supported by hangers 13 arranged to run on a track 14 secured to the top of the car. The door is operated by a lever 15 connected to the door by a link 16 and pivotally mounted at 17 on a bracket 18 secured to the top of the car and provided with braces 29 secured to the upper crosshead of the car framework. According to the preferred arrangement, the top of the lever is provided with an arcuate strap 19 having a center coincident with the pivot point of the lever. A pair of chains 20 and 21 are secured to opposite ends of the arcuate strap. The other ends of the chains are secured to opposite ends of a sleeve 22 arranged on the shaft of operating motor 23 supported on the top of bracket 18. The chains are helically and oppositely wound on the sleeve so that one chain winds up and the other unwinds as the motor rotates in one direction and the other winds up and the first chain unwinds as the motor rotates in the opposite direction. Thus the motor, upon rotation in a direction to wind up chain 21, moves operating lever 15 about its pivot in a direction to open the door and, upon rotation in a direction to wind up chain 20, moves operating lever 15 in the opposite direction to close the door.

Lever 15 is connected by linkage 24 to a check 25 for cushioning the door at the end of its opening and closing movements. A switch 26 is operatively connected to the lever to be opened as the door starts its opening movement and to be closed as the door returns to closed position. Another switch 27 is arranged to be opened by a cam on the lever as the door reaches open position and to close again as the door starts its closing movement.

A door lock cam 28 is provided for unlocking the hatchway door at a floor at which a stop is made by the car. This cam is biased into position to unlock the hatchway door and is arranged to be retracted by the car door operating mechanism. For this purpose, the cam is connected to lever 15 by means of chain 30 passing over an idler pulley 31 mounted on the car framework. With this arrangement, as the car door moves toward open position, the door lock cam falls into position to effect the unlocking of the hatchway door. The cam is lifted to lock the hatchway door as the lever 15 operates to move the car door to closed position.

Details of the mechanism above described are shown in Figures 2 to 5 inclusive. The lever 15 is formed of two sections, an arm 35 in the form of a plate to which strap 19 is secured and another arm 36 in the form of an extension bar. The arms are secured together by bolts which extend through bushings 37 and 38 and a spacer

40. The spacer 40 is welded to the front of arm 35 and is provided with a slot 41 to receive arm 36. The bushings are also welded to arm 35, extending through apertures therein to form additional spacers to space the arms from each other. The lower bushing 37 also is provided with a slot 42 to receive arm 36. The bushing 38 houses a roller bearing (not shown) arranged on the connecting bolt 43 which is secured to bracket 18 to form the pivot, the portion 44 of the bushing between arm 35 and the bracket 18 serving to space the arm from the bracket.

The linkage 24 connecting the lever 15 to the check 25 comprises a lever 47 and a link 45. The lever 47 is connected to the check while the link is connected to lever 47 and to arm 35, the connection to arm 35 being effected by the bolt 46 extending through bushing 40. The check 25 is pivotally mounted on a sub-bracket 48 secured to the main bracket 18 at the rear thereof so that the check is to the rear of the bracket 18. Thus the lever 47, in order to connect to the link 45 which is in front of bracket 18, is formed with two arms 50 and 51 straddling the bracket 18 and joined by yoke 52. This lever is pivotally mounted on another sub-bracket 53 secured to main bracket 18.

The switch 26 is mounted on a sub-bracket 54 secured to main bracket 18. This switch is arranged within the housing 55 and has an operating lever 56 on the outside of the housing. This lever has an operating pin 57 which is operated by a slotted cam 58 pivotally mounted on housing 55.

The cam in turn is connected by lug 60 and rod 61 to arm 35 to be operated thereby during movement of the car door. The switch 26 may serve as a gate contact to prevent operation of the car unless the car door is closed.

The switch 27 is also mounted on a sub-bracket 62 secured to main bracket 18. This switch is arranged within the housing 63 and has an operating lever 64 on the outside of the housing. A roller 65 is mounted on the end of this lever in position to be operated by a cam 66 adjustably mounted on the rear of arm 35. Switch 27 may serve as a door open limit switch to effect the deenergization of the door operating motor 23 as the door reaches open position.

The main bracket 18 is bent rearwardly at the top to form a mounting for the motor 23, the motor being secured to the bracket by bolts 67. On the end of its shaft opposite the sleeve 22, the motor is provided with a thrust bearing (not shown). The sleeve 22 is secured to the motor shaft by the elongated key 68, the key having lugs 70 at its ends which extend outwardly through slots 71 in the sleeve. The ends of the chains 20 and 21 are secured to these lugs as by pins extending through the chain links and the lugs. The chains may be of the so-called cable or leaf type. The sleeve is provided with a helical groove 72 to receive the chains. The groove is arranged in the direction of a right hand thread, the chain 20 being wound thereon in a clockwise direction from the point of connection to its lug 70 and the chain 21 being wound counterclockwise from the point of connection to its lug 70. The chains are led off the bottom of the sleeve from adjacent portions of the groove and in the direction of the helix angle of the groove. The ends of the chains are connected to the ends of strap 19 by eye bolts 73 extending through apertures in the outwardly bent portions 74 of the strap. Springs 75 are arranged on the shanks of the eye bolts between portions 74 and nuts 76.

The strap 19 is welded to arm 35, the arm being of such length that the strap is immediately beneath the chains at the point where they leave the sleeve 22, this relationship being maintained regardless of the position of the door operating lever, owing to the strap being formed on an arc about the center of rotation of the lever. Thus the strap supports the chain between its ends and sleeve 22, thereby obviating any slack in the chains as the door operating lever is moved from one position to another, the springs 75 maintaining the chains in a state of tension. In order to save weight, the strap 19 is made narrow and extends substantially in the same direction as the chains, a slight deviation being made for purposes of clearance. A guard 77 is secured to the motor frame by straps 78, this guard serving as a cover for the chains, particularly at the point where they wind around the sleeve 22.

The mechanism is illustrated in Figures 1, 2 and 3 in door closed position. In order to open the door, the motor is energized in such way as to effect clockwise rotation, as viewed in Figures 1 and 3, thereby causing the chain 21 to wind up and chain 20 to unwind. The winding up of chain 21 acts to pull the gate operating lever 15 in a direction to swing it counterclockwise about its pivot 17, thereby moving the door to open position. At the same time, it allows retiring cam 28 to drop into position for unlocking the hatchway door.

During the initial door opening movement, the rod 61 is pushed upwardly, swinging the slotted cam 58 clockwise about its pivot, thereby forcing the operating lever 56 of switch 26 counterclockwise to effect the opening of the contacts of this switch. These contacts are maintained open during the remainder of the door opening movement, inasmuch as the rod 61, being connected to the right of the pivot of lever 15, maintains cam 58 in switch operating position as the door operating lever reaches door open position. Just before the door becomes fully open, cam 66 engages operating roller 65 of switch 27, moving lever 64 into position to open the contacts of this switch. With switch 27 used as a door open limit swtich, this causes motor 23 to be deenergized.

The length of arm 36 of lever 15 is such that, when the door reaches fully open position, the lever is at an angle on the other side of vertical equal to its angle to vertical when in door closed position. During the movement of the door operating lever to open the door, it acts through link 45 to swing lever 47 clockwise about its pivot during the first part of the door opening operation and then returns the lever during the remainder of the door opening operation. Thus the piston rod of door check 25 is moved upwardly and then back downwardly as the door opening operation takes place. As the end of its downward stroke is reached, it acts to cushion the door opening movement, thereby bringing the door to a gradual stop as it reaches open position.

To close the door after it has been moved to open position, motor 23 is energized for rotation in a counterclockwise direction, thereby causing chain 20 to wind up and chain 21 to unwind. This acts to pull the gate operating lever in a direction to swing it clockwise about its pivot, thereby moving the door to closed position and retracting cam 28.

During the initial door closing movement, cam 66 disengages operating roller 65, permitting the closing of switch 27, and as the door reaches closed position, rod 61 pulls cam 68 downwardly

sufficiently to effect the closing of switch 26. During the door closing operation, lever 47 is operated in a manner similar to that described for the door opening operation to lift the piston rod of door check 25 during the first part of the door closing operation and lower it again during the latter part of this operation. As the end of the downward stroke of the door check piston rod is reached, the check acts to cushion the door closing movement, thereby bringing the door to a gradual stop as it reaches closed position.

The diameter of sleeve 22 and the radius of strap 19 are chosen to give the desired speed reduction. A sleeve of relatively small diameter may be used. For example, an arrangement having a sleeve of ¾ inch groove diameter and a strap of 20½ inch radius has been found satisfactory in actual practice.

The springs 75 serve not only to maintain the chains taut but also to cushion the application of the force of the motor to the door in starting the movement of the door, thereby eliminating jars. In case of power failure, the door may be readily operated manually as the friction due to the rotation of the motor by the chain is practically negligible. It is preferred to employ a torque motor for operating the door as the desired operating speed may be readily obtained by balancing the torque of the motor against the load. This arrangement minimizes the possibility of any one being injured by being struck by the door in closing as the momentum of the door is small and the motor is easily stalled.

By leading the chains on and off the sleeve at the helix angle of the groove, the possibility of the chains piling up, that is, climbing back on themselves, is eliminated. The groove may be omitted if desired if the chains are led off and on the sleeves at sufficient angle to prevent piling up. However, the grooved sleeve is preferred as it renders the mechanism more quiet and eliminates wear incident to the ends of the chain pins rubbing against each other.

Although a cable chain arrangement has been described, it is to be understood that other flexible means may be employed. Where chains are used, however, it is desirable that they be of such construction as to admit of being led off the motor shaft at an angle.

It will be seen from the above description that the door operating mechanism is of simple construction, being of few parts, and positive in operation. Furthermore, it is noiseless in operation as there are no gears or sprocket wheels, the chain, which itself is silent in operation, being kept taut and simply winding on and unwinding from the motor shaft.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope theerof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:—

1. Operating mechanism for an elevator door comprising; a motor; a pivoted lever having one arm connected to the door and the other arm provided with an arcuate member extending beneath the shaft of said motor; a pair of flexible connectors; means securing one end of each connector to said shaft, said connectors being oppositely wound about said motor shaft and extending therefrom in opposite directions onto said member; and means connecting said connectors at their other ends to opposite ends of said member.

2. Operating mechanism for an elevator door comprising; a pivoted lever having one arm connected to the door and the other arm provided with a segment; a motor; a pair of chains; means securing the ends of said chains to the shaft of said motor, said chains being helically and oppositely wound about said motor shaft and extending therefrom in opposite directions onto said segment and at an angle sufficient to prevent their winding back on themselves; means connecting said chains at their other ends to opposite ends of said segment; and means mounting said motor so that said segment extends immediately beneath said chains at the points where they leave said motor shaft so as to support the unwound portions of said chains.

3. Elevator car door operating mechanism comprising; a lever pivotally mounted on the car and having one arm connected to the car door and the other arm provided with a segment; a motor mounted on said car; a pair of chains; means securing the ends of said chains to the shaft of said motor, said chains being helically and oppositely wound about said motor shaft, so that one chain winds up and the other unwinds as the motor rotates in one direction and said other chain winds up and said one chain unwinds as the motor rotates in the other direction, and extending from said motor shaft in opposite directions onto said segment and at an angle sufficient to prevent their winding back on themselves; and means connecting said chains at their other ends to opposite ends of said segment so as to pull said lever in opposite directions about its pivot, upon rotation of said motor in opposite directions, to open and close said door, said motor being mounted so that said segment extends immediately beneath said chains at the points where they leave said motor shaft so as to support the unwound portions of said chains.

4. Elevator car door operating mechanism comprising; a lever pivotally mounted on the car and having one arm connected to the car door and the other arm provided with an arcuate portion having its center of curvature coincident with the pivot point of said lever; an operating motor for said lever; a sleeve arranged on the shaft of said motor; means mounting said motor on said car so that said sleeve is immediately above said arcuate portion of said lever; a pair of chains connected at their ends to opposite ends of said sleeve and helically and oppositely wound thereon so that one chain winds up and the other unwinds as the motor rotates in one direction and said other chain winds up and said one chain unwinds as the motor rotates in the other direction, said chains being led from said sleeve at the bottom of the sleeve in opposite directions and at the helical angle at which they are wound thereon onto said arcuate portion of said lever; and means connecting said chains at their other ends to opposite ends of said arcuate portion so as to pull said lever in opposite directions about its pivot, upon rotation of said motor in opposite directions, to open and close said door.

5. Elevator car door operating mechanism comprising; a lever pivotally mounted on the car and having one arm connected to the car door and the other arm provided with an arcuate portion having its center of curvature coin-

cident with the pivot point of said lever; an operating motor for said lever; a sleeve arranged on the shaft of said motor, said sleeve having a helical groove arranged thereon; means mounting said motor on said car so that said sleeve is immediately above said arcuate portion of said lever; a pair of chains connected at their ends to opposite ends of said sleeve and oppositely wound thereon in said groove so that one chain winds up and the other unwinds as the motor rotates in one direction and said other chain winds up and said one chain unwinds as the motor rotates in the other direction, said chains being led from said groove at the bottom of the sleeve in opposite directions at the helix angle of said groove onto said arcuate portion of said lever; and means connecting said chains at their other ends to opposite ends of said arcuate portion so as to pull said lever about its pivot in a direction to open said door upon the winding up of said one chain and to pull said lever about its pivot in the opposite direction to close said door upon the winding up of said other chain, said connecting means including a spring at each end of said arcuate portion interposed between the end of the chain and said end.

6. Elevator car door operating mechanism comprising; a lever pivotally mounted on the car and having one arm connected to the car door and the other arm provided with an arcuate strap having its center of curvature coincident with the pivot point of said lever; an operating motor for said lever mounted on said car and having one end of its shaft immediately above said strap; a sleeve arranged on said end of said shaft to be rotated thereby, said sleeve having a helical groove arranged thereon; a pair of cable chains, said chains being connected at their ends to opposite ends of said sleeve and being oppositely wound thereon in said groove and led from adjacent portions of the groove at the bottom of the sleeve in opposite directions at the helix angle of said groove onto said strap whereby upon rotation of said motor in one direction one of said chains is wound up and the other unwound and upon rotation of said motor in the opposite direction said one chain is unwound and said other chain is wound up; and means connecting said chains at their other ends to opposite ends of said strap so as to pull said lever about its pivot in a direction to open said door upon the winding up of said one chain and to pull said lever about its pivot in the opposite direction to close said door upon the winding up of said other chain, said connecting means including a spring at each end of said strap interposed between the end of the chain and the strap, said strap supporting said chains between its ends and said sleeve and being arranged at substantially the helix angle of said groove.

EDWARD LEE DUNN.