This invention relates to electric switch operating mechanism. More particularly the invention relates to a mechanism which operates with a snap action and in which the driven shaft or spindle is positively moved or "kicked-off" during movement of the switch to "off" position.

It is an object of the invention to provide an improved snap-acting switch mechanism in which the operating shaft and handle when moving from one position of rest toward its next position, e.g., from "on" to "off", will not move through an angle as great as the angle between those positions prior to operation of the switch mechanism. In other words, the handle and its shaft do not overtravel or travel past their next position when turned to operate the switch.

Another object is to provide a positive "kick-off" to start the actuated element or switch spindle on its way when the operating shaft has moved the mechanism to dead center position.

Another object is to provide means to prevent removal of the handle shaft except when the switch is in "off" position, in a mechanism of the foregoing type.

Other objects and advantages of the invention will become apparent as it is described in connection with the accompanying drawing.

In the drawings:

Fig. 1 is an elevation view of a switch to which the operating and kick-off mechanisms are applied.

Fig. 2 is a plan view partly broken away of the parts of the invention illustrated in Fig. 1 with the cover plate removed.

Fig. 3 is a transverse section view taken along line 3-3 of Fig. 1 illustrating the operating and kick-off mechanism of the invention.

Fig. 4 is a view similar to Fig. 3 but with the parts in the position wherein the kick-off mechanism is functioning.

Fig. 5 is a fragmentary plan view of the central portion of the cap plate in association with the operating stud shaft.

Fig. 6 is a fragmentary vertical section view of the operating shaft, handle shaft and cap plate of the switch.

Referring to the drawings, the body 16 of the switch is mounted upon a metallic base plate 12 and has on its top a plate 14. As illustrated the switch body may be made up of a stack of insulating discs which are suitably hollowed out to receive the contact-carrying elements both fixed and movable of the switch.

The operating mechanism of the switch is mounted on the top plate 14 and between it and a mounting plate 16. The mounting plate 16 is parallel to the top plate 14 and is secured in place by nuts 17 which are screwed on the ends of bolts 18 passing through all elements of the switch body and extending beyond the top of the mounting plate 18. By this means all parts of the switch body and associated plates are secured together. The mounting plate 16 may be spaced from the top plate 14 by a circular insulating member preferably moulded from insulating material with a circular cavity in its center to permit movement of the operating parts of the switch-operating mechanism.

Rotatably mounted in the top plate 14 and in the base plate 12 is a contact-carrying spindle 20. The upper end 21 of this spindle is rectangular in section and extends slightly above the top plate 14 and has mounted upon it a stamped sheet metal arm 22. A rectangular aperture in arm 22 receives the end 21 of spindle 20 and the end of the spindle is peened over on the arm so that the two turn as a unit. A pin 24 extends from the outer end of arm 22 in the opposite direction from the spindle 20 and affords an anchor for one end of a tensioned over-center coil spring 26. By the action of this spring, as will hereinafter be more fully described, the arm 22 is moved between two fixed stop pins 28 and 30 mounted in the plate 14 and extending in a direction opposite to the spindle 20. The stop pins 28 and 30 are so placed as to halt the arm 22 and spindle 20 when the movable contacts, not shown, which are mounted thereon, are in register with fixed contacts of the switch (not shown). Since the fixed and movable contacts form no part of the invention and since their structure may be varied widely within the scope of the invention, they need not be described in detail.

It is sufficient to mention that the movable contact may be a bridging contact which is insulated in any conventional fashion from the spindle and turns therewith so as to bridge the fixed contacts or disengage them according to the operation of the switch spindle.

Mounted in the middle of the mounting plate 16 is an operating or stud shaft, designated generally by the numeral 40 in axial alignment with the spindle 20. Formed on the central portion of the shaft 40 is a collar 42 which rests upon the upper surface of the mounting plate 18. The lower end of the shaft 40 extends through the mounting plate and its tip 44 is of reduced diameter and has flattened sides for the purpose of securing a stamped sheet metal operating lever 46 thereon. In one end of lever 46 is an aperture
of non-circular form configured to fit exactly around the tip 44 of the shaft 40 and the tip 44 is peened over to permanently secure the operating lever and operating shaft together for operation as a unit. The other end of the operating lever 45 has a pin 46 mounted thereon and extending parallel to the axis of the switch spindle in direction towards the arm 22. This pin 46 affords an anchor for the other end of the switch operating spring 26.

From the foregoing it may be seen that as the operating lever 46 is moved in a clockwise direction from the position of Fig. 2 to the position of Fig. 3, the switch spring 25 will be stressed and its line of action will pass across the coinciding axes of the spindle and operating shaft thereupon causing the arm 22 and the switch spindle to move in a counter-clockwise direction (referring to Figs. 2, 3 and 4) until the arm 22 strikes the stop 28.

As the operating lever 46 is moved in the opposite (counter-clockwise direction) the switch spring will again be caused to move across the axis of the switch spindle and operating shaft thereupon cause reverse movement of the arm 22.

In order to stop the motion of the operating lever 46, pins 50 and 52 are mounted in the mounting plate 16 in a direction to extend toward the top plate 14.

In order to positively move the arm 22 and switch spindle so as to compel disengagement of the fixed and movable contacts in case they should be inclined to stick, I have provided a kick-off member 60, the main portion of which is stamped flat from sheet metal but has an end 62 offset downwardly. The shape of the kick-off member may be observed from examination of Figs. 1, 3 and 4. The kick-off member is pivotally mounted at one end upon a fixed pivot pin 64 extending downwardly from the under-side of the mounting plate 16. The kick-off member 60 lies against the under-surface of the mounting plate 16 and has a stud 65 extending downwardly from its mid-portion in position to be engaged by the operating lever 46 as that arm approaches dead center position in moving from "on" to "off" position of the mechanism.

The free offset end 62 of the kick-off member 60, when in the "on" position of the switch lies against the spring-anchor pin 24 of the contact-operating arm 22 as may be observed by referring to Fig. 3.

As may be seen in Fig. 4 when the operating lever 46 engages the stud 66 the kick-off lever will be rotated in clockwise direction (referring to Fig. 4) and by this rotation the offset end 62 will push the pin 24 and arm 22 in clockwise direction to start the spindle and the switch contacts it carries moving in clockwise direction toward "off" position. Thereafter the tension of the switch continues and completes the movement of the arm 22.

From the foregoing it may be observed that the location of the stops 26 and 33 define and limit the angle of movement of the switch contacts and spindle 20; and stop pins 50, 52 define and limit the angle of movement of the operating lever 46 and stud shaft 40.

By referring to Fig. 4 into which the parts have been moved from the "on" position of Fig. 3 in the course of actuation of the mechanism to the position of Fig. 2 (off), it may be observed that the kick-off member 60 is positively engaging the arm 22 to move it. At this stage the operating lever 46 has moved through an angle substantially less than the full angle between Fig. 3 and Fig. 2. At the position of Fig. 2 or very slightly beyond the snap-over of the arm 22 will take place. Hence the operating lever 46 and stud shaft 40 have no overtravel but cause actuation of the mechanism prior to completion of movement "on" to "off." Similarly, overtravel from "off" to "on" does not take place.

Although the positive operating means does not function during the movement from "off" to "on" position, there is no necessity for such positive movement since when the movable contacts are coming into engagement with the fixed contacts, they are already moving rapidly under the impetus of the switch spring. Thus normally and naturally any tendency of the contacts to stick while they are becoming engaged is overcome.

For the purpose of manually turning the operating stud shaft 40, its upper end is slotted diametrically and is recessed axially by a cylindrical bore 45. The cylindrical bore receives the end of an operating handle shaft 70. A diametrical pin 72 is driven through the handle shaft 70 and engages in the slot 47 in the stud shaft 40 so that the handle shaft 70 is therefore separable from the operating stud shaft 40.

Overlying the operating mechanism is a stamped metal cap plate 80 which is secured in position by nuts 82 threaded on the ends of bolts 84 which serve to mount the whole switch base and operating mechanism. The cap is approximately circular in plan having a central portion pressed out or offset upwardly. In the center of the offset part of the cap plate 80 is an aperture aligned with the stud shaft 40, the aperture being of such size as to permit entrance of the end of the handle shaft 70. Since the handle shaft is provided with the diametrical pin 72, there is provided a diametrical slot 86 communicating with the aperture 84 so as to permit entrance of the handle shaft 70 but only when the pin 72 is in register with the diametrical slot 88.

In assembling the cover on the switch, the slot 88 is so located with relation to the slot 47 in the stud shaft 40 that the two are in register in the "off" position of the switch. Upon insertion of the handle shaft and turning it to operate the switch, the pin 72 will move immediately under the surface of the cap 80. Thus in the "on" position of the switch and at all positions between it and "off" position, it will be impossible to remove the handle shaft.

Normally the handle shaft is mounted on and swings with an arm of conventional box or housing which encloses the whole switch mechanism. A suitable mounting of the handle shaft on the cover is disclosed in my co-pending application, U. S. No. 39,280. Thus in view of the aforesaid cooperation of handle shaft and cap plate 80, it is impossible to open the cover except in "off" position of the switch.

Many modifications within the scope of my invention will occur to those skilled in the art and therefore it is not limited to the specific embodiment illustrated.

I claim:

1. In an electric switch, a switch casing, a rotatory spindle for operating switch contacts with-in said casing, an arm mounted on said spindle and turning therewith, an operating shaft in alignment with said spindle but spaced therefrom, an operating lever mounted on said shaft
and turning therewith, an over-center spring having its end connected to said spindle arm and said operating lever and movable by said operating lever to cause movement of said switch spindle with a snap motion, a kick-off lever pivoted about a fixed pivot spaced from the spindle axis and engageable by said operating lever when the latter has partially moved from one position of rest to another, said kick-off lever engaging said spindle arm when the former has been engaged by said operating lever whereby to positively start said spindle rotating, said spring thereafter completing the rotation of said spindle from one switch position to another, cover means cooperating with said casing to enclose the aforesaid elements and having an opening for an end of said operating member, a removable member engageable with said operating member through said opening, and means associated with said removable member and said operating member to prevent removal of the former except when the spindle is in a certain position.

2. An electric switch as claimed in claim 1 wherein the connection between said operating member and said removable member is a pin and slot connection.

3. An electric switch as claimed in claim 1 wherein there is a pin on the removable member and a slot in said cover means to receive said pin when said removable member is in a certain position and to prevent removal in any other position.

4. An electric switch as claimed in claim 3 in which the operating member is recessed to receive said removable member and pin.

5. In an electric switch, a rotary spindle for operating switch contacts, means carried by and rotating with said spindle, a rotary operating means, spring means connecting said spindle-carried means and said operating means for moving the former when the latter has moved a predetermined distance, kick-off means caused to engage with the spindle-carried means by said operating means when the latter has moved a predetermined distance whereby to positively start said spindle rotating, said kick-off means pivoted about a fixed pivot spaced from the axis of said spindle, base and cover means cooperating to house the aforesaid elements, said cover means having an opening for said operating means, a removable member engageable with said operating means, and means associated with said removable member and said operating means to prevent removal of the removable member except when the spindle is in a certain position.

6. An electric switch as claimed in claim 5 wherein there is a pin and slot connection between said operating means and said removable member.

7. In an electric switch, a rotary spindle for operating switch contacts, means carried by and rotating with said spindle, a rotary operating means, spring means connecting said spindle-carried means and said operating means for moving the former when the latter has moved a predetermined distance, kick-off means caused to engage with the spindle-carried means by said operating means when the latter has moved a predetermined distance whereby to positively start said spindle rotating, said kick-off means being pivoted about a fixed pivot spaced from the axis of said spindle, base and cover means cooperating to house the aforesaid elements, said cover means having an opening for said operating means, a removable member engageable with said operating means, a pin on the removable member and a slot in said cover means to receive said pin when said removable member is in a certain position and to prevent removal in any other position.

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