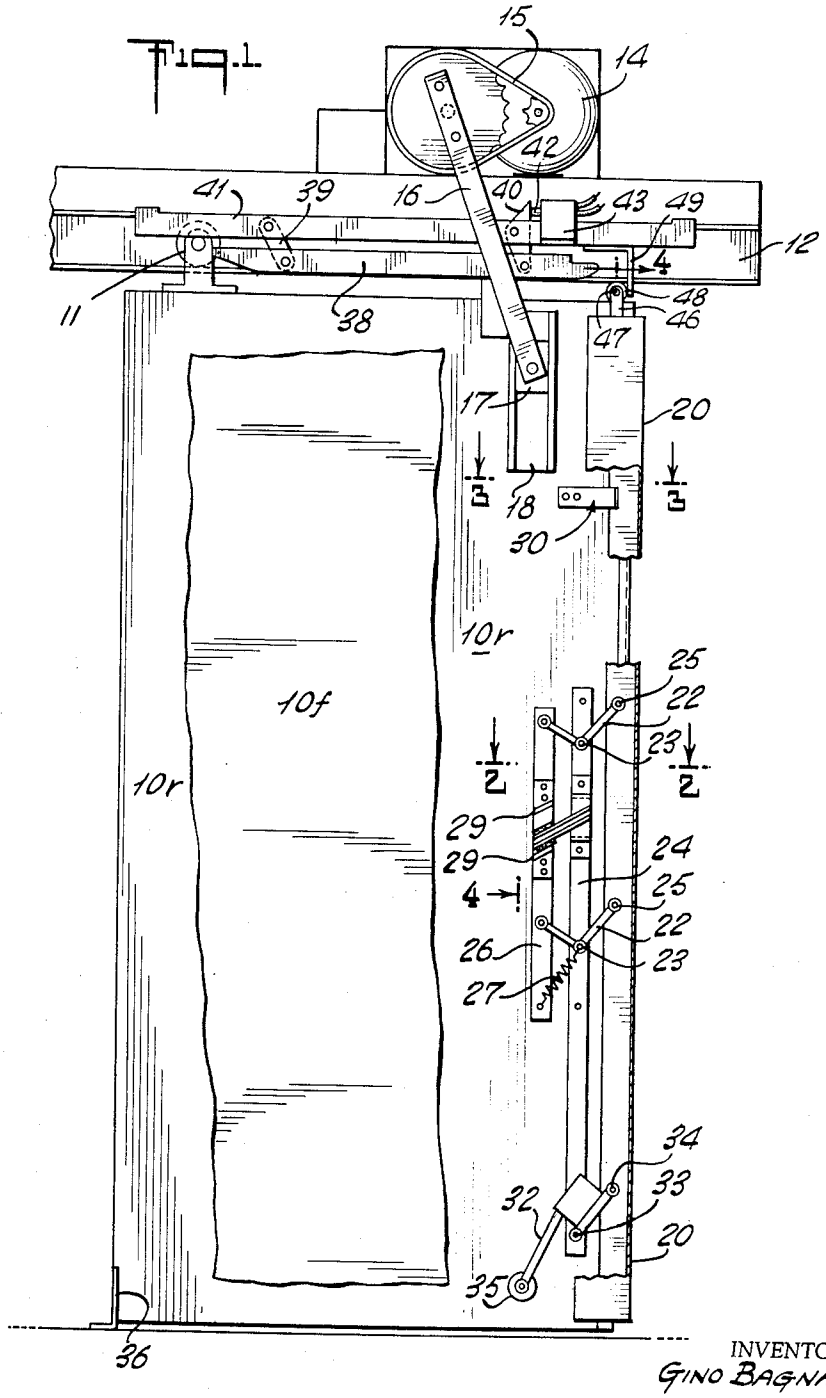
Feb. 2, 1965 G. BAGNASCO 3,168,165

PROTECTIVE DOOR REVERSING MEANS

Filed June 11, 1962 3 Sheets-Sheet 1

Fig. 1



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PROTECTIVE DOOR REVERSING MEANS

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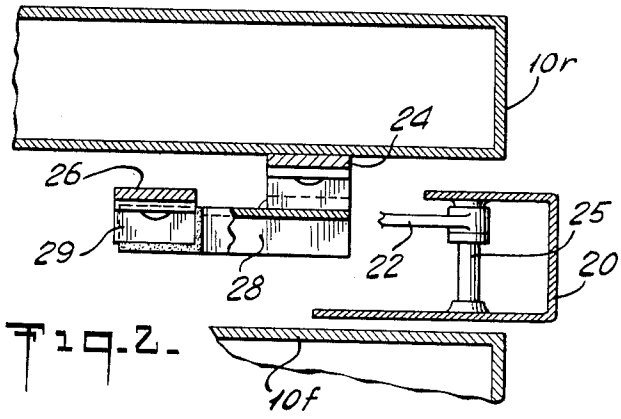


Fig. 2.

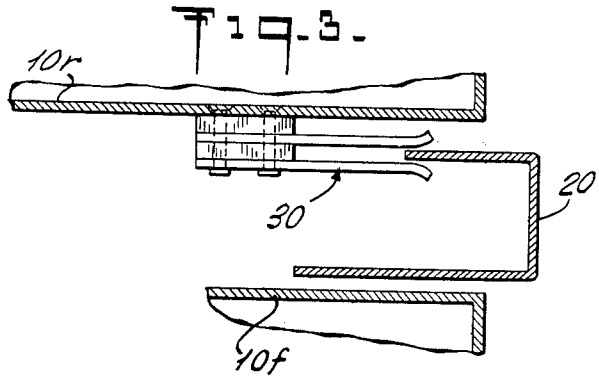


Fig. 3.

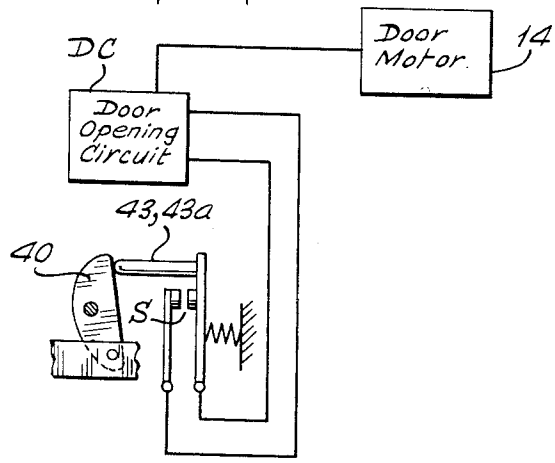


Fig. 5.

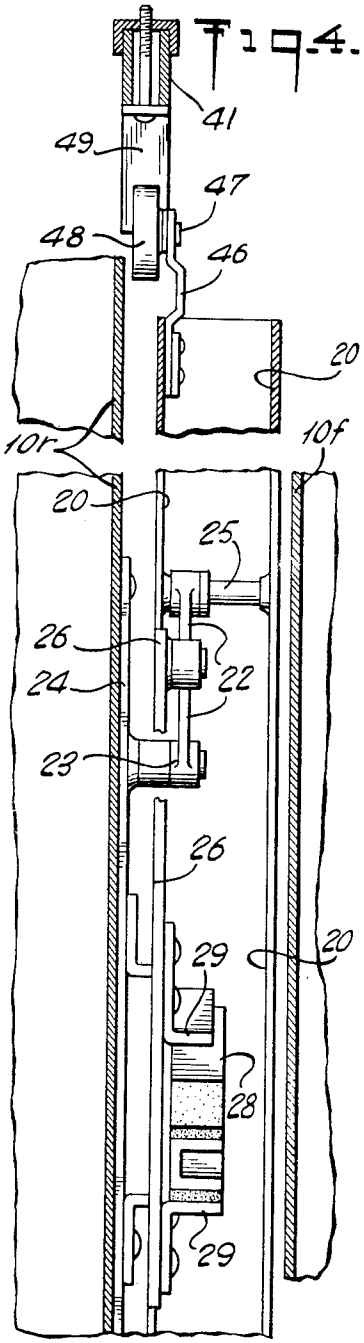


Fig. 4.

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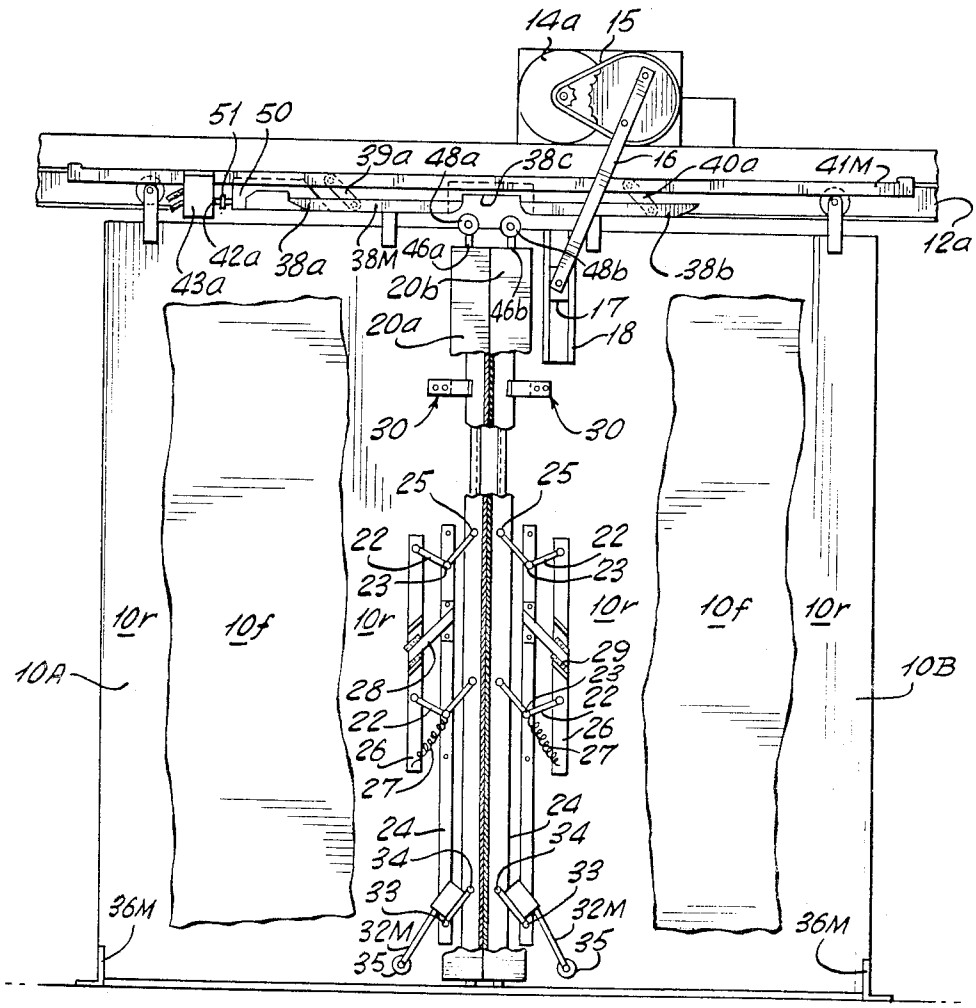
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PROTECTIVE DOOR REVERSING MEANS

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FIG. 6



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3,168,165

PROTECTIVE DOOR REVERSING MEANS

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8 Claims. (Cl. 187—52)

This invention relates to protective means in elevator systems for automatically reversing a door actuator from door-closing to door-opening mode when closing travel of a door is obstructed by an entering or leaving passenger.

Such protective means involve an obstruction detector on the door and a responsive reversing control circuit for the door actuator, commonly an electric motor. Prior protective means use an electrical obstruction detector and extend electrical connections from the detector to the part of the motor reversing control circuit external to the door. These electrical connections generally include cable wires concealed in the door and extended, with necessary cable slack, to terminals on a support relative to which the door has opening and closing travel. One objection is the danger of the cable slack snagging on a part of the system external to the door. Another objection is that because of the repeated opening and closing of the door, the cable slack continually whips back and forth, tending to deteriorate rapidly and inviting danger of wire breaks. Among other objections is that the containment of the wires in the door complicates the door structure and requires it to be taken apart for inspection and replacement of wires.

The stated and other objections are avoided by the present invention through the provision of a protective door reversing means having no electrical part in or on the door and relying on a mechanical arrangement to detect an obstruction in the path of a closing door and thereupon to operate a switch for reversing the door actuator, specifically a door motor.

The novel arrangement involves a mechanical obstruction detecting device on the door in combination with an external switch-controlling device mechanically responsive to movement of the detecting device produced by encounter with an obstruction.

More specifically, the obstruction detecting device involves a touch-retractive front safety edge of the door and a connected element displaced by retraction of the safety edge, while the switch-controlling device is movably mounted on a support relative to which the door has opening and closing travel and is engaged by said element for response to retraction of the safety edge.

In the preferred arrangement, the retraction of the safety edge results in movement of the connected element transversely of the door travel, and the switch-controlling device is mounted for abuttable engagement by the element and for movement in response to the movement of the element transversely of door travel. Considering the usual horizontally slidable vertical door in an elevator system, the switch-controlling device is located adjacent a horizontal boundary, preferably the upper boundary, of the door opening, while the element connected with the safety edge moves vertically upon horizontal retractive movement of the safety edge and through abuttable engagement with the switch-controlling device controls related vertical movement thereof.

More specifically, in the preferred arrangement the switch-controlling device comprises a horizontally disposed bar with an abuttable edge traversed by an element at one end, preferably the upper end, of a horizontally retractive vertically disposed front safety edge of a horizontally slidable vertical elevator door. The safety edge is mounted to the door for inclined parallelogram movement relative to the door involving a horizontal retractive component of movement of the safety edge and an attendant vertical movement thereof such that the element thereon moves toward the switch-controlling bar and presses on its abuttable edge to displace it for causing operation of the switch. If the door is then moving in closing direction, the operation of the switch resulting from retraction of the safety edge will reverse the door motor. The switch-controlling bar is contoured for switch-operating displacement by the element on the safety edge upon retraction of the safety edge at any point of a range of travel of the door between its open and closed limits. To provide tolerance for uncritical, tolerable extent of retractive movement of the safety edge, the element connected with the safety edge preferably traverses the switch-controlling bar at a small clearance distance from the abuttable edge of the bar when the safety edge is in unretracted position.

A feature of the invention is a parallelogram mounting for the switch-controlling bar enabling it to be vertically displaced with minimum friction and effort in response to vertical movement of the element connected with the safety edge. More specifically, the bar is suspended parallelogram-wise, above the element connected with the safety edge, for vertical and horizontal components of displacement upon vertical displacement of said element, whereby the switch can be operated by the horizontal displacement of the car and the bottom edge of the bar reserved for engagement with said element, while at the same time the weight of the bar can be utilized as a resistance factor in idling the switch pending retraction of the safety edge. Magnification and hence rapidity of response of the switch to retractive movement of the safety edge can readily be obtained, if desired, either through movement-multiplying lever means between the bar and the switch or by providing a larger horizontal than vertical component of parallelogram movement of the bar and arranging the switch for direct response to the horizontal component, or by a combination of movement-multiplying lever means and a preponderant horizontal component of parallelogram movement of the bar.

The invention is applicable to single doors or to multiple-unit doors opening either to one side or to opposite sides, the latter type being called center-parting doors. For multiple-unit doors opening to one side, the leading door unit only need be provided with a safety edge. For center-parting doors, both doors should be provided with safety edges meeting and retracting when the doors are closed.

In connection with center-parting doors, the invention provides a switch-controlling bar with abuttable edge lengths respectively traversed by elements on the safety edges of the respective doors, so that retraction of the safety edge of either door when in a range between open and closed positions will actuate the bar. According to the invention, the bar is here offset; specifically, recessed, between the abuttable edge lengths for idly accommodating the elements on the safety edges when these edges are retracted in the closed position of the doors.

The above mentioned and other features and objects of this invention and the manner of attaining them will become more apparent and the invention itself will be best understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a broken, fragmentary front view of a single-door elevator car provided with the novel protective arrangement;

FIGS. 2, 3 and 4 are enlarged sectional views taken respectively on lines 2—2, 3—3, and 4—4 of FIG. 1;

FIG. 5 is a simplified block diagram of the door motor reversing circuit including a switch in the protective means; and

FIG. 6 is like FIG. 1 but shows the invention in a form applicable to center-parting doors.

Referring to FIG. 1, it shows pertinent elements of a single-door elevator car to which the invention is applied. The door has front and rear panels 10*r* fixed to each other in spaced apart facing relation. A hall door 10*f* is shown for completeness, although it forms no part of the invention. The door is conventionally hung for horizontally slidable opening and closing travel, as by roller bearing sheaves (of which only one sheave 11 appears in FIG. 1), secured to the door at its upper border and running on a door track 12 suitably mounted on the car frame and constituting, in itself, a frame element. Conventional door actuating means are used and include a reversible electric motor 14, mounted on the frame, and a wheel 15 belt-driven from the motor. A crank rod 16 extends between wheel 15 and a slide block 17 keyed into a confining guide bracket 18 carried by rear door panel 10*r*. During clockwise movement of wheel 15 through an appropriate angle, the throw of the crank rod opens the door; on reverse movement of the wheel, the crank rod closes the door. Obviously, opening or closing of the door is dependent on the direction in which door motor 14 is run. In an attendantless elevator system, the interval and direction of operation of the door motor are controlled and monitored by known automatic call circuitry. Supplementing this circuitry is protective door reversing means for interrupting closing movement of the door if an obstruction is in its path and returning the door to the open position. Protective door reversing means may also be used, if desired, with attended elevator cars.

According to the present invention, the protective door reversing means uses a mechanical obstruction detecting device comprising a touch-retractive front safety edge or stile 20 of the door. Any suitable shape of stile 20 may be used. It is here preferred to use a stile in the form of a U-shaped channel bar. The base of the channel bar forms the leading edge of the door. Means connected to the sides of the channel bar are provided to mount the channel bar or stile to the door for horizontal retractive or retiring movement of the stile relative to the door in response to a light pressure against the base or front of the stile. The mounting of the stile to the door is such as to provide for parallelogram movement, or movement parallel to itself, relative to the door, in inclined direction such that the horizontal retraction of the stile is accompanied by its vertical endwise movement, preferably upward. Through means explained later, this endwise movement of the stile is utilized in controlling switching of the door motor 14.

The means for mounting the stile or safety edge 20 to the door for parallelogram movement includes a pair of similar upper and lower bell cranks 22 pivoted at 23 to a bracket bar 24 fixed to the rear door panel 10*r*. At their right ends, the bell cranks freely receive pins 25 fastened at vertically spaced points between the sides of the channel body of the safety edge. At the opposite ends, the bell cranks have pivotal connection with a balance bar 26 the weight of which substantially counterbalances the weight of the safety edge. A light spring 27 urges the balance bar 26 upwardly, therethrough biasing the bell cranks in a direction to maintain the safety edge normally in extended or outward position relative to the door. A stop bar 28 is fixed to the bracket 24 and reaches at its outer, felted end between stop lugs 29 carried by the balance bar 26, the play between the bar 28 and the stop lugs 29 determining the limits of inward and outward movement of the safety edge relative to the door. To assist in restricting or preventing lateral movement of the safety edge, a guide assembly 30 (FIGS. 1 and 3) extending from rear door panel 10*r* has straddle engagement with a side of the channel body of the safety edge.

The safety edge 20 is retracted in the open and closed limits of the door. Retraction in the closed limit results from contact of the safety edge with the closed limit boundary of the door opening. For retracting the safety edge when the door is at its open limit, means including a bell crank 32 are provided. The bell crank 32 is fulcrumed at 33 to the door-based bracket 24. One end of the bell crank is pivotally connected at 34 to the safety edge. The opposite end of the bell crank has a roller 35. As the door nears its open limit, the roller 35 meets a stop piece 36, with the result that the bell crank 32 is rocked counter-clockwise (FIG. 1), retracting the safety edge. Between the open and closed limits of the door, the safety edge may be retracted by engagement with an entering or leaving passenger or object.

Retraction of the safety edge when the door is in a range of travel between its limits is mechanically communicated to a door motor switch-controlling device including a bar 38 (FIG. 1). The bar 38 is horizontally disposed along a horizontal boundary of the door opening, preferably the upper boundary, as shown. A pair of links 39 and 40 suspend the bar 38 parallelogram fashion from a mounting bar 41 which is secured to door track 12. Link 40 has an upper arm against a switch button 42 protruding from a switch box 43 fixed on mounting bracket 41. The force exerted by the weight of bar 38, acting through link 40, is enough to keep the button 43 depressed. In the illustrated example, the switch S, indicated in FIGURE 5, is of the type biased to closed status and is held open by depression of the switch button 43. The balance of forces between bar 38, with connected link 40, and the switch normally maintains the switch open and the bar in its lower left hand position shown in FIG. 1. The links 39 and 40 are tilted in a direction such that upon upward displacement of bar 38, it also has a component of horizontal displacement to the right, rocking link 40 counter-clockwise to relieve pressure on switch button 43, thereby permitting switch S to close.

If a switch of the normally open type were used, the links 39 and 40 would be reversely tilted so that upward displacement of bar 38 would be accompanied by bar movement to the left, and link 40 would rock clockwise to depress the switch button for closing the switch. The links are tilted less than 45° to the vertical, so that bar 38 will have a larger horizontal than vertical component of displacement, thus magnifying the swing of the link 40 horizontally relative to the switch button 42, with resulting increase in the rapidity and sensitivity of switch response to upward displacement of the bar. Through a conventional door opening circuit, indicated in FIG. 5 by block DC, closure of switch S results in reversing the door motor 14 if then in door-closing mode.

Switch-operating displacement of bar 38 is effected in response to vertical movement of an engaged element connected with the safety edge 20. In the preferred example, this element comprises an arm 46 rigidly extending upwardly from the safety edge (see FIGS. 1 and 4) and provided at the upper end with a journaling stud 47 for a roller 48, preferably rubber-covered. During a range of travel of the door between its limits, the roller 48 traverses the abuttable bottom edge of the bar 38. In the extended, normal position of the safety edge, it is also in down position, as is the roller 48. The roller 48 then is at tolerance distance, in the order of one-eighth of an inch, from the abuttable edge of the bar 38. If the safety edge is significantly retracted while the door is at any point within said range of door travel between limits, the roller 48 rises and presses on the abuttable edge of the bar 38 to displace it upwardly, whereupon the pressure on switch button 43 is relieved and switch S (FIG. 5) closes. If motor 14 is in door-closing mode at the time the switch S closes, then the closure of the switch acts via circuit DC to reverse the door motor to door-opening mode for returning the door to open position.

As explained, safety edge 20 is retracted in each limit position of the door. It is not desired to actuate the

switch-controlling bar 38 when the safety edge is retracted at or near either door limit. Accordingly, the bar 38 is contoured at the ends, upwardly beveled as shown, to permit roller 48 to rise when the door is at or near either limit, without effectively displacing the bar. A damping stop 49 attached to bracket 41 encounters roller 48 as the door comes to its closed limit and insures, by its pressure against the side of the roller, the retraction of the safety edge when the door is fully closed.

FIG. 6 shows the invention in relation to center-parting doors 10A and 10B provided with touch-retractive front safety edges 20*a* and 20*b* carrying arms 46*a* and 46*b* for rollers 48*a* and 48*b*, respectively. The doors are moved in relatively opposite directions through conventional drive connections with a door motor 14*a* on the elevator car frame. As in the previous example dealing with a single-door elevator car, each of the doors 10A and 10B when at its open limit has its safety edge retracted by means including a bell crank 32M and coacting damping bumper 36M. In closed position of the doors, their safety edges meet and retract. In the center-parting door arrangement, a common switch-controlling bar 38M is associated with both doors. Bar 38M is horizontally disposed adjacent the upper horizontal border of the two-door opening. The bar is suspended for parallelogram movement from a bar 41M on a door track 12*a*, by means of a pair of links 39*a* and 40*a* of equal length. Fixed to the bar 38M is a block 50 having a threaded stud 51 engaged with a switch button 42*a* of a switch S (FIG. 5) in switch box 43*a* mounted on bar 41. As in the previous example, the switch is of the normally closed type and the balance of forces between bar 38M and the switch button is such that the switch is normally maintained open and the bar is normally maintained in its lower leftward position.

The bar 38M has two abuttable edge lengths 38*a* and 38*b* respectively traversed by rollers 48*a* and 48*b* during a range of travel of the doors between their open and closed limits. The bar is contoured so that when the safety edges are retracted at or near the open and closed limits of the door, resulting rise of the rollers 48*a* and 48*b* will not effectively displace the bar. To avoid actuation of the bar by the rollers when the doors are at or near their open limits, the ends of the bar are beveled upwardly, the block 50 also being recessed. To accommodate the two rollers 48*a* and 48*b* idly when the safety edges are retracted in the closed, meeting position of the doors, the bar 38M is formed with a recess 38*c* between the abuttable edge lengths 38*a* and 38*b*. If the safety edge of either door is significantly retracted while the door is in a range between open and closed limits, the roller on the safety edge rises sufficiently to engage and press against the confronting abuttable edge of the bar 38M and displace it upwardly. The upward displacement of the bar is accompanied by its displacement to the right, thus relieving the pressure of the stud 51 on the switch button 42*a*, whereupon the switch in the box 43*a* closes and reverses the door motor 14*a* if then in door-closing mode. The tilt of the links 39*a* and 40*a* is less than 45° to the vertical, so that the horizontal component of displacement of the bar 38M is greater than its vertical component of displacement, with consequent magnification of switch response to vertical displacement of the bar.

While the foregoing description sets forth the principles of the invention in connection with specific apparatus, it is to be understood that this description is made only by way of example and not as a limitation of the scope of the invention as set forth in the objects thereof and in the accompanying claims.

I claim:

1. In an elevator system, a frame, a pair of center-parting door slidable in said frame between abutting closed limits and opposing open limits, electrically reversible drive means for moving said doors in opposite directions between their respective open and closed limits, a parallelogram member movably mounted on the frame adjacent to said doors and extending between the open limits thereof, said parallelogram member having a component of motion transverse to the motion of said doors, a touch-retractive front safety edge movably mounted on each of said doors, both of said front safety edges being provided with an element for engaging and displacing said parallelogram member in response to retraction of the edge throughout a range of closing travel of the respective door from its open toward its closed limit, switch means mounted on said frame and operative in response to displacement of said parallelogram member, circuit means coupled between said electrically reversible drive means and said switch means for reversing said drive means when in the door closing mode, and means for preventing said elements from engaging said parallelogram member near the closed limits of said doors to allow said front safety edges to meet and retract upon closure of said doors without producing a reversal of said drive means.

2. The combination defined in claim 1 wherein said parallelogram member comprises a switch-controlling bar extending horizontally on the frame adjacent a horizontal boundary of the door opening and having an abuttable edge of predetermined length traversed by said elements during a predetermined portion of said range of door travel, and wherein said means for preventing said elements from engaging said parallelogram member near the closed limits of said doors comprises a recess in said bar near the closed limits of said doors.

3. The combination defined in claim 2 wherein said bar is mounted on the frame for parallelogram movement having a component in the vertical direction, said elements being on an end of the corresponding safety edge adjacent to the bar, said safety edges being mounted to the door for inclined parallelogram movement relative to the door including a horizontal retractive movement and an accompanying endwise movement in which said element moves vertically to produce responsive vertical displacement of said bar upon abutting said abuttable edge length.

4. The combination defined in claim 3 wherein said bar is disposed adjacent to the upper boundary of the door opening and each of said elements being at the upper end of the corresponding safety edge in confrontation to the bar along the abuttable edge length thereof, and a parallelogram linkage suspending the bar from the frame for its vertical displacement responsive to the vertical movement of said elements accompanying retraction of the corresponding safety edge.

5. The combination defined in claim 4 wherein the inclination of the parallelogram movement of the safety edges is in such a direction as to produce a vertically rising movement of the corresponding element upon retraction of the safety edge, whereby the element presses on the abuttable edge to displace it positively upward when confronted thereby.

6. The combination defined in claim 5, the bar having a horizontal component of displacement accompanying its vertical displacement, and means through which the switching device is made responsive to the horizontal component of bar displacement.

7. The combination defined in claim 6, the parallelogram linkage being arranged for magnifying the horizontal component of bar displacement relative to the vertical component of bar displacement so as to increase the sensitivity of response of the switching device to the vertical displacement of the bar determined through said element by the retraction of the safety edge.

8. The combination defined in claim 7, said elements comprising a roller for anti-friction riding on the abuttable edge length of the bar.

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