

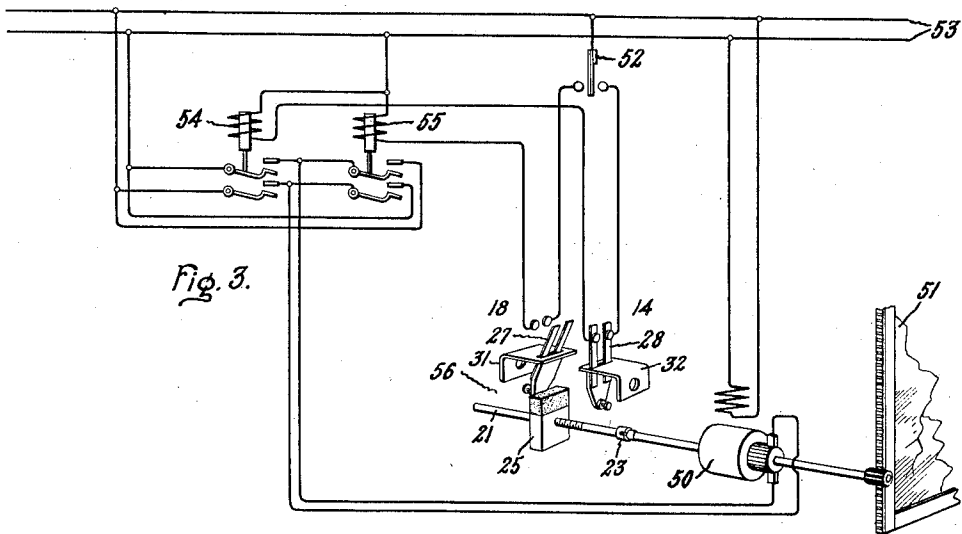
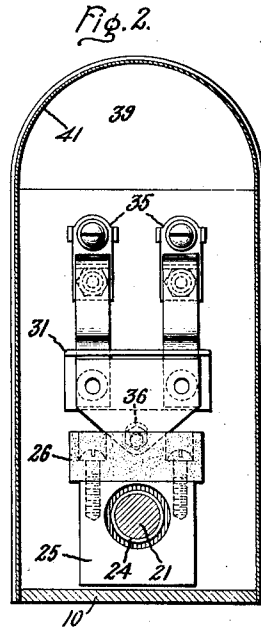
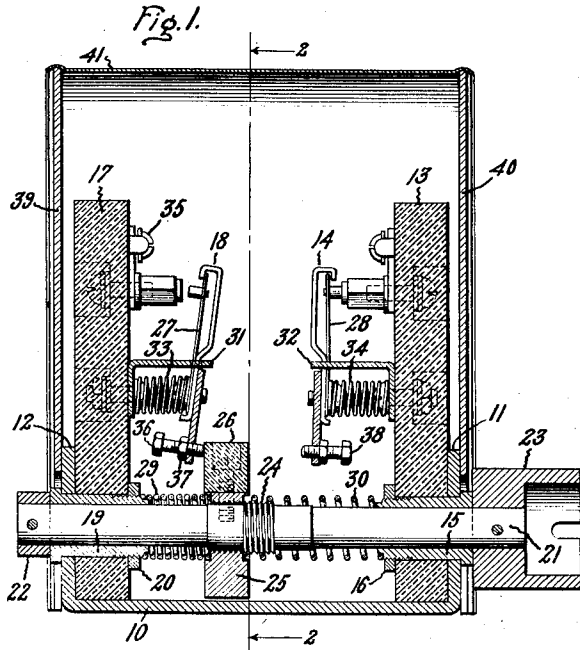
Aug. 25, 1925.

R. W. GOFF

LIMIT SWITCH

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Inventor :
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UNITED STATES PATENT OFFICE.

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LIMIT SWITCH.

Application filed February 2, 1925. Serial No. 6,176.

To all whom it may concern:

Be it known that I, ROBERT W. GOFF, a citizen of the United States, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Limit Switches, of which the following is a specification.

This invention relates to mechanically operated circuit controlling devices and more particularly to limit switches of the type having a screw mechanism for operating a circuit controlling member responsively to a predetermined number of revolutions of the rotatable shaft of an electric motor or the like.

One of the objects of the invention is to provide a simple and reliable form of limit switch mechanism of the above character in which the possibility of damage to the operating screw is effectively eliminated.

A further object of the invention is to provide a switch of the above character which may be employed to automatically limit the operation of an electric motor in both directions of operation and which may be inexpensively manufactured, easily installed and which at the same time is thoroughly efficient, safe and durable in service.

In carrying my invention into effect in a preferred form, I employ a screw and traveling nut mechanism for operating a movable circuit controlling member and I arrange the operating mechanism so that the traveling nut runs off the end of the screw in case the screw continues to be rotated after the operation of the circuit controlling member. Thus continued rotation of the screw has no further effect upon the traveling nut and the possibility of jamming or breaking the switch mechanism is entirely avoided. In order to insure the re-engagement of the traveling nut with the operating screw upon reverse rotation of the latter, I provide biasing means such as a compression spring which is arranged to be put under strain when the nut runs off the end of the screw and serves to maintain the nut in operative relation with the end of the screw.

Although not necessarily limited thereto, the invention is particularly adapted to limit the operation of an automatically controlled reversible electric motor employed to oper-

ate a movable device having definite limits of operation such, for example, as a thermostatically controlled motor operated window opening and closing arrangement or the like.

For a better understanding of my invention reference is had to the following description taken in connection with the accompanying drawing in which Fig. 1 is a side elevation partly in section of a limit switch mechanism embodying the invention; Fig. 2, is a mid sectional view of the switch mechanism shown in Fig. 1, and Fig. 3 is a schematic diagram showing an automatic motor operated window opening and closing control system employing my improved form of limit switch mechanism.

The novel features and combinations which I believe to be characteristic of my invention are pointed out with particularity in the appended claims.

Referring to Figs. 1 and 2, of the drawing the limit switch mechanism in the preferred form illustrated comprises a frame 10 preferably formed of sheet metal with the ends 11 and 12 bent up in parallel spaced relation. A base 13 of suitable insulating material carrying the switch 14 is secured to the upturned end 11 of frame 10 by means of a headed bolt 15 and a clamping nut 16. In a similar manner the base 17 carrying the switch 18 is secured to the upturned end 12 of frame 10 by means of the bolt 19 and the clamping nut 20 with the switches 14 and 18 disposed in opposing spaced relation as indicated in the drawing.

In the preferred form of construction shown, the bolts 15 and 19 are each of suitable material such as brass or the like and are centrally drilled and reamed to form bearings for the rotatable operating shaft 21. In order to maintain the shaft 21 in its bearing, a collar 22 is suitably fixed to one end thereof and a driving coupling 23 is secured to the other end thereof. The coupling 23 may be of any form desired although the form illustrated permits the limit switch to be readily connected to be driven from the shaft of an electric motor or the like.

An intermediate portion 24 of shaft 21 is of enlarged diameter and threaded to form an operating screw or worm. A co-operating traveller for the operating screw 24 is formed by the nut 25 which is disposed upon shaft 21 and is adapted to travel upon

the screw thread or worm 24 upon rotation of shaft 21. To prevent rotation of nut 25, one side thereof is flattened and disposed into sliding engagement with the base 10.

5 An operating arm 26, preferably of insulating material, is suitably secured to the nut 25, so as to operate the movable circuit controlling member 27 of the switch 18 when the nut 25 is moved to the left hand end of screw 24, as shown in the drawing, and to
10 operate the movable circuit controlling member 28 of the switch 14 when the nut 25 travels to the right hand end of the screw 24.

The cooperating screw 24 and nut 25
15 are so designed that the nut runs off the left hand end of the screw after operation of the movable circuit controlling member 27 and off the right hand end of the screw after operation of the movable circuit controlling member 28, thus in each case stopping
20 all further movement of the operating arm 26 and preventing jamming or breaking of the switch mechanism even though the rotation of shaft 21 continues. To insure reengagement of the nut 25 upon reverse rotation of the shaft 21, a suitable
25 spring 29 is arranged to be placed under strain when the nut 25 runs off the left hand end of screw 24. This serves to press the nut in abutting engagement with the end of screw 24 to be engaged thereby upon a reversal in the direction of rotation of shaft
30 21. A similar spring 30 is arranged to be put under strain when the nut 25 runs off the right hand end of screw 24 in order to bias the nut into operative relation with the right hand end of the screw 24. Preferably, the
35 opposite sides of nut 25 are suitably recessed to receive the ends of the biasing springs 29 and 30 which surround the shaft 21 on either side of nut 25 and the ends of bolts 15 and 19 are chamfered to form
40 seats for the other ends of springs 29 and 30 as shown in the drawing.

It will be observed that the movable circuit controlling members 27 and 28 are each
45 pivotally mounted upon a support 31 and 32 respectively and are biased into circuit closing engagement with the stationary contacts cooperating therewith by the biasing
50 springs 33 and 34 respectively. As shown more in detail in Fig. 2, the movable circuit controlling member 27 of switch 18 is arranged to bridge the stationary contacts 35
55 when the member 27 is in the circuit closing position. It will be understood that the movable circuit controlling member 28 of switch 14 serves to bridge the stationary contacts cooperating therewith in a similar
60 manner.

In order to permit adjustment of the travel of nut 25 required to operate the switch 18, the movable switch member 27 is
65 provided with the set screw 36 which may be extended any desired amount into the path

of movement of the operating arm 26 and held therein by the lock nut 37. The movable circuit controlling member 27 also is provided with an adjustable set screw 38 for varying the travel of nut 25 required to operate the switch 14.

An enclosing casing for protecting the limit switch mechanism from dust and moisture as well as mechanical injury is formed
75 by the end plates 39 and 40 which are each suitably secured to an upturned end of the frame 10 as shown and the removable cover 41 may be grooved to slide over the end plates as indicated in the drawing.

Although my improved form of switch
80 mechanism is of general application, it may be employed with particular advantage in an automatic control system for a reversible motor operated window closing and opening
85 mechanism such as is diagrammatically illustrated in Fig. 3. In the arrangement shown the reversible motor 50 is of the direct current shunt wound type and is mechanically connected through suitable gearing to effect the opening and closing of a window
90 51 under the control of an automatic temperature responsive device such as the thermostatic switch 52. Motor 50 receives power from the supply line 53 through one of the
95 electromagnetic reversing switches 54 and 55. It will be understood that the limit switch mechanism 56 is a diagrammatic illustration of the device previously described in connection with Figs. 1 and 2.

With the supply lines 53 energized from a
100 suitable source, the automatic window opening and closing control system illustrated in Fig. 3, operates in the following manner: The window 51 is shown in the open position and hence the free end of the automatic control thermostat 52 may be assumed to be slowly flexing to the right, responsively to a decrease in temperature. Upon the free
105 end of thermostat 52 finally engaging with the right hand stationary contact cooperating therewith an energizing circuit for the operating winding of electromagnetic reversing switch 54 is established from upper supply line through the thermostat 52, the
110 switch 14 and the operating winding of reversing switch 54 to the lower of the supply lines. The resulting closure of reversing switch 54 connects the motor 50 to the supply lines 53 for operation in the direction
115 required to close the window 51, which will be the clockwise direction of rotation in the arrangement shown. It will be evident that upon the initial rotation of motor 50 in the clockwise direction and consequently the rotation of shaft 21 of the limit switch mechanism 56 in a similar direction, the biasing
120 spring 29 presses the traveling nut 25 into operative relation with the left hand end of the screw thread 24 thereby starting the nut 25 to travel upon the screw 24 as the motor
125 130

50 continues to rotate in a clockwise direction. The resulting movement of operating arm 26 to the right permits the switch 18 to return to the closed position in accordance with its bias. After a predetermined travel of the nut 25 determined by the setting of the set screw 36, the latter is engaged by the operating arm 26 to operate the movable circuit controlling member 28 of the switch 14 to the circuit opening position. This interrupts the energizing circuit of reversing switch 54 and serves to disconnect the motor 50 from supply lines 53. However, the momentum of the moving part may continue the rotation of motor 50 after the deenergization thereof. However, no damage results to the switch 56 due to the fact that the nut 25 runs off the right hand end of screw 24 shortly after operating the circuit controlling member 28 to the open position and the continued rotation of shaft 21 has no further effect upon the nut 25.

Should the closure of window 51 result in a gradual increase in the temperature of the thermostat 52, the free end of the latter will flex to the left and finally engage with the left hand stationary contact cooperating therewith. This completes an energizing circuit for electromagnetic reversing switch 55 extending from the upper supply line through the thermostat 52, the limit switch 18 and the operating winding of switch 55 to the lower supply line. Upon the resulting closure of switch 55, the motor 50 is connected to supply line 53 for operation in the reverse direction to return the window 51 to the open position in which it is shown in the drawing. Upon the initial counterclockwise rotation of shaft 21, the biasing spring 30 serves to reengage the traveling nut 25 with the right hand end of screw 24 and the nut proceeds to carry the operating arm 26 to the left, thus permitting the reclosure of switch 14 in accordance with its bias and effecting the opening of limit switch 18 after a predetermined travel determined by the setting of the set screw 38. The opening of switch 18 deenergizes the reversing switch 55 which thereupon opens and disconnects motor 50 from the supply lines 53. Again the momentum of the moving part may continue the rotation of shaft 21 but it will be evident that the travel of nut 25 ceases when the nut runs off the left hand end of screw 24.

From the foregoing it will be obvious that repeated opening and closing of window 51 may occur under the control of thermostat 52, the operation being at all times limited by the limit switch mechanism 56. By suitable adjustment of set screws 36 and 38 the limits between which the window 51 is operated may be independently varied as desired.

In accordance with the provisions of the

patent statutes I have described the principle of operation of my invention together with the apparatus which I now consider to represent the best embodiment thereof but I would have it understood that the apparatus shown is only illustrative and the invention may be carried out by other means.

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

1. Switch mechanism comprising a movable circuit controlling member, a rotatable screw, a traveling member adapted to travel on said screw out of operative relation therewith, means for biasing said member into operative relation with the screw, and means whereby the said circuit controlling member is operated upon a predetermined travel of said travelling member on said screw.

2. Switch mechanism comprising a movable circuit controlling member, a screw and traveller mechanism for operating said member from one circuit controlling position to another position responsively to rotation of said screw, the said traveller being adapted to run off the end of said screw upon continued rotation thereof, and means for maintaining the said traveller in operative relation with the said screw after overrunning the end thereof.

3. Switch mechanism comprising a movable circuit controlling member, a screw and traveling nut mechanism for operating said member from one circuit controlling position to another position responsively to the travel of said nut upon rotation of said screw, the said nut being adapted to run off the end of said screw upon continued rotation thereof, and a biasing spring arranged to be put under strain when the said nut runs off the end of said screw for biasing the nut into operative relation with the end of said screw to be re-engaged thereby upon reverse rotation of the screw.

4. Limit switch mechanism comprising a movable circuit controlling member biased to one position and operable to a second position, a screw and traveller mechanism for operating said member to said second position responsively to rotation of said screw in a predetermined direction and for permitting the return of said member to said biased position responsively to rotation of said screw in the reverse direction, the said traveller being arranged to run off the end of said screw upon continued rotation thereof in said predetermined direction, and biasing means for maintaining the said traveller in operative relation with the end of said screw to be engaged thereby upon reverse rotation of said screw.

5. Limit switch mechanism comprising a rotatable shaft having an enlarged screw threaded portion, a nut disposed on said shaft and adapted to travel upon the threaded portion of said shaft upon rotation there-

of, said nut being adapted to run off the end of said threaded portion upon continued rotation of said shaft, a pivotally mounted circuit controlling member biased to the circuit closing position and disposed in the path of said traveling nut to be operated thereby to the open position upon a predetermined rotation of said shaft, and means for biasing said nut into operative relation with the end of the threaded portion of said shaft to be engaged thereby upon rotation of said shaft in the reverse direction to permit said circuit controlling member to return to its biased position.

6. Limit switch mechanism comprising a rotatable shaft having an intermediate portion thereof of enlarged diameter and screw threaded, a nut disposed on said shaft and adapted to travel from one end of the threaded portion of said shaft to the other end upon rotation thereof in a predetermined direction and to return to said one end of the threaded portion of said shaft upon rotation thereof in the reverse direction, switch mechanism disposed in the path of travel of said nut to be operated thereby, and means comprising a compression spring surrounding said shaft on each side of said intermediate threaded portion for biasing said nut into operative relation with said threaded portion upon the nut overrunning either end of said threaded portion.

7. Limit switch mechanism comprising a movable circuit controlling member biased to the circuit closing position, a rotatable shaft having an enlarged screw threaded central portion, a nut cooperating with the threaded portion of said shaft and arranged to run off of one end thereof upon continued rotation of said shaft in one direction and to run off the other end thereof upon continued rotation of said shaft in the opposite direction, means adjustably disposed in the path of travel of said nut and operatively connected with said circuit controlling member for operating the same to the open position responsively to a predetermined rotation of said shaft in said one direction, and means including a biasing spring surrounding said shaft and arranged to be put under strain by the travel of said nut upon continued rotation of said shaft in said one direction for maintaining said nut in operative relation with said threaded portion of said shaft and thereby insure the re-engagement of said nut with said threaded portion to permit the return of said circuit controlling member to the biased position upon the rotation of said shaft in the reverse direction.

8. Limit switch mechanism comprising a pair of pivotally mounted circuit controlling members disposed in opposing spaced relation, a rotatable screw, a traveller arranged to travel on the said screw to operate one of said circuit controlling members upon rotation of said screw in one direction and to operate the other circuit controlling member upon rotation of said screw in the other direction, said traveller being adapted to run off each end of said screw upon continued rotation in a corresponding direction, and means for insuring the re-engagement of said traveller with said screw upon reverse rotation thereof.

9. Limit switch mechanism comprising a pair of pivotally mounted circuit controlling members disposed in opposing spaced relation, a screw and travelling nut mechanism for separately operating each of said members, the said traveling nut being adapted to move into operative relation with one of said members when the said screw is rotated in one direction and to move into operative relation with the other of said members when the said screw is rotated in the reverse direction and the said nut being adapted to run off each end of said screw upon continued rotation thereof in a corresponding direction, and means for insuring the re-engagement of said nut with said screw upon the rotation thereof in the reverse direction.

10. Limit switch mechanism comprising a pair of pivotally mounted circuit controlling members disposed in opposing spaced relation, an operating member slidably mounted between said circuit controlling members and having a screw threaded aperture therein, a rotatable shaft having a screw threaded portion engaging the screw threaded aperture of said operating member to slide the same into operating engagement with each of said circuit controlling members upon rotation of said shaft in a corresponding direction, said operating member being arranged to run off the threaded portion of said shaft upon continued rotation thereof in either direction, and a pair of biasing springs, each surrounding said shaft on opposite sides of said threaded portion, for insuring the re-engagement of said operating member with the threaded portion of said shaft after overrunning each end thereof upon reverse rotation of the shaft.

In witness whereof, I have hereunto set my hand this 31st day of January, 1925.

ROBERT W. GOFF.