Feb. 16, 1954 D. W. JOHNSON 2,669,612

SELECTOR SWITCH WITH STEP-BY-STEP CONTROL

Filed Nov. 8, 1951

2 Sheets-Sheet 1

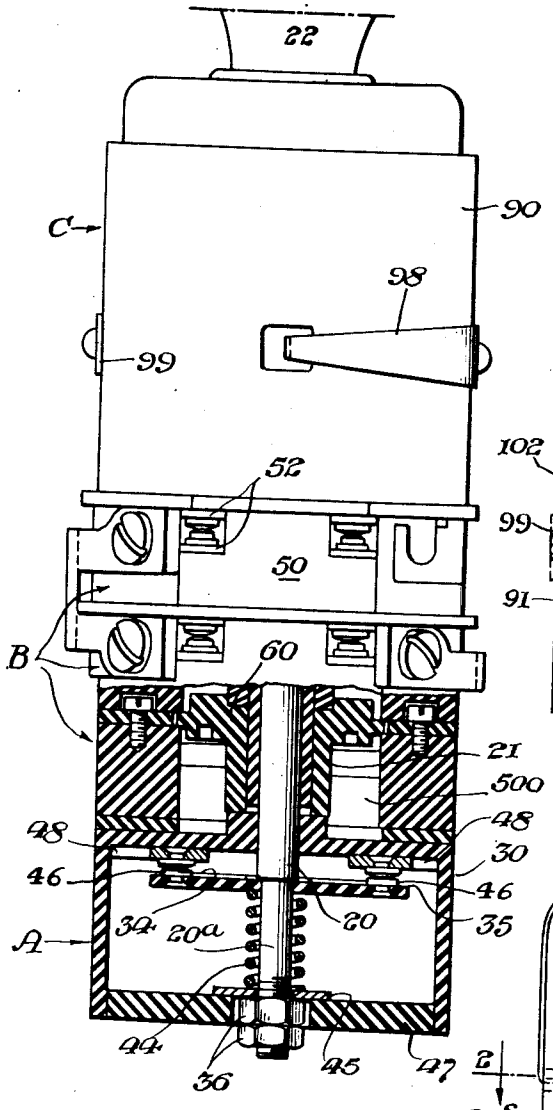


Fig. 1.

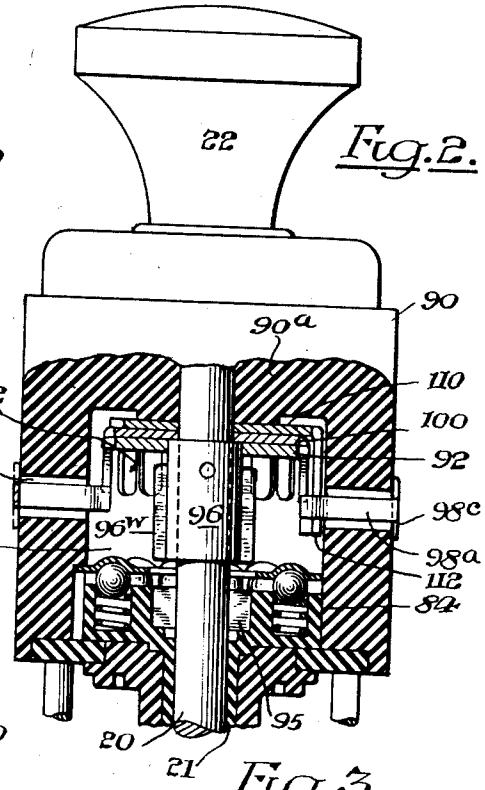


Fig. 2.

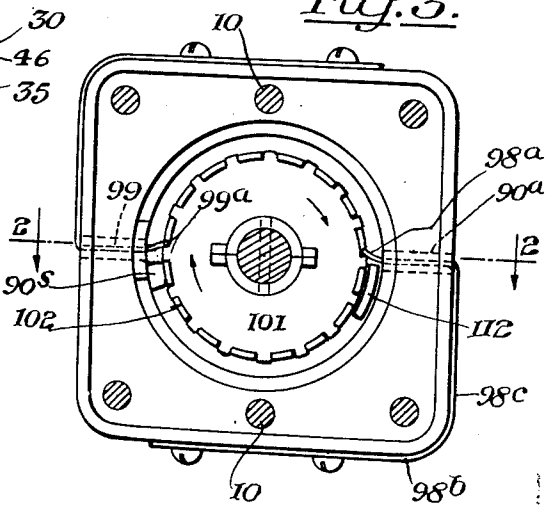


Fig. 3.

Inventor:
David W. Johnson
by his Attorneys,
Howson and Howson.

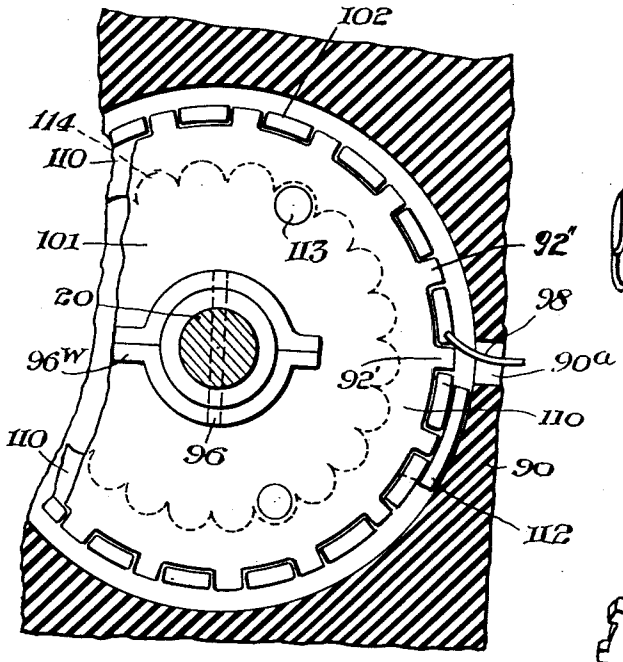
Feb. 16, 1954 D. W. JOHNSON 2,669,612

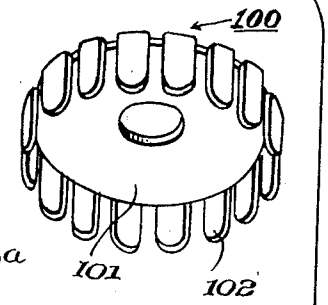
SELECTOR SWITCH WITH STEP-BY-STEP CONTROL

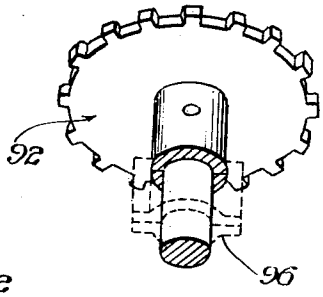
Filed Nov. 8, 1951

2 Sheets-Sheet 2

Fig. 4.







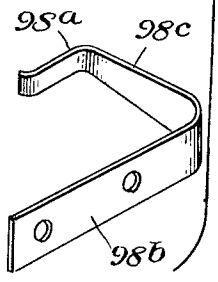


Fig. 7.

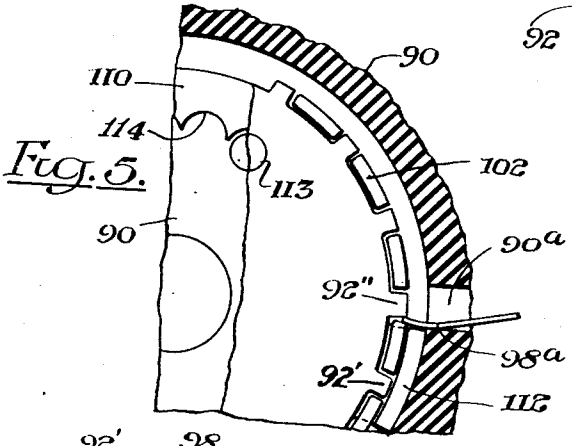


Fig. 5.

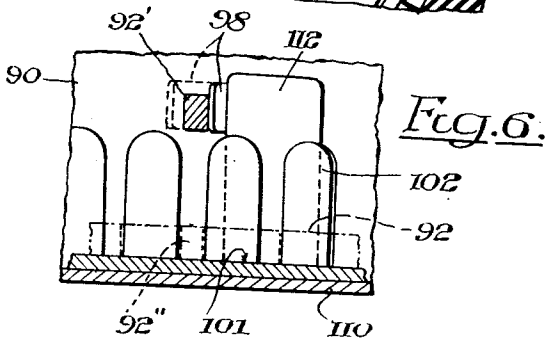


Fig. 6.

Inventor:
David W. Johnson
by his Attorneys,
Howson and Howson

Patented Feb. 16, 1954

2,669,612

UNITED STATES PATENT OFFICE

2,669,612

SELECTOR SWITCH WITH STEY-BY-STEP CONTROL

David W. Johnson, Hartford, Conn., assignor to The Arrow-Hart & Hegeman Electric Company, Hartford, Conn., a corporation of Connecticut

Application November 8, 1951, Serial No. 255,343

18 Claims. (Cl. 200—4)

1

This invention relates to selector switches of a type in which the controller is rotatable manually to select a desired set of contacts for controlling desired circuits and is movable axially by pushing or pulling to open or vary power line or control circuit arrangements, the switch also having means to prevent selection (rotary movement) except in a certain axial position of the controller wherein the power or control circuit contacts are usually open.

This invention is a further development or improvement upon the invention of my prior Patent 2,451,224 dated October 12, 1948 entitled "Push Pull Selector Switch."

In some uses of this type of switch, it has been found desirable or necessary that the rotation for selection of desired circuits be controlled so that there must be a halt or momentary stopping in each rotary position and axial movement to open or vary the power or control circuit contacts, as the switch is rotated in one direction, but wherein the rotation in the opposite direction can be accomplished freely and as rapidly as possible without halting in any position as the rotation proceeds. In other uses, it may be necessary for the controller to halt in each rotary position when rotating in either direction. Some examples of uses wherein step-by-step or in-sequence operation, without skipping or passing through any stage, is desired or necessary, is in acceleration and deceleration of some motors, in changing transformer connections, and in operating frequency changers. Occasionally where theoretically no halt or positive stop nor need to proceed in-sequence would seem necessary, it has been found in practice that such step-by-step or in-sequence action is needed, the reasons not always being understood or foreseen by engineers in their calculations.

It is an object of the invention to provide a rotary selector switch of the foregoing type with means positively to stop rotation in each new and succeeding position until the switch shaft is moved axially to establish the selected arrangement and concomitantly to free the stopping means.

Another object of the invention is to provide a switch having the foregoing means but which will permit rotation in one direction freely when the control shaft is in one axial position.

In the drawings:

Fig. 1 is a broken side elevation view partly in section of a selector switch embodying the invention;

Fig. 2 is a longitudinal section view of the top

2

portion of the switch illustrated in Fig. 1, the section being taken along line 2—2 of Fig. 3;

Fig. 3 is a bottom view of the switch illustrated in Fig. 2 with the indexing means removed;

Fig. 4 is an enlarged detail view partly in section and partly broken away, looking into the parts as in Fig. 3;

Fig. 5 is an enlarged fragmentary detail view partly in section of the same parts illustrated in Fig. 4 but in an advanced position;

Fig. 6 is an elevational fragmentary detail view partly in section showing the parts in the position of Fig. 5;

Fig. 7 is an exploded perspective view of the stop member, ratchet-wheel and pawl as used in the preceding figures.

The invention is shown in the drawings in connection with a switch of the push-pull type having the general construction of the switch shown in my application Serial No. 576,270 now Patent 2,451,224 issued October 12, 1948. A switch as disclosed in my Patent 2,451,224 comprises sections such as A, B and C, formed as molded insulating base members which carry various conductive or functional parts and are secured together by bolts 10 which extend through all the sections and have nuts thereon. Operation of the device is by rotation of a shaft 20 which passes through all the sections and carries a handle 22 at one end.

Of the various sections, section A may contain fixed and movable contacts and is shown as a rectangular insulating body or base member 30 having a chamber in which are mounted spaced contacts 43 having extensions leading to outer faces of the member 30 for the usual circuit connections (not shown). The circuit through the contacts 43 is arranged to be completed by contacts 46 mounted on a non-conductive bridging member 34 and connected by a metallic strip 35. The bridging member 34 is freely mounted on a portion 20a of the shaft 20 of reduced diameter and is held in engagement with the shoulder by a spring 44 which surrounds the shaft portion 20a and is held confined by a washer 45 secured on the shaft 20 by nuts 36. The washer 45 bears against a removable end piece 47 secured in the end of the member 30 and provided with an opening through which the shaft 20 and nuts 36 project.

A switch structure in accordance with this invention may comprise a plurality of B sections, each section comprising a substantially square body member 50 of molded insulation with flat top and bottom faces and centrally apertured, as

at 500, to receive the operating shaft 20, a sleeve 21 square in cross section mounted on the shaft 20 and a cam member 60 having a square opening so as to be operated by rotation of the sleeve 21. Each section also comprises electrical contacts 52, one of each pair of said contacts being spring-biased to engaging position and arranged to be operated by the cam member 60 to a position in which the contacts are separated. The cams 60 and sleeve 21 are positioned on the shaft 20 so that rotation of the shaft in one direction will permit some contacts to engage while separating others and operation of the shaft in the opposite direction will cause a different arrangement of the closed and open contacts as shown in my prior application.

The section C also comprises a rectangular block 90 of molded insulation and having a central opening for the reception of the shaft 20. At the outer end of the block 90, a handle 22 is fixed on the end of shaft 20. At the other end of the block 90 the central opening is enlarged for an appreciable depth providing a large chamber or recess 91. In it an indexing spring-pressed-ball retainer disc 84 turns with the shaft 20 when a winged collar 96 pinned on shaft 20 has its wings 96*w* enter a complemental recess 95 in the ball retainer as the shaft is pushed axially and turned thereafter. The end of the sleeve 21 is located in a square recess coaxial with shaft 20 so that the sleeve and disc turn together with shaft 20, all as in my prior Patent 2,451,224.

Also in chamber 91 is secured a stamped sheet metal stop member 110 comprising a ring with a stop lug 112 extending axially from its periphery. The inner periphery of the stop member is scalloped, having a series of semi-circular indentations or recesses 114 arranged in circular pattern to permit passage of the shanks of one or more of securing screws 113 which are provided to hold the locking member 100 to the body 90. When located in a predetermined position, the stop plate 110 is held against rotation by the interengagement of the shanks of the screws 113 and the recesses 114.

To prevent turning of the shaft 20 from one operating position to another except after it has been pushed (down in Figs. 1 and 2) to open contacts 46 and 48 in section A, a lock member 100 is seated in the housing 90 upon the stop plate 110. The lock member may comprise a disc stamped from sheet metal with a series of arcuate concentrically located fingers 102 bent to extend parallel to the axis of the shaft 20.

Engaging with the lock member 100 is a ratchet wheel 92 secured fixedly on the shaft 20 and having teeth on its periphery of size to fit slidably within the spaces between the fingers 102 of the lock member when the shaft is moved axially. When the shaft is pushed from the position in Figs. 1 and 2, the ratchet wheel teeth slide out of the spaces between the fingers 102 and the shaft then can be turned. When the shaft is pulled or moved axially back again, it becomes latched against rotation by the teeth of the ratchet-wheel again engaging in the spaces between the fingers 102.

In order to control rotation of the shaft 20 after its has been pushed axially to disengage the ratchet-wheel 92 from the stop member 100, I provide a spring pawl member designated generally by the numeral 98. This pawl functions to limit clockwise rotation of the shaft and ratchet-wheel to the distance between the one tooth and the next succeeding tooth until the shaft and ratchet-wheel are pulled axially. In the form illustrated, the spring pawl 98 comprises a sheet-metal strip of thin resilient metal stamped into Z-shape. One part 98*b* is secured flat against the outside of the insulating body 90 by rivets or other suitable means. Extending at right angles from the part 98*b* is an arm 98*c* which passes through a radial passage 90*a* into the insulating body 90 and has a bent finger 98*a* on its end.

The free end or finger 98*a* of the pawl is positioned to normally lie over one of the fingers 102 of the stop member 100 adjacent the advance edge of that finger as is illustrated in Fig. 4. Thus the pawl does not interfere with axial movement of the ratchet-wheel out of the spaces between the fingers, so long as the pawl is in its normal position.

On pushing the shaft and ratchet-wheel (referring to Figs. 4 and 5), the tooth 92′ moves in front of the pawl finger 98*a*. On clockwise rotation, the next succeeding tooth 92″ comes into engagement with the pawl finger and bends the pawl finger until it abuts the fixed stop lug 112 and is restrained thereby, thus stopping the further movement of the ratchet-wheel. So long as the ratchet-wheel and shaft are in that axial position, i. e. pushed, they cannot be rotated further than one tooth. On reverse axial movement of the ratchet-wheel and shaft, the ratchet-wheel tooth 92″ moves out of the plane, the pawl allowing it to snap back by its own resilience from the position of Fig. 5 to the position of Fig. 4. This allows the shaft and ratchet-wheel to again be pushed. This time the tooth 92″ will be in front instead of behind the pawl finger so that the ratchet-wheel can be turned clockwise one more step.

The end of the pawl finger 98*a* is inclined slightly against the clockwise rotation or in the counterclockwise direction of the ratchet-wheel 92. Hence on counterclockwise rotation, the ratchet-wheel can turn freely; the pawl then merely rides idly over the periphery of the ratchet-wheel teeth without exerting any restraint against counterclockwise rotation.

If it is desired to control counterclockwise rotation of the shaft in the same manner as the clockwise rotation is controlled, a similar pawl 99 can be mounted in identically the same manner on another or on the opposite side of the body 90. In this case however the inclination of the pawl finger 99*a* is in opposition to counterclockwise rotation and the finger overlies the opposite edge of some one of the stop fingers from that which the pawl 98*a* overlies. The particular one of the stop fingers 102 which the pawl finger 99*a* overlies may be on the diametrically opposite side of the stop member 100; but it can be any stop finger which spaced from the one over which the pawl 98 is located. A stop rib 90*s* running axially paralleling the outside of the body 90 may be formed integrally with the body on the interior wall of the body cavity 91 to function in the same manner as the stop lug 112 in case it is not desired to duplicate the finger 112 on the opposite side of the stop member 110.

From the foregoing, it will be observed that I have provided means which permits the axial movement, as by pushing, of the shaft 20 and the concomitant operation of the switch contacts in the section A of the switch and at the same time prevents rotation in either clockwise or counterclockwise direction (or both if so desired) more than the distance equal to the spacing of the

teeth upon the ratchet-wheel. Moreover, if the rotation is to be retarded to a step-by-step halting in one direction only, then the rotation in the opposite direction may be freely accomplished as soon as the shaft has been moved axially, that is pushed, to disengage the ratchet wheel 92 from the stop member 100. Furthermore, the means provided requires after the halting of the movement, in clockwise direction for example, that the shaft and ratchet-wheel be moved axially again to cause disengagement of the contacts in section A before it is possible to axially push and turn the shaft and ratchet-wheel again in either direction. Subsequent clockwise rotation will also be impeded after a one-step movement.

It will be obvious that the principles of the invention are not limited in application to a switch having 16 positions, as is the case in the one illustrated in the drawings, but it may also be applied to switches having a greater or lesser number of positions.

Many modifications of my invention will occur to those skilled in the art. Therefore I do not limit it to the particular embodiment herein disclosed.

What I claim is:

1. In an electric switch, a shaft, means for manually moving said shaft rotatively and axially, fixed means to lock said shaft against rotation when the shaft is in one axial position, positioning means fixed on the shaft and engageable with said locking means in said axial position but released from the locking means in another axial position of the shaft permitting rotation of the shaft, fixed and movable contact means, means operated by rotation of the shaft to operate said contact means selectively as said shaft is rotated into angularly spaced positions, and means operating on rotation of said shaft from one angular position to another to stop the rotation in said other position, said shaft being rotatable beyond said other position on movement of said shaft to cause release of said stopping means.

2. In an electric switch, a shaft, means for manually moving said shaft rotatively and axially, fixed means to lock said shaft against rotation when the shaft is in one axial position, positioning means fixed on the shaft and engageable with said locking means in said axial position but released from the locking means in another axial position of the shaft permitting rotation of the shaft, fixed and movable contact means, means operated by rotation of the shaft to operate said contact means selectively as said shaft is rotated into angularly spaced positions, and means engageable by said positioning means on rotation of said shaft from one angular position to another to stop the rotation in said other position, said shaft being rotatable beyond said other position when said positioning means is moved to release said stopping means.

3. In an electric switch, a shaft, means for manually moving said shaft rotatively and axially, fixed means to lock said shaft against rotation when the shaft is in one axial position, positioning means fixed on the shaft and engageable with said locking means in said axial position but released from the locking means in another axial position of the shaft permitting rotation of the shaft, fixed and movable contact means, means operated by rotation of the shaft to operate said contact means selectively as said shaft is rotated into angularly spaced positions, and

means operating on rotation of said shaft from one angular position to another to stop the rotation in said other position, axial movement of said shaft causing release of said stopping means and permitting subsequent rotation of said shaft into a third angular position.

4. A switch as claimed in claim 3 having contact means operable by axial movement of the shaft to control circuit connections during releasing movement of said stopping means.

5. In an electric switch, a shaft, means for manually moving said shaft rotatively and axially, fixed means to lock said shaft against rotation when the shaft is in one axial position, positioning means fixed on the shaft and engageable with said locking means in said axial position but released from the locking means in another axial position of the shaft permitting rotation of the shaft, fixed and movable contact means, means operated by rotation of the shaft to operate said contact means selectively as said shaft is rotated into angularly spaced position, and means operating on rotation of said shaft from one angular position to another to stop the rotation in said other position, said stopping means being released by axial movement of the shaft in shaft-locking direction and permitting continued rotation of the shaft after movement again to disengage said locking and positioning means.

6. In an electric switch, a shaft, means for manually moving said shaft rotatively and axially, fixed and movable contact means, means operated by rotation of the shaft to operate said contact means selectively as said shaft is rotated into angularly spaced positions, means to lock said shaft against rotation in one axial position but permitting rotation of the shaft in a second axial position, and means operable when the shaft is in said second axial position for stopping the rotation of the shaft after it has rotated from one angular position to another angular position, said stopping means being de-activated on moving said shaft axially toward said one axial position and permitting continued rotation to a third angular position after axial movement into said second axial position again.

7. The switch as claimed in claim 6 wherein the locking means comprises a positioning member on the shaft and a fixed locking member and the positioning member engages the stopping means to stop rotation of the shaft.

8. An electric switch as claimed in claim 7 wherein the stopping means includes a spring-pressed member operable to stop said rotary movement in one direction but not in the other direction.

9. The switch as claimed in claim 6 wherein the locking means includes a positioning member on the shaft, and wherein the stopping means includes a member biased into one position in which axial movement of the shaft is permitted and rotary movement of the shaft is also permitted until said positioning member comes into a second angular position.

10. An electric switch as claimed in claim 6 wherein the stopping means includes a spring-pressed member operable to stop said rotary movement in one direction but not in the other direction.

11. A switch as claimed in claim 4 having contact means operable by axial movement of the shaft to control circuit connections during releasing movement of said stopping means.

12. In an electric switch, a shaft, means for

manually moving said shaft rotatively and axially, fixed and movable contact means, means operated by rotation of the shaft to operate said contact means selectively as said shaft is rotated into angularly spaced positions, means to lock said shaft against rotation in one axial position but permitting rotation of the shaft in a second axial position, stopping means, and means on said shaft engageable with said stopping means on rotation of the shaft from one angular position to another to stop said shaft in said other position, said stopping means being released by axial movement of said shaft in shaft-locking direction and thereafter upon axial movement in shaft-unlocking direction permitting resumation of rotation of the shaft to a third angular position.

13. An electric switch as claimed in claim 12 wherein the stopping means includes a spring-pressed member operable to stop said rotary movement in one direction but not in the other direction.

14. In an electric switch, a shaft, means for manually moving said shaft rotatively and axially, fixed and movable contact means, means operated by rotation of the shaft to operate said contact means selectively as said shaft is rotated into angularly spaced positions, means to lock said shaft against rotation in one axial position but permitting rotation of the shaft in a second axial position, stopping means and means on said shaft engageable with said stopping means on rotation of the shaft from one angular position to another to stop the shaft in said other position, said stopping means being released by axial movement of said shaft in shaft-locking direction, said stopping means permitting axial movement of the shaft in both stopping and released positions.

15. In an electric switch, a shaft, means for manually moving said shaft rotatively and axially, fixed and movable contact means, means operated by rotation of the shaft to operate said contact means selectively as said shaft is rotated into angularly spaced positions, means to

lock said shaft against rotation in one axial position but permitting rotation of the shaft in a second axial position, and a stopping member biased into one position but movable into an other position by rotation of the shaft into a succeeding position and there stopping rotation of the shaft, said stopping member being released by axial movement of the shaft and upon release returning under bias to said one position.

16. A switch as claimed in claim 15 wherein reverse rotation of the shaft moves the stopping member into a position permitting said reverse rotation freely.

17. A switch as claimed in claim 15 having contact means operable by axial movement of the shaft to control circuit connections during releasing movement of said stopping means.

18. In an electric switch, a shaft, means for manually moving said shaft rotatively and axially, fixed means to lock said shaft against rotation when the shaft is in one axial position, positioning means fixed on the shaft and engageable with said locking means in said axial position but released from the locking means in another axial position of the shaft permitting rotation of the shaft, fixed and movable contact means, means operated by rotation of the shaft to operate said contact means selectively as said shaft is rotated into angularly spaced positions, and a stopping member biased into one position but movable into another position by said positioning member by rotation of the shaft into a succeeding position and there stopping rotation of the shaft, said positioning member being unrestrained by engagement with said stopping member on reverse rotation of the shaft.

DAVID W. JOHNSON.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,451,224	Johnson	Oct. 12, 1948
2,451,225	Johnson	Oct. 12 1948