

[54] **DOOR OPERATING MECHANISM**
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[51] Int. Cl.**E05f 15/20**
[58] Field of Search.....**49/28, 29, 30, 199, 49/200, 360; 318/266, 267, 265**

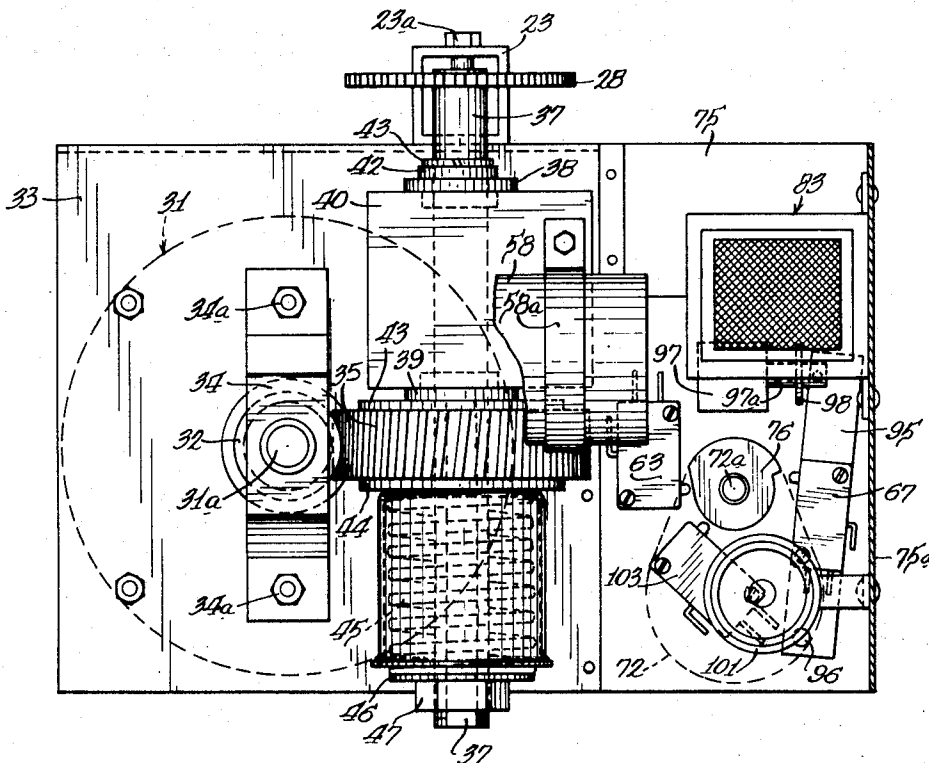
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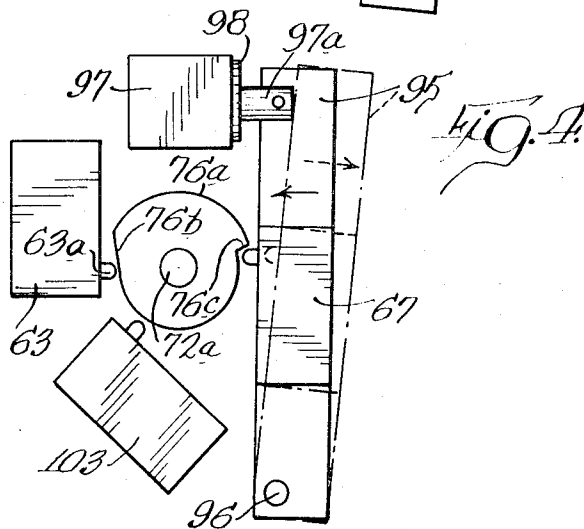
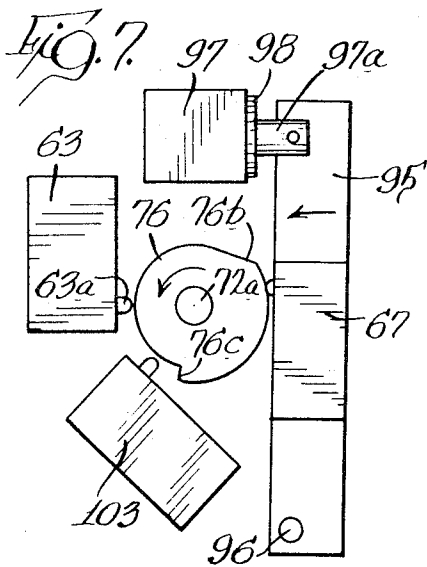
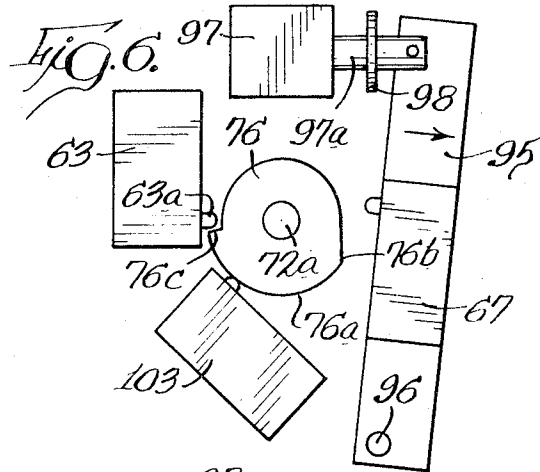
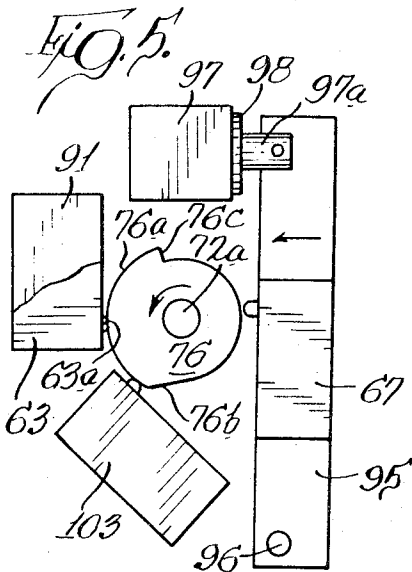
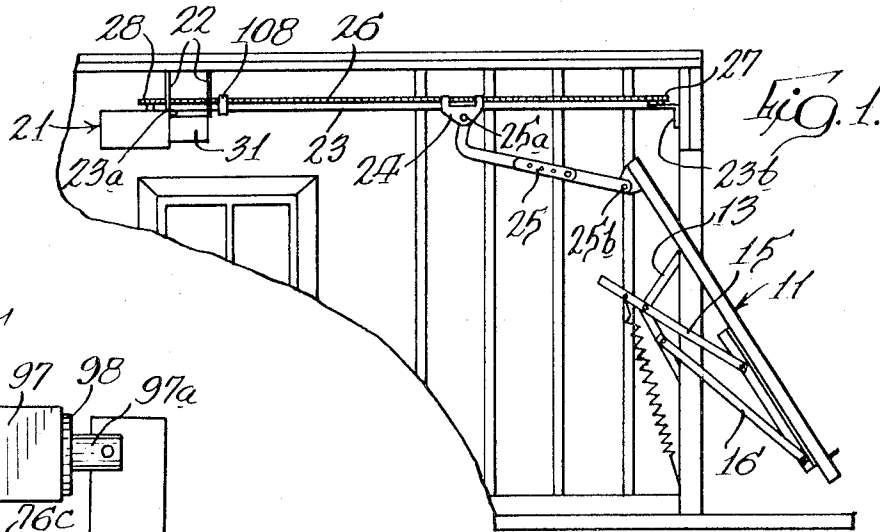
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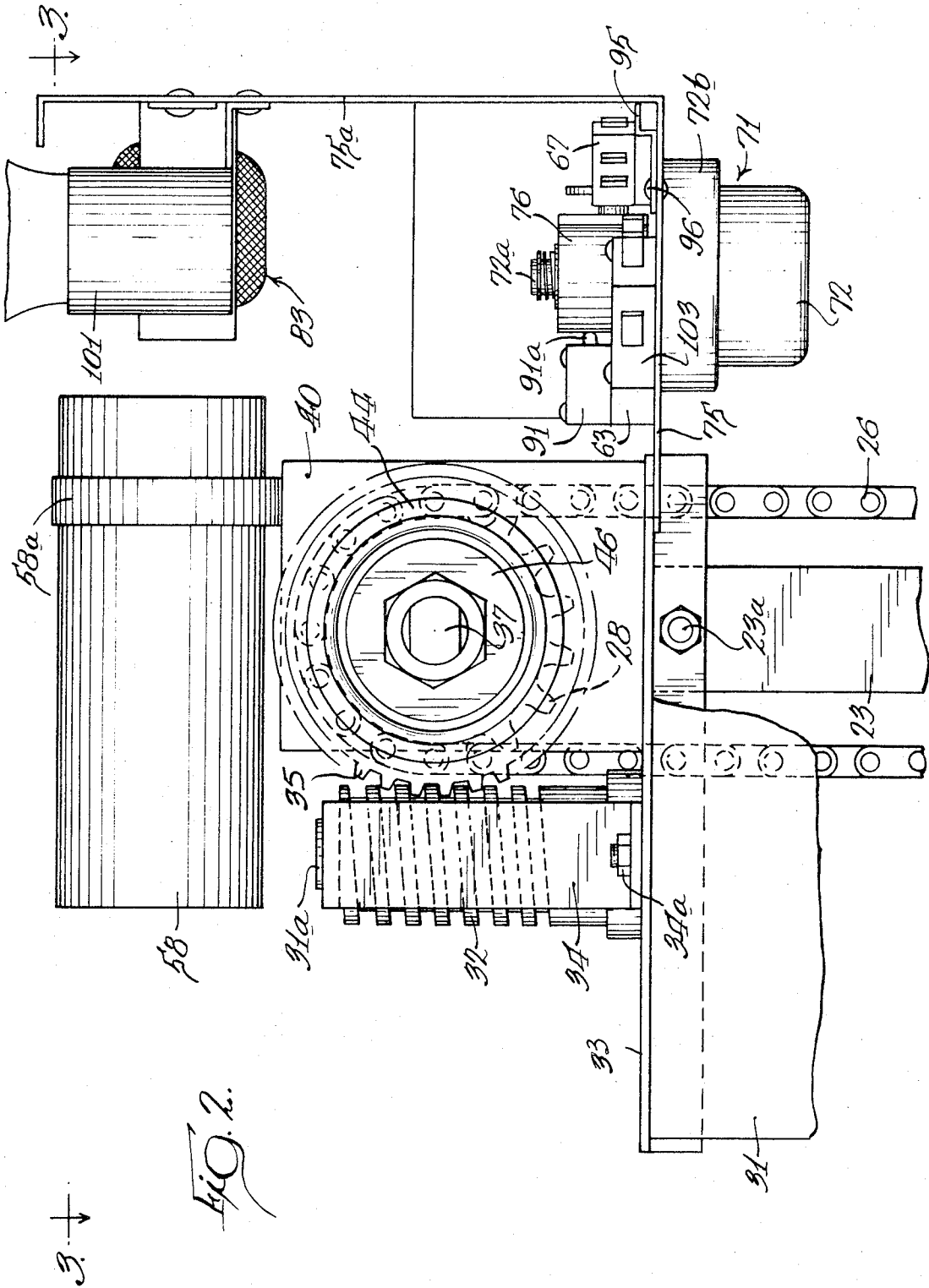
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[57] **ABSTRACT**
This invention relates to a door operating mechanism for moving a door in opening and closing movements in response to actuation of a selectively operable door operating switch. The door operating mechanism has an electric drive motor which is reversibly operated under the control of reverse and forward motor control switches to respectively open and close the door at a selected rate. The door operating mechanism is characterized by the provision of an electric timer, operated under the control of the door operating switch, and a cam mechanism driven by the timer at a speed related to the selected rate of door movement for operating forward and reverse motor control switches to control the mode and duration of door movement.

13 Claims, 8 Drawing Figures







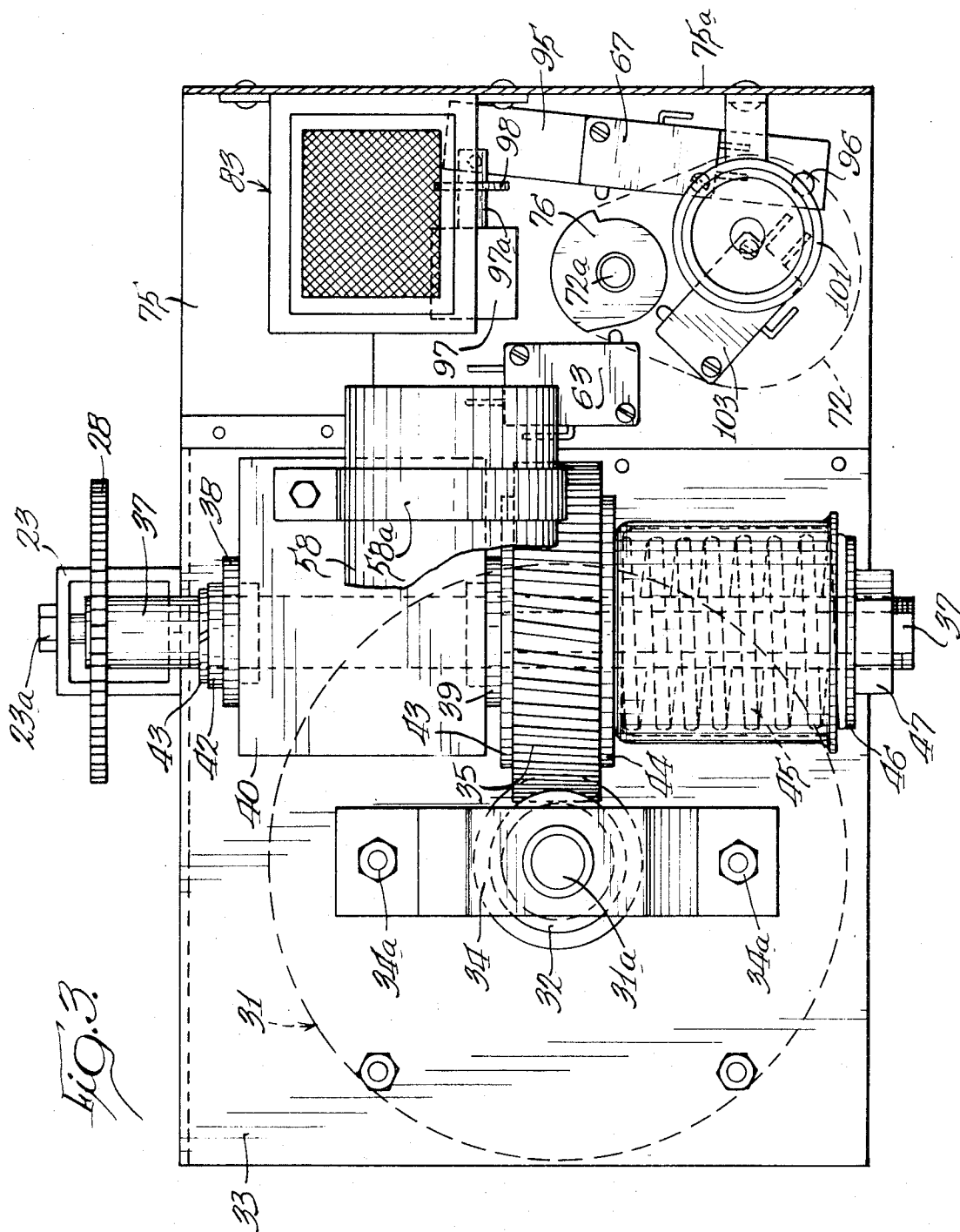
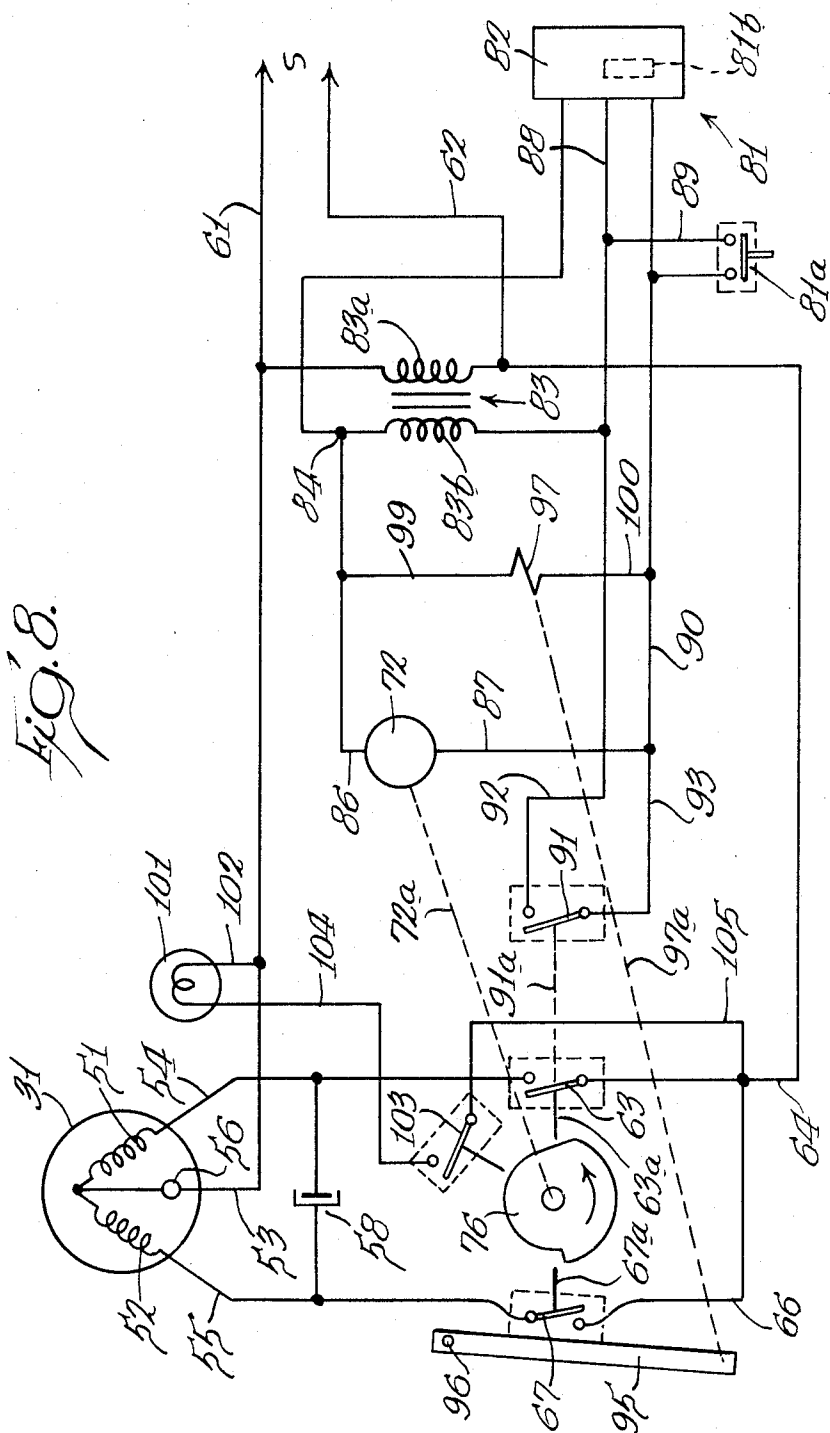


Fig. 8.



DOOR OPERATING MECHANISM

BACKGROUND OF INVENTION

The door operating mechanism of the present invention is generally adapted for use in operating doors such as garage doors as well as industrial and commercial doors. Doors of this type include what is commonly known as overhead sectional track type, one-piece track type, one-piece pivotal or trackless type, or one or two-piece swinging, one-piece sliding, two-piece sliding or bi-parting, and others.

It is common practice in door operating mechanisms to utilize a reversible electric drive motor to effect opening and closing movement of the door. Some prior door operating mechanisms directly sense linear movement of the door by limit switches positioned alongside the path of movement of the door or the door operating trolley, and others sense linear movement of the door by limit switches operated by rotary actuators driven through a speed reducing mechanism from the door drive motor. Many door operating switches, however, whether of the manual pushbutton type or remote radio controlled type, are merely single pole switches which produce a similar signal to initiate either opening or closing movement and it was accordingly necessary in the prior door operating mechanism to provide additional switch mechanism to control the mode of operation in a manner such that actuation of the door operating switch produces opening movement of the door when the door is closed and closing movement of the door when the latter is open.

SUMMARY OF THE INVENTION

The present invention relates to a door operating mechanism of the type having a reversible electric drive motor and mechanism for operatively connecting the drive motor to a door to effect opening and closing movement of the door at a selected rate when the drive motor is respectively rotated in reverse and forward directions. The invention provides a novel mechanism for actuating the forward and reverse switches for the drive motor utilizing an electric timer and a rotary cam mechanism driven by the timer at a speed related to the selected rate of door movement and operative during one portion of the cam cycle to actuate the reverse switch and energize the drive motor in a reverse direction for a time interval sufficient to effect opening movement of the door, and operative during a second portion of the cam cycle to actuate the forward switch and energize the drive motor in forward direction to close the door. The timer is energized under the control of a door operating switch and the timer operated cam mechanism operates to both control of the mode and duration of energization of the drive motor to effect a selected opening movement of the door when the latter is closed and a corresponding closing movement of the door when the door is open. In order to insure proper timing of the opening movement of the door, in the event the door operating switch is deactuated before the door is fully opened, a hold switch mechanism is advantageously provided and arranged for operation by the timer controlled cam mechanism to maintain the timer motor energized during opening movement of the door. In order to allow selective stopping of the door during closing, without loss of timing control, provision is made for interrupting energization of the door drive

motor whenever the door actuator switch is deactuated.

It is the object of the present invention to provide a door operating mechanism having a simple and reliable control for controlling the mode and duration of door operation during its opening and closing movements.

Another object of this invention is to provide a door operating mechanism in accordance with the foregoing object and which enables full door opening movement with only a short duration closing of the door operating switch.

Another object of this invention is to provide a door operating mechanism in which the door can be stopped in any intermediate position during closing by merely deactuating the door operating switch, without loss of timing control.

These, together with other objects and advantages of this invention, will be more readily understood by reference to the following detailed description when taken in connection with the accompanying drawings wherein:

FIG. 1 is a side elevation of a typical installation of a door operator mechanism for opening and closing a door;

FIG. 2 is a top plan view of the door operator mechanism with portions of the housing broken away to illustrate the construction;

FIG. 3 is a rear side view of the door operator mechanism taken on the plane 3—3 of FIG. 2;

FIGS. 4, 5, 6, and 7 are diagrammatic views illustrating the timer operated cam and switch mechanism in different operative positions; and

FIG. 8 is a schematic diagram of an electrical control circuit for the door operator mechanism.

FIG. 1 in the drawings illustrates somewhat diagrammatically a side elevation of a conventional garage door installation with the door operator mechanism of the present invention applied thereto. It will be understood that this is by way of illustration and that the invention may be applied to other garage door installations including overhead sectional type; one-piece track type; one-piece pivotal or trackless type; one or two-piece swinging type; one-piece sliding and two-piece sliding or bi-parting and others. As shown in the drawings, the garage door designated generally by the reference numeral 11 is of the one-piece type mounted by suitable mechanism for movement from a vertically disposed closed position to a horizontally disposed opened position. In the illustrated embodiment, this mounting means includes (usually at each side of the door) a bracket 13 fixed to the door jam 14, linkages 15 and 16 connected to the door 11 and to the bracket 13, and a tension spring 17 connected to the linkage 15 and to the door jam and arranged to counteract with weight of the door and yieldably urge the door toward an open position.

The door operating mechanism 21 is mounted, as by brackets 22, from an overhead support such as a ceiling, and, in the embodiment shown, a track 23 has one end connected at 23a to the door operator mechanism 21 and at its other end connected by a mounting bracket 23b to the wall over the door opening. A trolley 24 is slidable along the track and is connected by a door operating arm 25 to the door. The door operating arm 25 is pivotally connected at its opposite ends 25a and 25b to the trolley and door respectively, and the trolley operates, when moved rearwardly along the

track (toward the left as viewed in FIG. 1), to pull the door toward a generally horizontal open position. Conversely, when the trolley is moved forwardly (to the right as viewed in FIG. 1) it operates to move the door to a generally upright closed position. As is conventional in door operators of this type, a cable, chain or screw is provided for moving the trolley along the track and, in the form shown, the trolley 24 is connected to one run of an endless chain 26 that extends along the track and is entrained over an idler sprocket 27 at the forward end of the track and over a drive sprocket 28 (FIGS. 2 and 3) at the rear end.

Referring now specifically to FIGS. 2 and 3, the door operating mechanism 21 includes a reversible electric drive motor 31 having an output shaft 31a drivingly connected to the drive sprocket 28, through a speed reducing drive mechanism which is preferably arranged to slip under overload to prevent damage to the motor. In the embodiment shown, the motor 31 is mounted on a support plate 33 and the motor shaft 31a extends through the support plate and has its outboard end supported in a bearing bracket 34 secured to the support plate as by fasteners 34a. A worm gear 32 is nonrotatably mounted on the motor shaft 31a and meshes with a worm wheel 35 which is rotatably supported on an upright drive shaft 37. Shaft 37 is rotatably supported in combined radial and thrust bearings 38 and 39 in the upper and lower legs of a generally U-shaped bracket 40 secured to the mounting plate 33, and downward movement of the shaft 37 is limited by a thrust collar 42 and a split ring 43 disposed in a groove in the shaft. The trolley drive sprocket 28 is nonrotatably secured to the upper end of the shaft for rotation therewith. A slip clutch mechanism is provided for drivingly connecting the worm wheel 33 to the shaft 37, so as to normally drive the shaft 37 at a speed and in a direction correlative with the speed and direction of rotation of the screw 32 on the electric drive motor 31. The slip clutch can be of any suitable construction and, in the embodiment shown, comprises opposed clutch plates 43 and 44 disposed at opposite sides of the worm wheel 33 and in frictional engagement with suitable clutch faces on opposite sides of the worm wheel. The clutch plates 43 and 44 are slidably and nonrotatably keyed to the shaft 37 and the plates are yieldably urged into frictional engagement with the clutch faces at opposite sides of the worm wheel by a spring 45 interposed between one of the clutch plates 44 and a thrust washer 46 which is adjustably positioned by a nut 47 threaded on the shaft. As will be seen, adjusting the nut 47 along the shaft toward the worm wheel increases the spring pressure supplied to the clutch plates 43, 44 to control slippage between the worm wheel 33 and the shaft. In practice, the nut is adjusted so as to normally prevent slippage between the worm wheel and the shaft and is arranged to slip only when the door strikes an obstruction or otherwise encounters excessive resistance to movement in either direction.

The electric drive motor 31 is of the reversible type and is preferably a single-phase permanent-split-capacitor type induction motor diagrammatically shown in FIG. 8 and having first and second field windings 51 and 52 with a first or common lead 53 connected to one end of each of the windings 51 and 52, and second and third motor leads 54 and 55 connected to the other ends of each of the windings 51 and 52. A motor overload protector 56 can be provided in the

common lead 53 and a motor phase shifting capacitor 58 is connected to the second and third motor leads 54 and 55. As shown in FIGS. 2 and 3, the capacitor 58 is conveniently mounted by a bracket 58a on the shaft mounting bracket 40.

The door operating unit 22 is connected to a source of electrical power such as the usual 115 volt AC household power supply indicated at S in FIG. 8 through conductors 61 and 62. The common motor lead 53 is connected to one of the power supply conductors 61 and the second motor lead 54 is connected through a normally open switch 63 and conductor 64 to the other power supply conductor 62, to energize the motor in a reverse direction when the switch 63 is closed. The third motor lead 55 is connected through normally open switch 67 and conductors 66, 64 to the power supply conductor 62, so as to energize the motor in a reverse direction when the switch 67 is closed. As will be seen from FIG. 8, when the switch 63 is closed, power is supplied directly through one motor lead 54 to motor winding 51 and through the phase shifting capacitor 58 and motor lead 55 to the other winding 52 to cause rotation of the motor in one direction, herein referred to as the reverse direction, to move the trolley 24 rearwardly for opening the door. Conversely, when the other switch 67 is closed, power is supplied through conductors 64, 66 and motor lead 55 directly to the motor winding 52, and through phase shifting capacitor 58 and motor lead 54 to the other motor winding 51, to drive the motor in the other or forward direction to move the trolley 24 forwardly to close the door. In accordance with the present invention, the sequence and duration of operation of the reverse and forward switches 63 and 67 is controlled by a timer controlled cam mechanism designated generally by the number 71.

The timer controlled cam mechanism 71 includes a unidirectional electric timer motor 72 of the synchronous type which is operative, when energized, to rotate its output shaft 72a through a built-in speed reducing mechanism 72b at a low speed related to the selected rate of door movement by the drive motor 31 and such that the output shaft 72a will be rotated through one-half revolution in a time interval slightly greater than the time interval required for the drive motor 31 to move the door from its closed to a selected open position. The timer motor 72 and speed reducing mechanism 72b can be mounted in any suitable manner and as shown in FIGS. 2 and 3, the timer motor is secured to a housing wall 75 attached to the motor support plate 33. A cam 76 is nonrotatably secured to the timer motor shaft for rotation therewith, and the switches 63 and 67 are mounted at locations to be actuated by the cam 76. The switches 63 and 67 are preferably arranged so that the cam 76 alternately actuates the switches 63 and 67 and for this purpose the switches 63 and 67 are positioned angularly with respect to the cam 76 so that the actuators 63a and 67a are angularly spaced apart around the cam 180° from each other. In other words, the switches 63 and 67 are positioned so that the actuators 63a and 67a are located in diametrically opposite sides of the cam. Cam 76 is arranged to be rotated in the direction indicated by the arrows in FIGS. 4-8 and has a raised cam portion 76a extending through somewhat less than 180° of the cam periphery to provide a delay interval between actuation of the switches 63 and 67. A rise portion 76b is provided at

the lead end of the cam portion 76a to effect smooth actuation of the switches, and a fall portion 76c is provided at the trail end of the cam portion shaped to effect rapid opening of the switches. As previously mentioned, the timer motor is selected to drive the cam at a speed related to the rate of movement of the door by the drive motor 31 and such that the cam portion maintains the reverse and forward switches 63 and 67 respectively actuated for a time interval sufficient to allow the drive motor to effect a preselected opening and closing movement of the door. For example, if the drive motor, operating through the speed reducing gearing and drive mechanism previously described is arranged to effect opening movement of the door in a time interval of about 14 seconds, then the timer motor is selected so as to complete one revolution in a time interval somewhat greater than twice the time required for opening the door, viz. about 36 seconds, to provide 14 seconds for opening and 14 seconds for closing and a delay interval of about 4 seconds between actuation of the switches 63 and 67. It is understood of course that this delay interval between actuations can be varied somewhat from time described and that the speed of operation of the door can also be varied to provide a desired rate of door movement. With the above-described times, the cam portion 76a is selected to have an accurate extent between 150° - 160°.

The timer motor 72 is selectively energized under the control of a door operating switch mechanism 81. Door operating switches are commonly of the same single-pole type and frequently include a manually operable, normally open switch 81a which can be operated by a push-button or a key, and a normally open remotely operated switch 81b commonly operated to its closed position by a radio controlled operator 82. The door operating switch mechanism is arranged so that the timer motor 72 is energized whenever the manually operated switch 81a or remote operated switch 81b is closed and, preferably, the timer is arranged to operate at a low voltage for example at 24 volts so as to simplify wiring. For this purpose, a step-down transformer 83 is provided and has its primary 83a connected across power supply conductors 61, 62 and its secondary connected to provide low voltage power at terminals 84, 85. As shown in FIGS. 2 and 3, the transformer 83 is conveniently mounted on a housing wall 75a. As diagrammatically illustrated in FIG. 8, the timer motor has one lead 86 connected to one of the low voltage terminals 84. The door operating switches 81a and 81b are connected by conductors 88 and 89 to the other low voltage terminal 85 and are operative, when either switch 81a or 81b is actuated to its closed position, to apply power through conductor 90 and timer motor lead 87, to the timer motor to energize the same. Thus, the door operating switches 81a and 81b are connected electrically in parallel with each other so that closing of either one of the door operating switches 81a or 81b starts energization of the timer motor 72. In order to assure continued energization of the timer motor during opening of the door, a hold switch 91 is provided and arranged for operation by a cam 76. Hold switch 91 is of the normally open single-pole type and is connected electrically in parallel with door operating switches 81a and 81b by conductors 92 and 93 to supply power to the timer motor and maintain the timer motor energized when the hold switch 91 is closed. Hold switch 91 is advantageously mounted alongside

the reverse operating switch 63 for the drive motor as shown in FIG. 2 and has its actuator 91a positioned so as to be closed whenever the cam portion 76a operates the switch 63 to its closed position. Thus, in order to open the door, it is only necessary to close the door operating switch for a short time interval sufficient to energize the timer motor and cause the cam portion 76a to close the forward switch 63 and the hold switch 91. Hold switch 91 remains closed as the cam rotates until the cam portion 76a moves past the actuator 91a to allow switches 63, 91 to open. In order to assure that the timer motor is energized whenever the reverse switch 63a is closed to energize the drive motor in its reverse or door opening direction, provision is preferably made to effect actuation of hold switch 91 to its closed position slightly before switch 63 is closed by cam portion 76a and to maintain switch 91 closed until slightly after switch 63 is opened by cam portion 76a. This can be easily achieved by shaping the cam 76 so that the cam portion that engages actuator 91a has a slightly greater arcuate extent than the cam portion that engages actuator 63a.

During closing movement of the door it is desirable to be able to stop the door in any intermediate or partially closed position, in the event the person operating the door notes the presence of an individual or some obstruction in the path of movement of the door. In order to enable selective stopping of the door in any intermediate position during closing of the same, provision is made for interrupting energization of the drive motor in its reverse direction, whenever the door operating switches 81a, 81b are deactuated. In the preferred embodiment illustrated, this is effected by mounting the forward motor operating switch 67 for shifting movement relative to the cam 76 into and out of an operative position. As best shown in FIGS. 5-7, the switch 67 is mounted on a lever 95 which is pivotally supported at one end by a pin 96 on the housing wall 75, to enable movement of the switch 67 in a direction generally radially of the cam 76. The lever 95 is yieldably urged to a retracted position to move the switch 67 to an inoperative position shown in phantom in FIG. 4 in which its actuator 67a is out of the path of travel of the cam, and an electroresponsive operator has its solenoid 97 mounted on the housing wall 75 and its plunger 97a operatively connected to the lever 95 to move the switch 67 to an operative position shown in solid lines in FIG. 4 with its actuator 67a in the path of movement of the cam when the solenoid 97 is energized. The lever 67 can conveniently be urged to its inoperative position by a spring (not shown) located in the solenoid 97 and a stop 98 conveniently located on the cam plunger 97a, is provided to limit movement of the lever 95 to its operative position. As shown in FIG. 8, the solenoid 97 is connected electrically in parallel with the timer motor 72 as by conductors 99, 100 so that the solenoid is energized whenever the door operating mechanism 81 is closed and deenergized when the door operating switch mechanism is opened. Thus, if the cam 76 has moved to a position such that the cam portion can actuate switch 67 to close the door, then the switch 67 will be automatically moved to an inoperative position to stop the drive motor 31 whenever the door operating switches 81a, 81b are opened.

It is frequently desirable to provide some auxiliary equipment such as lights and warning devices which may be operated at different times during the door

opening and closing cycle. In the embodiment illustrated, a lamp 101 is provided for illuminating the area serviced by the door and is connected through conductor 102 to one of the power supply conductors 61 and through conductor 104, normally open lamp switch 103 and conductors 105 and 64 to the other power supply conductor 62 so that the lamp is energized when the lamp switch 103 is closed. The lamp switch 103 can be conveniently operated by the timer controlled cam 76 and, as shown, is mounted on the housing wall 75 at a location angularly intermediate switches 63 and 67 so as to be actuated by the cam portion 76a after the cam portion operates the switch 63 and while the door is in its open position.

OPERATION

From the foregoing it is thought that the construction and operation of the door operating mechanism will be readily understood. Assuming that the door is in its fully closed position and that the drive motor is arranged so that, when energized in its reverse direction in response to closing of the switch 63, it will move the door to a selected open position in a predetermined time interval, and further that the timer controlled cam is in the position shown in FIG. 4. When either of the door operating switches 81a or 81b is closed, they complete a circuit to the timer motor 72 to energize the same and start rotation of the cam 76. After a short timed interval, for example 3 or 4 seconds, the cam portion 76a engages switch actuator 63a to close switch 63 and energize the drive motor 31 in its reverse direction as shown in FIG. 5. The cam portion 76a also operates to close the holding switch 91 to maintain the timer motor 72 energized. The door operating switches 81a or 81b can then be opened and the timer motor will continue to rotate the cam through approximately one-half revolution in a time interval for example 14 seconds, sufficient to allow the drive motor 31 to open the door to a selected open position. At the end of the first half revolution of the cam 76, the cam portion 76a moves out of engagement with the actuator 63 to allow the reverse switch 63 to open and stop the drive motor and, shortly thereafter, the cam portion 76a allows the hold switch 91 to open and stop the timer motor in the position shown in FIG. 6. The door will then remain in its open position until one of the door operating switches 81a or 81b is again actuated to a closed position. At that time, the timer motor is again energized and the solenoid 97 is also energized to move the forward switch 67 to its operative position as shown in FIG. 7. Thus, as the cam rotates it actuates the switch 67 to its closed position to energize the drive motor in a reverse direction to close the door. The timer motor 72 will remain energized so long as one of the door operating switches 81a, 81b is actuated and, if one of the door operating switches is held in its actuated position until the door is closed, the cam portion 76a will move past the actuator 67a as shown in FIG. 7, and allow the drive motor to stop when the door reaches its closed position. However, if the person actuating the door operator switch notes any obstruction in the path of the door, he can merely open the door actuator switch. This will deenergize the timer motor 72 and will also deenergize the solenoid 97 so as to move the forward switch to its inoperative position to deenergize the drive motor 31 and prevent further closing of the door. When the obstruction is removed, the door actuating

switch can be actuated to again energize the timer motor for the remainder of that half cycle. Simultaneously, solenoid 97 will move the forward switch 67 back to its operative position so that the cam portion 76a again actuates switch 67 to energize the drive motor in its reverse direction to complete closing of the door. Thus, the door can be stopped in any intermediate closed position, without effecting the timing of the operations. A stop 108 is preferably provided along the trackway to limit opening movement of the door to the desired level. Preferably, the stop 108 is positioned so as to engage the trolley 24 when the door operating mechanism has moved the door to its selected opened position and then stopped. If the movement of the door during the time interval controlled by the cam 76 exceeds that required to move the door to a position in which the trolley engages the stop 108, then the clutch mechanism previously described can slip sufficient to allow limited over travel of the drive motor. Conversely, if the door reaches its fully closed position or strikes an obstruction without deactuation of the door operating switches 81a and 81b, the afordescribed clutch mechanism can again slip to prevent damage to the door.

Although a specific embodiment of the invention has been herein illustrated and described, it will be understood that changes and variations may be made in the construction without departing from the spirit and scope of the invention as expressed in the appended claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A door operating mechanism comprising: a reversible electric drive motor and means for operatively connecting the drive motor to a door to effect opening and closing movement of the door at a selected rate when the drive motor is respectively rotated in reverse and forward directions, a first switch means operable when actuated to energize said drive motor in said reverse direction and a second switch means operable when actuated to energize said drive motor in said forward direction, a unidirectional electric timer motor, rotary cam means driven by said timer motor through an operating cycle at a speed related to said selected rate of door movement and operative during a first portion of the cam cycle to actuate said first switch means to energize the drive motor in said reverse direction and maintain said first switch means actuated for a preselected time interval sufficient to effect opening of the door and then deactuate said first switch means to stop opening movement of the door, the cam means being operative during a second portion of the cam cycle to actuate said second switch means to energize said drive motor in said forward direction and maintain said second switch means energized for said preselected time interval to effect closing of the door and then deactuate said second switch means to stop closing movement of the door, and timer control means including door operating switch means operative when actuated, to energize said timer motor to rotate the cam means.

2. A door operating mechanism according to claim 1 wherein said timer control means includes a hold switch means operative when actuated to energize said timer motor, said cam means including means operative during said first portion of said operating cycle to actuate said hold switch means to continue energiza-

tion of the timer motor until said cam means deactuates said first switch means.

3. A door operating mechanism according to claim 2 including electroresponsive means operated under the control of said door operating switch means for interrupting energization of said drive motor in said forward direction whenever said door operating switch means is deactuated.

4. A door operating mechanism according to claim 2 wherein said second switch means is mounted for movement into and out of an operative position in the path of travel of said cam means, and means responsive to actuation of said door operating switch means for moving said second switch means to its operative position and responsive to deactuation of said door operating switch means to move the second switch means out of its operative position to thereby interrupt closing movement of the door whenever the door operating switch means is deactuated.

5. A door operating mechanism according to claim 1 wherein said second switch means is mounted for movement into and out of an operative position in the path of travel of said cam means, and means responsive to actuation of said door operating switch means for moving said second switch means to its operative position and responsive to deactuation of said door operating switch means to move the second switch means out of its operative position to thereby interrupt closing movement of the door whenever the door operating switch means is deactuated.

6. A door operating mechanism according to claim 1 including lamp control switch means operated by said cam means for energizing a lamp when the door is open.

7. A door operating mechanism comprising: a reversible electric drive motor and means for operatively connecting the drive motor to a door to effect opening and closing movement of the door at a selected rate when the motor is respectively rotated in reverse and forward directions, a rotary cam having a cam portion along its periphery, a first switch means having an actuator positioned at a first location in the path of travel of said cam portion and operative when actuated by the cam portion to energize the drive motor in said reverse direction, a second switch means having an actuator positioned at a second location in the path of travel of the cam portion and operative when actuated to energize said drive motor in said forward direction, said second location being approximately 180° with respect to said cam means from said first location whereby said cam means actuates said first and second switch means during alternate half revolutions of said cam means and said cam portion having an arcuate extent sufficiently less than 180° to provide a delay interval between actuations of said first and second switch means, a unidirectional electric timer motor operable when energized to rotate said cam means at a speed related to said pre-

lected rate of door movement such that said cam portion actuates said first and second switches for a time interval sufficient to effect opening and closing movement of a door, and timer control means including door operating switch means operative when actuated to energize the timer motor to rotate said cam means.

8. A door operating mechanism according to claim 7 wherein said timer control means includes a hold switch means operative when actuated to energize said timer motor, said cam means including means for actuating said hold switch means while said cam portion engages the actuator of the first switch means to maintain the timer motor energized until said cam portion deactuates said first switch means.

9. A door operating mechanism according to claim 7 including electroresponsive means operated by said door operating switch means for interrupting energization of said drive motor in said forward direction whenever said door operating switch means is deactuated.

10. A door operating mechanism according to claim 8 wherein said second switch means is mounted for movement into and out of an operative position in the path of travel of said cam means, and means responsive to actuation of said door operating switch means for moving said second switch means to its operative position and responsive to deactuation of said door operating switch means to move the second switch means out of its operative position to thereby interrupt closing movement of the door whenever the door operating switch means is deactuated.

11. A door operating mechanism according to claim 7 wherein said second switch means is mounted for movement into and out of an operative position in the path of travel of said cam means, and means responsive to actuation of said door operating switch means for moving said second switch means to its operative position and responsive to deactuation of said door operating switch means to move the second switch means out of its operative position to thereby interrupt closing movement of the door whenever the door operating switch means is deactuated.

12. A door operating mechanism according to claim 7 wherein said drive motor comprises a permanent-split-capacitor type motor having first and second motor windings and a motor capacitor connected to one end of each winding, said first and second switch means comprising first and second normally open single-pole switches respectively connected in series with said first and second motor windings and a source of power.

13. A door operating mechanism according to claim 7 including lamp control switch means having an actuator positioned in the path of travel of said cam means at a third location intermediate said first and second locations to be actuated when said cam means is stopped with the door in its open position.

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