Aug. 21, 1962 P. KARMEL ET AL 3,050,155

PROTECTIVE MECHANISM FOR DOORS

Filed Dec. 21, 1953 3 Sheets-Sheet 1

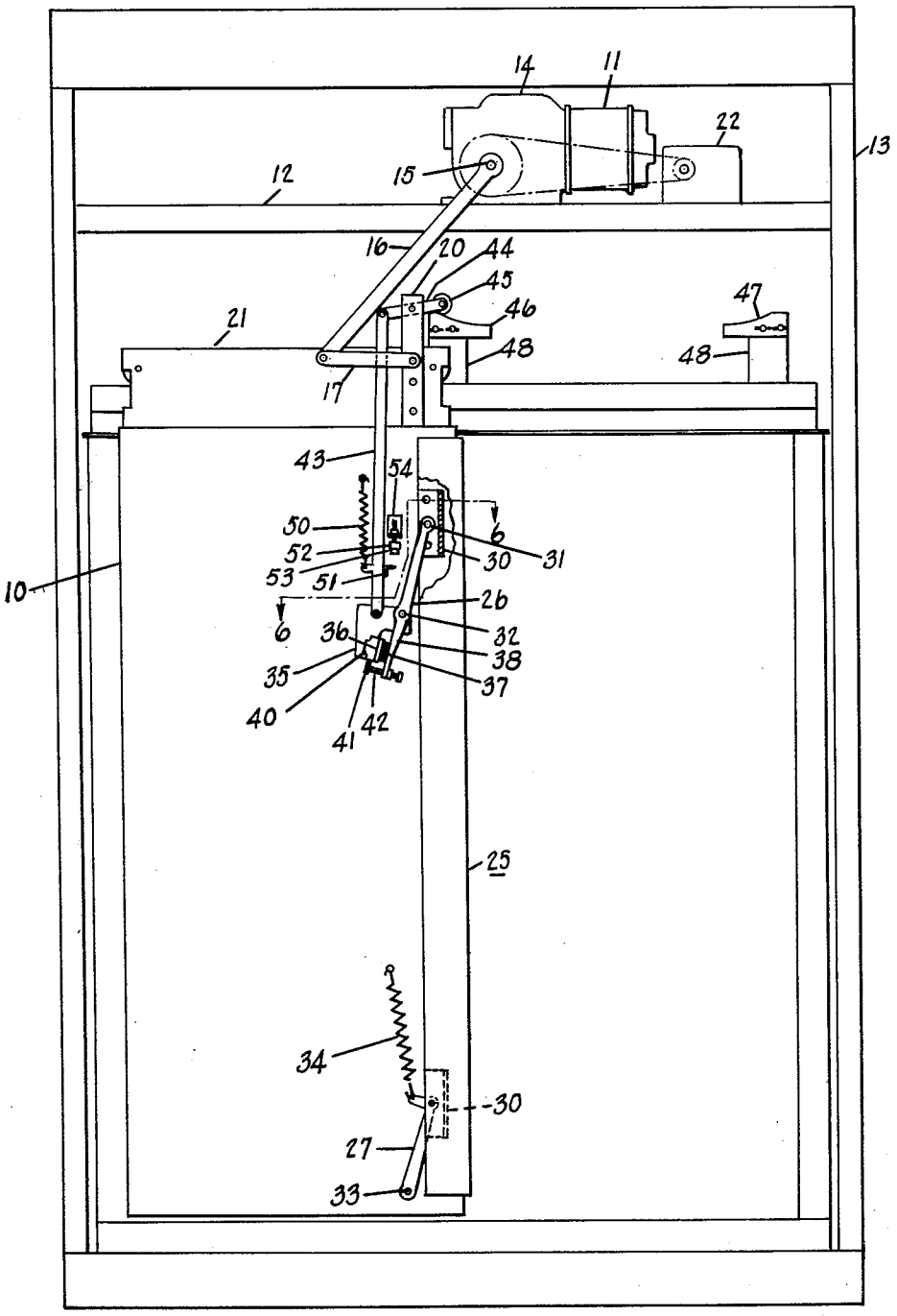

FIG. 1

PHILIP KARMEL
BENJAMIN WHITEHEAD TUCKER, JR. INVENTORS

BY Frank H. Emrick ATTORNEY

Aug. 21, 1962 P. KARMEL ET AL 3,050,155

PROTECTIVE MECHANISM FOR DOORS

Filed Dec. 21, 1953 3 Sheets-Sheet 2

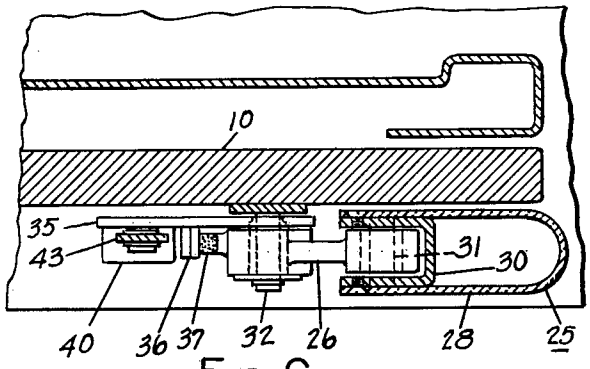

FIG. 6

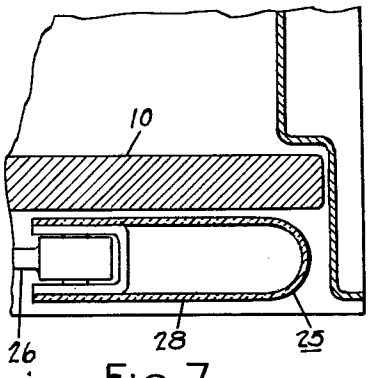

FIG. 7

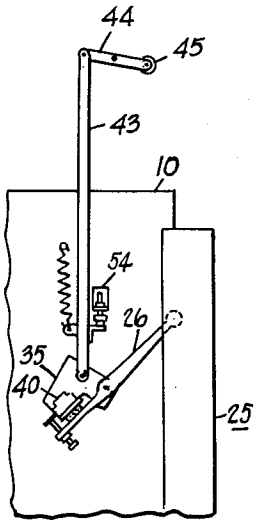

FIG. 2

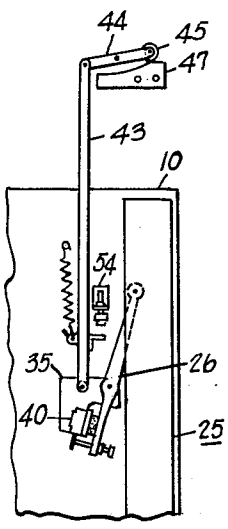

FIG. 3

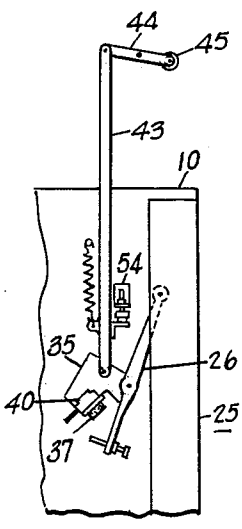

FIG. 4

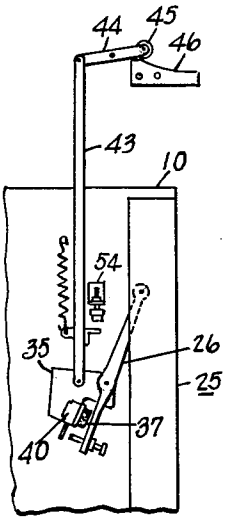

FIG. 5

PHILIP KARMEL
BENJAMIN WHITEHEAD TUCKER, JR. INVENTORS

BY Thos. H. Tunick ATTORNEY

Aug. 21, 1962 P. KARMEL ET AL 3,050,155

PROTECTIVE MECHANISM FOR DOORS

Filed Dec. 21, 1953 3 Sheets-Sheet 3

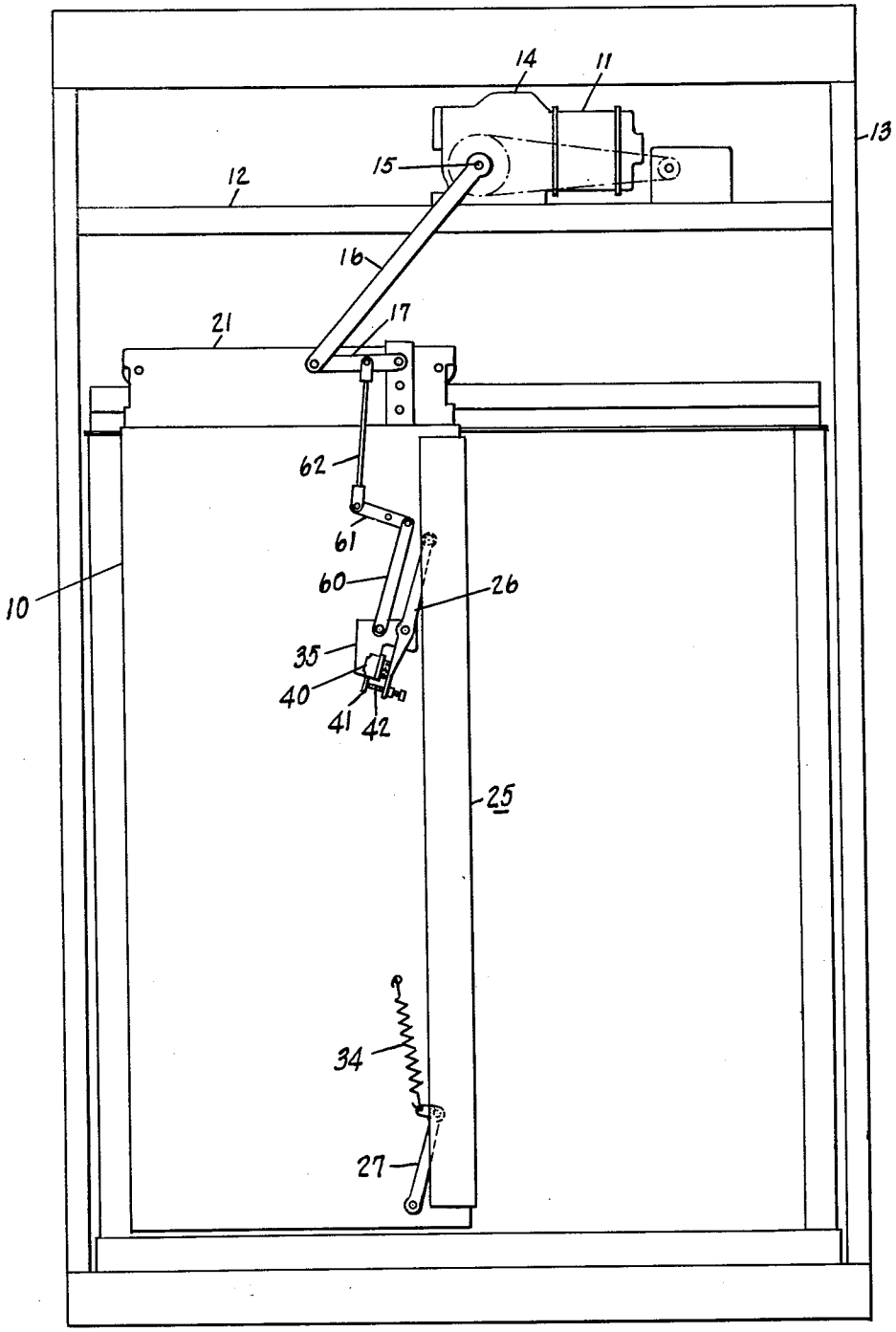

FIG. 8

PHILIP KARMEL
BENJAMIN WHITEHEAD TUCKER, Jr.
INVENTORS
BY Frank H. Emrick ATTORNEY

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Patented Aug. 21, 1962

3,050,155

PROTECTIVE MECHANISM FOR DOORS

Philip Karmel, New York, N.Y., and Benjamin Whitehead Tucker, Jr., South Orange, N.J., assignors to Otis Elevator Company, New York, N.Y., a corporation of New Jersey

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5 Claims. (Cl. 187—52)

The invention relates to mechanism for providing protection to persons against closing power operated doors such as are found in elevator installations.

In modern elevator systems in which the elevator cars are operated without attendants, the doors of each elevator are closed automatically incident the starting of the car. In collective control installations in which both the starting and stopped of the cars are under the control of the passengers and intending passengers themselves, after each stop the doors close automatically incident to the restarting operation at the expiration of a time interval. In installations in which the cars are subject to dispatching mechanism, the doors of the selected car close automatically incident to the dispatching operation and also the doors of each car close automatically at the expiration of a time interval after each stop in response to a call. Since no attendant is present in either case to act as a guard, precautions are usually taken to minimize the possibility of passengers entering and leaving the car being struck by the closing doors. This is particularly important in the case of dispatcher controlled cars in which round trip operating time is an important factor so that to minimize this time not only are the cars operated at relatively high speeds but the doors are operated at fast speed as well.

Various types of mechanisms have been used in the past to arrest door motion when a person is in danger of being struck by a closing door. One type is a mechanical protective device carried by the car door which is actuated by contact with the person in the path of its movement. An arrangement which has been extensively used is a yieldable member, termed a protective edge, mounted to extend parallel to and in front of the leading edge of the car door. When the protective edge yields upon contacting a person, it actuates control mechanism. This mechanism causes the door operating mechanism to be brought to a stop, arresting the door closing motion, and preferably also causes the door operating mechanism to return the door to open position. The protective edge extends ahead of the door a distance such as to enable the door to be brought to a stop before it strikes the person, thus minimizing the possibility of real injury to the person.

It has been the usual practice with protective edges in the past to arrange the parts so that with the doors in open position the protective edge is even with the car door jamb, thus positioning the leading edge of the car door back of the jamb the same distance that the protective edge extends ahead of the door. In this way the protective edge does not obstruct or narrow the opening. As the amount which the protective edge leads the door is a function of door closing speed, space requirements usually limit either the door closing speed, width of entranceway or both. In some installations, this limitation has been overcome by retracting the protective edge as the door reaches open position, so that both the car door edge and protective edge line up with the door jamb. In retracting the protective edge the control mechanism

is actuated and in order to enable the closing of the door to be effected, a limit switch is provided so that the door closing circuits can be established with the protective edge retracted. However, this renders the protective mechanism ineffective until the door in closing has moved far enough to release the limit switch.

The present invention is directed to mechanism of this character and has as its principal object the provision of a protective device of the type having a yieldable edge leading the door by door stopping distance and being moved into a retracted position when the door reaches open position, in which control mechanism is provided which is actuated to prevent the closing of the door when the yieldable edge is pressed against with the door in fully open position or contacts a person at the initiation of the door closing operation.

In carrying out the invention according to the preferred arrangement, two relatively rotatable members are pivotally mounted on the car door, one member connected to the protective edge and the other member connected to retracting mechanism and so related that when the protective edge is moved by pressure of a person's hand in door open position or by striking a person during door closing operation, relative movement of these members takes place which actuates switching mechanism to prevent closing of the door, but when the retracting mechanism is actuated, the protective edge is retracted through the other member and no relative movement of these members takes place so that the switching mechanism is not actuated.

According to the construction illustrated, the protective edge is connected to the door by pivoted levers. On the axis for one of these levers is a rotatable member which carries a control switch for the door operating mechanism, the lever having an arm for operating the control switch. The rotatable member is connected by linkage to retracting mechanism. The protective edge biases the switch operating arm into position to engage the switch and hold it in door closing position, the rotatable member having a stop for limiting the movement of the arm with respect to the switch. The rotatable member when moved by the retracting mechanism acts through the switch operating arm to retract the protective edge without operating the switch. However, the rotatable member is biased to protective edge extended position so that movement of the protective edge toward the door by force exerted on the protective edge causes disengagement of the switch operating arm from the switch, causing the switch to be actuated to position to prevent power closing of the door. In one arrangement illustrated, the retracting mechanism comprises a stationary cam which acts through a lever and link as the door reaches open position to move the rotatable member and protective edge to retracted position. In another arrangement, the retraction is effected by linkage connected to the door operating mechanism.

Features and advantages of the invention will be seen from the above discussion and from the following description and appended claims.

For convenience the invention will be described with reference to an elevator car door and its operating mechanism, hoistway door mechanism not being shown.

In the drawings:

FIGURE 1 is a somewhat simplified view in front elevation of an elevator car having a power operated car door with the door provided with protective mechanism embodying the invention, the parts being shown in door open position;

FIGURE 2 is a fragmental detail of the protective mechanism of FIGURE 1, with the parts shown for the door between open and closed position but with the protective mechanism unactuated;

FIGURE 3 is a view similar to FIGURE 2, with the parts shown in door closed position;

FIGURE 4 is a view similar to FIGURE 2 with the protective mechanism actuated;

FIGURE 5 is a view similar to FIGURE 4 but with the protective mechanism actuated when the door is in fully open position;

FIGURE 6 is an enlarged detail taken along line 6—6 of FIGURE 1 with the parts shown for door open position;

FIGURE 7 is a detail similar to FIGURE 6 with the parts shown for door closed position; and

FIGURE 8 is a view similar to FIGURE 1 with another arrangement for retracting the protective edge.

Referring first to FIGURE 1, the car door **10** is illustrated as a single speed, side opening door. The door operating mechanism is illustrated as a motor **11** mounted on a crossbeam **12** of the car framework **13**. The motor operates through reduction gearing **14** to rotate shaft **15** upon which is mounted the door operating arm **16**. The operating arm is connected by a link **17** to a bracket **20** secured to door hanger **21**. **22** is a casing for the door limit switches operated by motor **11**. The protective edge **25** is yieldably mounted on the car door by a pair of levers, the upper lever being designated **26** and the lower lever **27**. The protective edge is illustrated in the form of an elongated U shaped member **28** of suitable material such as Lucite, extending substantially the full length of the door. As shown in FIGURE 6, the member **28** is secured to channel brackets **30**, on each of which is mounted a pivot pin **31** for one of the levers **26** and **27**. The levers **26** and **27** are fulcrumed on pins **32** and **33** respectively, mounted on the car door. **34** is a spring connecting an arm on lever **27** and the door and acting as a counterbalance for part of the weight of the protective edge.

Also mounted on pivot pin **32** for lever **26** is a rotatable plate **35**. Formed on this plate is a bent out portion **36** serving as an abutment and having a bumper **37** of sound deadening material, such as rubber, secured thereto. This bumper is engaged by an arm **38** extending from lever **26**. Also mounted on the abutment **36** is a switch **40**, preferably of a micro-motion type, having an operating member **41** adapted to be engaged by a screw **42** adjustably mounted on the end of an arm **38**. With the arrangement illustrated, the switch is biased to position to prevent the closing of the door, but is normally held in position by screw **42** to enable the door closing operation to take place.

Plate **35** is connected by a link **43** with one end of a lever **44** pivotally mounted on bracket **20**. On the other end of lever **44** is a roller **45** for engaging cams **46** and **47**, one at each end of door travel. These cams are adjustable and are illustrated as mounted on brackets **48** mounted on top of the car. Spring **50** connected between link **43** and door **10** acts as an over-counterbalance for the plate **35** and link **43**. A stop bracket **51** is affixed to link **43** for engaging an abutment **52** having a sound deadening bumper **53** mounted on a bracket **54** secured to the door for adjustably limiting the amount of extension of the protective edge.

In operation, upon operation of the door operating mechanism to close the door, arm **16** moves counterclockwise to push the door closed. As this takes place the protective edge **25** moves toward extended position, acting through lever **26** and bumper **37** to rotate plate **35** clockwise and thus through link **43** and lever **44** to maintain roller **45** on cam **46**. Thus the movement of the protective edge into extended position is governed by the contour of the cam. This movement is stopped by the engagement of stop **51** with bumper **53**, as illustrated in FIGURE 2. As the door nears closed position, roller **45** engages and rides up cam **47**, acting through lever **44**, link **43**, plate **35**, bumper **37** and lever **26** to retract the protective edge as shown in FIGURES 3 and 7. Upon operation of the door operating mechanism to open the door, the protective edge is reextended as described for the door closing operation, the contour of cam **47** governing this movement. As the door reaches open position, roller **45** engages and rides up cam **46**, acting through lever **44**, link **43**, plate **35**, bumper **37** and lever **26** to retract the protective edge as shown in FIGURE 1.

It is to be noted that in all of this movement the protective edge, due to its weight, maintains arm **38** of lever **26** in engagement with bumper **37**. Thus operating member **41** of switch **40** is continuously engaged by screw **42** to maintain the switch in position to permit the closing of the door. However, upon a force being exerted edgewise on the protective edge, as for example in striking a person during door closing, it yields, moving back toward the leading edge of the door. As this movement takes place, lever **26** moves counterclockwise but plate **35**, due to the action of spring **50**, is maintained in position with stop **51** in engagement with bumper **53**. As a result, screw **42** disengages operating member **41**, permitting switch **40** to be operated into condition, as illustrated in FIGURE 4, for bringing the door operating mechanism and thus the door to a stop before the leading edge of the door strikes the person. Also, the circuits are preferably arranged so that this operation of switch **40** causes the door to be returned to open position, even though pressure on the protective edge is removed, permitting the reextension of the protective edge and reengagement of screw **42** with switch operating member **41**.

When the door is in fully open position, a person entering or leaving the car can prevent the initiation of the door closing operation by pressing against the protective edge with his hand. As before, due to the action of spring **50**, plate **35** is prevented from following lever **26** as the protective edge yields. As a result, switch **40** is actuated as illustrated in FIGURE 5, preventing the establishment of circuits to cause the closing of the door. The same action takes place during the initial door closing movement for, regardless of the position of the protective edge with respect to the leading edge of the door when pressure is applied to the protective edge, spring **50** prevents plate **35** following lever **26** upon the yielding of the protective edge, causing switch **40** to be actuated.

Another arrangement for retracting the protective edge is illustrated in FIGURE 8. In this arrangement, a short link **60** connects plate **35** with one end of a lever **61** pivotally mounted on the door. The other end of this lever is connected by a link **62** to a point on link **17** of the door operating mechanism. As the door closes, link **17** is swung counterclockwise, acting through link **62**, lever **61** and link **60** to cause extension of the protective edge. When link **17** reverses its movement, the protective edge is gradually retracted so that it is moved into fully retracted position when the door has closed. Reverse action takes place when the door is opened. If while the door is fully open or at any time during closing movement of the door, the protective edge strikes an obstruction it yields, causing counterclockwise movement of lever **26**. As plate **35** is connected through linkage to the door operating arm, it does not follow lever **26** with the result that switch **40** is operated to prevent the initiation of the closing of the door or to stop door closing movement.

It is preferred that the protective edge in door open position extend out a short distance, say one half inch beyond the leading edge of the door as illustrated in FIGURE 6. This facilitates a person, especially one moving across the threshold near the time for door closing to be initiated, pushing on the protective edge with his hand to prevent the closing of the door. Also the protective edge is effective during the initial door closing movement as well as during the remainder of the door closing operation, as the protective edge upon force being exerted on it at any point in its movement yields sufficiently to enable switch **40** to move into position to prevent closing of the

door. While the protective edge is not completely extended during the initial door closing operation so that the leading edge of the door has a shorter distance to move before striking a person, the speed which the door has attained is less so that the door is stopped in a shorter distance. The rate at which the protective edge is extended and retracted is governed by the contour of cam **46** in the arrangement of FIGURE 1, the cam being longer, the higher the door closing speed. The amount of extension of the protective edge to take care of different operating speeds is determined by the setting of abutment **52**. In the arrangement of FIGURE 8, this is taken care of by the point of connection of link **62** to link **17**.

The arrangements illustrated are quiet in operation. The bumper **37** minimizes any noise of engagement of arm **38** with abutment **36** and the bumper **53** minimizes noise incident to the engagement of bracket **51** with abutment **52**. Also cams **46** and **47** are arranged so as to be gradually contacted by roller **45**. In addition the cams may be made of a noise minimizing material such as canvas Bakelite. The arrangement is very sensitive as only a small amount of yield of the protective edge operates switch **40**. Also, the construction is very simple, yet positive and reliable in operation.

It is contemplated that many apparently widely different embodiments of the invention can be made without departure from the spirit and scope of the invention. It is therefore intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In combination, a power actuated elevator sliding door, a first member rotatably mounted on said door, a second member rotatably mounted on the same axis as said first member, a switch mounted on said first member and operable by relative rotative movement of said members, a protective edge for the door, means including said second member for yieldably and movably supporting said edge on said door and in substantially constant parallel relationship thereto, and means connected to said first member operable upon rotative movement of said second member by yielding of said edge to hold said first member against rotative movement to cause operation of said switch and operable as the door reaches open position to cause rotative movement of said members as a unit to retract said edge without actuating said switch.

2. In combination, a power actuated elevator sliding door, a lever rotatably mounted on said door, a plate rotatably mounted on said door on the same axis as said lever, switching mechanism carried by said door and operable by relative rotative movement of said lever and plate, a protective edge for said door, means including said lever for yieldably supporting said protective edge on said door in movable but substantially constant parallel alignment therewith, said protective edge biasing said lever for movement as a unit with said plate and acting when moved relative to said door to rotate said lever, and means connected to said plate acting upon rotative movement of said lever by the yielding of said protective edge as a result of the application of external force thereto to hold said plate against rotative movement and thus effect operation of said switching mechanism, said last named means being operable as the door reaches open position to cause rotative movement of said plate and lever as a unit to retract said edge without operating said switching mechanism.

3. In combination; a power actuated elevator sliding door; a protective edge for said door; means yieldably mounting said protective edge on the leading edge of said door, said mounting means including a pair of levers rotatably mounted on said door to each of which said protective edge is connected; a plate rotatably mounted on said door on the same axis as that of one of said levers; means connected to said plate and acting as the door approaches its opened position to rotate said plate in one direction and as the closing of the door is initiated to rotate said plate in the opposite direction; an abutment on said plate, said one lever having an arm and said protective edge acting to bias said arm into engagement with said abutment whereby, upon said rotation of said plate in said one direction as the door approaches its opened position, said one lever and plate are rotated as a unit to move said protective edge to a retracted position with respect to said door and, upon initiation of the closing of the door from opened position, said plate and said one lever are rotated as a unit in the opposite direction, returning said protective edge to its extended position, said protective edge upon yielding from its extended position when an external force is applied thereto acting to move said arm of said one lever away from said abutment; and a control switch carried by said plate, said control switch being biased to operated condition but being maintained in unoperated condition by said protective edge during said retraction and extension thereof and being released to operated condition by movement of said arm of said one lever away from said abutment upon said yielding of said protective edge.

4. In combination; a power actuated elevator sliding door; a protective edge for said door; a pair of levers rotatably mounted on said door and pivotally connected to said protective edge for yieldably mounting said protective edge on the leading edge of said door; a plate rotatably mounted on said door on the same axis as that of one of said levers; camming means connected to said plate and acting as the door approaches its opened position to rotate said plate in one direction and as the door initiates its closing movement to release said plate for rotation in the opposite direction; an abutment on said plate, said one lever having an arm biased into engagement with said abutment by said protective edge whereby, upon rotation of said plate in said one direction as the door approaches its opened position, said one lever is rotated by said plate to move said protective edge to a retracted position with respect to said door and, upon release of said plate as said closing of said door is initiated, the biasing action of said protective edge rotates said plate in said opposite direction, acting through said one lever, and returns said protective edge to its extended position, said protective edge upon yielding from its extended position when an external force is applied thereto acting to move said arm of said one lever away from said abutment; and a control switch mounted on said plate, said control switch being maintained in a first position by the biasing action of said protective edge while said arm of said one lever is in engagement with said abutment during said retraction and extension of said protective edge and being actuated to a second position by movement of said arm of said one lever away from said abutment upon said yielding of said protective edge.

5. In combination; an elevator sliding door; power actuating mechanism for said door; a protective edge for said door; a pair of levers rotatably mounted on said door and pivotally connected to said protective edge for yieldably mounting said protective edge on the leading edge of said door; a plate rotatably mounted on said door on the same axis as that of one of said levers; linkage connecting said plate to said power actuating mechanism to cause as the door approaches its opened position rotation by said power actuating mechanism of said plate in one direction and to cause as the door initiates its closing movement rotation by said power actuating mechanism of said plate in the opposite direction; an abutment on said plate, said one lever having an arm biased into engagement with said abutment by said protective edge whereby, upon rotation of said plate in said one direction as the door approaches its opened position, said one lever is rotated by said plate to move said protective edge to a retracted position with respect to said door and, upon rotation of said plate in said opposite direction as said

closing of said door is initiated, the biasing action of said protective edge returns said protective edge to its extended position, said protective edge upon yielding from its extended position when an external force is applied thereto acting to move said arm of said one lever way from said abutment; and a control switch mounted on said plate for actuation by movement of said arm of said one lever away from said abutment upon said yielding of said protective edge.

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