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ELECTRIC SWITCH

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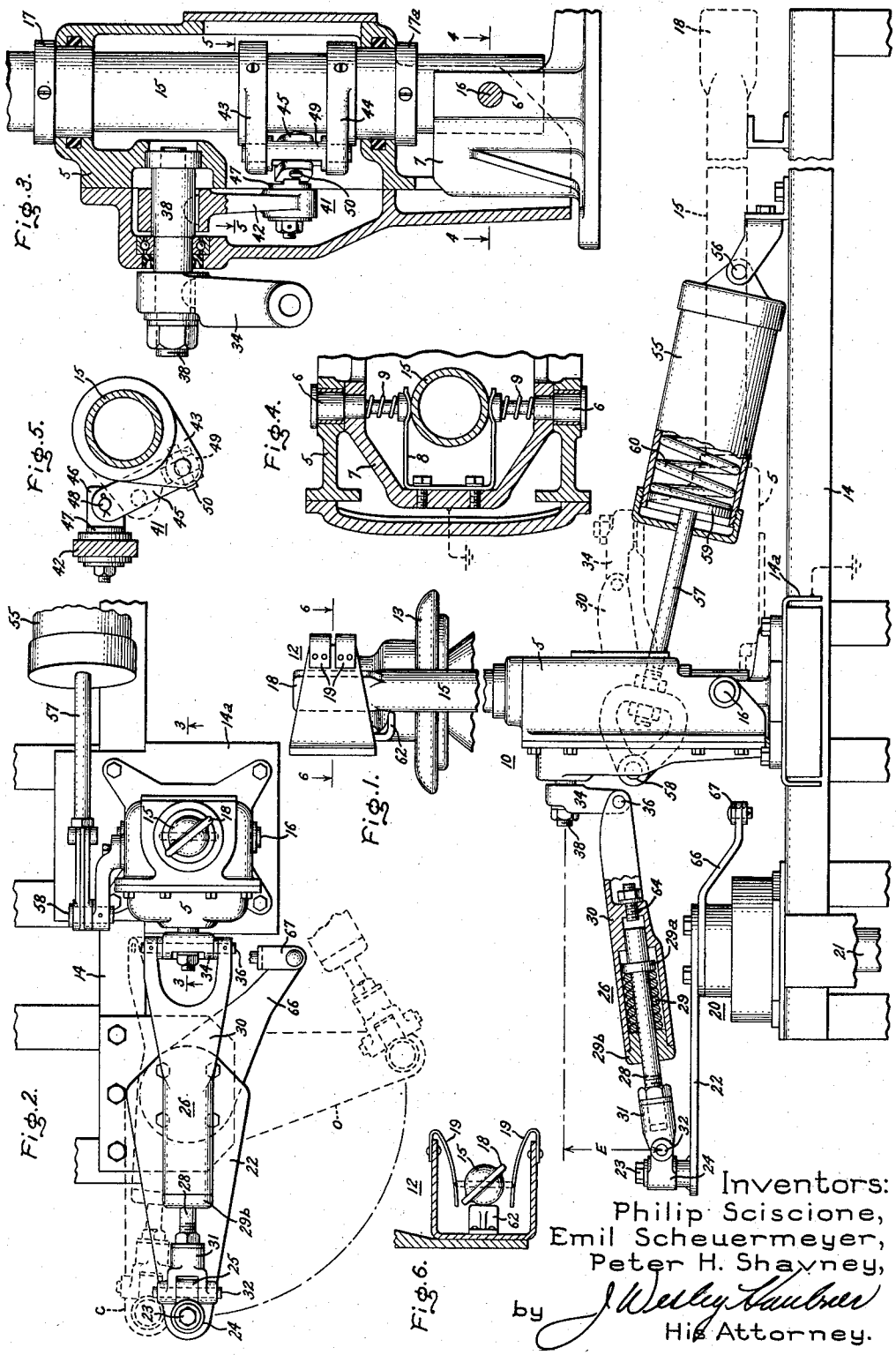

Fig. 3.

Fig. 5.

Fig. 4.

Fig. 1.

Fig. 2.

Fig. 6.

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# ELECTRIC SWITCH

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19 Claims. (Cl. 200—48)

This invention relates to an electric switch and, more particularly, to an electric switch of the type comprising an elongated switch blade which is rotatable about its longitudinal axis for the purpose of establishing high pressure contact between the switch blade and a cooperating stationary contact.

Typically, the blade of such a switch, in addition to being rotatably-mounted is also pivotally-mounted for swinging movement with respect to the stationary contact so as to provide for effective contact isolation. The most convenient source of power from which to obtain the forces necessary to produce this combination of rotary and swinging motions is usually a vertically-extending, rotatable operating shaft. For certain applications, there are mechanisms available which, when driven by such a vertically-extending shaft, are capable of imparting the desired motion to the switch blade. A typical example of such a mechanism is shown in U. S. Patent No. 2,531,165, issued to E. Scheuermeyer and assigned to the assignee of this invention. Such mechanisms, however, are suitable only for those applications in which the switch blade, in closed-circuit position, where it is to be rotated, is disposed generally horizontally. For a switch wherein the blade is to occupy a vertically extending closed-circuit position, i. e., a position parallel to the operating shaft, these mechanisms are incapable of imparting the required rotary motion to the blade. Insofar as we are aware, there are no commercially practical mechanisms which are available for such service.

Accordingly, it is a primary object of our invention to provide a novel switch operating mechanism which, when driven by a rotatable operating shaft, is capable of swinging a switch blade into and out of a circuit-closing position generally parallel to said shaft and of rotating said blade about its longitudinal axis when in said circuit-closing position.

It is a further object of our invention to provide for a switch of the above type an operating mechanism which, during closing, positively positions the switch blade with its longitudinal axis in a predetermined position prior to rotation of the blade into high pressure engagement with the stationary contact.

For imparting the desired rotation and swinging movement to the switch blade, there is provided, in accordance with one form of our invention, an operating shaft which extends generally parallel to the longitudinal axis of the switch blade when in its closed circuit position. Coupled to the operating shaft is a radially extending crank which is movable in an arc the major portion of which is located at a side of said operating shaft generally opposite to the location of said switch blade. For transmitting motion from said crank to said switch blade, there is provided a swivel link pivotally connected at one of its ends to said crank. The other end of said swivel link is interconnected to the switch blade by means of a mechanism which is operable to effect rotation of said blade in response to movement of said crank through and adjacent a dead center position with respect to said



swivel link and which is operable to effect swinging movement of said blade in response to movement of said crank through the remainder of its arc.

The swivel link is constructed as a resiliently extensible member having sections which are movable relative to each other to permit blade-rotating forces to be transmitted through the link to the switch blade. In accordance with another feature of our invention, means are provided for positively limiting the elongation of said extensible link in response to movement of said crank into its dead center position. This latter feature insures that mechanism will positively position the switch blade within the stationary contact before the blade is rotated into high pressure engagement therewith.

Our invention will be better understood from the following description when considered in connection with the accompanying sheet of drawing, and its scope will be pointed out in the appended claims.

In the accompanying sheet of drawing, Fig. 1 is a side elevational view of an electric switch embodying our invention, and showing the blade of the switch positioned within the stationary contact; Fig. 2 is a plan view of the switch shown in Fig. 1, the stationary contact being omitted for clarity; Fig. 3 is a cross sectional view along the line 3—3 of Fig. 2; Fig. 4 is a cross sectional view along the line 4—4 of Fig. 3; Fig. 5 is a cross sectional view taken along the line 5—5 of Fig. 3; and Fig. 6 is a sectional view taken along the line 6—6 of Fig. 1 and showing the switch blade in different positions within the stationary contact.

In the embodiment of our invention shown in Fig. 1, we have illustrated a single-pole, outdoor grounding switch 10 which is utilized for connecting and disconnecting a stationary contact 12 and a grounded terminal 14*a*. The switch is mounted on a grounded framework 14, which carries a vertically extending stack of insulators 13, at the top of which the stationary contact 12 is mounted. In general, the switch 10 comprises an elongated switch blade 15 which is pivotally-mounted about an axis 16 for swinging movement into and out of a circuit-closing position within the stationary contact 12. The solid lines of Fig. 1 illustrate the position of the blade when in such a circuit-closing position, and the dotted lines illustrate the position of the blade when in a fully-open position.

In addition to being pivotally mounted, the blade 15 is also mounted for rotation about its own longitudinal axis. As is well known in this art, this blade rotation enables the flattened end 18 of the blade to fracture any ice which may be formed upon the stationary contact and to establish a high pressure contact between the switch blade and the stationary contact. The manner in which blade rotation establishes this high pressure contact is perhaps best illustrated in Fig. 6 wherein the flattened end 18 of the blade is shown seated between the usual resilient jaws 19 of the stationary contact 12. For a closing operation, the solid lines of Fig. 6 indicate the position of the flattened end immediately prior to effective blade rotation and the dotted lines indicate the position after such rotation. From this figure, it may be seen that this rotation will wedge the flattened end 18 between the resilient jaws 19, thereby establishing high pressure contact between the blade and the jaws. Reverse rotation of the blade will, of course, release this pressure, as will soon appear from a description of a switch-opening operation.

To illustrate more specifically the manner in which the blade 15 is mounted for rotary and swinging movement, reference is had to Figs. 3 and 4. In these figures the blade 15 is shown journalled for rotation in a housing, or support, 5. Suitable collars 17 and 17*a* secured to the switch blade in axially-spaced relationship cooperate with the housing 5 to prevent axial movement of the blade rela-

tive to the housing. This housing 5, which rotatably carries the switch blade, is shown pivotally-mounted on a pair of aligned pins 6 forming the pivot axis 16. These pins 6 are fixed to a rigid U-shaped bracket 7 which, in turn, is suitably secured to the grounded terminal 14*a* and the framework 14. Thus, when the housing 5 is swung about the pivot pins 6, a corresponding swinging movement is transmitted to the blade 15.

For electrically connecting the grounded bracket 7 and the switch blade 15, there is provided a U-shaped contact 8 suitably pressed into engagement with the cylindrical surface of the switch blade by springs 9. This contact arrangement forms no part of the present invention and simply acts to maintain an electrical connection between the bracket 7 and the blade 15 for all positions of the blade. Such an arrangement is described in greater detail in the above-mentioned Scheuermeyer patent.

For imparting the desired rotary and swinging movements to the blade, we have provided an operating mechanism 20 which is driven by a vertically-extending operating shaft 21 suitably journalled upon the stationary framework 14. This shaft 21 may be actuated either manually or by suitable power means such as an electric motor. The operating mechanism 20 comprises a crank 22 rigidly coupled to the shaft 21 and extending radially outwardly therefrom. At its outer radial end the crank 22 carries a vertically-extending spindle 23 upon which is rotatably mounted a swivel 24 including a transversely projecting tongue 25. Coupled to this swivel 24 is a resiliently extensible swivel link 26 having two relatively-rotatable and telescoping sections 28 and 30. A suitable compression spring 29 is disposed between a pair of stops 29*a* and 29*b* respectively fixed to the sections 28 and 30. This spring continuously acts in a direction to shorten the swivel link 26. Additional features of this extensible swivel link will soon be pointed out in greater detail.

Fixed to the telescoping section 28 is a yoke 31, which is pivotally joined to the tongue 25 by means of a suitable pivot pin 32. The outer end of the other telescoping section 30 is bifurcated to receive an intermediate crank 34 and is pivotally joined thereto by means of a suitable pivot pin 36. This intermediate crank 34 is keyed to an intermediate operating shaft 38 which is suitably journalled in the pivotally-mounted blade housing 5. As will soon appear more clearly, rotation of this intermediate shaft 38, which extends transversely relative to the switch blade 15, produces rotation of the switch blade, whereas bodily movement of the intermediate shaft is effective to swing the housing 5, and hence, the blade 15 about the common pivot axis 16.

For converting rotary motion of the intermediate shaft 38 into rotation of the switch blade 15, a linkage 41 is provided within the housing 5. This linkage is best seen in Figs. 3 and 5 and comprises a driving arm 42 keyed to the itnermediate shaft 38 and driven arms 43 and 44 pinned to the switch blade 15. The driving and driven arms are interconnected by a link 45 universally connected at opposite ends to the arms. More specifically, this link 45 is slotted in mutually perpendicular planes at its opposite ends. The slot at one of these ends receives a flattened tongue portion 46 of a pin 47, which is suitably mounted for free rotation within an aperture formed in the outer end of the driving arm 42. A pivot pin 48 freely extending through registering apertures in the flattened tongue portion 46 and in the link 45 pivotally interconnects the pin 48 and the link 45. The slot at the other end of the link 45 receives the flattened portion of a driven rod 49. This rod 49 extends between the driven arms 43 and 44 and is rotatably mounted in suitable registering apertures formed in the driven arms. A pin 50, which extends freely through registering apertures in the rod 49 and the link 45, pivotally interconnects the link 45 with the rod 49 and, hence, with the driven arms 43 and 44. This linkage 41 which has just been described, not only converts the rotary motion of the shaft 38 into switch blade rotation but also acts to amplify this rotary motion, whereby rotation of the shaft 38 through a small arc drives the switch blade through a relatively large arc. This amplification is made possible by the relatively great effective length of the driving arm 42 in comparison to that of the driven arms 43, 44.

For counterbalancing the blade structure so as to aid the operating mechanism in swinging the blade upwardly from the dotted-line, fully-open position to the solid-line closed position, we provide suitable energy-storing means interconnecting the blade-supporting housing 5 and the framework 14. As shown, this energy-storing means comprises a closed cylinder 55 pivotally supported on the frame 14 at 56 and carrying a piston rod 57 pivotally connected at 58 to the blade housing 5. As shown in Fig. 1, between the free end of the cylinder 55 and a piston 59 on the piston rod 57, there is provided suitable resilient means such as a spring 60. Thus, during downward swinging, or switch-opening movement, the spring 60 has energy stored therein. When the switch subsequently is returned to its closed position, the stored energy is released to aid the closing operation, as is desired.

Additional features of our invention will become apparent from the following description of a switch-closing operation. Assume first that the switch is in its fully-open position. For such a switch position, the blade 15 will extend generally horizontally as shown by the dotted lines of Fig. 1, and the operating crank 22 will occupy a position O generally perpendicular to the plane of swinging movement for the blade, this position O being shown by the dotted lines of Fig. 2. When the main operating crank 22 is rotated in a clockwise direction (as seen in Fig. 2) the swivel link 26 is placed in tension and acts through the intermediate crank 34 and shaft 38 to swing the housing 5 and the switch blade 15 upwardly (as seen in Fig. 1) about their common pivot axis 16. Continued rotation of the crank 22 produces continued upward swinging movement of the switch blade until the blade enters the jaws of the stationary contact 12 and engages a fixed stop 62 mounted thereadjacent. At the beginning of this swinging movement, i. e., when the blade was in the fully-open position, the spring 29 within the extensible link 26 was at its maximum operating length. Unless the blade, when swung upwardly, had encountered some other obstruction before it engaged the stop 62, the spring 29 would have remained extended at this length until the stop was engaged. However, after the stop is engaged, continued clockwise rotation of the crank 22 up to the dead center position (shown in solid lines in Fig. 2) extends the swivel link 26 and compresses its spring 29. In accordance with my invention, this extension of the swivel link may continue until the mechanism moves into its dead center position, but, at that instant, further extension is positively prevented. In the preferred form of my invention, this is accomplished by so dimensioning the spring 29 that it is compressed solid when the crank 22 moves into dead center position. Alternatively, this limiting action may be obtained by providing suitable stops for preventing further extension of the swivel link 26 when it moves through the dead center position.

If the blade, in swinging upwardly, had encountered some obstruction, such as ice formed on the stationary contact, the spring 29 would yield to cushion a portion of the resulting shock. If the obstruction is not broken away after initial contact with the blade and, as a result, the movement of the blade is temporarily blocked, continued motion of the crank toward dead center position will quickly compress the spring 29 solid and cause the mechanism to positively drive the blade through the obstruction and into engagement with the stop 62. Rendering the swivel link 26 inextensible during movement through the dead center position insures that the blade, at this instant, is always positioned within the jaws of the stationary contact and against the stop 62. At this instant, the angular position of the flattened end 18 of

the blade will always be the same, i. e., as shown by the solid lines of Fig. 2 and Fig. 6.

When the blade has assumed this determinate position against its stop and within the jaws of the stationary contact, it is then prepared for rotation into high pressure contact with the jaws. This rotation of switch blade is accomplished by continuing the rotation of the main crank **22** through dead center and into the dotted line position C show in Fig. 2, in which position it is stopped by suitable limit means (not shown). This continued rotation of the main crank **22** through and past dead center applies to the intermediate crank **34** a force which acts in a substantially tangential direction with respect to the intermediate shaft **38**. This force acts through an effective lever arm E which extends vertically between the swivel **24** and the center line of shaft **38**, as seen in Fig. 1. This tangential force acting through the lever arm E, of course, rotates the intermediate shaft **38** which, in turn, imparts to the internal linkage **41** a force which rotates the switch blade **15**. Even though shaft **38** is rotated through only a relatively small angle by the movement of the main crank past dead center and into the position C, this rotation when amplified by the linkage **41**, is sufficient to rotate the switch blade through a relative large arc of about 45 degrees. This 45 degree movement effectively rotates the flattened end **18** of the switch blade into high pressure engagement with the jaws **19** of the stationary contact.

Although a certain amount of switch blade rotation is produced by movement of the crank **22** through the portion of its arc immediately ahead of dead center, this rotation is such that it does not interfere with entry of the blade into the jaws **19** of the stationary contact **12**.

It should be noted that the movement of the crank **22** from dead center into the fully-closed position C produces forces which tend both to shorten the swivel link **26** and to twist the swivel link about its longitudinal axis. Because of the particular construction of the swivel link, these forces do not interfere with the performance of the mechanism in achieving rotation of the switch blade during this range of movement. More particularly, the tendency of the link to shorten is provided for by the fact that the swivel sections **28** and **30** are mounted to slide relative to each other, and the tendency of the link to twist is provided for by the fact that the section **30** is free to rotate relative to section **28**. The spring **29**, which expands slightly during this range of crank motion, tends to maintain the switch blade seated against the stop **62**.

When it is desired to open the switch, the main crank **22** is rotated in a reverse direction, i. e., counterclockwise from the position C to the position O (as seen in Fig. 2). Rotation of the crank from the position C to the dead center position returns the intermediate crank **34** to a vertical position. In returning to its vertical position, the crank **34** rotates the intermediate shaft **38**, and, through the linkage **41**, imparts reverse rotation to the switch blade **15**. This reverse rotation of the switch blade moves the flattened end **18** into the solid line position of Fig. 5, where it is out of engagement with the contact jaws. Any ice which might have formed on the stationary contact of the closed switch would be effectively broken away by this rotation of the flattened end **18**. This movement of the crank **22** back to dead center again compressed the spring **29** solid, but as the crank continues in its movement and passes over dead center, the spring again becomes extended, until it reaches a maximum length which is limited by the engagement of telescoping section **28** with an adjustable stop **64**, best seen in Fig. 1. After this engagement has occurred, continued rotation of crank **22** applies a compressive force to the telescoping section **30**. This compressive force, which is transmitted through the intermediate crank **34** and its shaft **38** to the switch-blade housing **5**, acts to pivot the switch blade downwardly about its pivot axis **16**. When the main crank **22** has finally moved into position O, the switch blade has been swung into its fully-open, dotted-line position shown in Fig. 1.

Thus, in summary, it may be seen that we have provided a mechanism which, when driven by the rotatable operating shaft **21**, is effective to swing the switch blade **15** into and out of a position generally parallel to the shaft and to rotate the blade about its longitudinal axis when in said position. In general, this mechanism comprises (I) a crank **22** which is movable through an arc (between O and C) the major portion of which is disposed at a side of the operating shaft **21** generally opposed to the location of the switch blade; (II) a swivel link **26** connected at one of its ends to said crank; and (III) means **34, 38, 41** interconnecting the other end of said swivel link **26** and said switch blade and operable to effect rotation of the blade in response to movement of said crank through and adjacent a dead center position with respect to said swivel link. This latter means, when acting through the pivotally-mounted blade housing **5**, is also operable to effect swinging movement of the blade in response to movement of the crank **22** through the remainder of its arc. As may be seen in Fig. 2, the above-mentioned dead center position is located at a side of the operating shaft **21** which is generally opposite to the location of the switch blade.

The horizontal plane in which the swivel **24** moves is the level at which driving forces are applied to the swivel link **26**. It will be apparent from Fig. 1 that this level is located vertically between the switch blade pivot axis **16** and the axis of the intermediate shaft **38** in the closed position. Because forces are applied to the swivel link **26** at this particular level, the main crank **22** is effective both to raise the blade from its dotted line fully-open position of Fig. 1 and to apply a twisting force to the blade when it assumes its vertically extending position.

Although we have shown only a single pole switch, it will be understood by those skilled in this art that a switch having additional poles may be provided simply by mounting identical switch units in laterally-spaced relationship on the frame **14** and interconnecting these switch units for simultaneous, or group, operation. For suitably interconnecting switch units in this manner, we have shown an arm **66** projecting radially outward from the main operating shaft **21** and a coupling bar **67** pivotally connected to the outer end of the arm **66**. The coupling bar would be identically connected to corresponding arms provided on corresponding switch units (not shown).

While in the preferred embodiment of our invention disclosed hereabove, both the blade swinging and rotating forces have been applied through the swivel link **26**, it will be apparent that this link, without the internal mechanism **41**, could be utilized solely for the purpose of swinging the blade, whereas a separate connection from the crank **22** to the switch blade **15** could be utilized for rotating the blade while in its vertical position.

Various other modifications and changes may be made without departing from our invention in its broader aspects. The disclosed embodiment of our invention is merely a preferred form of the invention, and we, therefore, intend in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of our invention.

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

1. An electric switch comprising a stationary contact, a switch blade rotatable about its longitudinal axis and pivotally mounted for swinging movement into and out of a circuit-closing position adjacent said stationary contact, an operating shaft rotatably mounted with its longitudinal axis laterally-spaced from and generally parallel to the longitudinal axis of the switch blade when in said circuit-closing position, a crank coupled to said shaft and movable in an arc the major portion of which is disposed at a side of said shaft generally opposite to the location

of said switch blade, a swivel link pivotally connected at one end to said crank, means interconnecting the other end of said swivel link and said switch blade and operable to effect rotation of said blade about its longitudinal axis in response to movement of said crank through and adjacent a dead center position with respect to said swivel link and operable to effect swinging movement of said blade in response to movement of said crank through the remainder of its arc.

2. An electric switch comprising a stationary contact, a switch blade rotatable about its longitudinal axis and pivotally mounted for swinging movement into and out of a circuit-closing position adjacent said contact, an operating shaft rotatably mounted in spaced-apart, substantially parallel relationship to the switch blade when in said circuit-closing position, a crank coupled to said shaft and movable through an arc which terminates adjacent a predetermined dead center position at a side of said shaft generally opposite to the location of said blade, means interconnecting said crank and said blade and responsive to movement of said crank through and adjacent said dead center position to effect rotation of said blade about its longitudinal axis and responsive to movement of said crank through the remainder of its arc to effect swing movement of said blade.

3. In combination, a stationary contact, a switch blade rotatable about its longitudinal axis and pivotally mounted for swinging movement into and out of a circuit-closing position adjacent said stationary contact, a rotatably-mounted main operating shaft laterally-spaced from said blade and having its longitudinal axis generally parallel to the longitudinal axis of said blade when in said circuit-closing position, a radially-extending crank coupled to said main shaft and arcuately movable through a predetermined dead center position at a side of said main shaft generally opposite to the location of said blade, means interconnecting said crank and said blade and arranged to effect rotation of said blade about its longitudinal axis in response to movement of said crank through and adjacent said dead center position and arranged to effect swinging movement of said blade in response to movement of said crank through the remainder of its arc.

4. In combination, a support, a switch blade mounted on said support for rotation about its longitudinal axis, means pivotally mounting said support to permit swinging movement of said switch blade into and out of a circuit-closing position adjacent said stationary contact, an operating shaft rotatably mounted in laterally-spaced relationship to said support with its longitudinal axis extending generally parallel to the longitudinal axis of said switch blade when in said circuit-closing position, a radially extending crank coupled to said operating shaft and arcuately movable through a predetermined dead center position at a side of said shaft generally opposed to the location of said support, a linkage operatively interconnecting said crank and said switch blade and operable to effect rotation of said blade about its longitudinal axis in response to movement of said crank through and adjacent said dead center position and operable to effect swinging movement of said blade in response to movement of said crank through the remainder of its arc.

5. The switch of claim 4 in which said linkage includes a link comprising sections relatively movable to provide for extension of said link during a switch closing operation, and means operable during said switch closing operation for positively limiting extension of said link in response to movement of said crank into said dead center position.

6. In combination, a stationary contact, a pivotally-mounted support positioned beneath said stationary contact, a switch blade mounted on said support for rotation about its longitudinal axis, an operating shaft rotatably-mounted in horizontally-spaced relationship to said support with its longitudinal axis extending generally vertically, a radially extending crank coupled to said operating shaft and arcuately movable through a predetermined dead center position at a side of said shaft generally opposed to the location of said support, means interconnecting said switch blade and said crank and operable to effect rotation of said blade about its longitudinal axis in response to movement of said crank through and adjacent said dead center position and operable to effect swinging movement of said blade in response to movement of said crank through the remainder of its arc.

7. The combination of claim 6 in which said support is disposed in vertical alignment with said stationary contact.

8. In combination, a stationary contact, a support pivotally mounted in a position vertically aligned with said stationary contact, a switch blade mounted on said support for rotation about its longitudinal axis, an operating shaft rotatably mounted in laterally-spaced relationship to said support with its longitudinal axis extending generally vertically, a radially-extending crank coupled to said operating shaft and arcuately movable through a predetermined dead center position at a side of said shaft generally opposed to the location of said support, a swivel link connected at one of its ends to said crank, and means operatively connecting the other end of said swivel link to said switch blade and to said pivotal support, said means being operable to effect swinging movement of said blade into and out of a vertically-extending position in response to movement of said crank through a portion of its arc and operable when said blade is in said vertical position to effect rotation thereof in response to movement of said crank through and adjacent said dead center position.

9. In combination, a stationary contact, a pivotally-mounted support, a switch blade mounted on said support for rotation about its longitudinal axis, an intermediate operating shaft rotatably-mounted on said support and extending transversely with respect to said switch blade, force-transmitting means for converting rotation of said intermediate shaft into rotation of said switch blade, said shaft being bodily movable to effect swinging movement of said blade into and out of a circuit-closing position adjacent said stationary contact, a rotataby-mounted main operating shaft laterally spaced from said blade support and having a longitudinal axis generally parallel to the longitudinal axis of said blade when in said circuit-closing position, a radially-extending crank coupled to said main shaft and arcuately-movable through a predetermined dead center position at a side of said main shaft generally opposed to the location of said blade support, a linkage interconnecting said crank and said intermediate shaft and arranged to effect rotation of said intermediate shaft in response to movement of said crank through and adjacent said dead center position and arranged to bodily move said intermediate shaft in response to movement of said crank through the remainder of its arc, whereby to produce a combined rotating and swinging action of said switch blade.

10. The combination of claim 9 in which said force-transmitting means comprises a motion-amplifying linkage which is operable to rotate said switch blade through a relatively large arc in response to rotation of said intermediate shaft through a smaller arc.

11. The combination of claim 9 in which said force-transmitting means comprises a driving arm coupled to said intermediate shaft and extending radially therefrom, a driven arm coupled to said switch blade and extending radially therefrom, and a joining link pivotally connected to each of said arms.

12. The combination of claim 11 in which said driving arm has a substantially greater effective length than said driven arm.

13. An electric switch comprising a stationary contact, a switch blade rotatable about its longitudinal axis and pivotally mounted for swinging movement into and out of a circuit-closing position adjacent said stationary contact, an operating shaft rotatably-mounted with its longitudinal axis transversely-spaced from and generally parallel

to the longitudinal axis of the switch blade when in said circuit-closing position, a crank coupled to said shaft and movable in an arc the major portion of which is disposed at a side of said shaft generally opposed to the location of said switch blade, an extensible swivel link pivotally connected at one end to said crank, means interconnecting the other end of said swivel link and said switch blade and operable to effect rotation of said blade about its longitudinal axis in response to movement of said crank through and adjacent a dead center position with respect to said swivel link and operable to effect swinging movement of said blade in response to movement of said crank through the remainder of its arc, said swivel link being subjected during a switch-closing operation to forces tending to extend said link, and means operable during switch-closing movement of said crank through said dead center position to positively limit extension of said extensible link, whereby to positively position said switch blade in said circuit-closing position.

14. An electric switch comprising a stationary contact, a switch blade rotatable about its longitudinal axis and pivotally mounted for swinging movement into and out of a circuit-closing position adjacent said stationary contact, an operating shaft rotatably mounted with its longitudinal axis generally parallel to the longitudinal axis of the switch blade when in said circuit-closing position, means for mounting said switch blade in a location at one side of said shaft, a crank coupled to said shaft and movable in an arc the major portion of which is disposed at a side of said shaft generally opposed to the location of said switch blade, an extensible swivel link comprising a pair of relatively movable sections, a compression spring biasing said sections in a direction to shorten said link, means for pivotally connecting one of said sections to said crank, means interconnecting the other of said section with said switch blade and operable to effect rotation of said blade about its longitudinal axis in response to movement of said crank through and adjacent a dead center position with respect to said swivel link and operable to effect swinging movement of said blade in response to movement of said crank through the remainder of its arc, said swivel link being subjected during a switch-closing operation to forces tending to extend said link, and limit means operable during switch-closing movement of said crank through said dead center position to positively limit extension of said link, thus positively positioning said switch blade in said circuit-closing position during movement of said crank through dead center.

15. The combination of claim 14 in which the sections of said swivel link are mounted for rotation with respect to each other.

16. The combination of claim 14 in which said limit means includes structure which compresses said spriing solid during movement of said crank through its dead center position.

17. In combination, a stationary contact, a support pivotally mounted beneath said stationary contact, a switch blade mounted on said support for rotation about its longitudinal axis, an intermediate operating shaft rotatably mounted on said support and extending transversely with respect to said switch blade, said shaft being bodily movable to effect swinging movement of said blade into and out of a vertically-extending position of cooperation with said stationary contact, an intermediate crank coupled to said intermediate shaft and extending downward therefrom when said blade is in its vertical position, means for converting rotation of said intermediate shaft into rotation of said switch blade, a vertically-extending rotatably-mounted main operating shaft, a main crank coupled to said main shaft and movable in a generally horizontal plane through a predetermined dead center position at a side of said main shaft generally opposed to the location of said blade support, a swivel link connected at its opposite ends to said main and intermediate cranks and operable to effect rotation of said intermediate shaft in response to movement of said main crank through and adjacent its dead center position and operable in response to movement of said main crank through the remainder of its arc to bodily move said intermediate shaft, whereby to produce a combined rotary and swinging movement of the switch blade.

18. The combination of claim 17 in which the connection between the swivel link and the intermediate crank is located above the connection between the swivel link and the main crank at least during the time that the switch blade is disposed in its vertical position.

19. In combination, a stationary contact, a support pivotally mounted beneath said stationary contact, a switch blade mounted on said support for rotation about its longitudinal axis, an intermediate operating shaft rotatably mounted on said support and extending transversely with respect to said switch blade, said shaft being bodily movable to effect swinging movement of said blade into and out of a vertically-extending position of cooperation with said stationary contact, means for converting rotation of said intermediate shaft into rotation of said switch blade, a vertically-extending, rotatably-mounted main operating shaft, a main crank coupled to said main shaft and movable in a generally horizontal plane through a predetermined dead center position at a side of said main shaft generally opposed to the location of said blade support, a swivel link pivotally connected at one end to said crank and at its other end to said intermediate shaft and operable to effect rotation of said intermediate shaft in response to movement of said crank through and adjacent its dead center position and to effect bodily movement of said shaft in response to additional movement of said crank, the connection between said swivel link and said crank being located vertically between the pivot axis of said blade support and the axis of the intermediate operating shaft when in closed posittion.

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