March 22, 1960 G. H. MARMONT ET AL 2,929,623

DOOR OPERATING MECHANISM

Filed June 18, 1956 2 Sheets-Sheet 1

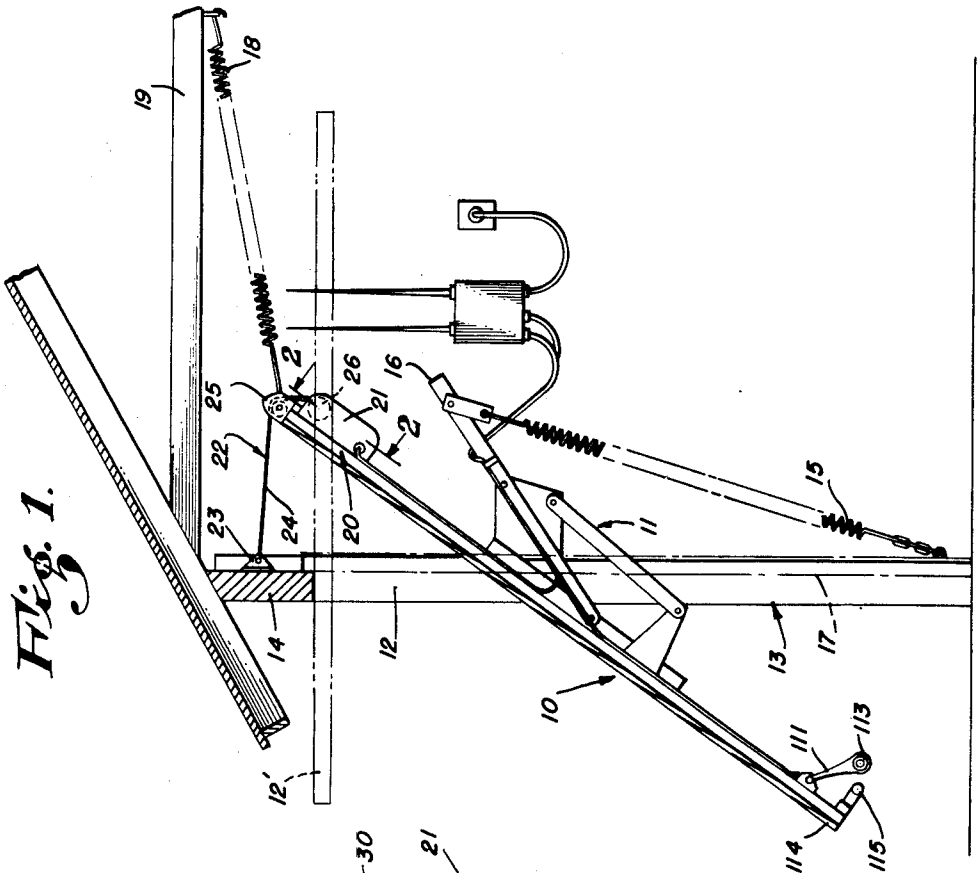


Fig. 1.

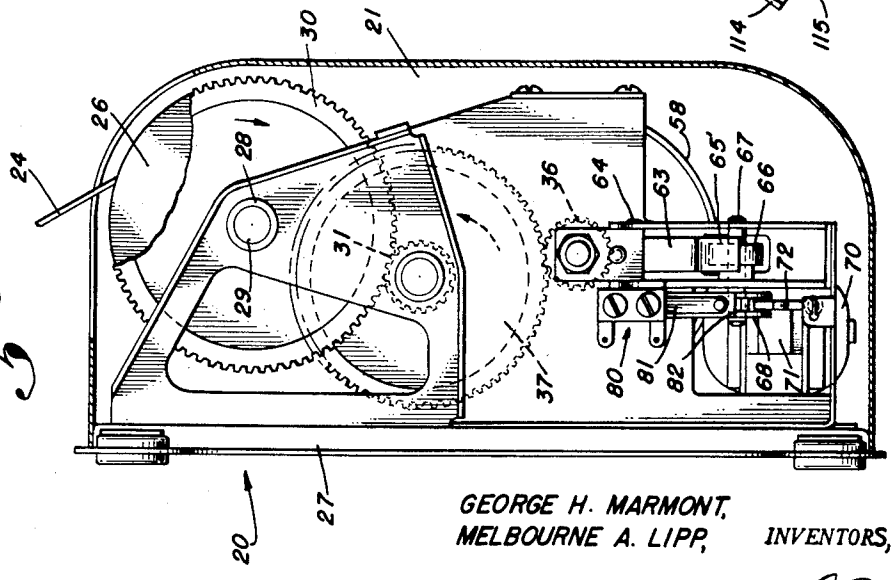


Fig. 3.

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2 Sheets-Sheet 2

Fig. 2.

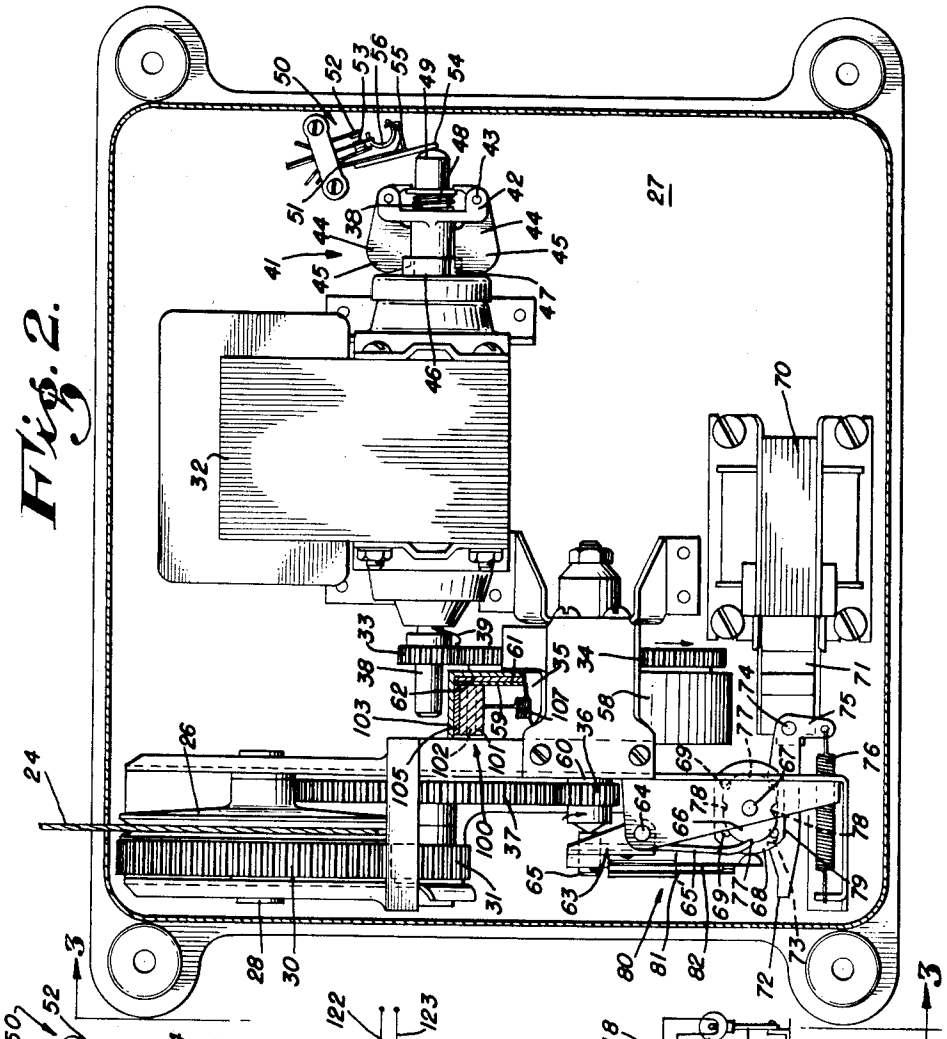
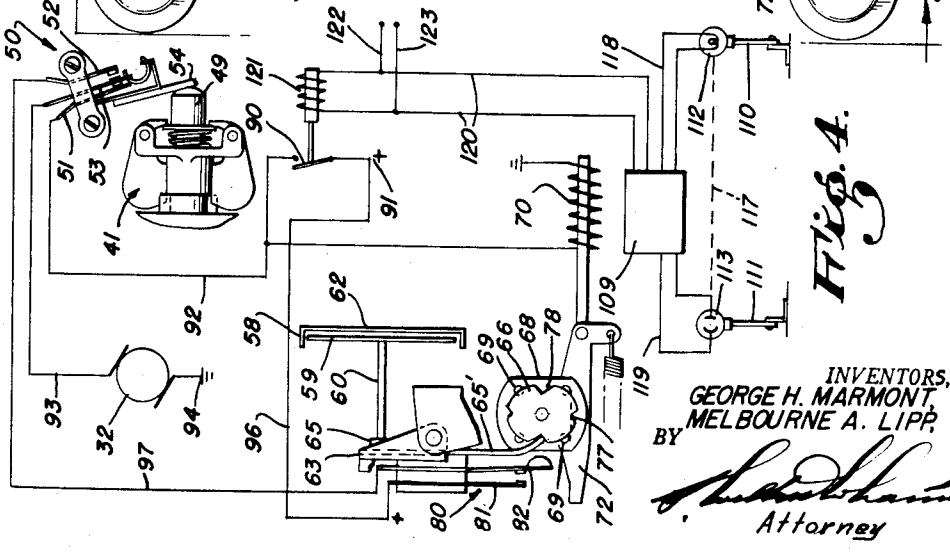


Fig. 4.



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DOOR OPERATING MECHANISM

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6 Claims. (Cl. 268—74)

This invention relates in general to devices for operating closures and relates in particular to a simple power driven device for opening and closing them.

It is an object of the invention to provide a simple and dependable device, adapted to be remotely controlled for opening and closing door members. Herein an embodiment of the invention will be described which is especially suited for the opening and closing of an overhead garage door, but it is to be understood that the specific terminology employed in connection with doors for garages, for example, is not intended to place a limitation on the type of closure with which the invention may be employed.

Garage doors of the overhead type are supported and/or guided so that they may be moved upwardly from vertical, doorway-closing position to a raised position in a substantially horizontal plane contiguous to the upper margin of the doorway. It is an object of the invention to provide a door actuator having means, adapted to remote control, for applying power to move the door downwardly from raised position to closed position against the force of counter-balancing means such as a spring which is capable of moving the door from closed to open position when a latching or holding mechanism of the device is released.

It is an object of the invention to provide a door actuator which may be electrically controlled from a switch which may be manually actuated or has means of actuation responding to a transmitted wave originating, for example, in apparatus carried by an automotive vehicle.

It is an object of the invention to provide a door closing mechanism having means for yieldably applying a force, such as a spring or counterweight for example, tending to move the door in one of its directions, and power driven means for moving the door in its opposite direction of movement, and latch means for holding the door against movement by the yieldable means for applying force thereto.

It is a further object of the invention to provide a door actuating mechanism wherein the means for moving the door in a direction opposite the yieldably applied force consists of a flexible line such as a cable arranged to have one end wound upon a reel which is driven through a releasable clutch, reverse rotation of which is prevented by a latch. Herein means are provided for releasing the clutch so that the door may be moved by the yieldably applied force.

A further object of the invention is to provide a door operating mechanism which is motor driven and is provided with a motor controlling switch means for closing an electric circuit through the motor, there being means for deenergizing the motor when the door has been moved into an extreme position.

A further object of the invention is to provide a door operating mechanism wherein the speed of the motor reduces or the motor stalls when the door has been moved into its extreme position, and wherein the means for deenergizing the motor responds to a reduction in speed or stalling of the motor.

In the prefered form of the invention a latch means acts, when the motor is deenergized, to prevent reverse rotation of the motor and thereby holds the door in the position in which it has been moved. Simple means are provided for releasing a clutch arranged between the motor and sheave to enable rotation of the sheave in reverse direction and permit the spring, or other yieldable force exerting means, to move the door into its other position.

Further objects and advantages of the invention may be brought out in the following part of the specification wherein many small details have been described for the purpose of competence of disclosure, without intending to limit the scope of the invention which is set forth in the appended claims.

Referring to the accompanying drawings which are for illustrative purposes only:

Fig. 1 is an elevational section schematically showing a preferred embodiment of the invention connected to a garage door and the frame therefor;

Fig. 2 is a face view of the power mechanism taken as indicated by the line 2—2 of Fig. 1;

Fig. 3 is a fragmentary elevational view looking rightwardly from the plane 3—3 of Fig. 2; and

Fig. 4 is a fragmentary face view of the switch and control mechanism of Fig. 2 in a second position thereof, and including a wiring diagram of the control circuit of the invention.

Fig. 1 shows a garage door member 10 supported by hinge means 11 so that it may be swung from a vertical position closing the door opening 12 defined by a door frame 13, upwardly in clockwise direction to a raised horizontal position contiguous to the lintle 14 of the door frame 13, as shown by dotted lines 12'. The hinge mechanism 11 includes a counterbalancing tension spring 15 which is connected to the inner end of one of the levers 16 of the hinge mechanism 11. Phantom lines 17 indicate one extreme position, namely, the closed position, of a door member 10, and the dotted lines 12' indicate the other extreme position of the door member 10.

The invention includes yieldable means for urging the door member into one of its positions and power operated means for moving it into the other of its positions. As this description proceeds, it will be understood that the yieldable means may be employed so as to urge the door member 10 into either one of its positions and that the power operated means may be then employed to move the door member into the other of its positions. In the form of the invention disclosed, a helper spring 18 is connected to the upper end of the door member 10 and to a rafter 19 of the garage, so that it will act in tension to move the door member in a first direction, namely, upwardly and clockwise, into the position 12'. An actuator 20 is connected to the door member 10 and the frame member 13 is adapted to act, against the tension of the spring 18 to move the door member 10 from the first position 12' thereof, counterclockwise and downwardly into the vertical position 17.

Although it will be understood that the positions of parts may be reversed, the form of the invention disclosed shows the actuator 20 as having a power unit 21 which is connected to the upper edge portion of the inner face of the door member 10 and a linkage 22 extending from the power unit 21 and being connected to the lintle member 14 by use of an attaching bracket 23. The linkage 22 comprises a tape, chain or cable 24 which runs over a sheave 25, mounted contiguous to the upper edge of the door member 10, to a spool or reel 26 forming a part of the power unit 21. As the reel 26 is rotated tension is applied to the cable 24 with the result that a force then acts tending to move the lintle member 14 and the upper end of the door member 10 toward each

other, but since only the door member 10 is movably supported, this force results in movement of the door member in counterclockwise direction toward and into a vertical, closed position 17 with relation to the frame member 13.

The power unit 21, which may be mounted either on the door or on the lintle of the door frame, includes a base 27 adapted to be secured to a supporting member by screws. Bearing members 28, supported on the base 27, carry a shaft 29 which supports the reel 26 and a gear 30. A pinion 31 is arranged to drive the gear 30. The pinion 31 is adapted to be driven by a motor 32, reduction gears 33 and 34, a clutch 35 and reduction gears 36 and 37. The gear 33 is driven by a rotary member 38, consisting of the shaft of the motor 32 which is of shaded pole type. An arrow 39 indicates the direction of rotation of the motor when the reel 26 is rotating in the direction required to wind the cable 24 thereon. Releasable means 41 are provided for preventing reverse rotation of the rotatable member or shaft 38. It comprises a bracket 42 mounted on the rightward outer end of the shaft 38 and having pins 43 supported on opposite sides of the axis of rotation of the shaft 38 and carrying counterweights 44, the leftward ends 45 of which project beyond the leftward margin of the bracket 42. The releasable means also include a stop member 46 which is supported by the motor housing in a position to surround a portion of the shaft 38, the member 46 having radial shoulders 47 arranged to be engaged by the counterweights when they are in retracted position, these shoulders 47 being positioned so that they will prevent reverse rotation of the counterweights and the shaft 38 supporting the same.

In addition to serving as holding means for the shaft 38, the counterweights 44 serve also as means for opening the motor circuit when the door member has been moved into closed position. A quick acting double throw switch 50 is arranged at the end of the shaft 38 in a position to be actuated by the movement of the sleeve 49. The switch 50 comprises stationary contacts 51 and 52 disposed on opposite sides of a movable contact 53. The switch 50 has an actuating element 54 supported by a leaf spring 55 so that it normally tends to swing leftward from the position in which it is shown in Fig. 2. When the counterweights 44 are in retracted position, the rightward end of the sleeve 49 swings the member 54 into the position in which it is shown in Fig. 2, at which time a C-spring 56 acts between the member 54 and movable contact 53 to hold the movable contact 53 in engagement with the stationary contact 51. When the motor 32 is energized, rotation of the counterweights 44 around the axis of the shaft 38 causes the counterweights to swing outwardly, with consequent movement of the sleeve 49 leftwardly against the pressure of the spring 48, so that the leaf spring 55 may swing the actuating element 54 leftwardly, whereupon the C-spring 56 will snap the contact 53 rightwardly from engagement with the contact 51 into engagement with the contact 52.

The clutch 35 includes a drum 58, which is connected to the gear 34 so as to rotate therewith around the axis of a supporting shaft 60 and a clutch plate 59 which is fixed on the shaft 60 and is disposed adjacent the radial wall 62 of the drum 58. The gear 36 is also fixed on the shaft 60 so that it will rotate when the drum 58 rotates the clutch plate 59. The clutch plate 59 has a frictional clutch facing 61 arranged for frictional engagement with the radial wall 62 of the drum 58 when the plate 59 is forced rightwardly by a cam-actuated lever 63 supported on a shaft 64 and having in one end thereof a screw 65 adapted to force the shaft 60 and the clutch plate 59 rightwardly when the remaining end 65' of the lever 63 is rotated in clockwise direction by a cam 66.

The cam 66 is rotatable upon a pin 67 and is affixed to spaced plates 68 having four pins 69 arranged therebetween and being positioned upon quadrants of a circle around the axis of the pin 67. For rotation of the cam 66 a solenoid 70 is provided having an armature 71 which carries a pawl 72 having a hook or shoulder 73 positioned so that it will engage a pin 69 and rotate the cam 66 and the plates 68 90° in counterclockwise direction when energization of the solenoid 70 moves the armature 71 rightwardly from the position in which it is shown in Fig. 2. The pawl 72 is connected to the armature 71 by a pin 74 and is provided with a short laterally projecting lever 75 which is pulled leftwardly by a spring 76, the spring 76 thereby serving to rotate the pawl 72 in clockwise direction so that it will be yieldably maintained in operative relation to the pins 69 of the cam 66, and also provide a force to return the armature 71 to the initial position thereof, shown in Fig. 2, when the solenoid 70 is deenergized. The cam 66 has two shallow peripheral depressions 77 in diametrally opposed relation and two relatively deep peripheral notches 78 arranged half-way between the depressions 77. Likewise, each plate 68 has two flats 79 corresponding in position to the notches 78. A switch 80 is arranged adjacent the plates 68 so as to be actuated thereby. The switch 80 comprises spring-supported contacts 81 and 82, the contact 82 carrying a body of insulating material for engagement with the peripheries of the plates 68, so that the switch 80 will be closed when the plates are in the position in which they are shown in Fig. 2.

In Fig. 4, the cam 66 is shown in a position wherein a notch 78 thereof is in engagement with the rear end 65' of the lever 63 so that the clutch plate 59 is released or spaced from the wall 62 of the drum 58, permitting the reel 26 to rotate in reverse direction so that the cable 24 will unwind as the spring 18 swings the door member 10 into raised position. The switch operating cams or plates 68 are in such position that the switch 80 will be open. A main control switch 90 is shown, which is normally in open position. This switch 90 may be operated in any selected manner, manually, electrically by remote control, or by switch operating mechanism which responds to a wave transmitted from radio equipment mounted on an automotive vehicle.

Closing the switch 90 will result in electric current being carried from a positive source 91 through a conductor 92 to the switch contact 51, which is engaged by the movable switch contact 53, because the motor 32 is at this time inoperative. From the contact 53, the electric current will flow through a conductor 93 to one terminal of the motor 32, the other terminal of which is shown as being connected to a ground 94. At the same time current will flow from the switch 90 through the winding of the solenoid 70, energizing the same so that the pawl 72 will be actuated to rotate the cam parts 66 and 68 90° in counterclockwise direction, actuating the clutch and closing the switch 80 whereupon the positive current source 91 will be connected through conductors 96 and 97 with the switch contact 52.

At the time of the closing of the switch 90, when the door is in open position, there will be substantially no load on the motor 32, for the reason that the tension in the cable will be at this time released. Therefore, the energization of the motor as a result of the closing of the switch 90 will effect an instantaneous rotation of the motor shaft and the counterweights mounted thereon, so that the counterweights will instantaneously move outwardly, retracting the member 49 in leftward direction to permit movement of the switch operating part 54 in leftward direction and thereby cause the switch contact 53 to snap over into engagement with the contact 52 so that energization of the motor 32, after the supply of current to the motor through the switch 90 is discontinued as the result of opening the same, will be accomplished through the closed circuit including the switch 80. Operation of the motor will continue until the door 10 is moved into closed position and stalling of the motor

32 occurs. The discontinuance of the rotation of the motor shaft 38 will permit the counterweights 44 to swing back into their retracted positions shown in Fig. 2, whereupon the switch contact 53 will be swung out of engagement with the contact 52, breaking the motor circuit through the switch 80 and deenergizing the motor. The contact 53 at this time will be swung into engagement with the contact 51, but this will not result in energization of the motor 32 for the reason that the circuit which includes the contact 51 will be open at the switch 90. Since the engagement of the counterweights 44 with the stops 47 at this time prevents reverse rotation of the motor shaft 38, the door 10 will be held in closed position until the switch 90 is again momentarily closed so as to energize the solenoid and effect rotation of the cam members 66 and 68 from the positions in which they are shown in Fig. 2 to the positions in which they are shown in Fig. 4, opening the switch 80 and bringing a notch 78 of the cam 66 into alignment with the rear end 65' of the lever 63, allowing the lever 63 to swing in counterclockwise direction and release the clutch plate 61 from engagement with the drum 58. The reel 26 may then rotate in reverse direction and the cable 24 will unwind therefrom as the spring 18 pulls the door 10 into open position at a rate of movement which is determined by a centrifugal governor 100 which is disposed within the drum 58. The governor 100 comprises weights 101 supported at ends thereof on pins 102 which project from the clutch plate 59, within the cylindrical wall 103 of the drum 58. These weights 101 have thereon friction shoes 105 adapted for engagement with the inner face of the cylindrical wall 103 when the weights 101 are swung outwardly by centrifugal force against the retracting action of tension springs 107. Since the drum 58 is held stationary on the up cycle, the function of the friction shoes 105 of the governor 100 is to limit the maximum speed of rotation of the reel 26 whereby the rate of movement of the door 10 from closed to open position is controlled.

In Figs. 1 and 4 is shown the safety equipment which forms part of the invention. It includes a photoelectrically actuated signal device 109 which may be of the type generally employed as an alarm for indicating the passage of persons or objects through a doorway. This signal device 109 has conductors 118 and 119 which extend to a lamp 112 and a photoelectric cell 113 which are supported respectively by brackets 110 and 111 mounted on the inner face of the door 10 at the lower corners thereof. The lamp 112 and the cell 113 are positioned inwardly of the lower edge 114 of the door 10 and also inwardly of the transverse brace 115 for the lower edge of the door 10. As indicated by dotted lines 117 in Fig. 4, a light beam passes parallel to the lower edge 114 of the door 10 from the lamp 112 to the photoelectric cell 113. If, during the lowering of the door 10 from the raised position thereof indicated at 12' in Fig. 1, the light beam 117 should be interrupted, an electrical impulse will be transmitted through conductors 120 for the purpose of actuating a control which will immediately reverse the direction of movement of the door 10. For this purpose a relay 121 is provided for momentarily closing the switch 90. The circuit formed by the conductors 120 is connected to this solenoid 121 which, if desired, may be actuated by other means. For example, the conductors 122 and 123, leading to the solenoid 121 may be connected to a control device, not shown, which is actuated by a received signal consisting of air-transmitted energy and in turn transmits a current impulse to the solenoid 121.

We claim:

1. In a mechanism for effecting movement in first and second directions of, and thereby opening and closing, a door member with relation to a frame member: means yieldably exerting force on said door member tending to move it in said first direction; means for moving said door member in said second direction, comprising a linkage having one end thereof connected to one of said members, means mounted on the other of said members for applying a force to said linkage to move said door member in said second direction, said means for applying force to said linkage comprising an electric motor arranged when energized to rotate in forward direction, a transmission including a rotary part driven by said motor and a clutch for connecting said rotary part to said linkage, means actuating said clutch and electrically energizing said motor so that said motor will act through said transmission to apply to said linkage a force which will move said door member in said second direction, means for stopping said motor when said door member reaches the end of its movement in said second direction, means for preventing rotation of said rotary part when said motor is stopped, whereby said door member will be then held at the end of its movement in said second direction by said linkage, said transmission, said rotary part and said means for preventing rotation of said rotary part; and means for releasing said clutch so that said linkage will be free to move and said door may be then moved in said first direction by said means yieldably exerting a force on said door member.

2. A mechanism as defined in claim 1 wherein said means for actuating said clutch comprises a lever arranged to be swung back and forth and to thereby effect engagement and disengagement of said clutch, a rotary member adapted upon partial rotations thereof to move said lever back and forth, and electromagnetically actuated pawl and ratchet means for consecutively imparting partial rotations to said rotary member.

3. A mechanism as defined in claim 1 having means operating in response to said door member encountering an obstruction in its path of movement in said second direction to release said clutch so that said door is then free to be moved in said first direction.

4. A mechanism as defined in claim 1 having a light source mounted on said door member near an edge thereof and a photoelectric element mounted on said door member in spaced relation to said light source to receive a light beam from said source, and means controlled by said photoelectric element and responsive to the interruption of said light beam to effect release of said clutch so that said door member is free to be moved by said force exerting means in said first direction.

5. A mechanism as defined in claim 1 wherein said rotary part has weights pivotally mounted thereon so as to be swung outwardly by centrifugal force, spring means arranged to move said weights inwardly toward the axis of said rotary part to retracted position as the speed of rotation of said rotary part is reduced, means acting in response to movement of said weights into retracted position to electrically deenergize said motor and to hold said rotary part from rotation in reverse direction and to thereby prevent movement of said door in said first direction during the time said clutch is actuated.

6. A mechanism as defined in claim 5 having means for releasing said clutch so that said means for exerting a force on said door member may move the same in said first direction, and means for controlling the rate of movement of said door member in said first direction.

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