DOOR OPERATOR MECHANISM

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Filed Dec. 22, 1966, Ser. No. 609,700

13 Claims. (Cl. 49—363)

The present invention relates to powered operators for doors and the like and, more particularly, to novel and improved means for controlling the stroke of the door operator and for facilitating manual operation of a horizontally sliding door normally power operated.

Various forms of electrically powered door operators for horizontally sliding doors have been known and used for many years, for example, in passenger elevators and especially with passenger elevators intended to be operated by passengers without an attendant. With door operators of this type, it is desirable to have a mechanism which accelerates the door or doors smoothly from rest at the respective full-closed or full-open positions, traverses the door at a reasonably uniform speed, at least in the central part of the door travel, and brings the door or doors smoothly to rest in the opposite limit of travel.

While elevator car doors and door openings are generally of relatively standard dimension, it is desirable to be able to suitably adjust the travel of the doors, such as by a relatively simple adjustment of the stroke of the door operator. Further, it is necessary, especially in the case of passenger operated elevators without an attendant, that the doors can be manually opened when power has been removed from the powered operator, even though the doors are fully closed and the operating crank or arm is in a dead-center position.

These and other advantages and improvements in powered door operators may be provided in accordance with the invention by the combination of an elongated rigid operator arm pivotally mounted at a suitable point on the car frame, a slider arm slidably mounted on the operator arm, and a driving element pivotally coupled to the slider arm for controlling the angular displacement of the operator arm and thereby the position of the door.

For a complete understanding of the invention, reference may be had to the following detailed description taken in conjunction with the figures of the drawings, in which:

FIGURE 1 is a diagrammatic elevational view of an elevator cab provided with a door operator mechanism in accordance with the invention; and

FIG. 2 is an enlarged view of the door operator mechanism of FIG. 1 showing a portion of the door and track and omitting parts which are not essential to a full and complete understanding of the invention.

In FIG. 1, a sliding horizontally movable door 10, shown in the closed position against a jamb 11, is supported by conventional roller hangers 12 from a suitable horizontal track bar 14 carried by a header 15 from a front support for the elevator cab ceiling (not shown). A return panel 16 closes the front of the cab except for the door opening. The bottom of the door is suitably guided in a conventional groove in a sill 18. The entire cab may be conventionally supported on a safety planks 19 spanning a pair of stiles 20 connected by a cross-head 21, to which hoisting ropes (not shown) may be conventionally attached. The powered door operator 22 is preferably mounted on the header 15, but may be suitably mounted on any convenient structural frame members.

When the door 10 is opened, it moves to the left (in FIG. 1) in front of the return panel 16, leaving an opening which is aligned with like openings in the hollowway.

In FIG. 2, a driving element for the powered door operator includes a drive wheel 30 driven by a conventional toothed rubber belt 32 from a smaller sheave 34, which may be driven either directly or through suitable stages of speed reduction by a selectively controllable power means 35, such as a conventional reversible electric drive motor.

A carrier 36 is clamped by suitable screws 38 and 39 to the side of the drive wheel 30, the screws 38 and 39 being spaced radially from the shaft 31, the axis of which defines a fixed reference point. The screw 38 passes through an arcuate slot 40 in the carrier 36 radially spaced from the screw 39, thereby facilitating the selective angular displacement of the carrier 36 on the drive wheel 30.

A stud 41 fixedly mounted on and protruding from a central point on the carrier 36 pivotally supports a drive link means 42. The drive link means 42 is maintained in a predetermined fixed angular relation to the drive wheel 30 by suitable resilient spring means 45 anchored at one end to an extension of the screw 39, and at its other end to a stud 43 positioned intermediate the respective ends of the drive link means 42. The spring means 45 firmly urges an intermediate contact portion of the drive link means 42 against a rigid stop 44 protruding from the face of the carrier 36.

Motive forces are applied to the door 10 from the power means 35 through the driving element 30 by an operator arm 46 which is pivoted at its upper end about a fixed stud 48 supported by the car frame at a suitable position defining a fixed reference point. A slider element 49, which may be of any suitable form, partially encircles the operator arm 46. An end of the drive link means 42, opposite to that pivotally connected to the carrier stud 41, is pivotally mounted at point 50 on the slider element 49.

As illustrated in FIG. 2, the drive wheel 30 is shown in its most counter-clockwise position. When the door 10 is opened, the drive wheel 30 rotates clockwise approximately 270° to provide maximum door travel. The lower end of the operator arm 46 is pivoted at point 51 to a suitable drag link 52 which is pivotally connected to the sliding door 10 by means of the door hanger 53. At full stroke, the operator arm 46 will swing to the left approximately 90°, providing a 3:1 reduction in angular velocity between the drive wheel 30 and the operator arm 46.

As indicated in FIG. 2, a radial dotted line from the center of the shaft 31 to the center of the pivot point 50 makes a right angle with the center line of the operator arm 46, so that the mechanism is on dead-center at its extreme of travel (the door fully closed). If it is necessary to open the door manually when the door 10 is in this position, and when no power is applied to the power means 35, a manual force may be applied to move the door 10 to the left (FIG. 2). This force will tend to move the pivot point 50 downwardly to the left about the carrier stud 41. This action by itself does not produce a moment about the center of the shaft 31, but as the drive link means 42 rotates about the reference point at the carrier stud 41, the spring means 45 is extended at least until a contact portion of the drive link means 42 meets a centrally located stop 54 on the carrier 36. With the spring means 45 extended, there is a substantial moment arm tending to turn the drive wheel 30. Under these conditions, the drive wheel 30 does in fact turn clockwise, rotating its driving mechanism in the same sense and overcoming the dead-center condition.

When the door 10 is fully open, the mechanism is in its extreme left hand position, and the door starts to close, any friction of the slider element 49 against the operator arm 46 will tend to rotate the drive link means 42 away from the stop 44. Therefore, the spring means 45 must be
selected so as to have a minimum strength characteristic sufficient to prevent rotation of the drive link means 42 during normal operation of the door 10 under the control of the door operator mechanism.

The parts of the door operator mechanism may be arranged in such a manner as to be capable of being assembled in a single housing or door frame. In particular, the carrier 26 is symmetrical about its center line which passes through the carrier stud 41 and has a second stop 56 adapted to contact the drive link means 42 when assembled for the opposite hand of door operation.

Conventional limit switches and motor control contacts may be incorporated in the door operator mechanism, as shown, for example, in United States Patent No. 2,998,245. Such limit switches are opened by rotation of the drive wheel 30. While the position for full closure does not change when the stroke is reduced by adjusting the relative position of the carrier stud 41 on the drive wheel 36 to the relative positions of the shaft 31 by means of the adjustment screw 38 and the arcuate slot 40 in the carrier 36, the full-open position does change and the limit switch operation must be suitably adjusted.

When the stroke of the operator arm 46 is adjusted from the position shown in FIG. 2, the angular velocity ratio between the drive wheel 30 and the operator arm 46 changes somewhat. For example, when the stroke is halved, the operator arm 46 swings through only about 45° instead of 90°, and the drive wheel 30 will rotate through 225°, giving a reduction in angular velocity of 5:1 instead of 3:1 obtained at full stroke.

In the preferred embodiment of the invention, it is desirable to put one extreme position of the drive wheel 30, permitting the other extreme position to be adjusted when the stroke of the operator arm is changed. This preferred arrangement may be obtained when the radial distance between the centers of the shaft 31 and the screw 39 is one-half the distance between the centers of the shaft 31 and the fixed stud 48. The preferred distance from the center of the screw 39 to the pivot point 50 is equal to the distance between the centers of the shaft 31 and the screw 39, thereby insuring that the angle at the pivot 50 subtended by points at the centers 48 and 31 will be a right angle, even when the carrier 36 is adjusted to a short stroke when at the end of the stroke (dead center).

Thus there is provided, in accordance with the invention, a novel and improved door operator mechanism in which the stroke of the operator arm may be readily adjusted on installation of the door operator mechanism to satisfy the requirements of a particular building without substantial change in the character of the operator arm motion, and a simple and dependable release mechanism facilitates manual movement of the door from a fully closed position without power.

It will be understood by those skilled in the art that the disclosed embodiment is meant to be merely exemplary, and is susceptible of modification and variation without departing from the spirit and scope of the invention. Thus the invention is not deemed to be limited, except as defined in the appended claims.

We claim:

1. In a powered operator for doors and the like adapted to selectively move a door between a plurality of different positions relative to a frame, the combination comprising an elongated rigid operator arm pivotally mounted about a first fixed reference point on the frame and having an end spaced apart from said first fixed reference point and coupled to the door for controlling the position of the door as a function of the angular displacement of said operator arm about said first fixed reference point, a slider element slidably mounted on said operator arm for sliding engagement therewith intermediate said first fixed reference point and said operator arm end, and a driving element adapted to be rotatably driven about a second fixed reference point spaced a predetermined distance from said first fixed reference point, said driving element being pivotally coupled to said slider element for controlling the angular displacement of said operator arm.

2. In a powered operator for doors and the like adapted to selectively move a door between a plurality of different positions relative to a frame, the combination comprising an elongated rigid operator arm pivotally mounted about a first fixed reference point on the frame and having an end spaced apart from said first fixed reference point and coupled to the door for controlling the position of the door as a function of the angular displacement of said operator arm about said first fixed reference point, a slider element slidably mounted on said operator arm for sliding engagement therewith intermediate said first fixed reference point and said operator arm end, a driving element adapted to be rotatably driven about a second fixed reference point spaced a predetermined distance from said first fixed reference point, and a driving element having one end pivotally mounted on said driving element about a second reference point on said driving element spaced radially from said second fixed reference point and an opposite end pivotally mounted on said slider element.

3. A powered door operator as claimed in claim 2, further comprising means for maintaining said drive link means in a fixed angular relation to said driving element about said second reference point.

4. A powered door operator as claimed in claim 3, wherein said drive link maintaining means comprises a stop on said driving element, and means for selectively holding a portion of said drive link means spaced apart from said second reference point in bearing relation against said stop.

5. A powered door operator as claimed in claim 4, wherein said holding means comprises a resilient spring means having one end coupled to a point on said driving element and an opposite end coupled to a point on said drive link means spaced apart from said second reference point.

6. A powered door operator as claimed in claim 5, further comprising means for selectively adjusting the position of said said second reference point on said driving element relative to said second fixed reference point for determining the amount of stroke of the door operator.

7. A powered door operator as claimed in claim 2, wherein said driving element comprises a wheel rotatably mounted on said shaft fixed relative to the frame, and power operated means are provided for rotating said driving element wheel to control door movement.

8. A powered door operator as claimed in claim 2, further comprising means for releasably maintaining said drive link means in a fixed angular relation to said driving element about said second reference point to provide positive door operation under the control of said driving element and for facilitating angular displacement of said drive link means relative to said driving element about said second reference point upon manual movement of the door.

9. A powered operator for elevator doors and the like adapted to be slidably moved between a fully closed and a fully open position within a door frame, comprising an elongated rigid operator arm pivotally mounted about a first fixed reference point on the frame and having an end spaced apart from said first fixed reference point and coupled to the door for controlling the position of the door as a function of the angular displacement of said operator arm about said first fixed reference point, a slider element slidably mounted on said operator arm for sliding engagement therewith intermediate said first fixed reference point and said operator arm end, a driving element adapted to be rotatably driven about a second fixed reference point on the frame spaced a predetermined distance from said first fixed reference point, and selectably controllable power means for rotatably driving said drive wheel, and driving link means having one end mounted on said drive wheel at a third reference point spaced radially from said second fixed reference point and an opposite end pivotally mounted on said slider element.
10. A powered door operator as claimed in claim 9, further comprising means for pivotally mounting said one end of said drive link means about said third reference point on said drive wheel, and means for maintaining said drive link means in a predetermined fixed angular relation to said drive wheel about said third reference point.

11. A powered door operator as claimed in claim 9, further comprising means for selectively positioning said third reference point on said drive wheel to adjust the stroke of the door operator.

12. A powered door operator as claimed in claim 9, further comprising a carrier pivotally mounted on said drive wheel having a stud mounted thereon defining said third reference point and adapted to pivotally receive said one end of said drive link means, said carrier stud being spaced from the axis of rotation of said carrier relative to said drive wheel, said drive link means having a contact portion spaced from said third reference point, fixed stop means mounted on said carrier and spaced apart from said carrier stud for engaging said drive link means contact portion, spring means having one end fixed relative to said drive wheel and another end attached to said drive link means at a point spaced from said third reference point for releasably maintaining said drive link means contact portion in engagement with said fixed stop means and for applying a force to return said drive link means contact portion to engagement with said fixed stop means upon displacement therefrom when the door is manually moved in overriding relation to the powered operator.

13. A powered door operator as claimed in claim 12, further comprising means for selectively adjusting the pivotal position of said carrier relative to said drive wheel.

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