This invention relates to innovations and improvements in spring actuated mechanisms for manually operating electrical switches and the like whereby the switches may be safely opened and closed, even by inexperienced operators, without damage to the equipment. In a broader sense, the invention relates to such mechanisms for operating rock shafts, and devices coupled thereto, with snap action.

As a typical example of the type of electric switches which may be opened and closed using the spring actuated mechanisms of the present invention, reference is made to so-called “A.C. indoor interrupter switches,” sometimes referred to as “arc chute switches.” Conventionally, three such switches are mounted on a rock shaft in a so-called cubicle. The cubicle is normally locked and the switches are manually operated from the outside by means of an operating handle.

Heretofore, it has been more or less conventional for the operating handle to turn a sprocket on the outside of the cubicle or cabinet by means of which a chain running over this outer sprocket and over a drive sprocket mounted on the rock shaft inside of the cabinet operates the switches thereon. By exercising care, experienced operators are usually able to open and close switches of the foregoing type by means of such operating handles, without endangering themselves or the equipment. However, inexperienced operators can easily endanger their own safety and the safety of the equipment by incorrect procedure in operation of the switches. For example, the operator, instead of continuing through the complete movement of the operating handle from one position to the other, once he has started the operation, may pause or hesitate during the operation, and, if this happens at certain critical stages in the operation of the switch, serious arcing may occur endangering the personal safety of the operator and resulting in severe damage to the equipment.

To minimize arcing and wear on the equipment, the switches should be opened and closed promptly and firmly, that is, with a quick, positive type of movement. If the operator moves the operating handle slowly or haltingly, quick closing and opening action will not be obtained even though the operator does not actually interrupt his opening and closing movement. This will give rise to excessive arcing and endanger the operator and the equipment.

In accordance with the present invention there is provided a spring actuated mechanism which may be readily installed on existing equipment as well as on new equipment, which will serve to eliminate the incorrect operation of switches of the type mentioned and assure the correct operation of the switches at all times, whether by experienced or inexperienced operating personnel. In other words, the mechanism provided by this invention is foolproof and removes the hazards which are normally associated in the operation of this type of switch.

Springs for operating electrical switches are known. However, in addition to being subject to improper operation as above pointed out, these known mechanisms have had other deficiencies. For example where springs serve to operate the switches, at least in the final opening and closing movements thereof, the switches often do not go or stay fully closed or fully opened. In the spring actuated mechanisms provided by the present invention, it is a specific feature thereof to provide for the positive final opening and final closing so as not to have to depend upon the spring for these final or terminal movements.

Since considerable periods may elapse between operations of switches of the type mounted in cubicles, there is a chance that the switch blades may become more or less "frozen" or "stuck" and with three being operated at once there may be difficulty encountered in opening such switches if spring action alone is relied on to do this. Accordingly, an important feature freeing or small initial opening movement imparted to the blade prior to the action of a compression spring to move the switches open.

An important object of this invention is the provision of spring actuated mechanisms for operating electrical switches and the like, such as indoor interruptor or arc chute switches mounted in cubicles, which mechanisms are inexpensive, fool-proof in operation, easy to install on either existing or new installations, require little maintenance, and which assure a proper opening and closing movement of such switches in a manner which eliminates or greatly minimizes the hazards normally encountered by reason of the incorrect operation of switches.

Another important object of the invention is the provision of spring actuated mechanisms of the type mentioned whereby the operator may safely discontinue either the opening or closing movement of the switch handle and restore it to its starting position, any time up to a point in the operation where injury may result to personnel or equipment if the movement of the switch is not followed through, but wherein after such a point in the operation has been passed the operator cannot reverse the opening or closing movement.

Another important object of the invention is the provision of spring actuated mechanism of the type described for operating electrical switches wherein spring movement is depended upon to impart a rapid or snap action to the switches in opening or closing but wherein there is a positive mechanical follow-up action at the end of either the opening movement or the closing movement which brings about a full and complete opening or closing as the case may be.

Still another important object of the invention is the provision of spring actuated mechanisms of the type described for operating electrical switches which may be readily adjusted so as to properly operate each set of switches to which it is applied even though there will be variation in the condition of the switches and the particular ease or manner in which they operate.

Certain other objects of the invention will in part, be obvious and will, in part, appear hereinafter.

For a complete understanding of the nature and scope of the invention reference may now be had to the following detailed description of a presently preferred embodiment thereof taken in connection with the accompanying drawings, wherein:

FIG. 1 is a fragmentary view, partly in vertical section, in a front-to-rear direction, and partly in side elevation, taken on the interior of a cubicle containing three arc interruptor or arc chute switches and showing the manner in which the spring actuated driving mechanism of the present invention is operated by a switch operating handle from the exterior of the cubicle, the view being taken on line 1—1 of FIG. 2.

FIG. 2 is a view taken generally on line 2—2 of FIG. 1;
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FIG. 3 is an enlarged, side elevation view (e.g. at one-half actual scale) of the spring actuated switch operating mechanism of the present invention on line 3—3 of FIG. 1;

FIG. 4 is a front elevation view of the mechanism shown in FIG. 3, certain parts being broken away;

FIG. 5 is a top plan view of the mechanism shown in FIGS. 3 and 4 with its stationary mounting and support base portion positioned on line 5—5 of FIG. 4;

FIG. 6 is a front elevation view of the stationary mounting and support fixture forming a part of the spring actuated mechanism;

FIG. 7 is a front elevation view of a combination sprocket support and rotary driving member taken on line 7—7 of FIG. 5, and forming one component of the spring actuated mechanism;

FIG. 8 is a top plan view of the member shown in FIG. 7;

FIG. 9 is a right end elevation view of the member shown in FIGS. 7 and 8;

FIG. 10 is a front elevation view of an actuating lever, taken generally on line 10—10 of FIG. 5, which element forms another component of the spring actuated mechanism;

FIG. 11 is a right end elevation view of the actuating lever shown in line 11—11 of FIG. 10;

FIG. 12 is a top plan view of the actuating lever shown in FIGS. 10 and 11;

FIG. 13 is a perspective view of a crank arm, taken generally on line 13—13 of FIG. 5, which crank forms still another component of the spring actuated mechanism;

and

FIG. 14 is a side elevation view of a sleeve member with depending arm for holding it against rotating.

Referring initially to FIGS. 1 and 2, the front and rear walls of a metal cubicle are indicated at 10 and 11, respectively, while the end walls are indicated at 12 and 13. These walls of the indoor air interrupter switches of known type (only one being shown), indicated generally at 14, are operably connected to a rock shaft 15 which may take the form of a pipe extending horizontally between the walls 12 and 13. The shaft 15 is rotatably supported at one end in a bearing 16 mounted on the wall 13 and its opposite end is rotatably supported from the wall 12 as will be described by the spring actuated switch operating mechanism of the present invention which is indicated generally 17.

Since the switches 14 are of known type, do not form a part of the present invention, and are shown for the purpose of completeness and illustration, the same will not be described in detail. Briefly, each switch 14 comprises movable two-piece blades 18 which are pivotally mounted at the bottom as indicated at 20 and which close or open or straddle their respective contacts 21.

The switches 14 are closed as shown in solid line in FIG. 1 and are open as shown in broken line therein. Each switch blade 18 is operated by means of a link 22 pivotally connected to the blade at approximately the mid-point 23. The link 22 includes an insulator 24 and the outer right end of the link 22 is pivotally connected by a pin 26 to the outer end of an operating arm 25. The arm 25 is adjustable position and clamped in place on the shaft 15 by drawing up the bolt 27. It will be seen that by rotating the rock shaft 15 counterclockwise 90° as viewed in FIG. 1 the switches will be moved to their fully opened position in which the blades 18 are completely separated from the respective contacts 21. When the shaft 15 is rotated clockwise the opposite direction, the switch will be closed. As is usual in this type of switch, switch 14 is provided with an arc interrupter chute 28 (FIG. 1) and an interrupter blade 29 (FIG. 2) the purpose and function of which are well known.

As previously mentioned, the switches 14 do not form a part of the present invention and are shown and described merely by way of illustration to show one type of switch which the spring actuated mechanism of the present invention may be utilized to operate.

The spring actuated mechanism 17 (FIG. 2) includes a drive sprocket 30 which is driven by a means of a chain 31 which extends through a slot opening 32 (FIG. 1) in the front cubic wall 10 and runs over an outer drive sprocket 33 having the same pitch diameter as the sprocket 30. The sprocket 33 is mounted on a support pin 34 extending from the opposite side of a support fitting 35 mounted on the outside of the front wall 10 over the opening 32. The bifurcated inner end of a manual operating handle 36 is secured to opposite ends of the pin 34, thereby being directly connected to the sprocket 33 and providing the means for operating the sprocket 33, the chain 31, and the inner drive sprocket 30.

As shown, when the handle 36 is in the vertical upright position the switches 14 are open, and when the handle is in the full down position the switches are closed. As will be explained below, while the handle 36 and the sprockets 33 and 30 rotate 180 degrees between open and closed position, the rock shaft 15 rotates only 90 degrees since this is all that is required to actuate the switches 14 between the fully opened and fully closed position. The construction of the spring actuated switch operating mechanism 17 will now be described followed by a description of the operation thereof.

One of the main components of the mechanism 17 is the stationary mounting and support fixture or casting 40 (FIGS. 3 and 6) having portions which enter into the functional operation of the mechanism. The casting 40 has a generally cylindrical, flat bottom, dish-shaped head portion 41 at the top and a vertical leg portion 42 which depends therefrom. The casting 40 is mounted inside the wall 12 by the bolts 43 and 44 (FIG. 3), or in any other desired manner. The casting 40 has a hub bearing 45 (FIG. 6) in the center of the head portion 41 which serves as a journal or support bearing for the adjacent end of the drive or rock shaft 15. A circular rim or wall projects forwardly from the flat backside of the casting 40 (i.e. toward the left as viewed in FIG. 3), this wall having a lower shallower portion 46, and an upper deeper or wider upper semi-circular ridge portion 47 with the steps therebetween being indicated at 48—48. The front face surface 49 (FIG. 6) of the ridge 47 lies in a plane which is perpendicular to the axis of the shaft 15.

On the inside or underside of the upper wall portion 47 two crank stops or projections 50 and 51 (FIG. 6) project radially in toward the center of the hub 45 with the opposed faces 52 and 53 respectively of these projections being angularly separated somewhat in excess of 90°, e.g. 100°. As will be pointed out below, the lugs 52—53 permit the shaft 15 to turn or rock 90° and the excess angular spacing is required because of the width of a rocker or crank arm projection.

An arcuate or sector-shaped portion 54 is integrally formed on the top of the casting 40 preferably being concentric with the bearing hub 45. The canopy 54 is provided on the underside with two sets of oppositely directed ratchet teeth 55 and 56 having a function to be described.

Returning to the previously mentioned drive sprocket 30 (FIG. 5), this sprocket being integral hub portion 60 on its rear side which telescopes over a hub 61 projecting from the front side of a sprocket support and rotary driving member 62 (FIGS. 7, 8, and 9). This assembly is rotatably mounted on the rock shaft 15 and prevented from moving outward thereon by means of a collar 63 secured to the inner face of the collar hub 61 projecting from the front side of a sprocket support and rotary driving member 62 (FIGS. 7, 8, and 9). This assembly is rotatably mounted on the rock shaft 15 and prevented from moving outward thereon by means of a collar 63 secured to the inner face of the collar hub 61 projecting from the front side of a sprocket support and rotary driving member 62 (FIGS. 7, 8, and 9). This assembly is rotatably mounted on the rock shaft 15 and prevented from moving outward thereon by means of a collar 63 secured to the inner face of the collar hub 61 projecting from the front side of a sprocket support and rotary driving member 62 (FIGS. 7, 8, and 9). This assembly is rotatably mounted on the rock shaft 15 and prevented from moving outward thereon by means of a collar 63 secured to the inner face of the collar hub 61 projecting from the front side of a sprocket support and rotary driving member 62 (FIGS. 7, 8, and 9). This assembly is rotatably mounted on the rock shaft 15 and prevented from moving outward thereon by means of a collar 63 secured to the inner face of the collar hub 61 projecting from the front side of a sprocket support and rotary driving member 62 (FIGS. 7, 8, and 9).
respectively, therein for receiving pins 69 and 70 (FIG. 3) for connecting the sprocket 30 to the member 62 so as to eliminate any relative motion therewith. On the rear side of the left hand side as viewed in FIGS. 5 and 7. On the opposite side of the opening 64, the member 62 has a projecting arm 72 the front side of which is flush with the base of the bosses 65 and 66, and the back of which is flush with the rear side of this member. The arm 72 is provided at its outer end with a hole 73 for receiving a pawl supporting pin 74 (FIG. 5) on which is mounted a pawl 75. On the rear of the arm 72 there projects a pair of parallel apertured ears 76 and 77 (FIG. 8) for supporting a pin 78 (FIG. 5) extending therebetween. A pair of upper and lower catches 80 and 81 (FIG. 3) are mounted on the pin 78 for pivotal movement in a front-to-rear direction. Each of the catch-members 80 and 81 is similarly shaped having a solid, somewhat curved outer portion (FIG. 3) and a bifurcated inner or mounting portion. These bifurcated inner portions interfit on the pin 78 as best shown in FIG. 5. A coil spring 85 (FIG. 5) is mounted on the pin in the space between the legs of the members 80 and 81 with the projecting opposite ends 86 and 87 of the spring bearing against the front sides of the members 80 and 81 as shown in FIG. 3. Thus, as viewed in FIG. 5, the ends of the spring 85 tend to return the pawl 75 to its original position thus forcing the pawl 75 to the right, i.e., the members 80 in a clockwise direction, and member 81 in a counterclockwise direction as viewed in FIG. 3.

The pawl 75 is biased in a radial or outwardly pointing position as shown in FIGS. 4 and 5, by means of a tension spring 88, one end of which is hooked to the back of the pawl 75 and the other end of which hooks over a pin 90 which projects through a hole 91 (FIG. 7) in the member 62.

The combination of the sprocket 30 and the sprocket support member 62, together with the pawl 75 and the catch members 80 and 81 comprise the rotary motion transmitting assembly.

Continuing the description of the components in their front-to-rear relationship, behind the combination sprocket support and rotary driving member 62 and its associated parts which have just been described, is a symmetrically shaped crank and spring actuating lever 91 shown in FIGS. 10, 11, and 12. This lever 91 has a center hub portion 105 which fits over the rock shaft 15 and is rotatable thereon. On the left as viewed in FIGS. 10 and 12 it has a spring attaching arm 93 the outer end of which is apertured at 94 whereby one end of a compression spring assemblage 96 (FIG. 4) may be pivotally connected as will be described below.

On the front side of lever 91 (i.e. toward the sprocket 30) a pair of driving ears 96 and 97 (FIG. 10) are integrally formed, the opposed driving faces thereof being angularly spaced about 110°. On the back side and opposite the arm 93 there projects a flat sector-shaped portion 98. The sector portion 98 has two catch-engagers in the form of forwardly projecting front projections 100 and 101 at the opposite extremities thereof. On the rear side of the sector portion 98 adjacent the opposite sides thereof there are rearwardly projecting legs 102 and 103 (FIG. 11) which are driven by sides of the legs 102 and 103 are angularly spaced 90° plus the angular width of a crank arm 104 (FIG. 13).

The crank arm 104 is mounted rearwardly of the actuating lever 91, and fits against the front side of the center hub portion (FIG. 5) of the casting 40. As distinguished from all of the other parts of the spring actuated mechanism herebefore described, the driving lever 104 is fastened to the drive shaft 15 so as not to be rotatable thereon. It has a split collar portion 105 which fits over the drive shaft 15 with the collar being provided with a pilcuring set screw 106. The collar 105 will be split at one side so as to be in the form of a clamp which may be drawn up by means of the clamping bolt 107. Projecting from the hub portion 105 is an arm portion 108 which is stepped so as to have a lower step portion 110 on the outer end for engaging the stop lugs 93 and 94 on the fixture 40 (FIG. 4) and a higher or thicker inner step portion 111 adapted to be engaged by the lugs 92 and 103 on the actuating lever 91.

The spring 95 controls and operates the mechanism 17 for critical portions of its operation. It is a relatively heavy compression spring which fits over an elongated bolt 113 (FIG. 4) the upper end of which is provided with a lifting nut 112 having a pair of apertures which straddle the aperture arm 93 of the member 91 with a pin 114 extending therethrough and secured in place by means of cotter pins 115 and 116.

At the bottom, the bolt 112 fits telescopically within an externally threaded sleeve 117 (FIG. 4) which is screwed through a threaded eye 118 formed on the outer end of a bolt or pin 120 (FIG. 3) which is rotatably supported in a boss 121 provided on the front face, bottom end, of the leg portion 42 of the support casting 40. The pin 120 is secured in place by means of a cotter pin 122. The outer end of the threaded sleeve 117 carries a jam nut 123 which may be tightened against the under side of the eye 118 to lock the sleeve 117 in place after adjustment. The upper end of the spring 95 bears against the integral washer portion 125 of the fitting 113 while the lower end presses against a washer 126. It will be seen that the degree of compression on the spring 112 may be adjusted by loosening the jam nut 123 and using a screw driver in the aligned notches 124 on the bottom of the sleeve 117 (FIG. 4) to rotate the threaded sleeve 117.

The various parts of the spring actuated assembly 17 are mounted on the shaft 15 in the relative position shown in FIGS. 3, 4, and 5, the purpose of which relationship will be clearer from the following description of the operation of the mechanism. On installation the various members are slipped in the proper order over the adjacent end of the shaft 15 before the casting 40 is fastened to the wall 12. They are then oriented and secured in place thereon.

While the parts may be placed directly over the shaft 15, it is preferred to first slip over the end of the shaft 15 a sleeve member 126 (FIG. 14) having at its rear end a depending tab or arm 127 which is notched as shown at 129 (FIG. 4) to fit over a pin 130 projecting from the casting 40. This arrangement serves to lock the sleeve 126 from turning on the shaft. It has been found that the presence of the sleeve member 126 prevents binding of the parts and minimizes the need for adjusting the mechanism.

In operation: In the drawings, all of the parts shown in full line correspond to the position which they occupy when properly adjusted and when the switches 14 (FIGS. 1 and 2) are closed. A padlock (not shown) which is usually secured to the operating handle 36 to prevent tampering, is removed and the operator grasps the grip at the top of the handle and pulls it out and up, preferably in a continuous movement. This produces a corresponding rotation of the drive sprocket 30 which turns on the rock shaft 15. Since the sprocket support member 62 is pinned to the sprocket 30 it is also caused to rotate on shaft 15 carrying with it the pawl 75 and the spring-biased stop members 80 and 81. It will be seen from FIGS. 3 and 5 that the outer ends of these members 80 and 81 engage the floor of the sector 98 on the actuating lever 91, except when raised therefrom one at a time as will be described. As will be described herein after, the member 80 is for engaging the raised portion or projection 100 on the lever 91, while the member 81 is for engaging projection 101 to bring the switches 14 to their fully open position if the action of the spring 95 does not fully accomplish this, while the member 81 is for engaging projection 101 to bring the switches 14 to their fully open condition if the spring action has not done this.

The sprocket 30 and the member 62 with the parts support thereon are free to turn or rotate approxi-
mately 75 degrees counter-clockwise, on the shaft 15 from their position as shown in FIG. 4. At the end of this initial movement indicated by line A, the pawl 75 will have previously engaged the adjacent edge of the canopy 54 on the fixture 40 and this will have caused the pawl to tilt clockwise so as to lie flat as it passes under the teeth 55. Also at the end of the first 75° of movement the boss 71 projecting on the rear of the member 62 will have moved sufficiently so as to engage the driving ear 97 (FIG. 10) on the actuating lever 91. By reason of engagement of boss 71 on the end of the counter clockwise rotation of the sprocket 30 and the support member 62 will produce a corresponding counter-clockwise rotation of the actuating lever 91. During the next 60 degrees of counter-clockwise movement of the operating handles 36, sprocket 30, support member 62 and actuating lever 91, to the place where arm 72 on member 62 registers with line B in FIG. 4, the spring 95 is compressed but is not yet brought to its so-called "toggle" position, i.e. where the spring is approximately in its vertical position, under maximum compression, and just ready to snap to its alternate position. At the end of this 60 degrees of movement indicated by line B in FIG. 4 (i.e. a total of 135° for the sprocket 30 and support member 63 and 60° for the actuating lever 91) the lug 103 on the rear side of the sector 98 of the actuating lever 91 will engage the inner step 111 on the crank arm 104. Also at the end of the 60° of movement the part will be almost (but not quite) under the uppermost tooth 56 which, on further rotation, serves to catch the pawl and retain it and the parts associated therewith so as to prevent rotation in a reverse direction. Hence, right up to the end of the 60° of movement and before the pawl 75 has been so caught under one of the teeth 55, it is possible for the operator to reverse the movement of the operating handle 36 and the various parts without in any way disturbing the switches 14.

However, starting at the end of this 135° of movement (60° for the spring attaching arm 93) additional movement of the operating handle 36 in the upward direction will bring the pawl 75 under the uppermost tooth 56 and from then on it is not possible for the operator to reverse movement of the handle 36 without first continuing on and opening the switches 14. Starting at the end of the 135° of movement of the handle 36 and the parts turned therewith, the crank arm 104 will now be rocked counter-clockwise, turning with it the rock shaft 15 to which it is keyed. Hence, opening forces will be applied to each of the switches 14 and the blades 18 will begin to move slightly but without separating from their spring contacts 21. However, this slight initial movement of the blades 18 is important since it serves to free the blades in case they have been stuck due, for example, due to not having been opened for some time. During the next 15° of movement of the arm 72 starting at line B, the compression spring 95 will be brought to "on toggle." After the spring 95 has thus been brought onto toggle following a total of 150° of the operating handle 36 as indicated by line C (FIG. 4) the spring 95 will go "over toggle" at any time or within the succeeding 15° of rotation of the handle 36. The exact time and place where the spring 95 takes over and goes "over toggle" depends upon such factors as the adjustment of the parts, the friction between various parts, the force required to operate the switches, and a number of similar factors.

Some place during this next 15° of movement of the arm 72 from line C to line D, the spring 95 will go over toggle and take over the operation of the mechanism temporarily. It will be seen that since the spring 95 is connected to the arm 93 of the actuating lever 91, when the spring 95 snaps over toggle it will carry the actuating lever 91, with it in a fast counter-clockwise movement to the position of the spring shown in broken line in FIG. 4. During this movement the actuating lever 91 by means of its rear driving lug 103 will serve to continue to engage and turn the crank arm 104, and thus drive the shaft 15 through the remainder of its 90° of movement, thus completely opening the switches 14.

After the spring 95 has gone over toggle and opened the switch 80, the operating handle still has anywhere from 15° to 30° to go before it will be in the fully down and open position. The spring 95 may not have quite opened the switches 14 to the fullest extent, or there may have been some back lash or re-bound after full opening. However, the projection 100 at the upper end of the actuating lever 91 will engage the catch member 80 which engagement serves to continue the rotation of the actuating lever 91 and thereby the crank arm 104 and the shaft 15 so as to bring the switches 14 to their fully open position.

It should be mentioned that prior to the time that the spring 95 goes over toggle and temporarily takes over opening of the switches, the trailing spring catch member 81 will be riding on the front cam surface 49 of the arcuate ridge 47 of the casting 40. This raises the catch 81 sufficiently from the sector portion 98 so that the trailing projection 101 will clear and pass under the stop 81 during the snap movement of the actuating lever 91 when the spring goes over toggle.

In the closing the switches 14 from their open position by means of the operating handle 36, a reverse sequence occurs. That is, during the first 75° of downward rotation of the handle 36 and the 60° of movement of the sprocket 30 and the parts associated therewith, only the sprocket 30 and the support member 63 with the parts mounted thereon will rotate on the shaft 15. At the end of this 75° of movement the paw 75 will have just tilted under the left hand edge (as viewed in FIG. 4) of the canopy portion 54 on the fixture 40 and the driving lug 71 on the rear of the member 62 will have just engaged the driving ear 96 on the actuating lever 91. During the next 60° of movement the spring 95 will be compressed as the arm 93 rotated downwardly in a clockwise direction. At the end of the initial 75° of clockwise movement the rear lug 102 on the rear of the actuating lever 91 will come into engagement with the left hand side of the step 108 of the crank arm 104. After 135° of rotation of the handle, the paw 75 will just be ready to come under the uppermost tooth 55, but will not quite have done so. Accordingly, if the operator desires, he may at this point or at any previous point return the handle to the up and fully open position without in any way moving the switches 14. However, on further movement the paw 75 will come under the uppermost tooth 55 and thereafter the handle 56 cannot be reversed or pushed down until after the switches 14 have first been fully closed.

As on opening, starting at the end of the 135° of upward movement, the spring 95 will be compressed to the toggle position during the next 15° of movement, and at some place during the succeeding 15° of movement. In going over toggle, the spring 95 will drive the actuating lever 91 in a clockwise direction and thereby continue to operate the crank arm 104 in the clockwise direction. During the snap action produced by over toggle position of the spring 95, the shaft 15 will be driven through the remainder of its 90° clockwise movement causing the switches 14 to be closed with a firm snap action.

At the end of the movement of the spring 95 when it goes over toggle, the operating handle or lever 36 will still have anywhere from 15° to 30° of movement before it is in its full upright position. In the event that the switches are not fully closed or have rebounded slightly from their fully closed position, the now leading catch 81 will engage the projection 101 on the sector portion 98 and produce continued clockwise rotation of the actuating lever 91 carrying with it the crank arm 104 and also the shaft 15. This insures that the switches 14 will be
brought to their fully closed position and remain there when the handle 36 is in its full position.

The now trailing member: 80 will be raised from the sector 86 in the surface 49 of the arcuate ridge 47 when the spring 95 goes over toggle during closing. This prevents interference with the snap action produced by the spring.

In view of the foregoing description it will be apparent that the spring actuated switch operating mechanism breaks down into the following components: a crank 104; a crank and spring actuating lever 91; first inter-engaging means in part on the crank and in part on the actuating lever, being the projection or inner step portion 108 on the crank and the projecting lugs 102 and 103 on the actuating lever; rotary driving means 62; second inter-engaging means in part on the actuating lever and in part on the rotary driving means, being the driving ears 96 and 97 and the lug or boss 71; and, toggle spring 95 and its associated means. In addition there is a ratchet and pawl means operably connected to the rotary driving means 62 (being the pawl 75 pivotally mounted thereon and the arcuate canopy 54 with its two sets of ratchet teeth 55 and 56), and cam means in the form of the arcuate ridge 47 for raising catch means 80 and 81.

It will be apparent that certain changes, and substitutions may be made in the foregoing components so long as the respective functions thereof are retained. Since changes may be made, and other embodiments of the invention produced, without departing from the spirit and scope of the invention, all matter described above or shown in the accompanying drawing is intended to be interpreted as illustrative and not in a limiting sense.

1. A spring actuated mechanism for operating devices coupled to a rock shaft, comprising, a crank adapted to be fixed on said shaft, a crank and spring actuating lever adapted to be rotatably mounted on said shaft adjacent to said crank, interengaging means on said crank and said actuating lever whereby said lever turns said crank in opposite directions with angular lost motion between such opposite movements, rotary driving means adapted to be rotatably mounted on said shaft in juxtaposition to said actuating lever, second interengaging means on said actuating lever and rotary driving means whereby said driving means turns said actuating lever in opposite directions with angular lost motion between such opposite movements, toggle spring means operably connected with said actuating lever for driving it in opposite directions with a snap-action as said means goes over center, and ratchet and pawl means operably connected with said rotary driving means for preventing reverse rotation thereof after reaching a predetermined position in at least one direction of rotation until after said toggle spring means goes over center.

2. A spring actuated mechanism for operating devices coupled to a rock shaft, comprising, a stationary fixture having a canopy-like formation adapted to overhang said shaft and having spaced oppositely directed ratchet teeth on the underside thereof, a crank adapted to be fixed on said shaft to rock the same, a crank and spring actuating lever adapted to be rotatably mounted on said shaft adjacent said crank, interengaging means on said crank and said actuating lever whereby said lever turns said crank in opposite directions with angular lost motion between such opposite movements, rotary driving means adapted to be rotatably mounted on said shaft in juxtaposition to said actuating lever, second interengaging means on said actuating lever and rotary driving means whereby said driving means turns said actuating lever in opposite directions with angular lost motion between such opposite movements, pivotally mounted on said shaft in juxtaposition to said actuating lever, second interengaging means projecting from said actuating lever and said rotary driving means whereby said driving means turns said actuating lever in opposite directions with angular lost motion between such opposite movements, engaging said spaced ratchet teeth and thereby preventing reversal of movement of said driving means after said pawl catches on one of said ratchet teeth until after additional movement in the same direction, and toggle spring means pivotally connected adjacent one end to said actuating lever outwardly from the axis of rotation thereof and adapted to be pivotally connected adjacent the other end to fixed support means.

3. A spring actuated mechanism for operating devices coupled to a rock shaft, comprising, a crank adapted to be fixed on said shaft, a crank and spring actuating lever adapted to be rotatably mounted on said shaft adjacent to said crank, interengaging means on said crank and said actuating lever whereby said lever turns said crank in opposite directions with angular lost motion between such opposite movements, rotary driving means adapted to be rotatably mounted on said shaft in juxtaposition to said actuating lever, second interengaging means on said actuating lever and rotary driving means whereby said driving means turns said actuating lever in opposite directions with angular lost motion between such opposite movements, toggle spring means operably connected to said actuating lever for driving it in opposite directions with a snap-action, said first interengaging means starting to rock said shaft in at least one direction before said toggle spring means goes over center in that direction.

4. A spring actuated mechanism for operating devices coupled to a rock shaft, comprising, a crank adapted to be fixed on said shaft, a crank and spring actuating lever adapted to be rotatably mounted on said shaft adjacent to said crank, interengaging means on said crank and said actuating lever whereby said lever turns said crank in opposite directions with angular lost motion between such opposite movements, toggle spring means operably connected with said actuating lever for driving it in opposite directions with a snap-action as said means goes over center, at least one catch engage on said actuating lever, a catch on said rotary driving means for each catch engage, each catch coming into engagement with the catch engage therefor after said toggle spring means has been driven over-center in one direction, and cam means for holding each catch out of the path of its catch engage when said actuating lever is driven with snap action in opposite directions.

5. A spring actuated mechanism for operating devices coupled to a rock shaft comprising, a stationary fixture having a generally arcuate ridge formation the front surface of which lies in a plane approximately at right angles to the axis of said shaft, a crank adapted to be fixed on said shaft to rock the same, a crank and spring actuating lever adapted to be rotatably mounted on said shaft in juxtaposition to said actuating lever, second interengaging means on said actuating lever and rotary driving means whereby said driving means turns said actuating lever in opposite directions with angular lost motion between such opposite movements, pivotally mounted on said shaft in juxtaposition to said actuating lever, second interengaging means projecting from said actuating lever and said rotary driving means whereby said driving means turns said actuating lever in opposite directions with angular lost motion between such opposite movements, pivotally mounted on said shaft in juxtaposition to said actuating lever, second interengaging means projecting from said actuating lever and said rotary driving means whereby said driving means turns said actuating lever in opposite directions with angular lost motion between such opposite movements, engaging said spaced ratchet teeth and thereby preventing reversal of movement of said driving means after said pawl catches on one of said ratchet teeth until after additional movement in the same direction, and toggle spring means pivotally connected adjacent one end to said actuating lever outwardly from the axis of rotation thereof and adapted to be pivotally connected adjacent the other end to fixed support means.
6. A spring actuated mechanism for operating devices coupled to a rock shaft, comprising, a crank adapted to be fixed on said shaft, a crank and spring actuating lever adapted to be rotatably mounted on said shaft adjacent to said crank, interengaging means on said crank and said actuating lever whereby said lever turns said crank in opposite directions with angular lost motion between such opposite movements, rotary driving means adapted to be rotatably mounted on said shaft in juxtaposition to said actuating lever, second interengaging means on said actuating lever and rotary driving means whereby said driving means turns said crank in opposite directions with substantially 90° lost motion permitted between such opposite movements, toggle spring means operably connected with said actuating lever for driving the same in opposite directions with a snap-action as said means goes over center, ratchet and pawl means operably connected with said rotary driving means for preventing reverse rotation thereof after reaching a predetermined position in at least one direction of rotation until after said toggle spring means goes over center, at least one catch engaged on said actuating lever, a catch on said rotary driving means for each catch engaged, each catch coming into engagement with the catch engaged thereof after said toggle spring means has been driven over-center in one direction, and cam means for holding each catch out of the path of its catch engaged when said actuating lever is driven with snap action in the opposite direction.

7. A spring actuated mechanism for rocking a rock shaft through substantially 90° comprising, a crank adapted to be fixed on said shaft, a crank and spring actuating lever adapted to be rotatably mounted for at least 150° movement on said shaft adjacent said crank, first interengaging means on said crank and said actuating lever whereby said lever turns said crank in opposite directions with substantially 90° lost motion permitted between such opposite movements, rotary driving means adapted to be rotatably mounted for at least 180° movement on said shaft in juxtaposition to said actuating lever, second interengaging means on said actuating lever and rotary driving means whereby said driving means turns said actuating lever in opposite directions with at least 90° angular lost motion permitted between such opposite movements, toggle spring means operably connected with said actuating lever for driving the same in opposite directions with a snap-action as said means goes over center, ratchet and pawl means operably connected with said rotary driving means for preventing reverse rotation thereof after said crank has started to turn but before said toggle spring means goes over center until after the later movement has occurred, a pair of angularly spaced catch engaged on said actuating lever, a separate catch on said rotary driving means for each of said catch engaged with each catch coming into driving engagement with its catch engaged after said toggle spring means has been driven over-center in one direction for driving said actuating lever to the end of its 90° movement in one direction, and cam means for holding each catch out of the path of its catch engaged when said actuating lever is driven with snap action in the opposite direction.

8. A spring actuated mechanism for operating switches and the like which are adapted to be operably mounted on said shaft, comprising, a stationary mounting and support fixture having a head portion and an elongated portion, said head portion having a hub and bearing for receiving said shaft arm, an arcuate ridge in spaced relation around said hub with the front face thereof lying in a plane substantially at right angles to said shaft arm, an arcuate canopy overhanging said ridge in spaced relationship therewith and having at least two angularly spaced, oppositely directed, ratchet teeth formed on the underside thereof, a crank arm secured on said shaft on the front side of said head portion, a symmetrically shaped crank and spring actuating lever rotatably mounted on said shaft in front of said crank arm and having a pair of angularly spaced rearwardly projecting lugs disposed for alternately engaging said crank arm from opposite sides so as to rock said shaft arm in opposite directions, a pair of front projections adapted to be alternately engaged by said rearwardly projecting lugs, a pair of driving ears angularly spaced a distance approximately equal to the spacing of said lugs and disposed to be alternately engaged by a driving lug, and a laterally projecting spring attaching arm, said arm and driving ears being on one side of the center of said actuating lever and said rearwardly projecting lugs and said front projections lying on the opposite side of said center; a rotary motion transmitting assembly comprising a support member rotatably mounted on said shaft in front of said actuating lever and having a rearwardly projecting driving lug adapted to alternately engage said driving ears and thereby turn said actuating lever in opposite directions, a pawl support, a rearwardly projecting catch support means for a pair of catches, a pawl pivotally mounted on said support thereof, spring means for biasing said pawl in a radially pointed direction, said pawl having such length as to be past the opposite ends of said canopy and tilt downward so as to pass underneath said canopy and alternately lockingly engage said ratchet teeth to prevent reserve movement of said support member until said pawl has cleared the end of said canopy opposite the end that was entered, a pair of rearwardly directed and biannularly spaced member pivotally mounted on said support member so as to pivot in a front-to-rear direction, spring means for rearwardly biasing said catch members whereby each catch is disposed to engage one of said front projections on said actuating lever, said catch members having por-
tions which ride on said ridge surface and thereby lift the same frontwardly so as to clear said front projections and a sprocket attached to the front side of said support member for rotating the same; and, a compression spring assembly having one end pivotally attached to said spring attaching arm and the other end pivotally attached to said elongated fixture portion at a point removed from said fixture hub, said spring being compressed to toggle condition when approximately in line with said fixture hub, and on passing over toggle in either direction acting to drive said actuating lever and crank independently of said rotary motor transmitting assembly.

10. The mechanism called for in claim 2 wherein said crank and spring actuating lever and said rotary driving means are separated from direct contact with said rock shaft by a closely fitting sleeve member mounted thereon.

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