

Oct. 23, 1951

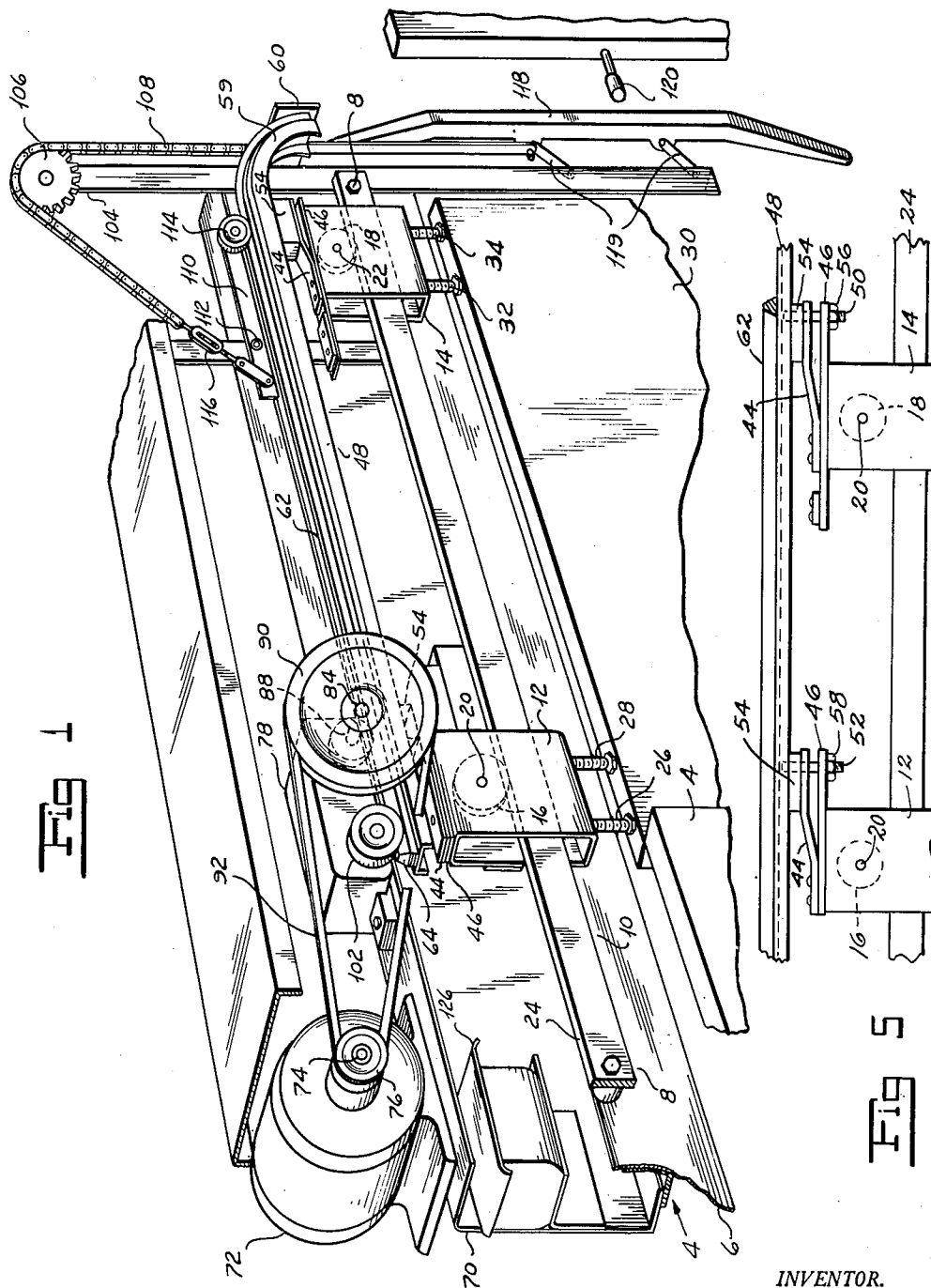
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2,572,196

ELEVATOR DOOR OPERATING MECHANISM

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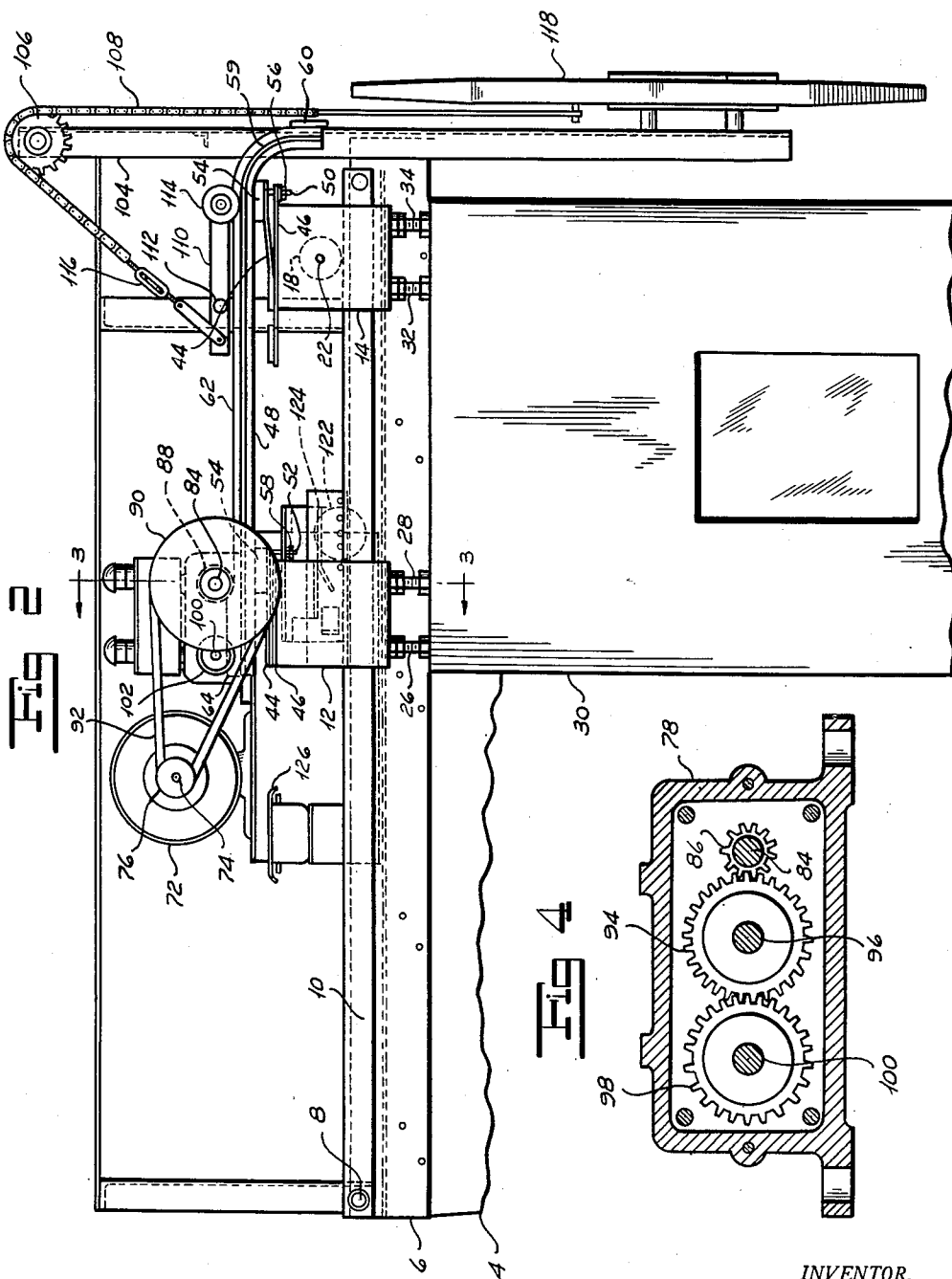
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ELEVATOR DOOR OPERATING MECHANISM

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3 Sheets-Sheet 2



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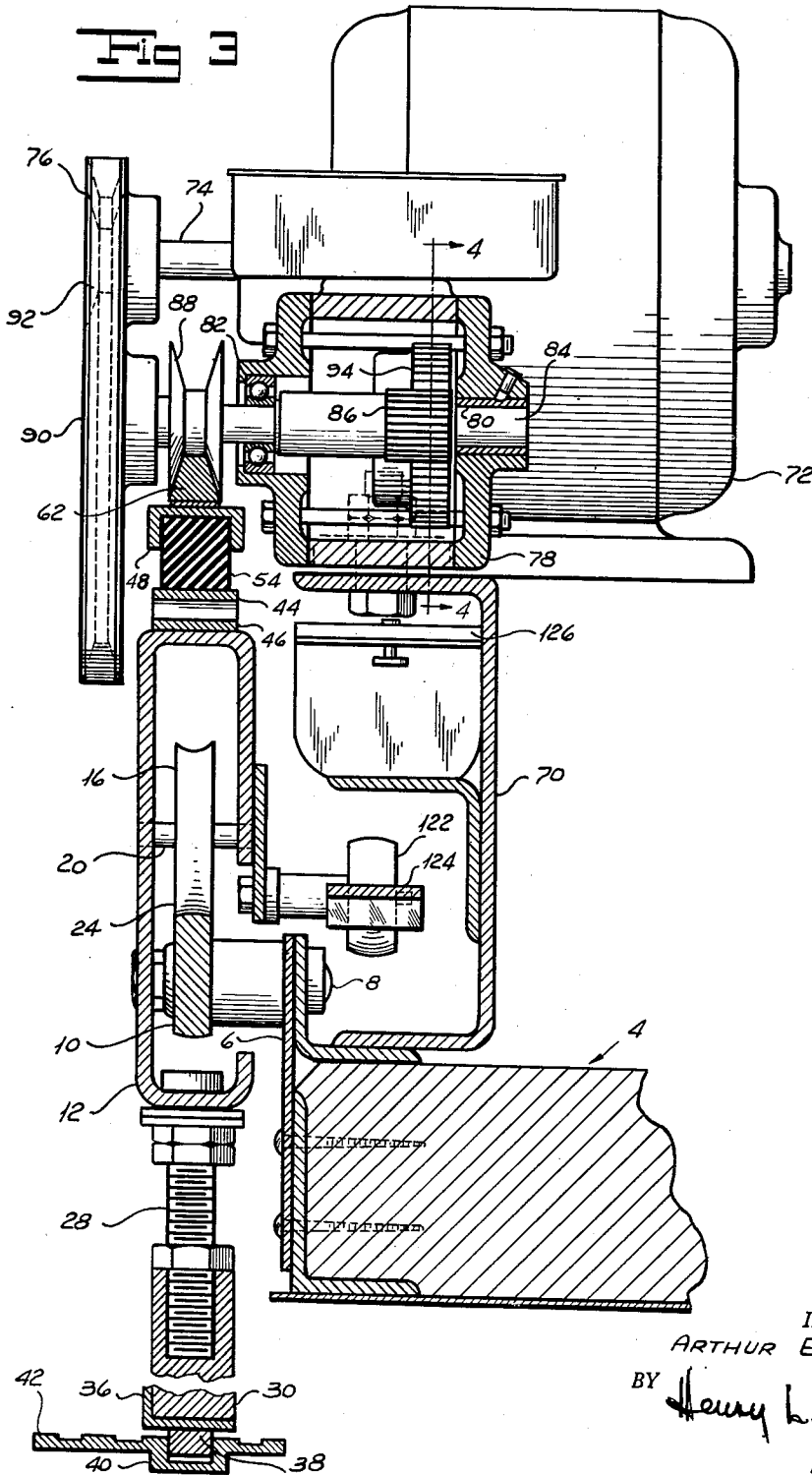
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ELEVATOR DOOR OPERATING MECHANISM

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3 Sheets-Sheet 3



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ELEVATOR DOOR OPERATING MECHANISM

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Application October 1, 1947, Serial No. 777,333

17 Claims. (Cl. 268—53)

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My invention relates to an improvement in elevator door operating mechanisms and more particularly to an improved means for opening and closing the doors of an elevator, both by hand control and in automatic electrically controlled elevators.

It is desirable in the operation of elevator doors that the final movement in the closing of the door be effected at a relatively slow speed in order to avoid slamming the door to a stop when it is being moved to closed position. Not only does this avoid injury to the co-acting door surfaces but the final movement at a slow speed lessens the danger of accidents and possible injury to passengers. This is especially true where the door operating means is positively connected to the door itself as in this case there is likelihood of serious injury to the limbs of a passenger or portions thereof which might become lodged between the door and the door jamb. It is desirable, therefore, to provide an operating means for an elevator door in which, when the door is accidentally obstructed, an over-run or slippage in the driving mechanism may occur until the obstruction is removed. The construction furthermore should be such that when the obstruction is removed the operation of the door will proceed so that the door may be moved to closed position. These desiderata are especially needed in an electrically controlled elevator which is completely automatic, since in elevators of this type no operator is present who is in a position to prevent possible accidental injuries.

In order to prevent the door from jarring to a stop at its opening limit position, it is also desirable to reduce the speed of the door during its final closing movement. In most of the doors of the prior art, the power is shut off at a point just short of the travel of the door to its opening limit position and the door is permitted to coast to this position with the result that the door jars to a stop. It is especially desirable to keep positive control of the elevator door during all times during its travel to open and closed positions.

While it is desirable to have the final movements of the door at slow speed for the reasons pointed out above, the intermediate motion of the door should be at a comparatively high linear speed in order to accelerate the operation of the elevator and to eliminate overlong stays at each elevator station.

In my co-pending application for "Elevator Door," Serial No. 673,408, filed May 31, 1946, now Patent 2,526,503, I have shown one structure capable of carrying out the above considerations

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in which I employ driving means of two different speeds with means for automatically engaging the driving means of lower speed when the door has moved to a predetermined position from the end of its travel to closed position.

One object of my invention is to provide a new and improved operating means for elevator doors.

Another object of my invention is to provide a door-operating means in which the door will close, first slowly, then rapidly, and then at a reduced speed to move the door smoothly to a closed position, avoiding slamming the door to a stop.

Another object of my invention is to provide a door-operating means in which the door will open, first slowly, then rapidly, and then at a reduced speed to move the door smoothly to open position, avoiding slamming the door to a stop.

Another object of my invention is to provide a door-operating means in which the door mechanism will overrun if movement of the door is obstructed, thereby preventing possible injury either to passengers in the elevator or to the operating mechanism.

A further object of my invention is to provide an operating mechanism in which the power is transmitted through a friction drive having two speeds and in which the amount of friction may be easily and expeditiously regulated.

Another object of my invention is to provide a door-operating mechanism in which the power is applied through a friction drive whereby, when the prime mover is stopped, the friction will act as a brake to hold the door in its closed or open position.

Other and further objects of my invention will appear from the following description:

In the accompanying drawings which form part of the instant specification and which are to be read in conjunction therewith and in which like reference numerals are used to indicate like parts in the various views:

Figure 1 is a perspective view of the upper portion of an elevator cab equipped with an improved door-operating means according to my invention.

Figure 2 is a front elevation of the upper portion of the cab shown in Figure 1.

Figure 3 is a sectional view drawn on an enlarged scale taken along the line 3—3 of Figure 2.

Figure 4 is a fragmentary sectional view taken on the line 4—4 of Figure 3.

Figure 5 is a fragmentary elevation showing the rigid elongated member through which the door is moved and its attaching means.

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In general, my invention contemplates the provision of a reversible prime mover, such as an electric motor or the like, driving a shaft carrying a friction pulley and a pinion which latter is positioned within a gear box provided with suitable reduction gears driving a terminal shaft carrying a pulley similar to the first driving pulley but operating at a lower speed. A strip of friction material is secured to a driving rail which is flexibly mounted on a pair of springs for vertical movement. The spring rail is formed with a section adapted to engage the slower speed pulley to cam the rail away from the high speed pulley upon its engagement with the low speed pulley. The position of the rail section is such that the door will automatically become engaged with the low speed pulley within a predetermined distance of its closed position. The length of the rail is such that, as the door moves to a predetermined distance from its closed position, the high speed pulley will ride off the rail, permitting the slow speed pulley to engage the rail and complete the opening movement.

More particularly, referring now to the drawings, the elevator cab indicated generally by the reference numeral 4, carries a structural member 6 to which is secured in any suitable manner, as for example by bolts 8, a fixed track 10. A pair of carriages 12 and 14 are provided with wheels 16 and 18, fulcrumed around pins 20 and 22, carried by the carriages 12 and 14. The wheels 16 and 18 are adapted to ride along the upper rounded surface 24 of the track 10. Supported by the carriage 12, I provide a pair of hanger bolts 26 and 28 adapted to adjustably support an elevator door 30 at one side thereof. The other side of the elevator door is carried by a pair of adjustable hanger bolts 32 and 34 which are supported by the carriage 14. The lower end of the door 30 which is shown in Figure 3 terminates in a guide fitting 36 provided with a projection 38 adapted to ride in the re-entrant portion 40 formed in the floor plate 42, thus permitting the door to roll to open and closed position but preventing the door from pivoting about its supporting wheels 16 and 18.

Secured to the upper side of each carriage 12 and 14, I provide a leaf spring 44 each mounted on a carrier plate 46. A rail 48 is secured at separated points thereof to each leaf spring and supported thereby through bolts 50 and 52. I interpose a rubber cushion block 54 between the rail 48 and each leaf spring. By adjusting the nut 56 carried by the bolt 50, I may govern the upper limit of motion of the right hand side of the rail as viewed in Figure 2. Similarly by adjusting the nut 58 I govern the upper limit of travel of the left hand side of the rail 40 under the influence of the leaf spring 44. It will be seen that I have thus provided a resiliently mounted rail which may move downwardly against the action of the leaf springs 44 and upwardly under their influence to limits determined by the nuts 56 and 58.

The right hand side of the rail 48 is curved downwardly and is guided by a bracket 60. Secured to the upper surface of the rail 48 in any suitable manner I provide a length 62 of a V-belt or other friction material. The V-belt 62 has its left hand portion formed with a section 64 of increased thickness. If desired, the section 64 may be a separate member secured to the upper surface of the V-belt 62 in any appropriate manner. The section 64 is formed at its right hand side to join the surface of the V-belt 62

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by a surface having a convenient slope. This section 64 just described acts as a cam to effect the engagement of the high speed pulley as will be hereinafter more fully pointed out.

Mounted on top of the cab 4 by any suitable structure as, for example, by the channel iron 70, I secure a prime mover such as the reversible electric motor 72. The motor shaft 74 terminates in a driving pulley 76 carried thereby for rotation therewith. Secured to the mounting 70 I provide a gear housing 78 in which is journaled, in any appropriate bearings 80 and 82, a shaft 84 to which is secured a pinion 86 within the gear housing 78. A small driving pulley 88 adapted to engage the rail member 62 and a large driven pulley 90 as can readily be seen by reference to Figure 3. A belt 92 provides the transmission means between the motor driving pulley 76 and the driven pulley 90, thus driving the shaft 84 and the pinion 86.

Referring now to Figure 4, it will be seen that the pinion 86 engages an idler gear 94 journaled about a shaft 96, carried by the gear housing 78. The idler gear in turn meshes with a driven gear 98 which is secured to the shaft 100 for rotation therewith.

The shaft 100 projects outside of the gear housing 78 and carries a door driving pulley 102 for rotation therewith. Since the shaft 100 is driven through a reduction gear, the pulley 102 will rotate at a lower speed than the pulley 88. The diameter of the fast pulley 88 is slightly greater than the diameter of the slow pulley 102. The pulley shafts 84 and 100 have their axes in the same horizontal plane. The result is that, when the rail 48 is in the region adjacent its mid-position, the fast pulley 88 will engage the friction surface 62 carried by the rail 48 and hold the rail downwardly against the action of its supporting leaf springs 44 and thus hold the friction surface 62 out of contact with the slow pulley 102.

Secured to the cab 4 adjacent its right hand side as viewed in Figures 1 and 2 I provide a vertical angle iron 104 to the upper end of which I journal a sheave or sprocket 106 over which I pass a flexible member such as a chain 108. An actuating lever 110 is pivoted around a bolt 112 and carries a roller 114 at one end thereof. The other end of the lever 110 is secured by an adjustable means such as a turn buckle 116 to one end of the chain 108. The other end of the chain is secured to a retiring cam 118 in any suitable manner. The retiring cam is adapted to co-act with a cam roller 120 to break the control circuit for the cab lifting motor and for freeing the hoist-way doors in the case of hand operated swing doors such as are employed in many apartment buildings with which my construction is especially adapted to be employed. The details of the inter-lock circuits are well known to the art and form no part of the instant invention. The operating means, however, associated with my door operating means are a part of this invention.

A roller 122 co-acts with a gate safety switch 124 such that as soon as the door has opened a small amount the circuit to the lifting motor is broken in a second place as an additional safety measure. I also provide a limit switch 126 for opening the circuit controlling the motor 72 when the door has reached its fully opened position.

In operation, let us assume that the cab door 30 is in the closed position or to the right as

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viewed in Figures 1 and 2. In this position the section 64 at the left hand side of the rail 42 which for purposes of convenience I will refer to hereinafter as a cam friction section is in engagement with the slow pulley 102. The radius of the slow pulley and the height of the cam friction section 64 is such that the fast pulley 88 is out of engagement with the friction surface 62 carried by the rail 48. The springs 44 permit the cam friction section 64 acting through the slow pulley 104 to cam the rail 48 downwardly. This downward motion of the rail 48 permits the disengagement of the friction surface 62 from the fast pulley 88. It is to be observed further that when the door is in closed position the fast pulley 88 does not engage either the friction surface 62 for the reason just described nor the cam friction surface since the length of this surface is such that it does not extend sufficiently to the right to contact the fast pulley 88.

When the elevator stops at a station, the motor 72, by appropriate controls well known to the art, will rotate in a clockwise direction as viewed in Figures 1 and 2. This will drive the driven pulley 90 in a clockwise direction and the pinion 86 in a clockwise direction, driving the idler gear 94 in a counter-clockwise direction and the driven gear 98 in a clockwise direction, thus driving the shaft 100 and its associated pulley 102 in a clockwise direction. In the closed position the pulley 102 is in engagement with the cam friction section 64 and the fast pulley 88 is out of engagement with all driving surfaces. The door will start to move to open position at the slow speed under the driving influence of the slow pulley 102, the rail 48 in the meantime being held downwardly against the action of the leaf springs 44. The left hand leaf spring carried by the carriage 12 will move downwardly through a greater amplitude than will the right hand leaf spring 44 which will move downwardly only sufficiently to accommodate the motion caused by the action of the slow pulley 102 against the camming friction section 64. As the door moves to the left, it will roll upon its supporting wheels 16 and 18 and the roller 114 carried by the lever 110 will ride along the friction surface 62 and downwardly along the downward curve at the right hand end of the rail 48 thus allowing the lever 110 to rotate in a clockwise direction and permitting the right hand end of chain 108 to move downwardly, thus moving the interlock cam 118 outwardly through the action of links 119 through which the interlock cam 118 is supported. When the cam 118 engages the interlock cam roller 120, the hoist-way door will be freed and the control circuit for the lifting motor will be opened so that the lifting motor cannot be started. As the door motion continues to the left, the slow roller 102 will ride off the end of the raised cam friction section 64 and permit the rail 48 to move upwardly under the influence of the leaf springs 44. When this occurs, the friction surface 62 will engage with the fast pulley 88. Since this pulley is larger in diameter than the slow pulley 102, we now have the fast pulley in driving engagement with the rail 48 while the slow pulley is held out of engagement therewith.

The initial opening motion of the door too will cause the roller 122 to open the gate safety switch 124.

Under the influence of the fast pulley, the door will open rapidly, moving to the left as viewed in Figures 1 and 2 until the high speed pulley

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rides free of the right hand side of the rail in the region of the downwardly-curved portion. When this occurs, the rail will move upwardly, permitting the slow speed pulley to engage it. The further motion of the door will continue at the speed of the slow speed pulley until the limit switch 126 controlling the control circuit of the motor 72 is opened, thus stopping the motor and preparing it to run in the opposite direction to close the door.

After the passengers have been discharged and it is desired to operate the elevator to another station, the door may be closed either automatically or in response to a control signal within the cab. This control signal causes the motor 72 to rotate in a counter-clockwise direction, thus driving both the fast and slow pulleys 88 and 102 in a counter-clockwise direction.

When the door is in the open position, the fast pulley 88 is out of engagement with the rail friction surface 62 and the slow pulley 102 will start to move the door to closed position at the low speed until the rail moves to the right sufficiently to engage the high speed pulley 88. The door will then move to closed position at the high speed until the slow pulley 102 engages the cam friction section 64. When this occurs, the rail will be cammed downwardly to break the driving contact between the friction surface 62 and the fast pulley 88 while making driving contact between the slow pulley 102 and the cam friction section 64. The door will continue to move to closed position under the slower speed of the slow pulley 102, the pulley moving the friction surface 64 to the right as viewed in Figure 1 and hence the rail 48, the carriages 12 and 14, and the door 30.

During this movement the roller 122 will close the gate switch 128 and will also operate just before the finally closed position a closing limit switch (not shown) as is well understood by those skilled in the art. The downwardly curved end 59 of the rail 48 will engage the roller 114 carried by the lever 110 and will rotate this lever in a counter-clockwise direction, thus moving the right hand end of the flexible member 108 upwardly and withdrawing the retiring cam 118 from contact with the interlock cam roller 120, closing the control circuit for the elevator lifting motor and locking the hoist-way door. The door moves at the slow speed to its closed position without jar and in a smooth manner.

It will be noted that the driving engagement between the prime mover and the door 30 is by means of either the fast or the slow pulley and either the friction surface 62 or the cam friction surface 64. If an obstruction is lodged between the elevator door jamb and the edge of the elevator door, the friction is such that the driving pulleys will over-run and prevent injury either to the door, the driving mechanism or to a portion of the anatomy of a person. Not only does the slow speed permit limbs or the extremities thereof to be withdrawn from the door and the door jamb but an additional safety feature is provided by means of my construction. The nuts 52 and 56 restrict the throw of the rail upwardly under the influence of the leaf springs 44. It will be observed, too, that my construction is such that the cycle of operations is governed by the actual position of the door so that in event of over-running or slippage occasioned by the door being obstructed, the cycle of operations will not be disrupted or be placed out of phase.

It will be observed that the high speed pulley 88 is a larger diameter than the slow speed pulley 102 so that, in addition to the differential in speed determined by the reduction gear, an additional increment of speed difference is provided by the difference in the diameters of the pulleys. If desired, the high speed pulley may be made sufficiently larger in diameter to effect the desired reduction in linear speed without the necessity of using reduction gears.

It will be seen that I have accomplished the objects in my invention. I have provided a structure capable of operating an elevator door at two speeds which is simpler in some respects than the construction shown in my co-pending application Serial No. 673,408, now Patent No. 2,526,503. I provided a new and improved operating means for elevator doors in which the door will close, first slowly, then rapidly and then at a reduced speed so that the door is moved smoothly to closed position, avoiding jarring to a stop against the door jamb. Similarly, by means of my door operator, the door will open, first slowly, then rapidly, and move finally to the open position in a smooth manner, avoiding jarring to a stop against the door jamb.

In event that obstructions are placed between the door and the door jamb, my door-operating means will over-run thereby preventing injury either to passengers in the elevator or to the operating mechanism. The friction with which my driving means engages the driving surfaces can be readily regulated. In the closed position or in the open position, the friction will act as a brake to hold the door in its closed or open position. My construction is simple, convenient to install and service and inexpensive to manufacture.

While I have described my invention with respect to a single sliding door, it is obvious that my invention may be employed for swinging hoist-way doors or with multiple doors without changing the principle of operation.

It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and sub-combinations. This is contemplated by and is within the scope of my claims. It is further obvious that various changes may be made in details within the scope of my claims without departing from the spirit of my invention. It is, therefore, to be understood that my invention is not to be limited to the specific details shown and described.

Having thus described my invention, what I claim is:

1. A door operator, including in combination a door, means for mounting the door for movement between limit positions, a rigid elongated member, flexible means for attaching said elongated member to said door, a pair of longitudinally spaced rotatable drive members, means for rotating said drive members, one of said members being formed with a larger diameter than the other, said drive member of smaller diameter being positioned constantly to engage said elongated member when the door is at a limit position, and means for engaging said drive member of larger diameter with said elongated member and disengaging said drive member of smaller diameter from said elongated member when the door has moved a predetermined distance from a limit position.

2. A door operator including in combination a door, means for mounting the door for move-

ment between limit positions, a rigid elongated member, flexible means for attaching said elongated member to said door, a pair of longitudinally spaced rotatable drive members, means for rotating said drive members at different speeds, said lower speed drive member being positioned constantly to engage said elongated member when the door is at a limit position, and means for engaging said higher speed drive member with said elongated member and disengaging said lower speed drive member from said elongated member when the door has moved a predetermined distance from a limit position.

3. A door operator as in claim 1 in which said flexible means for attaching said elongated member to said door comprises resilient means.

4. A door operator as in claim 2 in which said flexible means for attaching said elongated member to said door comprises resilient means.

5. A door operator as in claim 1 in which said means for attaching said elongated member to said door comprises resilient means, said means for engaging the drive member of larger diameter with the elongated member includes a friction camming surface carried by said elongated member adjacent one end thereof.

6. A door operator as in claim 2 in which said means for attaching said elongated member to said door comprises resilient means, said means for engaging the higher speed drive member with the elongated member comprises a camming surface carried by said elongated member adjacent one end thereof.

7. A door operator as in claim 1 in which said means for attaching said elongated member to said door comprises resilient means, the length of said elongated member being such that said drive member of larger diameter is out of engagement with said elongated member at a limit position of said door.

8. A door operator as in claim 2 in which said means for attaching said elongated member to said door comprises resilient means, the length of said elongated member being such that said higher speed drive member is out of engagement with said elongated member at a limit position of said door.

9. A door operator as in claim 1 in which said rigid elongated member is provided with a length of friction material adapted to engage said drive member of larger diameter.

10. A door operator as in claim 2 in which said rigid elongated member is provided with a length of friction material carried thereby, adapted to engage said higher speed rotatable member.

11. A door operator as in claim 1 in which said means for attaching said elongated member to said door comprises resilient means, said resilient means comprising a pair of leaf springs.

12. A door operator as in claim 2 in which said means for attaching said elongated member to said door comprises resilient means, said resilient means comprising a pair of leaf springs.

13. A door operator as in claim 1 in which said means for attaching said elongated member to said door comprises resilient means, said resilient means comprising a pair of leaf springs, and means for limiting the throw of said leaf springs.

14. A door operator as in claim 2 in which said means for attaching said elongated member to said door comprises resilient means, said resilient means comprising a pair of leaf springs, and means for limiting the throw of said leaf springs.

15. A door operator as in claim 2 in which said means for rotating said rotatable members at

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different speeds comprises a prime mover, means for operatively connecting said prime mover for rotating the higher speed rotatable member, and a reduction gear for rotating the lower speed rotatable member.

16. A door operator as in claim 1 including in combination an arm, means for pivoting said arm, a cam follower carried adjacent one end of said arm, said cam follower normally engaging said rigid elongated member, the end of said elongated member being formed with a curve adapted to rotate said arm, a retiring cam, a means responsive to the rotation of said arm for operating said retiring cam.

17. A door operator as in claim 1 including in combination an arm, means for pivoting said arm, a cam follower carried adjacent one end of said arm, said cam follower normally engaging said rigid elongated member, the end of said elongated member being formed with a curve

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adapted to rotate said arm, a retiring cam, a means responsive to the rotation of said arm for operating said retiring cam, said means comprising a flexible member, means for securing one end of said flexible member to said arm, a means for securing the other end of said flexible member to said retiring cam.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
676,833	Bitner	June 18, 1901
1,715,159	Bruns	May 18, 1929
2,166,527	Johnson	July 18, 1939
2,432,293	Giovanni	Dec. 9, 1947