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**DOOR OPERATOR**

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1 Claim. (Cl. 49—28)

This application is a continuation-in-part of S.N. 260,583 filed February 25, 1963 and now abandoned.

This invention relates to improvements in a power driven operator for a door, which is effective after the door opening movement has been begun by a person.

There is a demand for a door operator which is put into action by a user's beginning the door movement and which will complete the door opening and will reclose the door, or which will aid the user in opening and reclosing a particularly heavy door. For such door operator which is herein disclosed as being electric power driven, the structure is simplified by use of switches actuated dependent on the position of the door in place of the known electric eye or door mat weight-operated type of switches used in the known fully automatic door operator. The door operator is further simplified by use of an ordinary electric motor with known speed reducing means such as belts and pulleys or a fluid pressure transmission connecting the motor pulley with a linkage pivoted between the door and the speed reducer. The motor and the speed reducer and a part of the motor control switches are mounted on a plate which is movable relative to a base. Thus a standard motor, switches and speed reducer may be used and the specially designed parts are limited to the mountings and the operating arm. If either the door opening or door closing actions are interrupted by blocking the door, the motor and speed reducer mounting plate moves relative to the base and the switches thereon co-act with the stationary part of the base to open the motor circuit until door movement recommences. Although an electric power driven operator is preferred as being simplest, a fluid pressure operated motor may also be used with fluid flow control valves in place of electric switches. Any complications of fluid pressure control are far outweighed by the fact that a fluid pressure motor or transmission may be readily built to operate at low speed.

In the drawings:

FIG. 1 is a cross sectional view of a door frame and door with the present door operator shown in top plan view, the open position for door and the operator arms being indicated in dotted line.

FIG. 2 is a cross section of line 2—2 of FIG. 1.

FIG. 3 is a cross section of line 3—3 of FIG. 1.

FIG. 4 is a cross section of line 4—4 of FIG. 3.

FIG. 5 is an enlarged vertical section of one of the flexible and resilient posts for supporting a movable mounting plate on a fixed base, and

FIG. 6 is an electrical diagram showing the connections of the motor and the switches.

Referring to the drawings by numbered parts, 10 designates a frame in which a door 11 is mounted to swing about one of its vertical edges on hinges 12. A shelf-like structure 15 serves as a base and preferably is at least partially enclosed by side boards 16, and extends from the door frame adjacent to the hinged side of the door and provides a fixed and substantial support for the door operator structure. A plate 20 is movably supported on the base 15 by means of flexible and resilient posts 21 (see FIG. 5) comprising a flexible and resilient cylinder 22 with nuts 23 embedded in the ends thereof to receive screws 24 for attaching the posts respectively to the base 15 and the plate 20.

Any electric motor 30 driving in only one direction and preferably at a speed less than the speed of the usual fractional horsepower motor, is mounted on the plate 20

and has a pulley 31 connected by a belt 32 to another pulley 33. The pulley 33 is on a shaft 34 in a substantial bearing 35 in the mounting plate 20 and the shaft has fixed thereto another pulley 36. A belt 40 connects the pulley 36 to a pulley 41 on a shaft 42 in a bearing 43 which is large enough to extend through the base 15. The shaft 42 is connected to one arm 48 of a linkage, by releasable means such as a ball 49 seating under the pressure of a spring 50 in a socket in the shaft 42. The arm 48 is pivoted at its other end to a second arm 51 which is in turn pivotally connected at its other end with a bracket 52 on the door. Thus, whenever any unusual conditions prevent rotation of the arms 48, 51, the shaft is released and does not re-engage until the shaft makes one full revolution. Any unusual condition preventing movement of arms 48, 51, reacts on plate 20 as will be described, to open the circuit of the motor 30. Hence, detent 49, 50 is a protective device preventing damage to the mechanism if power is applied while an unusual condition exists.

A switch 56 (see FIG. 1) is mounted on the door frame to be opened by the door as it closes and the switch is closed as soon as the user swings the door out of contact with the switch button, and thus closes the motor circuit. Other switches 57 and 58 are normally closed and are placed on mounting plate 20 on opposite sides of a bracket 59 extending from a point (sideboard 16 of base 15) fixed with relation to the plate 20. Thus, as one or the other of the switches 57, 58 moves with plate 20 to bring the push button thereon against the bracket 58, the contacting switch is opened and interrupts the motor circuit.

The motor circuit is shown in FIG. 6 in the condition when the door is closed. At that time the switch 56 is open and both switches 57 and 58 are closed. When a user begins to open a door the switch 56 closes, the motor is energized to move the arms 48 and 51 from the superposed (dotted line) position shown in FIG. 1 to the extended (dot-dash line) position shown in FIG. 1 and on which the door is fully opened. If there is no obstruction to door opening or closing, the motor shaft rotation in one direction continues and the arms 48 and 51 move through their full movement to the superposed position for the arms, at which the door is closed.

If the door movement is blocked in either the opening or closing direction, the motor 30 continues to act on the linkage 48, 51 which is now held by the door, against further movement by the motor. Continued motor torque acts on the mounting plate 20 and its posts 21 flex to shift the plate relative to the shaft 42. Shifting of the plate 20 presses the button of either the switch 57 or the switch 58 on the bracket 59 and causes one of those switches to interrupt the motor circuit. If the door is moving in the opening direction when it is obstructed, the other of the switches 57 or 58 is opened to interrupt the motor circuit. All three of the switches 56, 57 and 58 are preferably adjustably mounted so that the closing and opening actions of the door may be made more, or less, sensitive.

In detail, a cycle of operation is as follows when the door is to be partly opened and is then to be blocked and held against further opening for an indefinite length of time:

(a) The person pushes on the door to allow the switch 56 to close (or actuates some other starting switch), to close the motor circuit.

(b) The motor 30 operates in one direction (e.g. clockwise) and moves the linkage into position for door opening, and the door commences opening.

(c) The person now places an obstruction in the path of the door, during opening, to prevent further opening thereof.

(d) The motor 30 remains energized even though its rotor is stopped by the door which is bearing on the obstruction.

(e) The torque of motor 30 reacts on plate 20 and distorts the posts 21 so that the plate shifts parallel to the base 15.

(f) Switch 57 is now opened by pressing against bracket 59 to de-energize the motor.

(g) The distortion of posts 21 tends to reverse drive so that the plate 20 may return to neutral position, thus reclosing switch 57.

(h) If the obstruction is now removed so that the door may continue its opening movement, the plate 20 is returned to neutral position by release of the stress on the posts 21, and the switch 57 is reclosed to re-energize the motor circuit.

(i) Motor rotation recommences and the door is first fully opened. Then the linkage reverses its direction of movement and the door is closed so that the starting switch 56 is reopened.

(j) The motor is de-energized, both switches 57 and 58 are in their normal closed position, and the plate 20 is in its neutral position so that the next closure of switch 56 again begins the above cycle.

(The only difference in the above cycle of actions when the obstruction is placed to stop the door during the door closing portion of the cycle, is that the plate is shifted to open switch 58 and the door closing recommences after the obstruction is removed.)

From the above it will be seen that a known electric motor rotatably driving in only one direction and mounted on a movable plate, produces movement of the plate in a direction dependent on the direction of the door swinging at the time the door reaches an obstruction. During normal operation of the door only the door jamb switch is operated. However, as soon as door movement is blocked, the motor mounting plate moves to open another switch and interrupts the motor circuit. The opened switch remains open until the obstruction is removed whereupon the mounting plate returns to its normal position and the circuit of the motor is re-closed.

I claim:

In a unitary power driven device for moving a door in opening and in closing directions relative to a fixed frame

and in the absence of an obstruction to door movement, a base fixed on the door frame, a plurality of cylindrical resilient bodies, each said body having one end fixed to said base, a plate secured to the respective free ends of said resilient cylindrical bodies for movement laterally in a plane substantially parallel with the base, an electric current supply circuit, a door opening and closing drive comprising an electric motor mounted on the plate and operable in one direction only, the motor reacting on the plate for movement thereof upon obstruction of door movement in either direction, speed reducer means mounted on the plate and driven by the motor, linkage pivotally connecting the speed reducer with the door for successive opening and closing thereof during energization of the motor, switch means for connecting the supply circuit to the motor upon beginning of voluntary opening of the door and for automatically disconnecting the supply circuit to the motor upon closure of the door, and motor control means mounted on the plate for opening the motor supply circuit upon movement of the plate due to motor torque acting on the linkage during obstruction of door movement, said motor control means comprising a pair of switches in series with said electric current supply circuit and provided with opposed actuating means, and an arm extending from said base between said switch actuating means, said switches being normally closed and said actuating means being effective to open said switches upon contact with said arm whereby said electric current supply circuit will be opened upon obstruction of door movement in either direction, the motor control means reclosing the motor supply circuit upon return movement of the plate to initial position following removal of the door obstruction.

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