

F. J. OSUCH ET AL
DOOR OPERATORS

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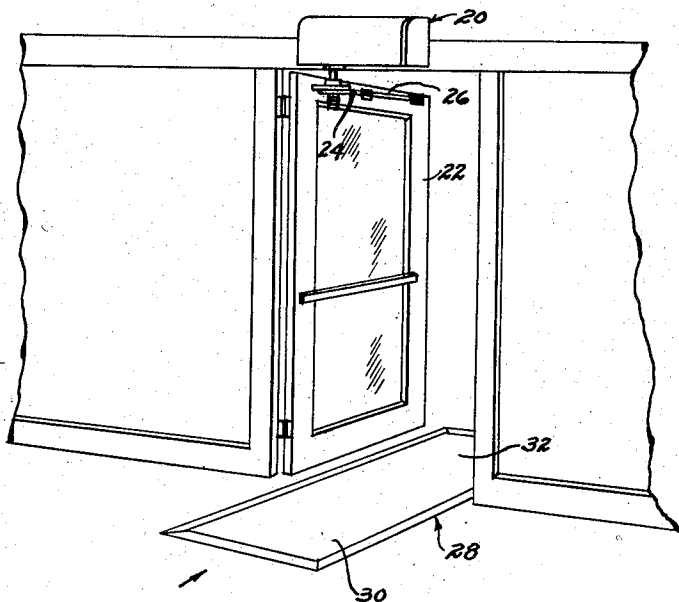
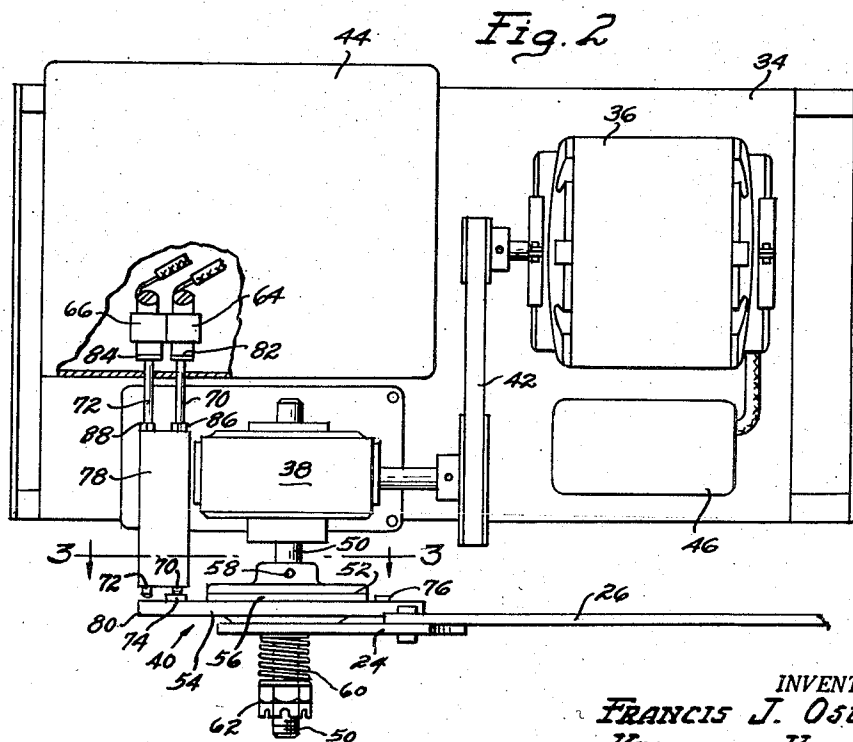


Fig. 1



INVENTOR.
FRANCIS J. OSUCH.
KENNETH KRAKE.
By *Wallace P. Lamb*
ATTORNEY.

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Fig. 5

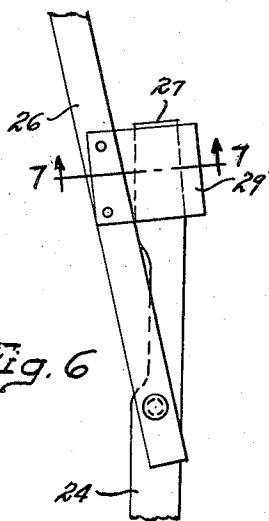
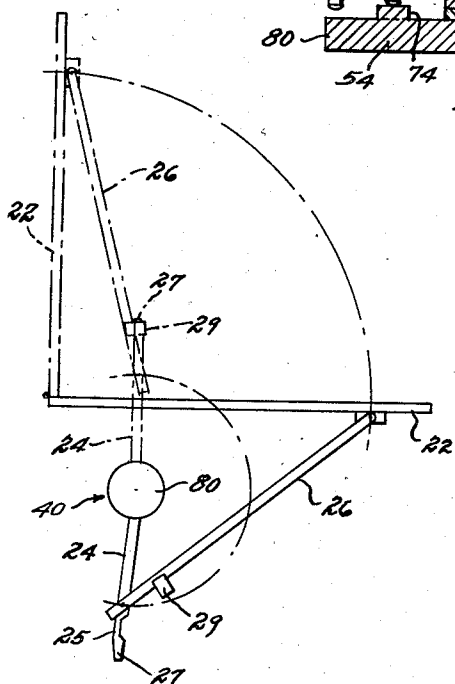


Fig. 6

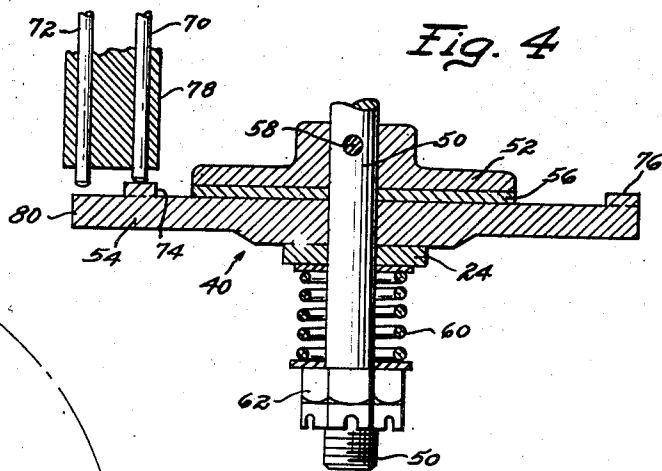


Fig. 4

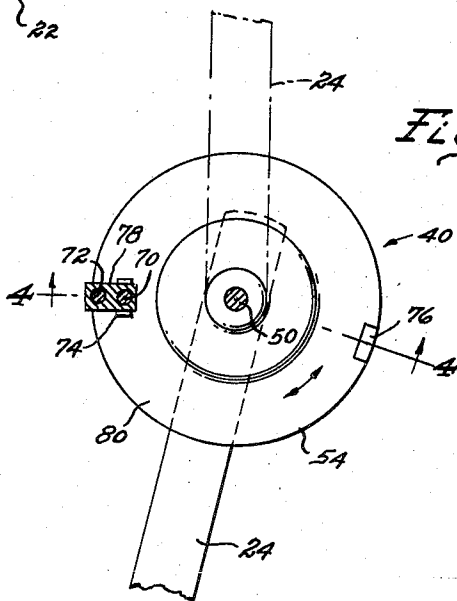


Fig. 3

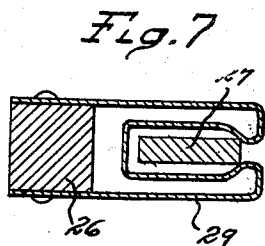


Fig. 7

INVENTORS.
FRANCIS J. OSUCH.
KENNETH KRAKE.

By Wallace P. Lamb
ATTORNEY.

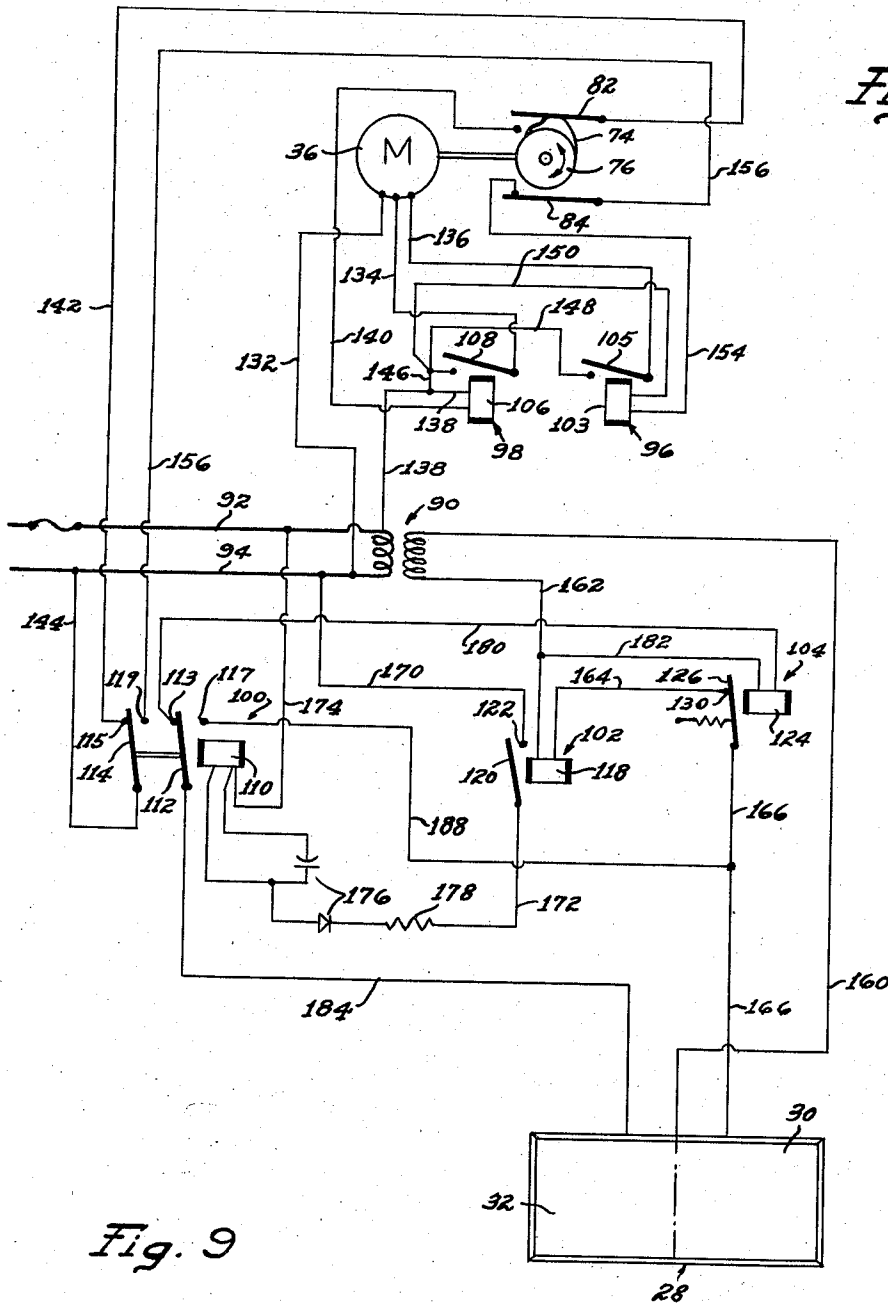
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INVENTOR.
FRANCIS J. OSUCH.
KENNETH KRAKE.

By *Wallace P. Lamb.*
ATTORNEY.

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2,843,376

DOOR OPERATORS

Francis J. Osuch, Detroit, and Kenneth Krake, Wayne Township, Mich., assignors to Robot Appliances, Inc., Detroit, Mich., a corporation of Michigan

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2 Claims. (Cl. 268—65)

This invention relates generally to door operators and particularly to electrically operated systems and operators for operating hinged doors.

One of the objects of our invention is to provide an improved hinged door operator which is entirely electrically operated.

Another object of our invention is to provide for opening and closing hinge doors, an improved operator which is electrically powered and the components of which are arranged such as to provide a small compact unit.

Another object of our invention is to provide an electric door operator of the above mentioned character which is inexpensive compared to operators of the past.

Another object of our invention resides in certain control and safety features of the door operator control system to insure proper operation under all circumstances.

Another object of our invention is to provide an electric door operator in which an operating arm driven by an electric motor to open and close a door is connected to the electric motor through a slip clutch drive which also actuates limit switches in a manner such that on closing of the door the relative positions of the lever and limit switch actuators always return to proper corresponding positions.

Specifically in connection with the next preceding object, it is an object to insure proper relationship between the operating arm and the limit switch actuators by having said arm and actuators both operated together from the driven side of the slip clutch.

A further object of the invention is to provide for hinge door operators a novel brake and door stop and one which is inexpensive.

Other objects of the invention will become apparent from the following description, taken in connection with the accompanying drawings in which:

Fig. 1 is a perspective view of our electric door operator shown installed to operate a hinged door;

Fig. 2 is a front elevational view of the door operator shown with its cover removed;

Fig. 3 is a horizontal sectional view, taken along line 3—3 of Fig. 2;

Fig. 4 is a vertical sectional view, taken along line 4—4 of Fig. 3;

Fig. 5 is a view illustrating a door and parts of our operator shown in both open and closed door positions;

Fig. 6 is a fragmentary enlargement showing the door operating lever and connecting link in the positions they will assume in door open position;

Fig. 7 is a cross sectional view, taken along line 7—7 of Fig. 6;

Fig. 8 is a diagrammatical view of the electrical system of our door operator, and

Fig. 9 is a cross section of a mat type electric control of the system.

Referring to the drawings by characters of reference, in Fig. 1, our electric door operator, designated generally by the numeral 20, is shown mounted above a doorway for opening and closing a hinged door 22. The operator

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20 is operatively connected to the door 22 by an operating lever 24 and a link 26. Extending through the doorway is a treadle, switch type mat 28 which when walked upon controls the electrical door operator to open and close the door. The mat 28 is comprised of two general sections including an approach or door opening section 30, and a door closing or safety section 32. The mat 28 is arranged to extend through the doorway with section 30 in an approach zone and section 32 in a zone posterior thereto with respect to the direction of traffic through the doorway. When a person walks onto the approach section 30, the operator 20 is initiated and the door is opened. As the person leaves mat section 30 and steps onto section 32, the door is held open and when the person steps off of section 32 the door, after slight delay is closed. It will be understood that the illustrated installation is for a doorway having traffic passing one way only i. e., the doorway will be either an entrance or an exit.

In accordance with one feature of our invention we provide a positive, frictional brake for stopping and holding the door in open position, or such that the door will not vibrate when it reaches its predetermined open position. To accomplish this economically and efficiently the operating lever 24 is provided with an extension 25 beyond the pivot connection with link 26 having a latch portion 27 adapted to engage in a socket type spring keeper 29 to hold the door steady in open position. The keeper 29 is attached to the link 26 and has spaced apart spring fingers for releasably holding the latch 27.

The mat section 30 has a lower contact 31 and an upper contact 33. Similarly the safety section of the mat includes a lower contact 35 and an upper contact 37. It will be understood that contacts 33 and 37 are biased upwardly to open position and that these contacts are closed respectively with contacts 31 and 35 when a person walks on and depresses the mat. Such mats usually include a layer of soft rubber and other details which have been herein omitted as such mats are well known in the art and constitute per se no part of the present invention. In this connection, it is pointed out that the present invention is not limited to use of so-called electric mats, but instead any type of control, such as photo-electric cells may be used, if desired.

With particular reference to Fig. 2, the door operator 20 includes a support or mounting 34, a reversible electric motor 36, a speed reducing mechanism or transmission 38, and a slip-clutch drive 40. The motor 36 and the speed reducing mechanism 38 are rigidly mounted on the support 34, and the motor may be connected to the mechanism 38 by means of pulleys and a drive belt 42, or by any other suitable means. The motor 36 drives the clutch 40 through the speed reduction mechanism 38 to turn the operating lever 24 which through link 26 opens and/or closes door 22. In the present arrangement, we have mounted on the support 34, directly above the mechanism 38, an electric control panel enclosed in a casing 44 and containing most of the electrical system and controls for the operator, but if desired said control panel may be remotely located with respect to the door operator.

The motor 36 is of the instantly reversible type which, in the present instance, has its capacitors enclosed in a separate casing 46 which may be suitably mounted on the support 34.

The speed reduction mechanism 38 is of conventional type, enclosed in a casing from which projects the drive shaft 50 of the mechanism. As shown, we have arranged the speed reduction mechanism 38 on the support 34 such that shaft 50 is vertical, the shaft depending below the operator casing for connection with slip clutch 40.

A driving component or plate 52 and a driven com-

ponent or plate 54 comprise the slip clutch 40. These clutch plates 52, 54 have central holes through which the speed reduced shaft 50 extends. Also the shaft may extend through the operating lever 24 which may be bolted or be otherwise secured to the underside of the lower clutch plate 54. A frictional drive facing 56 interposed between the plates is provided to effect proper drive friction and may be suitably secured to the face of drive plate 52. Drive plate 52 is pinned, as at 58, for positive rotation with shaft 50 whereas clutch plate 54 is free to slip under certain conditions. For example, if the door 22 should strike an object or person, or if for any other reason the load on the door exceeds the frictional force of the clutch, the clutch plates 52, 54 will slip to prevent damage to the object or injury to the person and also prevent damage to the door operator. To adjust and set the frictional force of the clutch, a coil spring 60 is provided and arranged to urge plate 54 against the friction facing 56. The spring 60 surrounds shaft 50 engaging the underside of lever 24 and is held under compression by an adjustment nut 62 which is threaded onto the shaft.

Disposed within casing 44 is a door closing limit switch 64 and a door opening limit switch 66. These switches are adapted to be actuated by the door operator to limit travel of the door in opposite directions. One of the features of our invention resides in an arrangement for operating the limit switches from the door operator in such manner that slipping action of the clutch 40 will not change the corresponding relation between the open or closed positions of the door and the limit switches. That is, under no conditions will clutch slippage result in the limit switches being actuated in any positions of the door other than the predetermined open and closed positions. To accomplish this we arrange to actuate the switches from the driven clutch plate 54 so that in the event of slippage the limit switches will not be actuated to stop motor 36 until clutch plate 54 and therefore door 22 is rotated to the corresponding open or closed position, as the case may be. To this end, we provide a pair of push rods 70, 72 for respectively actuating limit switches 64, 66, the push rods being respectively actuated by cams 74, 76 carried by clutch plate 54. The push rods 70, 72 are laterally positioned to shaft 50, extending vertically substantially from clutch plate 54 to the limit switches 64, 66. A body 78 supported on the mounting plate 34, slidably receives and guides the push rods. As shown, the driven clutch plate 54 extends beyond the periphery of the drive clutch plate 52 to provide a marginal carrier 80 for cams 74, 76. These cams 74, 76 are formed or secured to the upper surface of carrier 80 as may be desired and the cams are offset from each other so as to individually engage the adjacent ends of rods 70, 72. Also, the cams 74, 76 are radially spaced apart a distance substantially equal or corresponding to angular travel of door 22 between closed and open positions. The limit switches 64, 66 respectively have switch operators 82, 84 which are spring blades that normally bias to closed switch positions and at the same time urge the push rods 70, 72 downwardly. Such movement of rods 70, 72 is limited by stops 86, 88 which engaged the adjacent end of body 78. The stops 86, 88 may be nuts threaded onto the push rods to provide for adjusting the travel thereof.

In the electric circuitry view of Fig. 8 there is illustrated the usual transformer 90 to the primary coil of which is connected main power lines 92 and 94. The door operator motor 36 is connected to main lines 92, 94 and is under control of a pair of motor relays 96, 98, the limit switches 82, 84, and a control relay 100. These constitute two separate series circuits for motor 36. One of these circuits, including motor relay 96 and limit switch 84 is closed to operate motor 36 in a direction to open door 22, and the other of the circuits is closed to operate motor 36 in the reverse direction to close the door. The control for these circuits or relay 100 is controlled

by a starter relay 102 which in turn is controlled by the mat switches 31, 33. Also controlling starter switch 102 is a safety relay 104 which we have provided for the purpose of preventing door operation under certain circumstances, this safety feature being hereinafter more fully explained. The relays, limit switches and mat switches are in the positions they will assume when the door 22 is in closed position.

Motor relay 96 includes the usual coil 103 and armature switch 105, and similarly the other relay 98 includes a coil 106 and switch 108. These relays are normally open, as shown.

The control relay 100 comprises the usual coil 110 and double switches 112, 114. These switches normally engage a pair of contacts 113, 115 respectively, as shown in the drawing. A second pair of contacts 117, 119 are respectively engaged by switches 112, 114 when relay coil 110 is energized.

The starter relay 102 comprises a coil 118 and a switch 120 which is normally open, as indicated. When coil 118 is energized switch 120 engages a fixed contact 122 to close the circuit of control relay coil 110.

Safety relay 104 has a coil 124 and a switch 126, the switch being normally in engagement with a fixed contact 130. These contacts are broken upon energization of coil 124 whereby to deenergize relay 102 and as a consequence, relay 100.

The motor 36 is of the three wire reversible type having a lead 132 connected to main lead 94, a lead 134 connected to relay switch 108, and a lead 136 connected to relay switch 105. From the main line 92, a lead 138 connects to one end of relay coil 106 which has its other end connected by a lead 140 to the fixed contact of limit switch 82. A lead 142 connects limit switch 82 to control relay contact 115 and relay switch 114 is connected by a lead 144 to main line 94. From relay coil lead 138, a lead 146 connects to the fixed contact of relay 98 and from lead 146 a lead 148 connects to the fixed contact of the other motor relay 96. Also from lead 146, a lead 150 connects to one end of relay coil 103 which has its other end connected by a lead 154 to the fixed contact of limit switch 84. A lead 156 connects limit switch 84 to contact 119 of the control relay 100.

From contacts 33 and 37 (see Fig. 9), a lead 160 common to said contacts connects to the transformer secondary coil from which a lead 162 connects to one end of the starter relay coil 118. The other end of coil 118 is connected by a lead 164 to safety relay contact 130 and safety relay switch 126 is connected by a lead 166 to mat switch contact 31. Thus, it will be seen that when safety switch 126 is closed, starter relay 102 will be energized when a person steps upon the approach side 30 of the mat and closes contacts 31, 33. Starter relay switch 120 controls relay 100 and the circuit of switch 120 includes a lead 170 which connects relay contact 122 to main line 94. From relay switch 120, a lead 172 connects to one end of control relay coil 110 which has its other end connected by a lead 174 to the other main line 92 such that coil 110 and relay switch 120 are connected across the main lines. In lead 172, a capacitor 176 including a resistance 178 is provided to delay, for a short interval, parting of control relay contacts 113, 119 and as a consequence closing of the door. This feature is hereinafter more fully explained.

The safety circuit of relay 102 includes a lead 180 which connects relay contact 113 to one end of safety relay coil 124, the other end of the coil being connected by a lead 182 to lead 162 and thus to the transformer secondary. A lead 184 connects relay switch 112 to contact 35 of the safety side of the mat. Thus it will be seen that if a person is standing on the safety section 32 of the mat when the door is closed, relay switch 126 would be open so that the door would not open if a person stepped on the approach section of the mat. In other words, so long as a person or object is resting on the

mat safety section 32 the door will not open, thus preventing damage and injury.

Connecting switch 112 and starter relay 102 is a holding circuit for the latter including a lead 188 which connects contact 117 to lead 166. This holding circuit functions in conjunction with the capacitor 176 to insure that the door will not close during the time when a person is traversing the mat enroute through the doorway. It will be understood that as the person leaves mat section 30, the capacitor holds contacts 113, 119 engaged for a short time interval during which the person has stepped on safety section 32 and thereby established the following holding circuit: From the transformer secondary through lead 160, mat contacts 35, 37, lead 184, contacts 112, 117, lead 188, safety relay contacts 126, 130, lead 164, relay coil 118, and lead 162 back to the other side of the transformer secondary.

General operation

Assuming the door 22 to be closed and consequently the switches in the positions shown in Fig. 8, it will be seen that when a person steps on the approach side 30 of mat 28, mat contacts 31, 33 are closed which causes relay 102 to be energized which in turn causes control relay 100 to be energized. This engages control relay contacts 114 and 119, and contacts 112 and 117. Engagement of contacts 112 and 117 sets the holding circuit for starter relay 102. Engagement of contacts 114 and 119 closes the circuit of relay 96 since limit switch 84 is closed which causes the motor 36 to operate in a direction to open door 22. As cam 74 rotates it permits limit switch 82 to close so as to set the circuit for reverse operation or door closing, and when the door approaches open position, limit switch 84 is opened by cam 76. Obviously, so long as the person is on the approach side of the mat, the control relay 110 remains charged from the line and the door remains open. When the person steps onto the safety side 32 of the mat, contacts 35 and 37 are closed which completes the holding circuit of relay 102, thus assuring that relay 110 remains energized and the door open. When the person steps from the safety side and off of the mat 28, there is a short interval of delay before the relay 110 releases its switches or until dissipation of the charge stored by the capacitor 176. Consequently there is a corresponding delay in closing of the door 22 so as to insure that the person leaving the mat will clear the area before the door closes. When the relay coil 110 discharges, switches 112 and 114 will bias to the positions shown. In these positions, engagement of the relay contacts 112 and 113 sets the circuit of the safety relay 104 such that the circuit will be completed upon engagement of the mat safety contacts 35, 37. Engagement of relay contacts 114 and 115 will close the circuit of motor relay 98, since limit switch 82 is now closed, and the motor will operate in reverse direction and close the door 22. As the door starts to close, cam 76 moves away from and allows limit switch 84 to close and as the door approaches closed position cam 74 opens limit switch 82 to stop motor 36.

With regard to the safety relay 104, assume that a person is standing on the safety side of the mat when the door is closed and another person steps on the approach side 30 of the mat. In this circumstance, the circuit of the safety relay coil 124 is energized and the circuit to the starter relay 102 open to prevent door opening operation and thus assure that the person on the safety side of the mat will not be in danger of being struck by the door.

Detail description

When a person steps onto the approach side 30 of the mat, the mat contacts 31 and 33 are closed and the following circuit completed to starter relay coil 118: From the transformer secondary through lead 160, mat

contacts 31, 33, lead 166, safety relay switch 126, contact 130, lead 164, starter relay coil 118, and lead 162, back to the other side of the transformer secondary. Completion of this circuit energizes starter relay coil 118 and closes the following circuit to the control relay coil 110: From main line 94, through lead 170, relay contacts 122, 120, lead 172, capacitor 176, relay coil 110 and through lead 174 to the other line 92. Closing of the control relay circuit effects contact between relay contacts 114 and 119 and between contacts 112 and 117. Engagement of contacts 112 and 117 completes a holding circuit to starter relay coil 118, when a person traversing the mat steps from the approach section 30 onto the safety section 32 closing contacts 35, 37. This circuit is as follows: From the transformer secondary through lead 160, mat contacts 35, 37, lead 184, relay contacts 112, 117, lead 188, lead 166, safety relay contacts 126, 130, lead 164, starter relay coil 118, and lead 162 to the other side of the transformer secondary.

Engagement of control relay contacts 114 and 119 completes the following circuit to the motor 36: From main line 94, through lead 144 control relay contacts 114, 119, lead 156, limit switch 84, lead 154, motor relay coil 103, leads 150, 146 to the other main line 92. This closes the contacts of motor relay 96 which causes motor 36 to operate in a direction to open door 22. As the motor closes the door, cam 74 moves away from and permits limit switch 82 to close and as the door approaches closed position, cam 76 opens limit switch 84 which stops motor 36.

When a person steps from the safety side and off of the mat 28, there is a delayed action of relay 100, after which the switches assume the positions shown. In these contact positions a circuit is completed to the motor relay 98 to close the door, and another circuit may be completed if a person stands on the safety side of the mat. The first of those circuits is as follows: From main lead 94 through lead 144, relay contacts 114, 115, lead 142, the now closed limit switch 82, lead 140, relay coil 106, and lead 138 to the main line 92. Closing of this circuit energizes relay coil 106 closing switch 108 which completes the following circuit to motor 36. From main lead 92, through leads 138, 146, switch 108, lead 134, motor 36 and lead 132 to the other main lead 94. Energization of motor 36 through closing of relay 98 causes motor 36 to operate in a reverse direction to close door 22. The second of the circuits is as follows: From the transformer secondary through lead 160, closed contacts 35, 37, lead 184, contacts 112, 113, lead 180, coil 124, lead 182 and lead 162 to the other side of the transformer secondary.

When the door is moved to open position, the latch on the end of the door operating lever 24 engages frictionally into the spring keeper 29 on the link whereby to bring the door to a complete stop in open position without vibration. If for any reason the door 22 should strike an object, slippage at the clutch 40 takes place to prevent injury or damage. However, as we have mounted the cams 74, 76 on the driven clutch member, it will be appreciated that no amount of clutch slippage will change the relative relation between door travel and cam operation of the limit switches 64, 66. The reason for this is that cam operation and door operation are both effected from the driven clutch member.

From the foregoing description it will now be understood that we have provided an entirely electric door operating mechanism and in so doing have produced one which is efficient and inexpensive. It will also be understood that we have arranged the several components of the apparatus together with controls therefor such that the apparatus functions at all times in accordance with the most desired results. This includes operation of the door operator without failures and with safety under all possible conditions. Furthermore, we have provided a novel door operator of a character such that the safety

slip clutch thereof does not alter the relationship between door travel and limit switch cam travel. In addition, we have provided novel stop and holding means for holding the door open and carry said means on the connection between the door operator and the door.

While we have shown and described our invention in detail it is to be understood that the invention is to be limited only by the spirit and scope of the appended claims.

We claim:

1. A door operator for a swinging door comprising, a support, a reversible electric motor on said support, a speed reduction mechanism on said support disposed laterally of said motor and driven thereby, said speed reduction mechanism including a vertical driving shaft, a slip clutch including a rotatable driving clutch plate attached to said driving shaft adjacent and immediately below said speed reduction mechanism, a driven clutch plate engaging the under face of said driving clutch plate, a door operating arm having one end secured to said driven clutch plate for rotation therewith, a coil spring surrounding said shaft acting against the underside of said arm to urge said driven clutch plate against said driving clutch plate, an operator to actuate a switch to stop operation of said motor in one direction, a second operating member to operate a switch to stop operation of said motor in the opposite direction, and a pair of cams radially spaced on said driven clutch plate respectively to engage and move said operators.

2. A door operator for a swinging door comprising, a support, a reversible electric motor on said support, a

switch casing mounted on said support laterally of said motor, a speed reduction mechanism mounted in a casing on said support laterally of said motor and directly beneath said casing, said mechanism driven by said motor and having a stub driven shaft journaled within and projecting vertically from the casing, a clutch plate received on and attached to said stub shaft for rotation therewith, a driven clutch plate received on said stub shaft below said driving clutch plate and frictionally connected to the shaft solely by said driving clutch plate, a door operating arm received on said stub shaft below and secured to said driven clutch plate for rotation therewith, a coil spring acting against said arm to urge said clutch plates together, a pair of switch operating members laterally disposed from said speed reduction mechanism and extending from the top side of said driven clutch plate into said switch casing, and a pair of cams on the upper surface of said driven clutch plate respectively engaging and moving said switch operating members.

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