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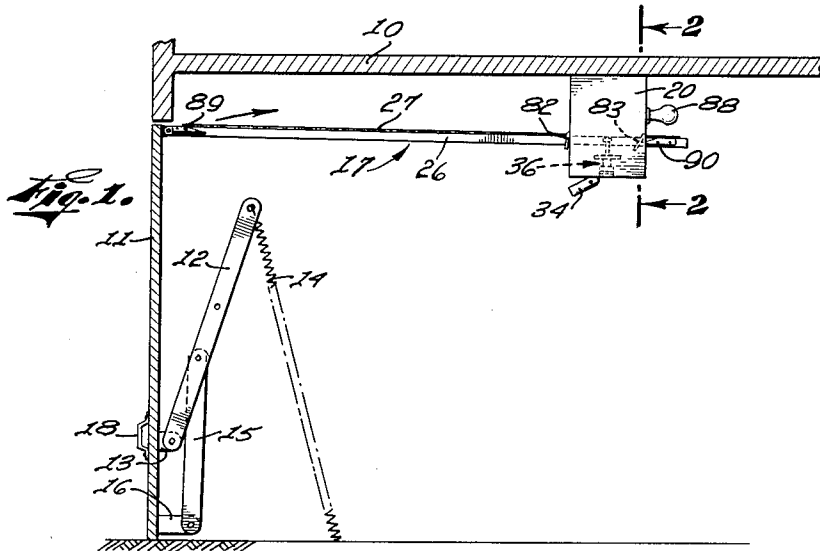
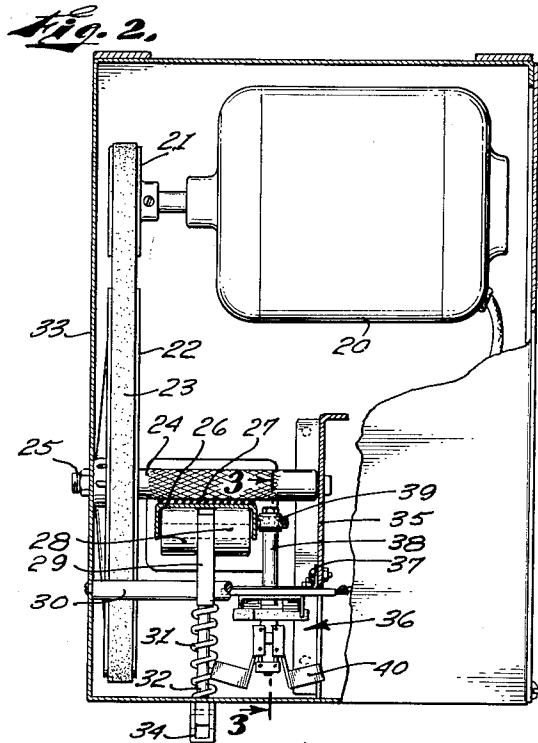
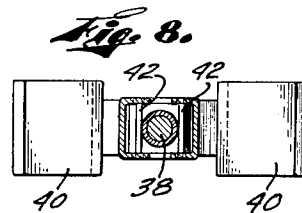
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3,045,164

SAFETY SWITCH FOR AUTOMATIC DOOR OPENERS

Filed May 12, 1958

2 Sheets-Sheet 1



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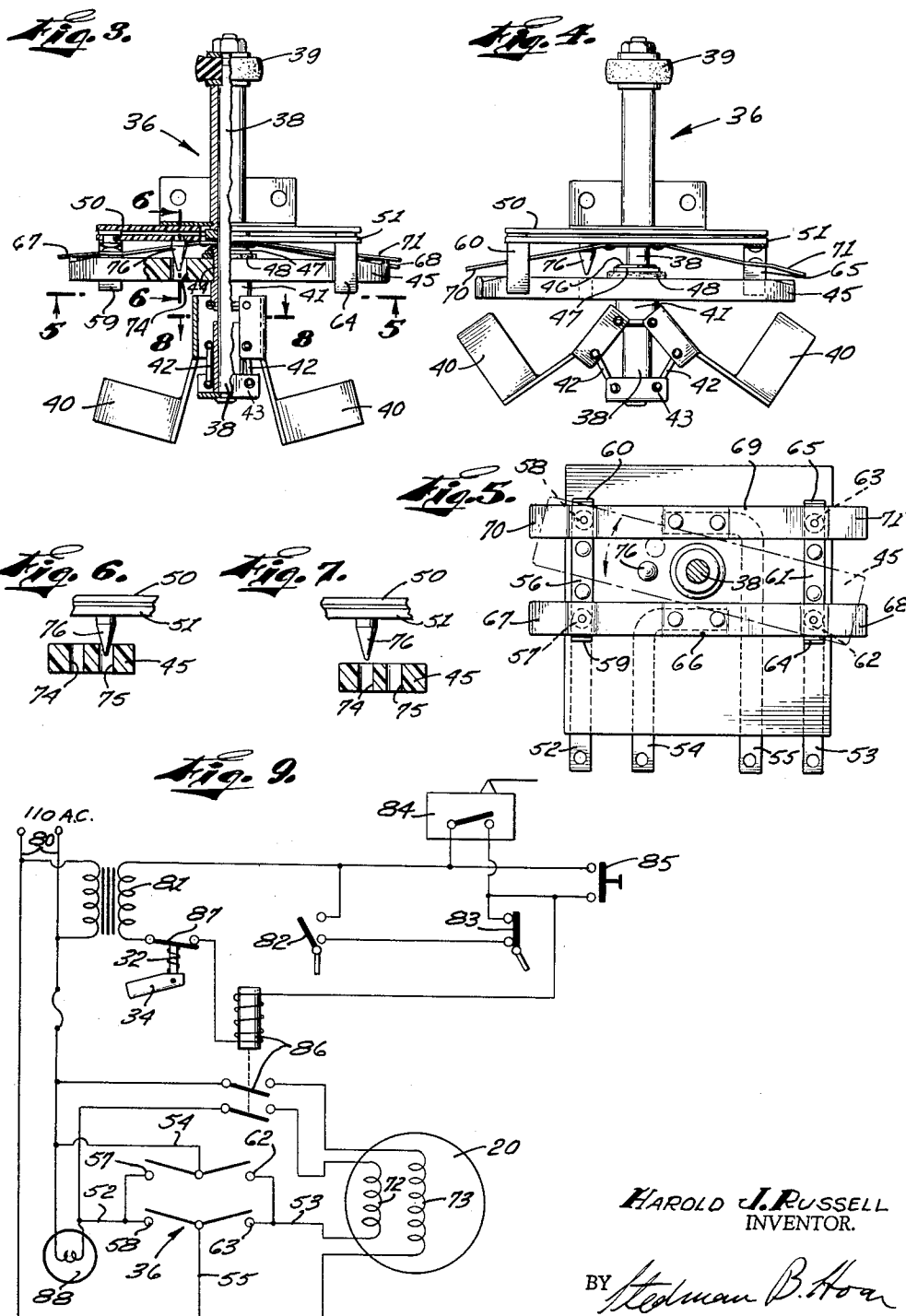
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SAFETY SWITCH FOR AUTOMATIC DOOR OPENERS

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2 Sheets-Sheet 2



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SAFETY SWITCH FOR AUTOMATIC DOOR OPENERS

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3 Claims. (Cl. 318-266)

This invention relates to devices for opening and closing doors by distant control, and more particularly relates to a safety system whereby, if the door should encounter an obstacle while opening or closing, it is automatically reversed. The invention has particular application to garage doors of the overhead suspension type but may be adapted to other styles of mounting. It is not unusual for an automobile driver to approach too close to a garage door before giving the signal which will cause the door to open, with the result that the door strikes the front of the automobile and damages either the lights and paint of the vehicle or its own driving mechanism, or both. The number of articles which, being misplaced, may interfere with the operation of a door, is roughly equal to the number of articles ordinarily stored in a garage, and also includes stray animals and wandering children who could be severely injured.

It is an object of my invention to provide means for reversing the travel of a door when an obstacle is encountered.

Another object of my invention is to provide a reversing switch which is actuated at each end of the normal travel of a door, to permit subsequent operation in the reversed direction.

A further object of my invention is to provide a reversing switch of simple design, low manufacturing cost, and trouble-free operation, inclusive of limit switches, which operates mechanically, rather than electronically, and thereby comes within the capabilities of the ordinary mechanically inclined person for its maintenance.

Still another object of my invention is to provide, beside limit switches, a reversing switch which is centrifugally operated, and which requires operation of the motor in order to attain centrifugal force sufficient to change its position.

Another object of my invention is to provide a centrifugal switch which enters a neutral position when centrifugal force is applied thereto, but at the same time enters a position of potential reverse which becomes actual, and in which the switch is secured, when the neutralizing centrifugal force ceases.

An important object and feature of my invention is to provide a reversing switch which does not stall the drive motor, but which instantly reverses the motor and keeps the motor running in the reversed direction so as to prevent injury to a person, animal, or object encountered by the door.

In the accompanying drawings, illustrative of a presently preferred embodiment of my invention but not intended to be limiting thereof,

FIG. 1 is a vertical sectional view of a building showing the mounting of a vertically swinging door and, schematically, the apparatus by which raising and lowering of the door is controlled;

FIG. 2 is a vertical sectional view on an enlarged scale, taken on the line 2-2 of FIG. 1, with the direction of view as indicated, showing a reversible motor for moving the door, and centrifugally actuated switch means by which the motor is operated;

FIG. 3 is a further enlarged vertical sectional view taken on the line 3-3 of FIG. 2, with the direction of view as indicated, showing the centrifugally actuated switch in a position assumed when the door is neither opening nor closing;

FIG. 4 is a fragmentary elevational view similar in

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viewpoint to FIG. 3, showing the centrifugally actuated switch in a position assumed when the door is moving;

FIG. 5 is a horizontal sectional view on the line 5-5 of FIG. 3, looking upward and showing the arrangement of contacts on the centrifugally actuated switch;

FIG. 6 is a fragmentary vertical section on a further enlarged scale and on the line of section 6-6 of FIG. 3, showing a detent for securing the centrifugally actuated switch in one of its limit positions when the door is not moving;

FIG. 7 is a view similar to FIG. 6 showing the detent in the unlocked position which it assumes when the door is moving as in FIG. 4;

FIG. 8 is a horizontal sectional view on the line 8-8 of FIG. 3 and on the scale of FIGS. 6 and 7; showing the mounting of the weights on the centrifugally actuated switch; and

FIG. 9 is a diagrammatic view of the electric circuits by which movement of the door is controlled.

Having reference now to the details of the drawing, I have shown in FIG. 1 the interior of a building 10, such as a garage, having a vertically swinging door 11. The door 11 may have any suitable type of apparatus for lifting and lowering it, for example a lever 12 pivoted on a member 13 and operated by a spring 14 about a fulcrum bar 15 which in turn is pivoted on a member 16. Such an apparatus is more or less conventional. To the top of the door 11 there is connected an operating bar 17. The door 11 may be opened and closed by means of a handle 18 or by pulling and pushing lengthwise upon the operating bar 17.

Lengthwise movement of the operating bar 17 is accomplished by means of a split phase reversible motor 20 driving through pulleys 21 and 22 and belt 23 of a roller 24 on the shaft 25 of the pulley 22 (FIG. 2). The operating bar 17 is preferably of two-piece construction, consisting of a channel iron, 26, carrying on its upper side a rubber friction strip 27, in contact with the roller 24. Against its under, or channel, side a pair of rollers 28 are pressed by a lever 29. The lever 29 is pivoted on a shaft 30 and is pressed upward by a coil spring 31 coiled around a pin 32. The parts enumerated 29 to 32 are all housed in a box 33 through the bottom of which the pin 32 extends. A handle 34, pivoted on the exterior end of the pin 32, has an over-center lever action against the bottom of the box 33, by which the spring 31 may be compressed and the pressure of the rollers 28 against the channel iron 26 may be released to permit the operating bar 17 to run freely between the upper roller 24 and the lower rollers 28, and thus to permit manual operation of the door 11.

A dividing partition 35 divides the bottom portion of the box 33 into two compartments, one of which houses sundry of the pieces of electrical equipment shown in FIG. 9 and which are not otherwise illustrated in detail, and the other of which houses the operating bar 17 and a centrifugally actuated switch 36. The switch 36 is supported by a bracket 37 upon the partition 35. A central shaft 38 of the switch 36 has a friction band 39 which rolls against the side of the channel iron 26, causing the shaft 38 to rotate first in one direction and then in the opposite direction as the operating bar is reciprocated. A pair of weights 40 is supported pivotally on a collar 41 which slides on the shaft 38, and the weights are further linked by links 42 to a second collar 43 secured to the bottom of the shaft 38. The weights 40 act in the same manner as the weights of a rotary governor on a steam engine: when the shaft 38 is rotated, the weights 40 fly outward, and since they can not raise the fixed collar 43, they pull the sliding collar 41 downward. The collar 41 has a neck 44 on which is mounted rotatably a press-bar 45 which is free to turn

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about the collar 41 but is held in vertical relation thereon by a flange 46 on the collar 41. The press-bar 45 is of dielectric material. Between the flange 46 and the press-bar 45 is a metallic washer 47 and a friction washer 48 of felt or like material which tends to cause the press-bar 45 to rotate as far as it may be permitted with the collar 41, but which permits the press-bar to be held from rotation while the collar continues to rotate.

Immediately above the collar 41 on the shaft 38, and held immobile by the bracket 37 are two dielectric plates 50 and 51, riveted together, and holding between them four switch terminal bars 52, 53, 54, and 55, as shown in FIG. 5 and schematically illustrated in FIG. 9. On the under side of the lower plate 51 is a bar 56, riveted through the plate 51, to the bar 52 and provided with contact points 57 and 58. The ends 59 and 60 of the bar 56 are turned down into the rotational path of the press-bar 45, to confine rotation of the press-bar between positions directly below the contact points 57 and 58. Similarly a bar 61 is riveted through the lower plate 51 to the bar 53 and is provided with contact points 62 and 63. The ends 64 and 65 of the bar 61 may be turned down like the ends 59 and 60, and for the same purpose. A leaf spring 66 is riveted to the terminal bar 54, and its free ends 67 and 68 extend directly under the contact points 57 and 62. Similarly a leaf spring 69 is riveted to the terminal bar 55, and its free ends 70 and 71 extend directly under the contact points 58 and 63.

The press-bar 45, swinging between the bar-ends 59 and 60, or the bar-ends 64 and 65, is limited to diagonal positions in which, when it is raised by falling of the weights 40, it presses either the leaf-spring ends 67 and 71 against the contact points 57 and 63, or the leaf-spring ends 68 and 70 against the contact points 58 and 62. Completion of the circuit through bar 52 contact point 57 and bar 54, and through bar 55, contact point 63 and bar 53 activates the starting winding 72 of the motor 20 in the direction to raise the door 11; conversely, completion of the circuit through bar 53, contact point 62 and bar 54, and through bar 52, contact point 58 and bar 55 activates the starting winding 72 of the motor 20 in the direction to lower the door 11. As is well known in the art, the running winding 73 of the motor 20 will be guided by the started winding 72.

In one arm of the press-bar 45 are two holes 74 and 75, and depending from the switch plate 51 at the same radial distance from the shaft 38 as the holes 74 and 75 is a detent pin 76. The pin 76 enters one or the other of the holes 74 and 75 when the press-bar 45 is raised in either of the hereinbefore mentioned diagonal positions, and holds the press-bar in the particular diagonal position, as shown in FIG. 3, until rotation of the shaft 38 raises the weights 40 and lowers the press-bar 45 away from the pin 76, as shown in FIG. 4, at which time the press-bar 45 is free to move by friction of the friction washer 48 to the other diagonal position.

As further shown in FIG. 9, to activate the motor 20, power is taken from a suitable source 80, through a transformer 81, and then through limit switches 82 and 83, a radio signal switch 84, and a push-button switch 85, which are all in parallel, to a two-pole relay switch 86 which opens and closes the circuits to the windings 72 and 73 of the motor 20. A manual control switch 87, in series with the other switches, is on the lever 29 and is operated by the handle 34; thus when it is desired to operate the door 11 by the handle 18, the operating bar 17 may be released from pressure of the rollers 28, and 24 so as to slide freely without turning the motor 20, and by the same handle 34, the switch 87 is held open and consequently the switch 86 is held open.

A lamp 88 is in circuit with the switch 36, to turn on when the door 11, is raised.

The limit switches 82 and 83 are controlled by trip brackets 89 and 90 attached to the operating bar 17.

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The bracket 89 trips the limit switch 82 at one end of the traverse of the operating bar 17, when the door 11 is fully open, and the bracket 90 trips the limit switch 83 at the other end of the traverse when the door is fully closed. Both limit switches are biased to be closed when not forced open by the trip brackets.

Operation

To assist in understanding the operation of the centrifugally actuated reversing switch, the contact points on the switch 36 which energize the starting winding of the motor 20 in the "up" or door-lifting direction will be characterized by the letter U, i.e. 57U and 63U, while the contact points which energize the starting winding in the "down" or door-closing direction will be characterized by the letter D, i.e. 58D and 62D.

It is the function of the centrifugally actuated switch 36 to anticipate the next movement of the door 11. If the door is closed or is closing, the next movement of the door must be the movement of opening. The switch 36 therefore must already be in a position in which it can, immediately that it receives a suitable signal, start the motor 20 in the direction of raising the door.

Whenever the motor 20 is running and the operating bar 17 (and the door 11) is moving, the weights 40 are rotating because of friction between the moving operating bar 17 and the friction band 39 on the shaft 38. Consequently the centrifugally rising weights 40 cause the sliding collar 41 and the press bar 45 to descend, releasing the press-bar from the detent pin 76. This action opens all contact points on the switch 36, and it happens as soon as the motor 20 reaches a suitable speed. The starting winding 72 of the motor is no longer needed and is out of circuit. But the press-bar 45 is moving by friction of the felt washer 48 from the diagonal position which it has been holding to the opposite diagonal position, where it then stands ready to close the switch 36 in the opposite direction, but does not close it until the motor 20 stops or slows down. Then the descending weights 40 lift the press-bar; the press-bar closes the switch 36 in the new direction; the switch closes the circuit of the starting winding of the motor in the new direction; and the detent pin 76 locks the press-bar on the new diagonal until the new movement shall begin.

If the door has completed its traverse and stops because a limit switch, 82 or 83, has opened, the closed switch 36 has no immediate effect, because the 2-pole relay switch 86 will have opened. But if the door has stopped or slowed down because it has hit an obstacle while in mid-traverse, closing the circuit of the starting winding of the motor in the new direction will reverse the motor, moving the door away from the obstacle.

As an example, let the door 11 be closed, with the manual release switch 87 closed, and the push-button switch 85, the radio switch 84, the limit switch 83 at the end of the downward traverse, and consequently the 2-pole relay switch 86, all open. The centrifugally actuated switch 36 is locked by the detent pin 76 with the press-bar 45 on the 57U and 63U points, in anticipation of the next movement of the door which cannot be other than upward. Now if the radio switch 84 (or the push-button switch 85) is closed, completing the circuit from the transformer 81 to the 2-pole relay switch 86, the latter switch will close. Because the switch 36 is already closed with the points 57U and 63U in circuit, the starting winding 72 starts the motor in the direction of lifting the door.

When the motor starts, the trip bracket 90 moves away from the limit switch 83, permitting the limit switch to close and to take the place in parallel of the radio switch 84 which may then open without affecting the circuit. As the motor 20 gathers speed, the centrifugally actuated weights 40 revolve and pull the press-bar 45 clear of the detent pin 76, and the felt washer 48 turns the press-bar 45 to the diagonal of the 58D, 62D points. The press-bar 45 will remain aligned with the new diagonal, but not pressing on the points to close them or locking itself on

the detent pin 76, as long as the weights 40 revolve. But at the instant that something stops the movement of the door, the weights 40 fall, and press-bar 45 rises and closes the points 58D, 62D and locks itself on the detent pin 76. If the cause of the stopping of the door was the arrival of the door at the normal end of traverse, then the trip bracket 89 will have opened the limit switch 82 and thus will have opened the 2-pole relay switch 86, and for the moment no further action will take place. The switch 36 will remain in its anticipating position, and locked against accidental displacement, ready to work instantly when called upon.

If on the other hand, the cause of stopping the door was some obstruction encountered before the normal end of traverse, then the switch 36 acts immediately to reverse the door, an act which is possible only because of the anticipating position forced upon the switch while the door was yet moving.

It should be further noted that when the door is lifted and the switch 36 is closed on the points 58D and 62D, there is a closed circuit through the terminal bar 52 and the lamp 88. The lamp is thereby lighted when the door is opened and while the door remains opened, by the switch being the anticipating position for the door to descend. But the instant that the anticipation ends and the door starts to descend, the switch is changed in position and the light 88 is extinguished. Thus the light cannot be forgotten and left burning when the garage is closed, a feature not only saving in electricity, but sometimes saving life as well, from carbon-monoxide.

The disclosed embodiment is not to be construed as a limitation upon my invention, the scope of which is deemed to include any desirable constructive modification within the spirit and breadth of the appended claims.

I claim:

1. In apparatus for moving a door, including a reversible electric motor having a starting winding and a running winding, and reciprocating means connecting said motor and said door for opening and closing said door in response to action of said motor in its reversible directions: a centrifugally actuated switch, connected with said starting winding and adapted to be closed in either of two positions, in one of which positions said switch actuates said starting winding to turn said motor in one direction and in the other of said positions said switch actuates said starting winding to turn said motor in the opposite direction; centrifugal means rotatable reversibly by said reciprocating means, and responsive to movement of said door for moving said switch to one of two open positions, from which one position said switch may be moved to that closed position actuating said starting winding in the opposite direction from which said motor is then running, said centrifugal means being responsive to deceleration of said door for thereafter closing said switch to reverse said motor; and limit switches over-riding the reversing action of said centrifugally actuated switch when said door is fully open or fully closed.

2. In apparatus for moving a door, including a reversible electric motor having a starting winding and a running winding, and reciprocating means connecting said motor and said door for opening and closing said door in response to action of said motor in its reversible directions: a switch having plural switch points and having two closed positions in one of which said switch closes a

circuit to said starting winding for turning said motor in a direction to open said door, and in the other of which closed positions said switch closes another circuit to said starting winding for turning said motor in a direction to close said door; a vertical shaft on said switch, in contact with said reciprocating means and reversibly rotatable thereby; a collar on said shaft, movable lengthwise thereof; weights hingedly connected to said collar, and adapted to fly outward by centrifugal force when said shaft is rotated, and then to move said collar upward on said shaft; a bar on said collar, connected thereto to move lengthwise of said shaft therewith, and rotatable independently thereof, said bar having a frictional engagement with said collar by which it tends to follow rotational movement of said collar; means limiting rotational movement of said bar to two positions, in one of which it is aligned with switch points closing said switch in said one closed position, and in the other of which it is aligned with switch points closing said switch in said other closed position; said bar being pressed by said collar, when said weights lack sufficient rotational speed to lift said collar, into point-closing contact with those switch points with which said bar is momentarily aligned, and being moved out of such contact and into alignment with the others of said switch points by the lifting of said collar responsive to centrifugal movement of said weights and said frictional engagement with said collar, so as then to assume an anticipating position from which said motor may be reversed upon deceleration of said weights.

3. In apparatus for moving a door, including a reversible motor, means connecting said motor and said door for moving said door in either opening or closing directions and subject to slippage and consequent deceleration when under overload, and switch means operable, when said door has attained either its fully opened or closed positions, for stopping said motor:

A switch in circuit with said motor having two closed positions respectively arranged for starting said motor in said two directions, and having two open positions each of which is associated with one of said two closed positions for permitting immediate direct movement of said switch from the respective open position to the associated closed position; and means responsive to movement of said connecting means at a speed in excess of a predetermined rate for moving said switch from whichever of said closed positions said switch may occupy at the instant to the open position associated with the other of said closed positions, said means being thereafter responsive to deceleration of said connecting means below said predetermined rate of movement for moving said switch from that one of said open positions which it then occupies to the closed position associated therewith.

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