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LIMIT SWITCH

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Fig. 1.

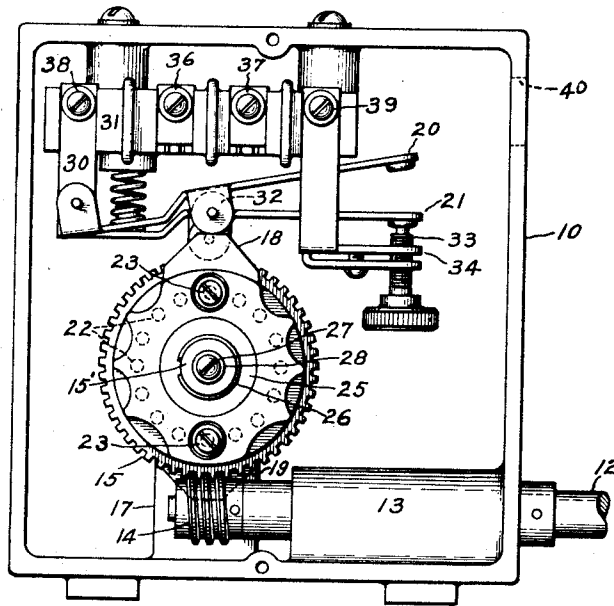
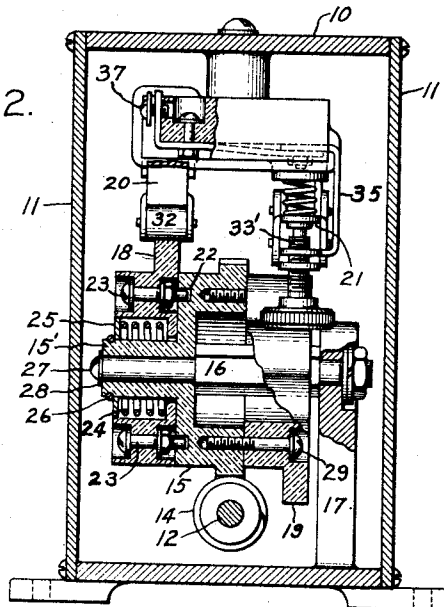


Fig. 2.



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LIMIT SWITCH

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The present invention relates to limit switches and has for its object the provision of an improved form of limit switch mechanism that has a wide range of adjustment and will open its contacts accurately after a desired number of revolutions of an operating member has occurred. Moreover, the improved form of limit switch of the present invention is of compact construction, permitting the switch to be utilized where space requirements are at a premium. In addition, the adjustment of the switch to open its contacts after the desired number of revolutions has occurred may be readily effected by hand without the use of tools or the loosening of any screws or other fastenings.

The improved limit switch preferably is provided with two circuit controlling members, one for each direction of operation so as to have a wide field of application, although it is particularly adapted for use in window control service or the like. In such service the windows ordinarily are opened and closed by means of an electric motor and the limit switch is employed to automatically interrupt the energizing circuit of the motor when the window is opened and also when the window is closed. A high degree of accuracy in the control of the operating motor is required to effect a proper closing of the window. Thus if the limit switch interrupts the motor circuit too soon the window will remain slightly ajar while if the limit switch opens the motor circuit after the window is fully closed the motor stalls and remains energized. Consequently, a very precise actuation of the limit switch just as the window reaches the full closed position is required. A lesser degree of accuracy of operation of the limit switch is required in opening the window since the degree of opening of the window ordinarily is not of great importance.

In the accompanying drawing Fig. 1 is a side view of the improved form of limit switch embodying the present invention and Fig. 2 is an end view with certain of the operating parts in section in order more fully to reveal the details of construction.

As shown in the drawing the limit switch

mechanism is mounted within and totally enclosed by the enclosing casing 10, which, is provided with the removable side covers 11. The operating shaft 12 for the limit switch is rotatably supported in the bearing 13 which preferably is cast integrally with the casing 10, as indicated in Fig. 1. The shaft 12 is arranged to be rotated in accordance with the operation of the device to be controlled as for example the window operating mechanism and carries the worm gear 14 which meshes with the gear wheel 15. As more clearly shown in Fig. 2, the gear wheel 15 rotates upon the shaft 16 which is fixedly secured to the pedestal support 17 extending from the casing 10. The gear wheel 15 carries two cam members 18 and 19 which operate respectively the movable contact members 20 and 21 of the limit switch mechanism.

The switch operating cam element 18 is mounted upon the gear wheel 15 so that it may be easily adjusted to any one of a plurality of angular positions with respect to the gear wheel. This is accomplished, by providing the gear wheel 15 with a series of locking holes 22 into which the locking pins 23 carried by the cam member 18 may be inserted. The cam member 18 is pressed by the spring 24 against the side of the gear wheel 15 to maintain the locking pins 23 firmly in engagement with the holes 22. The spring 24 is maintained under compression by the washer 25 which is held on the hub 15' of the gear wheel 15 by the ring 26, which is arranged to snap into a groove formed in the hub 15'.

With the mounting of the cam member just described, the cam member may be readily adjusted in the following manner: By moving the cam member 18 axially to the left along the hub 15' against the strain of the spring 24, the pins 23 are disengaged from the locking holes 22. The cam member 18 then can be rotated to any desired angular position upon the gear wheel 15 in which the two locking pins 23 register with any selected pair of the holes 22. Upon the release of the cam member 18 the pins 23 reengage with the selected locking holes and firmly maintain the cam member 18 in the selected angular po-

sition upon the gear wheel 15 so as to rotate as a unit therewith. It will be observed that the gear wheel 15 is held against axial movement on its shaft 16 by means of the screw 27 which is threaded into the end of the shaft 16 and holds the washer 28 against the end face of the hub 15'. For convenience in adjusting the angular position of the operating cam 18, the cam is provided with a serrated periphery such as shown in Fig. 1. This permits the cam to be readily grasped, retracted out of engagement with the gear wheel 15, and rotated to the desired angular position on the gear wheel 15 without the use of tools.

The cam member 19 is fixedly secured to the gear wheel 15 by the screws 29. In order to adjust the operating position of the cam member 19 with respect to the operating shaft 12, it is only necessary to remove the screw 27 and the washer 28. This permits the gear wheel 15 and the cam members mounted thereon to be moved as a unit axially along the shaft 16 so as to disengage the worm wheel 14. Thereupon the gear wheel 15 may be rotated to bring the cam member 19 into the desired operating position when the gear 15 is re-engaged with the worm 14.

The switch members 20 and 21, which are operated respectively by the adjustable cams 18 and 19, are pivotally mounted upon suitable supports 30 extending from the insulated base 31. Each of the movable switch members carries a roller 32 for engaging with the corresponding operating cam. It will be evident that the amount of rotation of the operating shaft 12 required to effect operation of the switch member 20 is dependent upon the angular position of the cam element 18 on the gear wheel 15. Thus, by adjusting the cam element 18 so as to engage the locking pins 23 with each of the series of locking holes formed in the gear wheel 15, operation of the switch member 20 may be effected over a wide range of rotation of the operating shaft 12. In addition to the wide range adjustment provided by adjusting the angular position cam element on the gear wheel, a fine control of the operation of the switch member 20 is obtained by varying the position of the roller 32 in the path of the operating cam 18. It will be observed that the stationary contact 33, cooperating with the movable switch member 20, is screw-threaded into the support 34 and hence is adjustable. Thus by screwing or unscrewing the stationary contact 33 the contact 20 is raised or lowered to thereby vary the position of the roller 32 in the path of cam 18. The combination of the rough adjustment and the fine adjustment permits the greatest accuracy to be obtained in the operation of the switch member over a very wide range of operation of the shaft 12.

The operation of the switch member 21 is effected by the cam element 19 which may occupy any desired angular position with ref-

erence to the cam element 18. Although the cam element 19 is not adjustably mounted with respect to the gear wheel 15, nevertheless a rough adjustment may be obtained by removing the gear wheel 15 from the shaft 16 as previously described. Then the degree of rotation of shaft 12 required to effect operation of the switch member 21 may be adjusted more accurately by raising or lowering the position of the switch member 21. This is accomplished by adjusting the position of the cooperating stationary contact in the manner previously described.

When the limit switch mechanism is used in window-closing service the very accurate and nice adjustment permits the contact 20 to be opened just as the window is operated to the full closed position. In such service the switch member 21 is employed to interrupt the motor circuit when the window has reached the open position where a high degree of accuracy is not required. Where a large number of windows are to be operated as in a green house, or other similar buildings, the adjustments permitted by the limit switch just described overcomes the difficulties due to variations in the amount of opening of the different windows as well as inaccuracy in mounting or connecting the limit switch therewith.

In order to facilitate the connection of the circuits to be controlled by the limit switch mechanism the terminals 36 and 37 for switch 21 are mounted on the same side of the insulating base 31 as the terminals 38 and 39 for switch 20. The terminal 36 is electrically connected, as indicated by the dotted lines in Fig. 2, to the support 35 which carries the adjustable stationary contact 33'. In a similar manner the terminal 37 is electrically connected to the switch member 21. It will be evident that the terminals 38 and 39 are connected respectively to the switch member 20 and cooperating contact 33. A suitable conduit opening 40 is provided in the casing 10 for leading in the wires to be connected to the respective terminals. The removable cover plates 11 permit ready access to the limit switch mechanism for making terminal connections and for adjusting the angular position of the operating cams, or the position of the adjustable stationary contacts 33 and 33' in the manner previously described. The simplicity of adjustment, the accuracy of operation, together with the wide range of adjustment, as well as the simple and rugged construction of the several operative parts, render the switch suitable for a wide field of service and particularly adapted for the control of electrically operated windows.

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

1. A switch mechanism comprising a movable switch member, a cam element for operating the switch member, a rotatable member

having means for supporting the cam element thereon to permit both axial and angular movement of the cam element with respect to the rotatable member, and axially detachable interlocking elements on the cam member and the rotatable member for connecting the same together for rotation in unison in each of a plurality of angular relations.

2. The combination of a movable switch member, a cam operating mechanism therefor comprising a rotatably mounted gear wheel having a series of holes radially disposed thereon, a cam member mounted on the hub of the gear wheel to permit both axial and rotational movement of the cam member with respect to the gear wheel, a locking pin carried by the cam member and adapted to engage with any selected one of the series of holes in the gear wheel, and a spring mounted on the hub of the gear wheel for resiliently holding the cam in locked engagement with the gear wheel.

3. A switch mechanism including relatively movable switch members, a rotatable member, a cam element adjustably mounted upon the rotatable member for effecting relative movement between the switch members upon angular movement of the rotatable member, and a member adjustably disposed in the path of the cam element and cooperating therewith for varying the angular movement of the rotatable member required to effect relative movement between the switch members.

4. The combination of a movable switch operating member, a rotatable operating cam therefor, a rotatable member concentrically mounted with respect to said cam element, means for locking the cam element to the said rotatable element in each of a series of definite angular positions, and means for varying the position of the said switch operating member in the path of the cam element for varying the angular movement of said rotatable member required to effect movement of the switch operating member with the cam element in each of said angular positions.

5. The combination of a rotatable member having a cam member rotatably supported thereon, one of said members having a series of locking holes formed therein and the other of said members having a locking pin adapted to be received in any selected one of said holes, means for resiliently holding said members in locked engagement, a switch having an operating member disposed in the path of movement of said cam member to be operated thereby, and means for adjusting the position of said operating member in the path of said cam member to vary the angular movement of said rotatable member required to effect operation of the switch.

6. The combination with a pair of movable switch members of an operating mechanism therefor comprising a rotatable gear wheel having an operating cam on each side thereof for operating a corresponding one of the switch members, said operating cams being angularly adjustable with respect to each other.

7. The combination of relatively movable circuit controlling contacts, a rotatable member having a cam element angularly adjustable thereon, a member disposed in the path of movement of the said cam element to be operated thereby upon rotation of said rotatable member an amount dependent upon the angular adjustment of said cam element thereon, said member being connected to effect relative movement of said contacts, and means for adjusting the position of said member with respect to the path of movement of the said cam element.

8. A limit switch mechanism comprising an enclosing casing having a pair of movable switch members mounted in spaced relation therein, a gear wheel mounted in the casing for rotation in a plane between said switch members, a worm gear in mesh with said gear wheel and having a shaft extending through said casing, a pair of cam elements mounted on opposite sides of said gear wheel each in operative relation with a corresponding one of said switch members, the position of each of said cams being adjustable to vary the rotational movement of said worm gear required to effect operation of the corresponding switch member.

9. A limit switch mechanism comprising a casing having an operating shaft rotatably mounted in one side thereof, a worm gear secured to the end of the shaft within said casing, a gear wheel removably mounted in mesh with said worm gear, a cam element fixedly secured to one side of said gear wheel, a second cam element adjustably mounted on the other side of said gear wheel and adjustable into each of a series of definite angular positions thereon, and a pair of movable circuit controlling contacts each mounted in spaced relation with a corresponding one of said cam elements to be operated thereby upon a predetermined operation of said operating shaft.

In witness whereof, I have hereunto set my hand this 17th day of January, 1928.

LEONARD P. HUTT.