

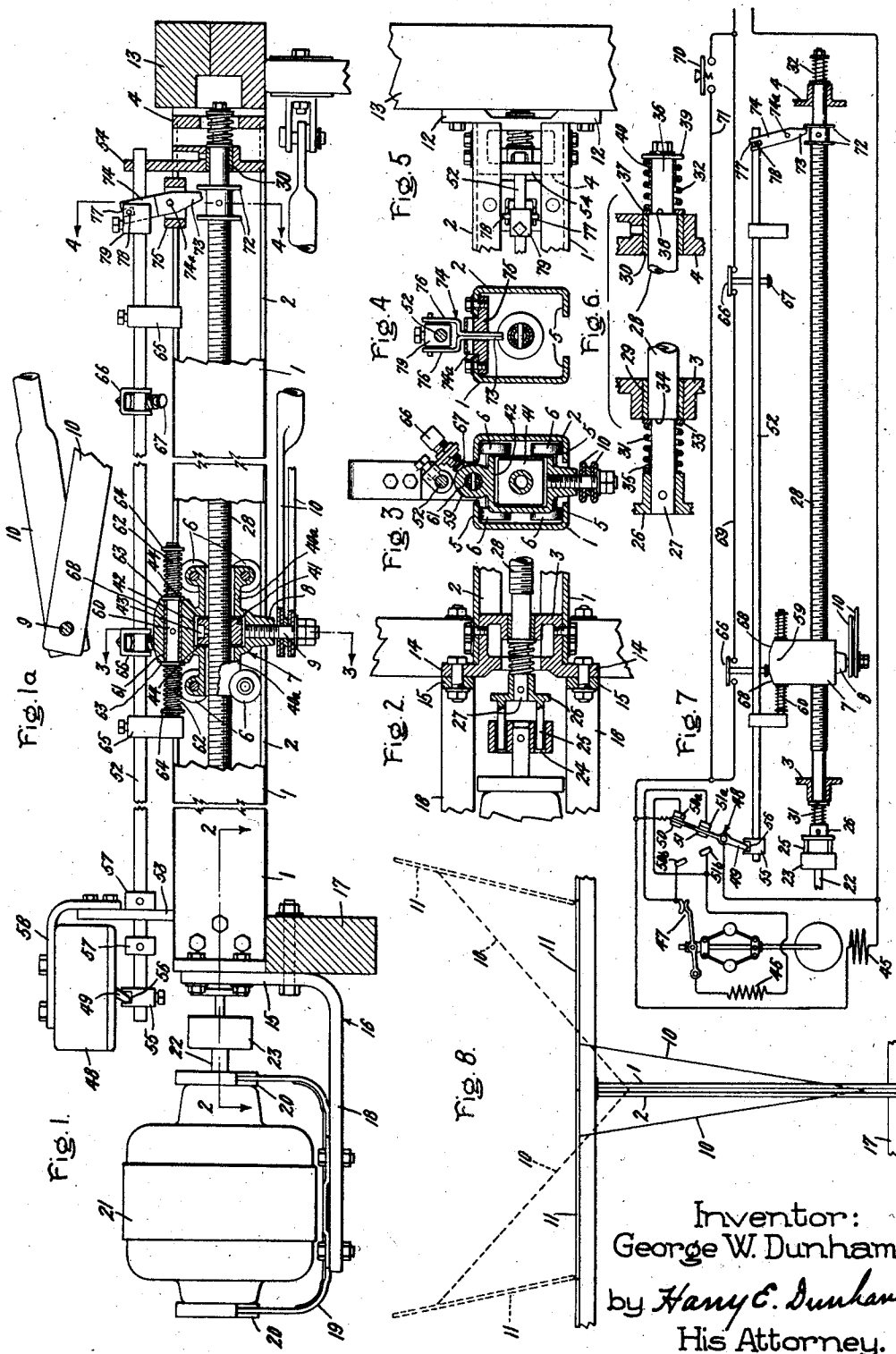
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DOOR OPERATING MECHANISM

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DOOR OPERATING MECHANISM

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The present invention relates to door operating mechanism for opening and closing garage doors and the like.

The object of my invention is to provide an improved construction and arrangement in door operating mechanism and for a consideration of what I believe to be novel and my invention attention is directed to the following description and the claims appended thereto.

In the accompanying drawing, Fig. 1 is a side elevation, partly broken away, of a door operating mechanism embodying my invention; Fig. 1a is a fragmentary bottom plan view of the links connecting the door operating mechanism to the doors; Fig. 2 is a sectional view taken on line 2-2 of Fig. 1; Fig. 3 is a sectional view taken on line 3-3 of Fig. 1; Fig. 4 is a sectional view taken on line 4-4 of Fig. 1; Fig. 5 is a top plan view of the front end of the door operating mechanism; Fig. 6 is a sectional view of the ends of the drive screw and of the supports therefor; Fig. 7 is a control diagram; and Fig. 8 is a diagrammatic view showing the application of the door operating mechanism to garage doors.

Referring to the drawing, the door operating mechanism comprises a track consisting of opposed channels 1 and 2 secured at each end to opposite sides of frames 3 and 4. The flanges 5 of the channels extend inwardly from the sides thereof and provide tracks for rollers 6 on a carriage 7. The underside of the carriage is provided with a boss 8 projecting between the lower flanges 5 and having a stud 9 fixed therein pivotally connected to links 10. As shown in Fig. 8, the other ends of the links 10 are connected to doors 11. With this construction it is apparent that the doors will be opened and closed as the carriage is moved back and forth.

The frame 4 at the front of the door operating mechanism is provided with flanges 12 which are bolted to the top door frame 13. The frame 3 at the rear of the door operating mechanism is provided with flanges 14 which are bolted to the upwardly extending arms 15 of angle shaped supports 16. The supports 16 are bolted to a cross frame member 17 of the garage. On the horizontal arms 18 of the supports 16 is secured a U-shaped base 19, to the upper edges of which are clamped rubber rings 20 supporting a reversible single phase induction motor 21. Pinned to the motor shaft 22 is a coupling member 23 having longitudinally extending openings 24 therein slidably receiving prongs 25 on a complementary coupling member 26 pinned to the reduced end 27 of a drive screw 28. As shown more clearly

in Fig. 6, the drive screw is journaled at opposite ends in bearings 29 and 30 respectively carried in the frames 3 and 4. The drive screw is slidable endwise through the bearings, the endwise movement being resisted by springs 31 and 32. The spring 31 is arranged around the reduced end 27 of the drive screw and between the inner edge of the coupling member 26 and a washer 33 bearing against a shoulder 34 on the drive screw. A sleeve 35 is arranged between the spring and the drive screw adjacent the coupling member 26. The spring 31 is confined between the washer 33 and the coupling head and maintained in a pre-stressed condition. It is effective to resist movement of the drive screw to the right as viewed in Fig. 6 under an end thrust greater than the initial stress of the spring 31. The spring 32 is of similar construction to the spring 31 and is arranged around the reduced end 36 of the drive screw and between a washer 37 bearing against a shoulder 38 and a washer 39 secured to the end of the drive screw. A sleeve 40 similar to the sleeve 35 is arranged between the spring 32 and the drive screw. The spring 32 is maintained in a pre-stressed or preloaded condition between the washers 37 and 39 and is effective to resist endwise movement of the drive screw to the left, as viewed in Fig. 6, up to the amount of preloading of the spring. Since the springs 31 and 32 are confined, each spring acts independently.

The drive screw 28 extends through sleeves 40a integral with the carriage 7 and cooperates with a nut 41 which non-rotatably fits in a square recess 42 in the carriage intermediate the sleeves 40a. As shown in Fig. 3, the recess 42 is open on one side so that the nut 41 may be inserted therein, the drive screw being threaded through the nut after its insertion in the recess. The upper side of the nut is provided with a recess 43 for receiving grease. As the drive screw 28 is rotated the carriage 7 is moved along the drive screw by the nut 41 which engages opposite end walls 44 of the recess 42 during opposite directions of movement of the carriage.

The electric motor 21 is a reversible single phase motor having a main winding 45 and a starting winding 46 controlled by a centrifugal switch 47 operated by the motor shaft 22. At starting, the switch 47 is closed, connecting the starting winding 46 to the motor terminals. Upon reaching a predetermined speed the circuit to the starting winding is opened by the centrifugal switch 47. The direction of rotation of the motor is controlled by a reversing switch 48 hav-

ing a pivoted operating member 49 carrying contacts 50 and 51 which are movable to positions engaging contacts 50a and 51a and 50b and 51b respectively. When the contacts 50 and 51 engage the contacts 50a and 51a as shown in Fig. 7, the starting winding 46 is connected to the motor terminals in the position causing the drive screw to rotate in the direction to move the carriage 7 to the right as viewed in Fig. 7. When the contacts 50 and 51 engage the contacts 50b and 51b respectively, the starting winding is connected to the motor terminals in the direction to cause opposite rotation of the drive screw 28. It should be noted that the reversing switch 48 is connected in series with the centrifugal switch 47 and that, accordingly, the reversing of the connections to the starting winding 46 is effective to reverse the direction of rotation of the motor only when the motor speed is low enough so that the centrifugal switch 47 is closed. This means that if the switch 48 is reversed while the centrifugal switch 47 is open, no current will flow through the switch 48.

The motor reversing switch 48 is controlled by a rod 52 slidably carried in ears 53 and 54 extending upward from the frames 3 and 4 respectively. Adjustably fastened to the rod 52 is a block 55 having a recess 56 receiving one end of the operating lever 49 of the reversing switch. Upon reciprocation of the rod 52 the reversing switch operating lever 49 will be moved to reverse the connections to the motor starting winding 46. The movement of the rod 52 is limited by stops 57 fixed to the rod and arranged on opposite sides of the ear 53. The reversing switch 48 is supported by a bracket 58 fixed to the upper end of the ear 53. Since the control rod 52 and the reversing switch are mounted on the frame the parts can be assembled and adjusted at the factory. On the upper side of the carriage 7 is a boss 59 which projects between the upper flanges of the channels 1 and 2. In the boss 59 is a rod 60 which is pinned to a bearing 61 slidable in the boss. The rod 60 is maintained in a central position by coil springs 62 arranged between washers 63 at each end of the boss and washers 64 fastened to each end of the rod. The ends of the rod 60 cooperate with stops 65 adjustably fixed to the rod 52. At each end of the travel of the carriage 7 the rod 60 engages one of the stops 65 and shifts the rod 52 endwise to reverse the switch 48. The springs 62 provide a yielding connection between the rod 60 and the carriage, preventing damage due to overtravel of the carriage. Also adjustably fixed on the rod 52 are normally closed limit switches 66. Each of the switches has an operating member 67 which cooperates with the boss 59 to open the switch. As shown in Fig. 7, the boss 59 is provided with inclined surfaces 68 at each end so that the switches 66 are gradually opened. The switches 66 are connected in series with one of the line conductors 69 supplying the motor. When either of the switches 66 is opened the motor is accordingly deenergized. The motor may be started while one of the switches 66 is opened by means of a push button switch 70 arranged in a conductor 71 connected across the switches 66. The push button 70 is biased to an open position. It need be held in the closed position only until the boss 59 on the carriage has moved from under one of the limit switches 66. After this the circuit to the motor is closed through the limit switches and the push button may be released.

The control rod 52 is also shifted to reverse the switch 48 by endwise movement of the drive screw 28. Such endwise movement occurs when the end thrust on the drive screw, due to the resistance offered to movement of the carriage, is greater than the initial stress in one of the springs 31 or 32. The drive screw has spaced flanges 72 between which fits the lower end 73 of a lever 74 pivoted on a pin 74a in a plate 75 fixed to the flanges 5 of the channel members 1 and 2. The lever 74 is provided with forked arms 76 at the upper end having notches 77 therein cooperating with a pin 78 fixed in a block 79 secured to the rod 52. Upon pivotal movement of the lever 74 about the pin 74a the rod 52 will accordingly be shifted endwise to reverse the switch 48.

When the door is in the closed position the parts occupy the positions shown in Figs. 1 and 7. To open the door the push button 70 is pressed, closing the circuit through the conductor 71, short-circuiting the limit switches 66, and energizing the motor 21. The motor starts to rotate in the direction causing the carriage 7 to be shifted to the right, as viewed in Figs. 6 and 7. As soon as the boss 59 on the carriage moves from under the adjacent limit switch 66 the switch closes and establishes a circuit to the motor independent of the push button 70. The push button may therefore be released. The starting winding 46 remains in the circuit until the motor speed reaches the value for which the centrifugal switch 47 is set to open. At this speed the switch 47 opens, cutting out the starting winding 46. Under normal conditions the rotation of the motor continues until the carriage 7 is moved under the limit switch 66 at the front of the frame. Upon reaching this position the boss 59 on the carriage lifts the operating member 67 of the switch to open the motor circuit and deenergize the motor. Upon deenergization of the motor it coasts to a stop in a few revolutions. This additional rotation of the motor causes a slight overtravel of the carriage, which causes the doors to be moved firmly to the open position. The spring 32 limits the strain on the drive screw by permitting the drive screw to move to the left, as viewed in Fig. 1.

Slightly before the opening of the limit switch 66 to deenergize the motor the right-hand end of the rod 60 engages the stop 65 and shifts the rod 52 to the right, as viewed in Fig. 7, moving the reversing switch 48 to the position in which the contacts 50 and 51 engage the contacts 50b and 51b. This connects the starting winding in the direction for reverse rotation of the motor. Since the switch 48 is shifted while the motor is running at its normal speed, the centrifugal switch 47 is open and there is accordingly no current flowing through the switch 48. The motor is not reversed; it is merely conditioned for operation in the reverse direction.

With this arrangement it is obvious that upon starting the motor the door is moved from the closed to the open position and automatically stopped. At the same time the motor is conditioned for operation in the reverse direction to close the door upon subsequent operation of the push button 70. The same sequence of operations takes place when the mechanism is operated to shut the door.

Under some circumstances the doors may strike an obstruction intermediate the opened and closed positions. Under this condition it is obviously inadvisable that the motor continue the

movement of the door. In the present construction this is prevented by the endwise movement of the drive screw permitted by the springs 31 and 32. If the motor is turning in the direction causing the carriage 7 to move to the right, as viewed in Fig. 1, the end thrust on the drive screw 28 is to the left. Under normal conditions this end thrust is less than the initial stress in the spring 32, and the drive screw 28 accordingly remains in its central position. Upon encountering an obstruction the resistance offered to further movement of the doors increases, and accordingly the end thrust on the drive screw 28 increases. This causes the drive screw to move to the left, as viewed in Fig. 1, and the flanges 72 on the drive screw cooperate with the lever 74 to move the rod 52 to the right. This shifts the reversing switch from the position shown in Fig. 7 to the position in which the contacts 50 and 51 engage the contacts 50b and 51b. The endwise movement of the drive screw under the increased end thrust takes place while the motor is still running at a speed sufficient to keep the centrifugal switch open. There is accordingly no current flowing through the reversing switch when it is shifted. Due to the obstruction encountered by the doors the motor speed finally decreases to a point at which the centrifugal switch 47 closes. Since the starting winding 46 is now connected for reverse direction of rotation the motor immediately reverses and causes the carriage 7 to return the doors to the closed position. Upon reaching the closed position the motor circuit is opened and the reversing switch 48 is moved to a position conditioning the motor for rotation in the direction to open the doors. In other words, upon encountering an obstruction the door is returned to the position from which it started and the motor control is conditioned to move the door in the proper direction upon operation of the push button 70.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In combination, a screw adapted to be ro-

tated by a reversible single-phase induction motor of the type having a control for opening its starting circuit upon reaching a predetermined speed, a drive nut on the screw, spring means for resisting the end thrust of the screw and permitting endwise movement of the screw under the end thrust, a reversing switch in the starting circuit for controlling the direction of rotation of the motor, a supply circuit for the motor, means for first operating the reversing switch and then opening the motor circuit at the limits of travel of the nut, means for closing the motor circuit to initiate the movement of the nut from each of its limits, and means responsive to endwise movement of the screw under end thrust of greater than a predetermined amount but less than that required to reduce the motor speed sufficiently to cause closure of the starting circuit at points intermediate the limits of travel of the nut for operating the switch to condition the motor for rotation in the reverse direction whereby the direction of movement of the nut is reversed upon encountering an obstruction which reduces the motor speed sufficiently to cause closure of the starting circuit.

2. In combination, a frame including a track, a drive screw carried in the frame, a carriage slidable on said track and including a nut cooperating with the drive screw, a reversible single-phase induction motor of the type having a control for opening its starting circuit upon reaching a predetermined speed for driving the drive screw, limit switches deenergizing the motor at limits of travel of the carriage, a switch in the starting circuit for reversing the motor, a control member on the frame cooperating with the carriage to reverse the switch at said limits, and means responsive to end thrust of said screw in excess of a predetermined amount, but less than that required to reduce the motor speed sufficiently to cause closure of the starting circuit, for actuating said control member to reverse the motor.

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