

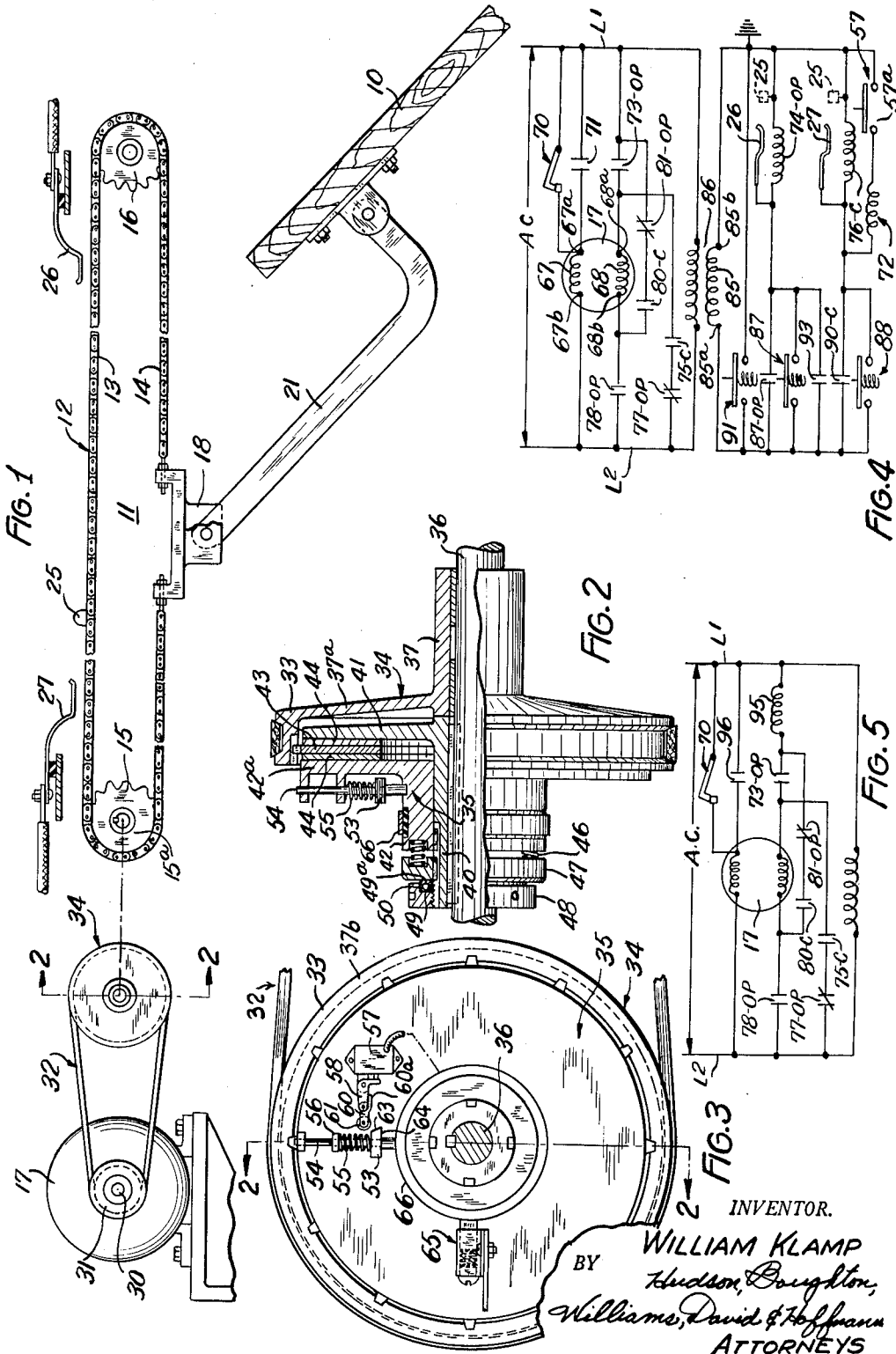
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DOOR OPERATOR CONTROL MECHANISM AND SYSTEM

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1

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The present invention relates to control means for reversing the direction of operation of a motor when a predetermined load is applied to drive mechanism being operated by the motor and, more particularly, to such a system which is particularly suitable for use in opening and closing a door.

An important object of the present invention is to provide a new and improved door operating mechanism which will be effective to reverse the motor driving the operator whenever the output element of a slip clutch connecting the motor to the door changes from a normal rotating condition to a condition such as a stopped condition indicative of an overload.

Another object of the present invention is to provide a new and improved door operating mechanism in which a centrifugal type switching means operated from the output element of a slip clutch interconnecting a drive motor and the door is operated to effect energization of the starting winding for the motor to reverse the motor when the clutch slips, the mechanism being so constructed and arranged that the starting winding does not remain energized in the event that the output element of the clutch never starts to rotate upon the starting of the motor or rotates at such a speed as to be incapable of actuating the centrifugal type switching means.

Another object of the present invention is to provide a new and improved drive mechanism in which a reversible motor drives the input element of a slip clutch having its output element connected to drive a load, and in which a centrifugally operated mechanism rotated with the output element of the clutch is adapted to control the motor upon the slipping of the clutch, but is ineffective to effect a control of the motor until the output element of the clutch has been driven at a predetermined speed by the motor and then falls to a speed lower than a predetermined speed or stopped.

A further object of the present invention is to provide a new and improved door operator in which a centrifugal switch type mechanism is actuated to reverse the drive motor when the output element of a slip clutch interconnecting the motor and door is stopped in response to an abnormal load applied thereto and while the motor is operating in a door closing direction, and in which the motor is a single phase motor and the centrifugal switch mechanism closes contacts in the starting circuit to energize the starting winding and in which the starting winding is de-energized when the motor starts regardless of the condition of the output element of the clutch.

Yet another object of the present invention is to provide a new and improved door operator control mechanism in which a centrifugal type switching mechanism is driven by the output element of a slip clutch connecting the drive motor and the door, and in which the drive motor is a reversible motor which is reversed by changing the power connections to a winding normally energized during the operation of the motor and in which the centrifugal switching mechanism effects a reversing of the motor when the output element of the clutch stops rotating while the motor is energized to operate the door.

Another object of the present invention is to provide a new and improved door operating mechanism in which a reversible motor drives the door between open and closed positions through a slip clutch and wherein centrifugal switching mechanism driven by the output element of the clutch is operated to reverse the direction of op-

2

eration of the motor when the output element of the clutch stops rotating while the motor is running, and which is so constructed and arranged to permit the load transmitted by the slip clutch to be finely adjusted so that the clutch will only transmit the load normally required to operate the door, thereby providing a control mechanism which is extremely sensitive to the presence of abnormal forces opposing movement of the door.

The above objects and others are accomplished by providing a door operating mechanism in which actuating means for stopping the motor from rotating in its direction of operation when the output element of the slip clutch changes from a normal rotating condition to one indicative of an overload is arranged so that the actuating means is not effective until the output element first obtains a predetermined speed in the direction of operation and the rotation of the element is then changed, e.g., stopped, to a condition indicating overload. Centrifugal force-responsive member is rotated from the output element of the slip clutch, and when the output element is rotated, the force-responsive member moves away from its axis of rotation due to centrifugal force. When the output element is stopped, the element moves or returns to a rest position and momentarily actuates control means during its return movement for reversing the motor if the motor is energized. In the preferred embodiment, the centrifugal force-responsive member is carried by the output element of the clutch and supported for radial movement with respect to the axis of rotation of the output element and biased to a rest position from which it is moved as the output element is rotated by the motor. A switch is disposed adjacent the centrifugal force-responsive member and a one-way actuating connection is provided between the member and switch so that the switch is momentarily actuated to momentarily make a circuit for reversing the motor as the centrifugal force-responsive member is returned to its rest position.

Further objects and advantages of the present invention will be apparent from the following detail description of the preferred embodiment thereof made with reference to the accompanying drawings forming a part of the specification and in which:

FIG. 1 is a view, somewhat schematic, of a door operator embodying the present invention;

FIG. 2 is a sectional view taken approximately along line 2—2 of FIG. 1;

FIG. 3 is an end view of that part of the apparatus shown in FIG. 2;

FIG. 4 is a circuit diagram which may be used with the operator shown in FIGS. 1—3; and

FIG. 5 is a modification of the circuit diagram of FIG. 4.

While the present invention is susceptible of various constructions and modifications and of use where it is desired to reciprocate a member between limit positions, which may be arbitrarily designated as open and closed positions, it is particularly useful when embodied in an operator for opening and closing a door, such as a garage door, or other closure. Referring to the drawings, the present invention is illustrated as embodied in an operator of a conventional type which need not be described in detail. Suffice it to say that a door 10 is operated between open and closed positions by a door operator 11 which includes an endless chain 12 having upper and lower runs 13, 14, respectively, the chain 12 being supported for movement through an endless path by spaced sprockets 15, 16. The sprocket 15 is secured to a shaft 15a driven by a reversible motor 17 which is operated in one direction to open the door and in the opposite direction to close the door.

A carriage 18 is fixed to lower run 14 of the chain 12. The carriage 18 is connected to the door 10 by a link 21

so that reciprocation of the carriage 13 along the bottom run of the endless chain 12 will cause the door 10 to open and close.

The upper run of the chain 12 has a limit lug 25 thereon which engages a leaf spring 26 when the motor 17 has been operated to move the carriage to the left, as viewed in FIG. 1, to a position where the door 10 is fully opened. The leaf spring 26 is supported at the right-hand end of the upper run, as viewed in FIG. 1, and is insulated from its support. The limit lug 25 is also adapted to engage a leaf spring 27, which is supported at the left-hand end of the upper run 13 and which is insulated from its support, when the motor 17 has been operated to move the carriage 13 to the right to a position where the door 10 is closed. The engagement of the lug 25 with either the leaf spring 26 or the leaf spring 27 will ground the particular leaf spring to de-energize control relays and the power circuit for the motor in a manner to be described hereinafter.

The motor 17 has a rotor shaft 30 which has a pulley 31 thereon which constitutes the driving pulley of a belt drive 32 for driving an input element or member 33 of a slip clutch 34. The slip clutch 34 includes an output element or member 35 which is connected to rotate a shaft 36 connected to drive the sprocket shaft 15a. The connection between the shaft 36 and the shaft 15a can be any conventional connection such that the shaft 36 stops when the door stops as it meets an obstruction.

The slip clutch 34 is a conventional type of slip clutch and includes the input element 33 which has a hub 37 rotatably mounted on the shaft 36 so as to be rotatable with respect thereto and a radially extending flange 37a. A belt-receiving pulley 37b is formed in the periphery of the flange 37a and the input element is rotated from the motor shaft 30 by the belt drive 32. The output element 35 of the clutch 34 has a hub 40 which is keyed to the shaft 36 for rotation therewith and a radially extending flange 41 adjacent the radially extending flange 37a of the input element 33. The hub 40 has a sleeve 42 slidable thereon but keyed thereto for rotation therewith and the sleeve 42 has a flange portion 42a facing the flanges 37a, 41. A clutch plate 43 is splined to the input element 33 and extends inwardly from the input element to a position between the flanges 42a, 41 and the flanges 41, 42a have clutch elements 44 thereon which cooperate with the clutch plate 43 to provide a friction-type clutch assembly. The sleeve 42 is spring-urged, by a plurality of springs 46, toward the flange 41 to apply a clamping force to the clutch plate 43. The springs 46 are interposed between the outer end of the sleeve 42, the left-hand end as viewed in FIG. 2, and a collar 47 which is slidably keyed to the hub 40. The springs 46 are received in spring seats in the adjacent sides of the collar 47 and the sleeve 42 and are spaced circumferentially about the hub 40. A nut 48 is threaded onto the outer end of the hub 40 and the side of the nut 48 facing the collar 47 is recessed to provide a seat for a ball-bearing 50 which has a race 49 fixed in the nut 48 and a race 49a which extends outwardly from the side of the nut 48 facing the collar 47 so that it engages the collar 47. The ball-bearing accommodates relative rotation between the collar 47 and the nut 48. Adjustment of the nut 48 by threading the nut onto the sleeve or backing it off from the sleeve will increase or decrease the compression in the springs 46 to vary the force with which the sleeve 42 clamps the clutch plate 43 between the cooperating clutch elements 44. If the compression of the springs 46 is increased by running the nut on the hub 40, the clutch will transmit greater torque before slipping, and if the compression in the springs 46 is decreased by backing off the nut 48, the clutch will transmit less torque before slipping. While the clutch 34 has been described in considerable detail, various types of conventional slip clutches which will provide overload protection by slipping when a predetermined load is applied

to the output element may be used insofar as the broader aspects of the present invention are concerned.

It can now be seen that the clutch 34 can be used to provide overload protection in the event that the door 10 meets an obstruction during its closing movement which would apply more than a normal load to the door 10. The torque which the clutch 34 will transmit before slippage is adjusted by adjusting the nut 48 and, preferably, the nut 48 is adjusted so that the clutch will slip if a force is called for which is greater than that normally necessary to effect a closing of the door 10. It will be noted that since the clutch 34 will slip, the motor 17 is not stalled and the danger of burning out the motor due to stalling and the drawing of large currents is minimized.

It is desirable, however, to reverse the door 10 when it is closing and the clutch 34 slips and rotation of the shaft 36 stops, as when the door meets an obstruction. To this end, the sleeve 42 has a centrifugal force-responsive member 53 mounted on a rod 54 extending radially outwardly from the hub of the sleeve 42 parallel to the outer side of the flange 42a. The centrifugal force-responsive member 53 is spring-urged inwardly to a normal or rest position shown in the drawings by a spring 55 disposed about the rod 54 and abutting the member 53 at one end and a lug 56 which extends outwardly from the flange 42a at the other end. The rod 54 has its radially outermost end supported in the lug 56. When the output element 35 is rotated, the centrifugal force-responsive member 53 will move radially outwardly against the action of the spring 55 due to centrifugal force, and when the rotation of the output element 35 stops, as when the door meets an obstruction, the spring 55 will urge the member 53 to the position shown in FIGS. 2 and 3. A switch 57 is fixed to the flange 42a adjacent the member 53 and the switch 57 is adapted to be actuated by movement of a pivoted lever 58 in a counterclockwise direction about its pivot as the lever is viewed in FIG. 3. The lever 58 has an arm 60 pivoted to the outer end thereof and the arm 60 has a portion 60a which abuts the lever 58 and prevents counterclockwise movement of the arm 60 about its pivot relative to the lever 58. A conventional hinge spring may be used to urge the arm 60 into engagement with the lever 58. Consequently, if the arm 60 is moved counterclockwise, the lever 58 will also be moved counterclockwise to actuate the switch 50. If, however, the arm 60 is moved clockwise, it will pivot about its pivotal connection to the lever 58 and the lever 58 will not be moved. The arm 60 has a roller 61 rotatably secured in the outer end thereof and the roller 61 is disposed in the path of movement of the member 53 from its normal or rest position shown in FIG. 3, outwardly to its position to which it moves when the output element 35 is rotated to drive the door 10 to an open or closed position. The arm 60 is moved clockwise about its pivotal connection to the lever 58 by movement of the member 53 past the roller 61. When, however, the member 53 moves from its radially outermost position to its rest position, the arm 60 is pushed in a counterclockwise direction to operate the lever 58 and to actuate the switch 57 as the member 53 moves to its rest position. The member 53 preferably has a bevelled surface 63 which facilitates the member 53 riding past the arm and roller 60, 61 when moving outwardly and which provides a shoulder 64 for moving the arm 60 in a counterclockwise direction when the member 53 moves inwardly. From the foregoing, it can be seen that the switch 57 is actuated whenever the output element 42 is rotating and is stopped.

The switch 57 is, in the preferred and illustrated embodiment, a normally open switch, which, when closed while the motor 17 is energized to operate the door in a closing direction, effects a reversing of the motor. If the motor 17 is operating in a door closing direction and the output element 35 stops, it is indicative of the fact that the door 10 has met an obstruction and the movement of the member 53 from an actuated position inwardly to its nor-

5

mal or rest position will operate the switch 57 to effect a reversal of the motor 17 to operate the latter in a door opening direction. Electrical connection is made to one side of the switch 57 by a brush and ring connection comprising a stationary brush 65 and a ring 66 on the sleeve 42 but insulated therefrom. The other side of the switch is grounded through the mechanism.

The motor 17 may be a single phase motor having a start winding which is de-energized after the motor has started. In this type of motor, severe damage can be done to the motor if the start winding is not de-energized after the motor starts. Referring to FIG. 4, the motor 17 is shown schematically as comprising a start winding 67 and a run winding 68. The start winding 67 has a terminal 67a connected to one side of the power supply, designated as L1 in the drawings, through a centrifugal switch 70 which may be the conventional switch commonly built into the rotor of this type of motor. The centrifugal switch 70 is closed when the motor is at rest and is opened after the motor has started to de-energize the start winding. The contacts of switch 70 are paralleled by the normally open contacts 71 of a reversing relay 72 so that, if the relay 72 is energized, a circuit will be completed for energizing the start winding 67. The start winding has a second terminal 67b which is connected to the other side of the power supply, designated in the drawings by L2.

The direction of operation of the motor 17 is controlled by controlling the phase of energization of the run winding with respect to the energization of the start winding. The run winding 68 has a terminal 68a which can be connected to L1 through normally open contacts 73-OP actuated by an "Open" relay coil 74-OP, or to L2 through normally open contacts 75-C actuated by a "Close" relay coil 76-C, and normally closed contacts 77-OP actuated by the relay coil 74-OP. The run winding also has a terminal 68b which can be connected to L2 through normally open contacts 78-OP actuated by the relay coil 74-OP, or which can be connected to L1 through a circuit including normally open contacts 80-C actuated by the relay coil 76-C and normally closed contacts 81-OP actuated by the relay coil 74-OP. If the relay coil 74-OP is energized, the terminal 68a is connected to L1 and the terminal 68b is connected to L2; and, if the relay coil 76-C is energized, the terminal 68a is connected to L2. Since the starting winding is always connected to the power supply in the same way, if the relay coil 74-OP is energized, the motor operates in one direction and if the relay coil 76-C is energized, the motor 17 operates in a reverse direction. In the illustrated embodiment, the motor 17 operates in a door opening direction when the relay coil 74-OP is energized. If both the relay coil 74-OP and the relay coil 76-C are energized, the motor 17 will also operate in a door opening direction since the circuit for energizing the run winding to operate in a door closing direction includes the normally closed contacts 81-OP and 77-OP which will be opened by the energization of the relay coil 74-OP.

The open relay coil 74-OP and the close relay coil 76-C are part of a low voltage control circuit for the motor 17, which control circuit is energized from the secondary coil 85 of a step-down transformer 86. The secondary coil 85 has terminals 85a, 85b, with the terminal 85b being connected to ground. The "Open" relay coil 74-OP may be energized by depressing an "Open" pushbutton switch 87 to connect one side of the relay coil to the terminal 85a, the other side of the relay coil 74-OP being connected to ground. When the relay coil 74-OP is energized, it operates its previously described contacts in the power circuit for the motor 17 to effect operation of the motor 17 in the direction to open the door and also closes holding contacts 87-OP connected in parallel with the open pushbutton switch 87 between the terminal 85a and the relay coil 74-OP. After the motor 17 has started,

6

the centrifugal switch 70 will open and the start winding will be de-energized.

The motor 17 may be operated in a direction to close the door by depressing a "Close" pushbutton switch 88 to connect one side of the relay coil 76-C to the terminal 85a of the secondary coil 85, the other side of the relay coil 76-C being connected to ground. When the pushbutton switch 88 is depressed, the relay coil 76-C is energized to close its contacts, hereinbefore described, in the power circuit for the motor to effect operation of the motor in a direction to close the door and the relay coil 76-C also actuates self-holding contacts 90-C connected in parallel with the "Close" pushbutton switch 88 to form a holding circuit for the relay coil 76-C.

The relay coils 74-OP, 76-C are de-energized when the door reaches its open or closed limit position by the engagement of the lug 25 with either the leaf spring 26 or the leaf spring 27 to short-circuit the energized coil causing it to drop out, opening its contacts in the circuit for the run winding and also its holding contacts in parallel with the corresponding pushbutton switch for energizing the coil. The leaf springs 26, 27 are connected to the sides of their respective coils connected to the terminals 85a, and the lug 25 is connected to terminal 85b through ground. The operation of the motor 17 may also be stopped at any time by depressing a pushbutton switch 91 which short-circuits the secondary coil 85 and causes the relay coils 74-OP, 76-C to drop out if either or both are energized. The release of the switch 91 will not re-energize the relay coils 76-C, 74-OP since the self-holding contacts 87-OP, 90-C will be open.

In the preferred and illustrated embodiment, when the clutch 34 slips and the output element 35 stalls while the door is operating in a door closing direction, the relay coil 72 is energized to reverse the motor 17. The relay coil 72 is connected in a series circuit with the switch 57, the series circuit being connected in parallel with the relay coil 76-C. The switch 57 has normally open contacts 57a so that normally the relay coil 72 will not be energized when the pushbutton switch 88 is depressed to energize the relay coil 76-C to operate the motor 17 to close the door. If the door closing operation is normal upon the energization of relay coil 76-C, the motor will rotate the output element 35 of the clutch 34 to drive the door 10 in a closing direction and the centrifugal force-responsive member 53 will move outwardly past the arm 60 to a position in which it is held by the centrifugal force. If the door now meets an obstruction, the output element 35 of the clutch 34 will stall and the clutch will slip so that the motor 17 continues to run and the switch 70 remains open. The stalling of the output element 35 will cause the member 53 to be moved inwardly under the action of spring 55 to actuate the switch 57 to close its normally open contacts 57a. Since the holding contacts 90-C have been closed by the energization of the coil 76-C, the closing of the contacts 57a will effect energization of the relay coil 72 and this will, in turn, close the normally open contacts 71 in parallel with the centrifugal switch 70 to energize the start winding. The relay coil 72 also has contacts 93 in parallel with the "Open" pushbutton switch 87 so that, when the relay coil 72 is energized, the relay 74-OP is energized to reverse the connections of the run winding to L1 and L2 and this, together with the closing of the contacts 71, causes the motor 17 to operate in a reverse direction. It will be noted that the relay coil 76-C will remain energized while the motor 17 is operated in a reverse direction, but this has no effect on the circuit, since the normally closed contacts of the relay coil 74-OP in series circuit with the contacts 75-C and 80-C render these circuits ineffective to energize the motor. The relay coil 72 is also ineffective to maintain the contacts 71 closed to keep the start winding energized since the contacts 57a are only closed momentarily while the member 53 is moving to its rest position. The momentary closing of the contacts is, however, long enough to

assure that the reversing will take place. When the door reaches its up-limit position, the lug 25 engages the leaf spring 26, short-circuiting the secondary coil 85 and causing all energized relay coils to drop out. At this time, the switch 57 will be actuated as the member 53 moves to its rest position, but the coil 72 will not be energized since the lug 25 has caused the de-energization of relay coil 76-C opening contacts 98-C through which the coil 72 is energized. Similarly, if the door completes its closing movement, the motor will not be reversed when the member 53 moves to a rest position since relay coil 76-C will have been dropped out by the lug 25 engaging spring contact 27 to open contacts 80-C.

One disadvantage of the above-described circuitry is that the stop button 91 must be pushed if the direction of door operation is to be reversed while the door is opening or closing. This is true because merely reversing the energization of the run winding by energizing the 74-OP coil when the door is operating in a one direction will not necessarily effect a reversal of the motor unless a circuit is also made for energizing the start winding. In the described circuitry, the centrifugal switch 70 will be open while the door is operating in a one direction and the contacts 71 will also be open, since the relay coil 72 is de-energized under normal conditions and the motor may have to be stopped to close switch 70 if it is to be reversed by pushing the switches 87, 88.

In the preferred embodiment, the contacts 71 of relay 72 are not used and the run winding of the motor is in series with a start relay coil 95 which functions to close contacts in the circuit for energizing the start winding to effect an energization thereof whenever the start relay is actuated (see FIG. 5). Preferably, the start relay is a differential current type of relay which requires a predetermined current magnitude to energize the relay, but which will not be affected by currents of a lesser magnitude. As is shown in FIG. 5, the start relay coil may be connected between the contacts 73-OP and the contact 81-OP, on one hand, and L1, on the other hand, so that regardless of the direction of operation of the motor, the current for the run winding must traverse the start relay coil. The start relay is such that, while the motor is running, the current in the run winding will not effect an actuation of the relay. I have found, however, that when the connections of the run winding to the power supply are initially made or interchanged as when the relay coil 74-OP is energized while the motor is operating in a door closing direction, the current surge in the run winding is sufficiently large to be used to actuate the relay and close its contacts 96 to connect the terminal 67a to L1. The closing of the contacts will effect a reversing of the motor upon the interchange of the connections and, when the motor has started running in the opposite direction, the current will be insufficient to maintain the contacts 96 energized and these contacts will drop out. If the start relay is used, it is not necessary to provide the centrifugal switch 70 to open the start winding after the motor starts since the start relay 95 will operate to accomplish this function. If, however, a commercial motor is being used which has the switch 70, the contacts 96 of the start relay may merely be connected in parallel with the centrifugal switch. The currents which are initially drawn when starting the motor from rest will also cause the start relay to be actuated to close the contacts to energize the start winding on starting from rest. If the switch 70 is used, the relay 95 is only needed for the reversing operation.

It can be further seen from the foregoing that the centrifugal force-responsive mechanism for controlling the motor is such that under no conditions will the start winding 67 remain energized if the motor is running, since either the switch 70 or the contacts 96, depending on the circuit used, will be open and the switch 57 will not make an independent circuit for energizing the starting winding.

The infinite adjustment provided by the nut 46 and the roller bearing associated therewith enables the clutch 34 to be precisely adjusted so that it will transmit only the normal force necessary to operate the door in a normal manner. It is further noted that, even if the clutch is adjusted too light so that when larger forces are required to operate the door in a normal manner, the clutch slips, there is no maintaining of the starting winding in an energized condition and the motor will be relatively safe from damage, even if the circuit of FIG. 4 is used or if external switching is utilized to reverse the connections to the start winding each time the motor is started. One of the worst conditions which can be met in door operation is when a door is opened a small amount as when it is operated to allow air to enter or to allow the ingress or exit of an animal. The door is lifted only a small distance from a closed position and, when the motor is started to close the door, the motor must operate against the conventional springs which are normally tensioned at this point to facilitate the opening of the door. The forces required can be quite large and, if the clutch is set on the light side, the output element 35 might never be rotated. Accordingly, if a circuit is used which relies upon the rotation of the output element of the clutch to open the starting winding circuit, the starting winding would not be opened and the motor might suffer severe damage.

As mentioned above, the present invention may also be used with a single phase motor where the movement of the door or part of drive mechanism effects a reversal of the connections of the start winding to the power supply after each motor start so that the direction of operation of the motor is reversed on the next start. Such a circuit is shown in my United States Patent No. 2,887,311 and in this type of circuit the switch 57 need only be connected in parallel with the centrifugal switch in series with the start winding and which normally operates to de-energize the latter.

In the mode of operation described above, the switch 57 effects the energization of a reversing relay which effects a reversing of the motor. It will be appreciated that the reversing relay could be utilized to make a shorting circuit across the secondary of transformer 85 to drop out all energized control coils and effects a stopping of the motor in response to the slipping of the clutch rather than a reversing of the motor. If the switch 57 is used in this manner, the normally open contacts of the switch 57 could themselves make the shorting circuit and the relay coil 72 eliminated. Furthermore, in a system which utilizes a single phase motor with a start winding whose connections to the power supply are reversed to change the direction of operation of the motor, the switch 57 need only effect the making of contacts in parallel with the normal centrifugal switch contacts associated with the motor. This conventional motor switch is shown in FIGS. 4 and 5 as the switch 70 and in the described type of system, which is fully disclosed in the aforesaid United States patent, the normally open contacts of the switch 57 can be connected in parallel with the centrifugal motor switch to complete a circuit about the motor switch when the door meets an obstruction and is to be reversed.

From the foregoing, it can be seen that the present invention provides a new and improved mechanism and control circuit for stopping the operation of the motor in one direction when the output element of a slip clutch interconnecting the motor and the load slips to indicate an overload on the clutch, the system being such that a single phase motor can be used without danger of maintaining the starting winding energized and such that a motor which is reversed by changing the connections of the run winding can also be used in the system.

While the preferred embodiment of the present invention and modifications have been described in considerable detail, it is hereby my intention to cover all modifications, constructions, and arrangements which fall within the abil-

ity of those skilled in the art and within the scope and spirit of the present invention.

Having described my invention, what I claim is:

1. A drive mechanism including a reversible motor and a slip clutch having a rotatable input element driven by said motor and a rotatable output element connected to drive a load, said clutch slipping and said output element stalling when a predetermined load is applied to the latter, control means for selectively energizing said motor to rotate in either of its directions of rotation and including reversing means for reversing said motor and causing the latter to operate in one direction and conditioned to be effective when said motor is energized to operate in its other direction comprising first means responsive to the rotation of said output element and operated momentarily from a normal condition which it has with said output element at rest or rotating to an actuated condition and returned to its normal condition when said output element changes from a rotating condition above a predetermined angular speed to one below that speed, said first means having said actuated condition only during the momentary operation thereof, and means responsive to the momentary actuation of said first means for energizing said motor to operate in a reverse direction to said other direction.

2. A drive mechanism including a reversible motor and a slip clutch having a rotatable input element driven by said motor and a rotatable output element connected to drive a load, said clutch slipping and said output element stalling when a load greater than a predetermined magnitude is applied to said output element, control means for selectively energizing said motor; a centrifugal force-responsive member rotated by the output element of said clutch and moved outwardly from a rest position upon rotation of said output element and returned to said rest position upon the stopping of said output element; first means having a nonactuated condition when said element is at rest or rotating continuously and responsive to the movement of said member and momentarily operated to an actuated condition and returned to said nonactuated condition in response to the movements of said member outwardly of said rest position and return in sequence, said first means having said actuated condition only during the momentary actuation thereof, and normally open circuit means conditioned to be effective when said motor is energized to operate in one direction and made momentarily to be energized in response to the actuated condition of said first means to effect the operation of said motor in its direction opposite to said one direction.

3. A drive mechanism including a reversible motor and a slip clutch having a rotatable input element driven by said motor and a rotatable output element connected to drive a load, said clutch slipping and said output element stalling when a load greater than a predetermined magnitude is applied to the output element of said clutch, a centrifugal force-responsive member rotated by the output element of said clutch and moved outwardly from a rest position upon rotation of said output element and returned to said rest position upon the stopping of said output element, normally ineffective reversing means for effecting a reversal of said motor when said motor is operating in one direction and including a circuit element operable to an actuated condition, circuit means responsive to a momentary actuation of said circuit element to effect a reversal of said motor, and motion transmitting means operated by the return movement of said member to effect a momentary actuation of said circuit element, said circuit element being actuated for effecting a reversal of said motor only during the momentary actuation thereof by said member and said motion transmitting means being a unidirectional motion transmitting means and responsive only to the return movement of said member to effect said momentary actuation of said element.

4. A drive mechanism as defined in claim 3 wherein said circuit element is a switch having normally open con-

tacts and said motion transmitting means comprises a one-way switch actuator engaged by said member as said member moves outwardly from the rest position and when said member returns to the rest position, said one-way actuator being operated by said member to actuate said switch only during the return movement of said member.

5. A drive mechanism for reciprocating a closure member between open and closed limit positions, said mechanism comprising a reversible motor; a slip clutch having a rotatable input element driven by said motor and an output element connected to drive said member, said clutch slipping and said output element stalling when the load applied to the latter exceeds a predetermined magnitude; and control means for said motor comprising a first relay coil energizable to effect operation of said motor in one direction and effective to reverse said motor if running in its other direction when said relay coil is energized, a second relay coil energizable to effect operation of said motor in its said other direction, means for selectively energizing each of said coils, reversing means conditioned to be effective when said second coil is energized and actuated to energize said first relay coil when said output element stops rotating comprising first means normally in a non-actuated condition when said output element is stopped or rotating responsive to the rotation of said output element and momentarily operated to an actuated condition and returned to said non-actuated condition when said output element changes from a rotating condition above a predetermined angular speed to one below that speed, said first means being in a non-actuated condition whenever said output element is below said predetermined speed, means responsive to the momentary actuation of said first means to effect the energization of said first coil and a reversing of said motor; and limit means for de-energizing said coils and rendering said reversing means ineffective when said member is moved to a limit position by operation of said motor in its said other direction.

6. A drive mechanism for reciprocating a closure member between open and closed limit positions, said mechanism comprising a reversible motor; a slip clutch having a rotatable input element driven by said motor and a rotatable output element connected to drive said member, said clutch slipping and said output element stalling when the load applied to the latter exceeds a predetermined magnitude; and control means for said motor comprising a first relay coil energizable to effect continuous operation of said motor in one direction to a limit position and effective to reverse said motor if running in its other direction when said first relay coil is energized, a second relay coil energizable to effect operation of said motor in its said other direction to a limit position, means for selectively energizing each of said coils, reversing means conditioned to be effective when said second coil is energized and actuated to energize said first coil when said output element stops rotating comprising a centrifugal force-responsive member rotated by the output element of said clutch and moved outwardly from a rest position upon rotation of said output element and returned to said rest position upon the stopping of said output element and first means responsive to the movements of said force-responsive member and momentarily operated to an actuated condition and returned to a nonactuated condition in response to the movements of said member outwardly of said rest position and return in sequence and having said non-actuated condition whenever said output element is not passing through the speed at which said first means is momentarily operated, normally de-energized circuit means energized momentarily in response to the actuated condition of said first means to effect the energization of said first relay coil, and limit means for de-energizing said second coil and rendering said reversing means ineffective when said closure member moves to its limit position in said other direction.

7. A drive mechanism for reciprocating a closure mem-

ber between open and closed limit positions, said mechanism comprising a reversible motor, a slip clutch having a rotatable input element driven by said motor and a rotatable output element connected to drive said member, said clutch slipping and said output element stalling when the load applied to the latter exceeds a predetermined magnitude, said motor being a single phase motor and having a start winding and a run winding and a centrifugal switch for de-energizing the start winding after the motor starts, reversing means for reversing said motor in response to the slipping of said clutch when said motor is operating in one direction comprising first means responsive to the rotation of said output element and momentarily operated to an actuated condition and returned to a non-actuated condition when said output element changes from a rotating condition above a predetermined angular speed to one below that speed and additional means responsive to the momentary actuation of said first means for energizing said motor to operate in a reverse direction comprising contacts connected in parallel with said centrifugal switch and momentarily made in response to the momentary actuation of said first means, said contacts being closed only during said momentary actuation due to the change in speed of rotation of said output element and limit means for stopping said motor and rendering said reversing means ineffective when said closure member moves to its limit position in said one direction.

8. A drive mechanism as defined in claim 7 wherein said first means comprises a centrifugal force-responsive member rotated by said output element and a one-way motion transmitting means actuated by said force-responsive member and transmitting actuating motion only when said member is moving toward a rest position upon the stopping of said output element and said additional means is a circuit element operated by said motion transmitting means.

9. A drive mechanism for reciprocating a member between limit positions, said mechanism comprising a reversible motor; a slip clutch having a rotatable input element driven by said motor and a rotatable output element connected to drive said member, said clutch slipping and said output element stalling when the load applied to the latter exceeds a predetermined magnitude; said motor being a single phase motor having a run winding and a start winding, control means for said motor comprising first and second relay coils operable to energize said run winding with currents of opposite phase to effect operation in opposite directions to a respective limit position, a start relay of the differential current type energized by current drawn by the run winding and actuated by the current surge occurring when said run winding is initially energized and when the phase of the energization of said run winding is reversed, a circuit for energizing said start winding including contacts actuated by said start relay to effect energization and de-energization of the start winding when said start relay is respectively actuated and dropped out, said first relay coil overriding said second relay coil when both are energized, reversing means conditioned to be effective when said second coil is energized and actuated to energize said first coil when said output element stops rotating comprising a centrifugal force-responsive member rotated by the output element of said clutch and moved outwardly from a rest position upon rotation of said output element and returned to said rest position upon the stopping of said output element and first means responsive to the movements of said member and momentarily operated to an actuated condition in re-

sponse to the movements of said member outwardly of said rest position and return in sequence, and normally de-energized circuit means energized momentarily in response to the actuated condition of said first means to effect the energization of said first relay coil.

10. A drive mechanism for driving a member, said mechanism comprising a reversible motor operatively connected to drive said member, said motor being a single phase motor having a run winding and a start winding, control means for said motor comprising first and second relay coils operable to energize said run winding with currents of opposite phase to effect operation in opposite directions, a start relay of the differential current type energized by current drawn by the run winding and actuated by the current surge occurring when said run winding is initially energized and when the phase of the energization of said run winding is reversed, a circuit for energizing said start winding including contacts actuated by said start relay to effect energization and de-energization of the start winding when said start relay is respectively actuated and dropped out, said first relay coil overriding said second relay coil when both are energized, reversing means conditioned to be effective when said second coil is energized and actuable to energize said first coil to effect a reversal of said motor.

11. A drive mechanism including a reversible motor and a slip clutch having a rotatable input element driven by said motor and a rotatable output element connected to drive a load, said clutch slipping and said output element stalling when a predetermined load is applied to the latter, control means for selectively energizing said motor to rotate in either of its directions of rotation and including control means for stopping the operation of said motor when the motor is operating in one direction and conditioned to be effective when said motor is operating in its one direction comprising first means responsive to the rotation of said output element and operated momentarily from a normal condition which it has when said output element is at rest and when said element is rotating to an actuated condition and back to said normal condition when said output element passes through a predetermined speed when changing from a rotating condition to a stopped condition, said first means being in a non-actuated condition except at said predetermined speed, and normally broken circuit means for stopping the operation of said motor in said one direction when made and made in response to the momentary actuation of said first means.

12. A drive mechanism as defined in claim 11 wherein said control means comprises a centrifugal force-responsive member rotated by said output element and a switch actuated momentarily by the movement of said member when said output element stops rotating.

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