

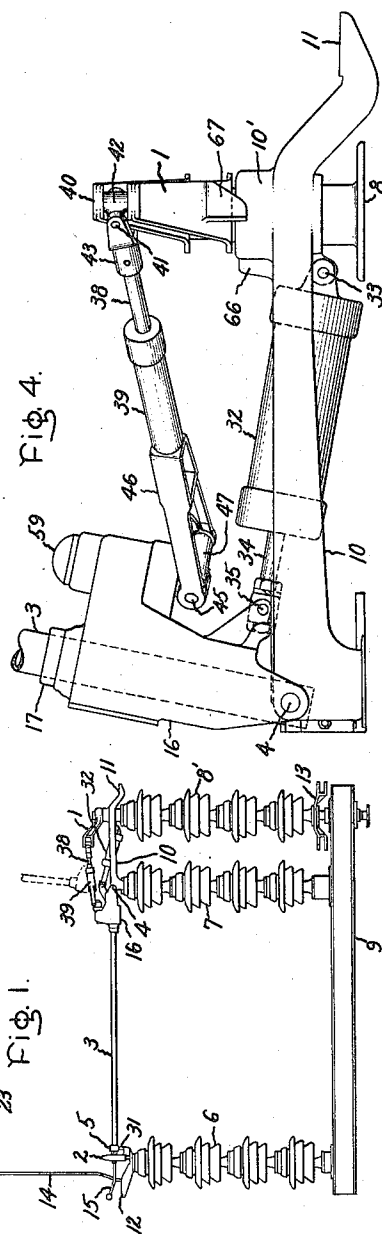
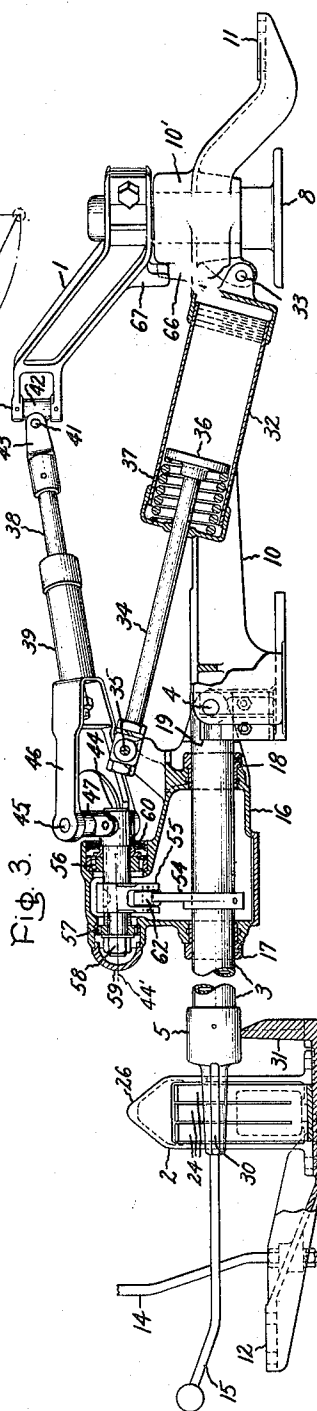
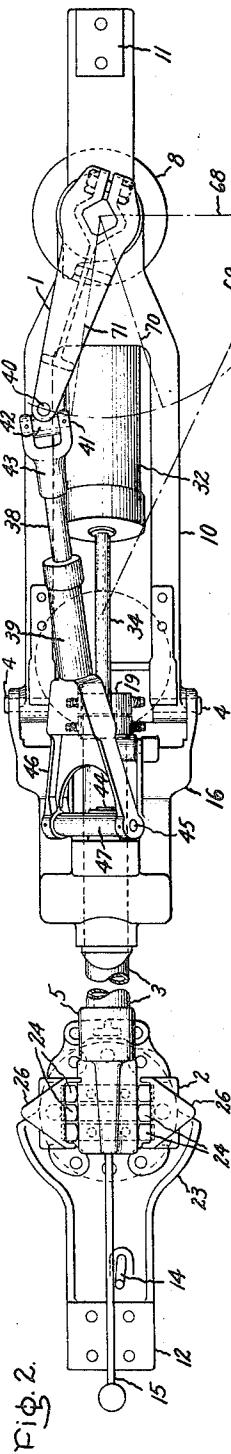
Nov. 21, 1950

E. SCHEUERMAYER
ELECTRIC SWITCH

2,531,165

Filed Sept. 17, 1947

2 Sheets-Sheet 1



Inventor:
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His Attorney.

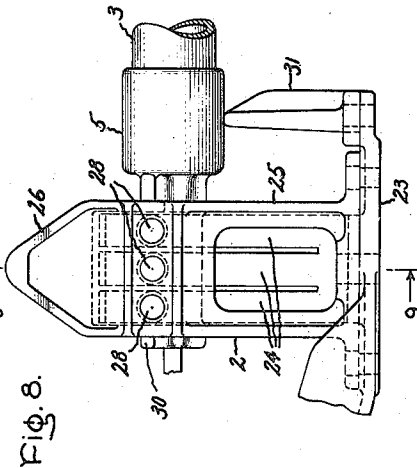
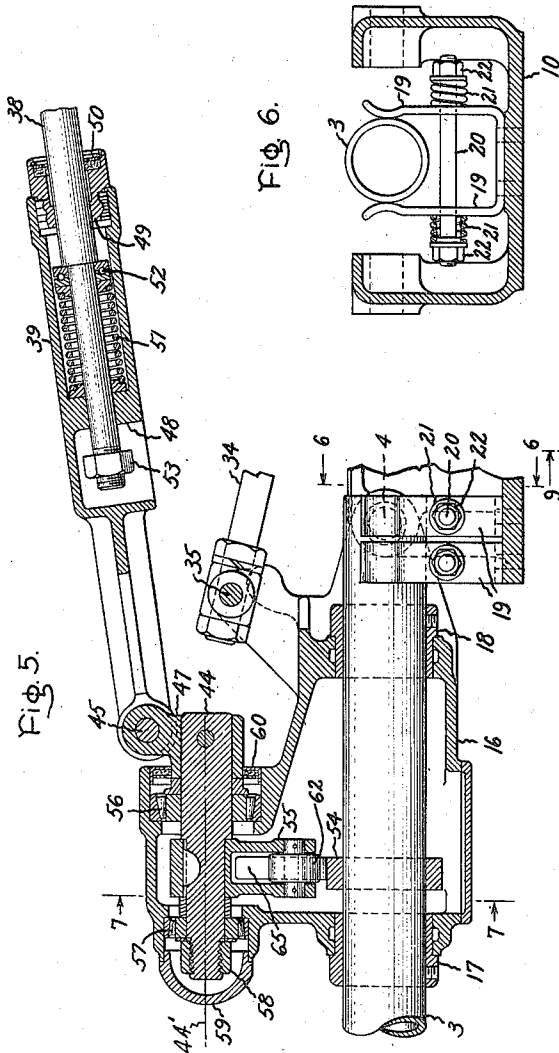
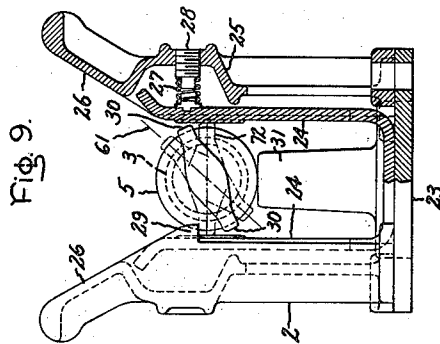
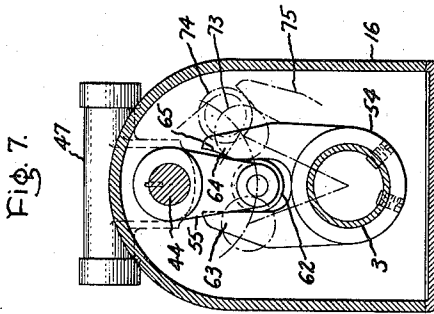
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2 Sheets-Sheet 2



Inventor:
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UNITED STATES PATENT OFFICE

2,531,165

ELECTRIC SWITCH

Emil Scheuermeyer, Upper Darby, Pa., assignor
to General Electric Company, a corporation of
New York

Application September 17, 1947, Serial No. 774,462

11 Claims. (Cl. 200—48)

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My invention relates to improvements in electric switches and more particularly to improvements in disconnecting switches and especially high contact pressure disconnecting switches for high voltage circuits.

It has been proposed to provide a relatively high contact pressure disconnecting switch by pivotally supporting a blade member on a stationary insulator for swinging movement to bring the free end of the blade into position between the spaced jaws of a stationary contact mounted on another insulator and then rotating the blade about its longitudinal axis into engagement with the jaws of the contact. These movements of the blade are, in general, obtained by rotating a stack of insulators on which is mounted a crank coupled to a blade rotating mechanism through a rigid link forming a toggle with the crank. However, arrangements with which I am familiar introduce an undesirable longitudinal movement of the blade especially while still in high pressure engagement with the stationary contact, involve structure which upon exposure to sleet and the like becomes difficult, if not impossible, to operate, or rely upon an operating mechanism which produces simultaneous swinging and rotation of the blade and which often produces a certain amount of binding and difficult action. Each of these features produces undesirable strains on the switch insulators and requires excessive operating forces. Moreover, for gang operated switches, it is desirable to provide for overtravel of the operating mechanism without producing any switch blade rotation or longitudinal movement after the blade has been rotated into engagement with the stationary contact. In a single pole switch, such overtravel is not necessary except for the purpose of biasing the switch closed, but disconnecting switches are usually built for gang operation, that is, two or more poles interlinked for operation by a single operating mechanism which may be operated manually for small switches but is generally a motor-operated mechanism. In this case, without suitable provision for free overtravel, it is necessary to make extremely close adjustments of the parts in the different poles. These adjustments are complicated because of lost motion variations in consequence of manufacturing tolerances. Such adjustments are not only difficult to make but also hard to maintain. Also, they are costly and extra hazardous after a switch is once installed.

An object of my invention is to provide an improved operating mechanism for more effective-

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tively avoiding the various difficulties and disadvantages noted above as usually present in the operation of a high contact pressure disconnecting switch of the type wherein a circuit controlling member is pivoted for swinging movement to bring its free end into position adjacent a stationary contact and is then rotated about its longitudinal axis into engagement with the contact. Another object of my invention is to provide an improved disconnecting switch having an operating structure such that the swinging and rotary movements of the circuit controlling member require relatively small effort and produce a minimum of strain on the switch parts and particularly the insulators. Still another object of my invention is to provide a switch mechanism which is subject to minimum disturbance during operation under ice and sleet conditions. A further object of my invention is to provide an improved high contact pressure disconnecting switch wherein there is no longitudinal movement of the circuit controlling member during the swinging and rotary movements thereof and wherein there is no appreciable rotary movement of the member as it is swung into position between the sides of the cooperating stationary contact. A still further object of my invention is to provide an improved disconnecting switch structure such that overtravel of the operating mechanism after the circuit controlling member is rotated into the contact pressure position is ineffective to produce further rotation whereby gang operation is possible without extreme refinements in the alignment of the different poles. These and other objects of my invention will appear in more detail hereinafter.

My invention will be better understood from the following description when considered in connection with the accompanying two sheets of drawings, and its scope will be pointed out in the appended claims.

In the accompanying two sheets of drawings, Fig. 1 is a side elevation of a disconnecting switch embodying my invention and shown in the closed position; Fig. 2 is a view to an enlarged scale looking down on the switch shown in Fig. 1; Fig. 3 is a side elevation, partly in section, of the switch shown in Fig. 1, also to an enlarged scale; Fig. 4 is a partial side elevation of the right-hand portion of the switch shown in Fig. 1 to an enlarged scale with the parts shown in the full-open position; Fig. 5 is a side elevation to an enlarged scale, and largely in section, of the pivotal and rotatable mounting of the circuit con-

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trolling member of the switch shown in Fig. 1 with the mechanism in the dead center position; Fig. 6 is a sectional elevation on the line 6—6 of Fig. 5; Fig. 7 is a sectional elevation on the line 7—7 of Fig. 5; Fig. 8 is a side elevation at the free end of the circuit controlling member, showing it in relatively high pressure engagement with its cooperating stationary contact; and Fig. 9 is an end view, partly in section, on the line 9—9 of Fig. 8 looking toward the stationary contact and the circuit controlling member which is shown in different positions occupied during the operation of the switch.

In the embodiment of my invention shown in Fig. 1, I have illustrated a single pole disconnecting switch comprising a rotatably mounted operating crank 1, a stationary contact structure 2 laterally offset from the axis of the crank, and a cooperating circuit controlling member 3 supported for swinging movement about an offset perpendicular axis 4 which is intermediate the contact structure and the axis of rotation of the crank and which is substantially perpendicular to the longitudinal axis of the member to bring the free end 5 of the member into a position adjacent the contact structure. The circuit controlling member 3, hereinafter called the blade for brevity, is further mounted for rotary movement about its longitudinal axis to engage the contact structure when the free end of the blade is in said adjacent position. The contact structure 2 is mounted on a stationary insulator stack 6, and the swing axis 4 of the blade 3 is mounted on a stationary insulator stack 7. The crank 1 is rigidly secured to a supporting member 8 mounted on an insulator stack 8' which is rotatably supported on a suitable structural framework base 9 and in a crossbrace 10 extending between the insulator stacks 7 and 8' and carrying the pivotal axis 4 of the blade 3. This crossbrace 10 is secured to the top of the insulator stack 7 and carries a bearing portion 10' for the supporting member 8. As shown, the crossbrace 10 is provided with a terminal 11, and the contact structure 2 is provided with a terminal 12. For interconnecting two or more poles for simultaneous operation, the rotating insulator stack 8' is provided at its base with a double crank 13. Obviously, the interconnected rotatable insulator stack 8' can be operated manually or by a suitable power-operated device. For interrupting current of relatively small magnitudes, such, for example, as the magnetizing current of a power transformer, the switch may be provided with cooperating arcing horns 14 and 15 respectively associated with the contact structure 2 and the blade 3.

In order to mount the blade 3 for its swinging and rotary movements, I provide a blade supporting hinge member 16 which is pivotally mounted on aligned pins 4 in the cross-brace 10. Collared bushings 17 and 18, secured to the blade 3 at opposite ends of the hinge member 16 and entering therein, as shown more clearly in Fig. 5, serve to support the blade rotatably on the hinge member and also to prevent endwise movement of the blade in the hinge member. For obtaining electrical conductivity without the use of flexible leads and the like, I provide at the hinge end of the blade 3 one or more U-shaped contacts 19 which, as shown more clearly in Fig. 6, are mounted on the hinge supporting end of the brace 10 adjacent the pins 4 so as to maintain contact with the hinge end of the blade at all times. For contact pressure adjustment, the

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relatively stiff sides of the contacts 19 may be urged toward each other by adjustable resilient means embodying a bolt 20 and springs 21 and nuts 22 thereon.

The stationary contact structure 2 comprises a base 23 on which, as shown more clearly in Fig. 9, is mounted a U-shaped contact having one or more relatively flexible contact tongues 24. As shown, this contact is mounted within housing elements 25 secured to the base 23 and provided with flaring arms 26 to guide the blade 3 in its entrance between the sides of the contact. As shown more clearly in Fig. 9, the tongues 24 of the contact are resiliently adjustable to vary the contact pressure by means of springs 27 interposed between the rear side of the contact tongues and threaded pins 28 mounted in the housing. For holding the blade 3 in the closed position, particularly against the opening tendency consequent upon short circuit currents, one side of the housing 26 may be provided with a hook-shaped portion 29 against which the end of the blade engages when in the closed position. For cooperative engagement between the free end 5 of the blade and the contact structure 24, the free end comprises a sleeve portion which is suitably secured to the blade 3 and a relatively flat portion having edges 30 which engage the contact tongues 24 at the end of the rotation of the switch blade after it is moved into position between the contact tongues 24, as shown more clearly in Fig. 9. In order to stop the swinging movement of the blade 3 in a predetermined position with the flattened end of the blade between the contact tongues 24, the base of the contact structure 23 is provided with a suitable stop 31.

For counterbalancing the blade structure in its swinging movement, I provide suitable energy-storing means inter-connected between the hinge element 16 and the rotating insulator end of the brace 10. As shown, this means comprises a closed cylinder 32 pivotally supported on the brace 10 at 33 and carrying a piston rod 34 pivoted at 35 to the hinge member 16. Between the free end of the cylinder 32 and a piston 36 on the piston rod 34, as shown in Fig. 3, there is provided suitable resilient means such as a spring 37. Thus, during the closing movement of the switch the spring 37 has energy stored therein, so as to ease the shock of closing and upon opening, this energy is in turn released to help the opening operation when swinging movement of the blade is possible.

In accordance with my invention, I provide an improved operating mechanism or means for effecting the swinging and rotary movements of the blade 3 substantially sequentially upon rotation of the crank 1 in one direction, clockwise as viewed in Fig. 2, whereby to swing the blade to bring the free end 5 into position adjacent the contact tongues 24 and then to rotate the blade to engage these elements. As shown, this means comprises a toggle including the crank 1 and a compressible swivel link having two relatively rotatable and longitudinally slidably movable sections 38 and 39. The section 38 is universally pivotally connected to the crank 1 for movement about two axes 40 and 41, the first of which is substantially parallel to the axis of rotation of the crank and the second of which is movable relatively to the first in a plane substantially perpendicular to the axis of rotation of the crank. This connection is effected by a trunnion 42 pivotally connected at 40 in the upper end yoke

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portion of the crank 1 and at 41 to a yoke 43 secured to one end of the section 38. The other section 39 is universally pivotally related to the blade 3 for movement about two axes, the first 44 substantially parallel to the longitudinal axis of the blade 3 and offset therefrom in a plane perpendicular to the pivot axis of the blade and passing through the axis of the crank and the second 45 movable relatively to the first in a plane substantially perpendicular to the longitudinal axis of the blade 3. For this purpose, the section 39 is provided with a yoke portion 46 which is pivotally jointed at 45 to a yoke member 47 which is rigidly secured to a shaft 44 suitably journaled in the hinge member 16 and arranged for rotation about the axis 44 to effect, in a manner hereinafter described, the rotation of the blade 3.

In order to maintain the axial alignment or colinear relation of the swivel sections 38 and 39, the section 39 is journaled in the section 38 at two points 48 and 49, as shown more clearly in Fig. 5. The journal or bearing 49, as shown, is in the form of a bushing provided with a moisture- and dust-excluding cover 50. In order to have yielding, swiveling involving both relative rotation and sliding of the compressible swivel sections 38 and 39, I provide resilient means on the swivel link tending to effect relatively sliding movement of the sections away from each other whereby to permit a lengthening of the link and adapted to be stressed near the overcenter portion of the toggle movement whereby to permit a shortening of the link after the pivoted switch member 3 engages with the stop 31. As shown more clearly in Fig. 5, this means comprises a compression spring 51 interposed between a shoulder on the section 38 and the bearing portion 48 on the section 39 to tend to lengthen the link and adapted to be compressed near the overcenter portion of the movement of the crank 1 whereby to permit a shortening of the link. In order to reduce the friction in connection with these actions, suitable antifriction means such as a ball or roller bearing 52 is provided adjacent the shoulder on the section 38. In order to prevent withdrawal of the section 38 from the section 39 and thereby rendering it impossible to perform the opening swinging movement of the blade 3, the end of the section 38 is provided with suitable stopping means such as a nut 53 which can be adjusted to fix the maximum length of the link when in abutting engagement with the shoulder 48.

For effecting the rotary movement of the blade 3 at the completion of the swinging movement thereof in the closing direction and the reverse rotary movement before the swinging movement in the opening direction, I provide, in accordance with my invention, a selective lost motion driving connection between the link 38-39 and the blade 3. As shown more clearly in Figs. 3, 5 and 7, this connection comprises two relatively movable cooperating driving elements 54 and 55. The element 54, which is illustrated in the form of a bifurcated arm, is rigidly mounted on the blade 3 substantially perpendicular thereto and within the hinge member 16, which is preferably in the form of a housing to keep the cooperating parts free of dirt, ice and the like. The driving element 55 is also supported within the housing hinge member 16 for bodily movement with the blade 3 during the swinging movement thereof and for rotation about an axis substantially parallel to the axis of the blade. For these purposes, the driving element 55 is suitably secured to the

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shaft 44 so as to turn therewith upon rotation of the shaft during a certain portion of the movement of the link 38-39. For ease in rotation, the shaft 44 is suitably journaled in antifriction bearings such as roller thrust bearings 56 and 57 which are arranged to prevent endwise movement of the shaft, the shaft 44 being held in position against the bearing 57 by suitable means indicated as a nut 58. A housing cover 59 is provided to enclose the housing at this end of the shaft. At the other end of the shaft, a suitable moisture- and dust-proof cover 60 is provided.

In accordance with my invention, the interlocking driving relationship or interengagement of the cooperating selective lost motion driving element 54 and 55 is such that throughout a predetermined portion of the rotary movement of the element 55 the blade 3 is rotated about its longitudinal axis from the inclined dotted position indicated by the axis line 61 in Fig. 9 to the horizontal dotted position shown in the same figure and, upon continued rotary movement of the driving element 55, no further rotation of the blade 3 occurs whereby to provide a certain amount of overtravel to avoid refinements in adjustment, especially for multipole switches. For this purpose, the driving element 55 is provided with suitable means such as a roller 62 which, as shown more clearly in Fig. 7, is movable between the bifurcations 63 and 64 of the driving element 54 so that it can roll along the inner edge of either of these bifurcations depending upon which direction the driving element 55 is turned.

In order to provide the desired selective lost motion overtravel feature after the blade 3 has been turned into the fully contacting position, the inner or camming edge of the bifurcation 64 of the driving element 54 is, in accordance with my invention, substantially straight throughout a predetermined portion of its length, as is clearly shown in Fig. 7, and thereafter has near the end of the bifurcation a circular idling connecting portion 65 of a radius substantially equal to the effective lever length of the driving element 55; that is to say, the distance from the center of the shaft 44 to the periphery of the roller where it engages the bifurcation 64. To provide the overtravel, this curved idling portion 65 of the camming edge of the bifurcation 64 is so positioned at the end of the rotary movement of the blade 3 into the contacting position, that the center of the curved portion 65 is in the axis 44' of the shaft 44 whereby movement of the driving element 55 maintains the driving element 54 in its final position without effecting any rotation thereof. Thus, with a gang-operated multipole switch, one operating mechanism may be used to actuate all of the poles simultaneously to the closed position and it is not necessary that the adjustment of the parts of the different poles with relation to each other be such that all of the blades reach the contacting position simultaneously. This is an important feature of switches embodying my invention since it eliminates the necessity for extreme refinements in adjustments which are costly to make and difficult to maintain. Since minor differences in the positions of the blades in the gang-operated switch are immaterial in the final open position, the camming edge of the bifurcation 63 may be straight as shown in Fig. 7. For limiting the angular movement of the crank 1 in the switch closing direction so as to hold the toggle comprising the crank and the compressible swivel link 38-39 in the overcenter position to which it becomes biased by

the compression spring 51 in the closed position of the switch, as shown in Fig. 2, suitable means may be provided such as coacting stops 66 and 67 respectively mounted on the bracket 10 and the crank 1.

Assuming the parts positioned in the full open position of the switch, as shown in Fig. 4, then the blade 3 is inclined toward the insulator 8' so that in case of any accidental breakage or the like the blade will not tend to fall into the closed position. In this full open position of the switch, the crank 1 extends outwardly from the center line of the switch approximately 90 degrees in the direction indicated by the dash-dot line 68 as shown in Fig. 2. In this full open position, the center line of the colinear compressible swivel link 38—39 is indicated by the dash-dot line 69. Also in this full open position of the switch, the nut 53 on the link section 38 abuts the shoulder 48 on the link section 39 since the link is in tension.

To close the switch, the rotatably supported insulator 8' and the crank 1 rigidly attached thereto are rotated clockwise from the position indicated by the dash-dot line 68 in Fig. 2 to the position indicated by the dash-dot line 70. During this movement of the crank 1, the hinge member 16 is rotated counterclockwise, as viewed in Fig. 4, about its pivotal axis 4—4 until the blade portion 5 comes to rest against the stop 31 on the contact structure 2. During this motion of the crank 1 from the position 68 to the position 70, the link sections are pressed toward each other with a tendency to compress the spring 39. It is to be remembered that because of the double bearing of the section 38 in the section 39 the link sections have to maintain their alignment, and, accordingly, because of the angular movement of the link there is relative rotation between the link sections 38 and 39 but, because of the proportioning of the parts, there is substantially no appreciable rotation of the section 39 about the axis 44' during the portion of the swinging movement of the blade 3 before entering the contact tongues 24 and coming to rest against the stop 31.

When the blade portion 5 comes to rest against the stop 31, the position of the flat end of the blade with reference to the contact tongues 24 is indicated by the broken line outline having the axis 61 shown in Fig. 9. This is substantially the same relative angular position which the flat end of the blade had when it was in the full open position shown in Fig. 4. During the swinging and rotating movements of the blade 3 there is no longitudinal motion of the blade. Also, during the swinging movement of the blade, the pivoted end has remained in contact with the contact elements 19. If now the crank 1 is rotated clockwise from the position 70 to the dead center or center line position of the switch, then since the blade can have no further counterclockwise swinging movement and also because of the universal connection at each end of the link 38—39 and the necessity for providing a combined yielding telescoping and swivel movement of the sections of the link, the spring 51 is compressed and the parts taken the position shown in Fig. 5 with the flattened end of the blade 3 turned from the dotted line position indicated by the axis 61 to the full line position 30 shown in Fig. 9, but the blade is not yet in engagement with the contact tongues 24.

During the clockwise movement of the crank 1 from the position 70 to the dead center position 75

shown in Fig. 5, the roller 62 has moved downwardly along the straight edge portion of the bifurcation 64 on the arm 54 to effect the rotation of the blade 3. Upon further clockwise movement of the crank 1 from the dead center position to the position indicated by the dash-dot line 71 of Fig. 2, the length of the link 38—39 is somewhat increased and the blade is rotated further clockwise, as viewed in Fig. 9, into the full contacting position indicated by the broken line 72. This final rotation of the blade occurs due to the movement of the element 55 about its axis 44' with the roller 62 moving up the straight edge portion of the bifurcation 64 of the arm 54 on the blade. The blade is now in the fully engaged position against the latch hook 29 on the left-hand housing 26 shown in Fig. 9. Further movement of the crank from the position shown by the dotted line 71 in Fig. 2 to the full line position shown in this figure continues rotation of the element 55 counterclockwise, as viewed in Fig. 7, with the roller 62 now riding along the curved edge idling portion 65 of the bifurcation 64. No further rotary movement of the blade takes place, however, because from the dotted line position 73 of the roller 62 to the final position thereof indicated by the dotted line 74 in Fig. 7, the bifurcation 64 of the arm 54 has its curved portion 65 moved over to the right so that it is now on center with the axis 44'. Consequently, all that the roller 62 does during this movement is to maintain the arm 54 in the position 75 in which it was placed during the movement of the crank from the position 70 to the position 71 shown in Fig. 2. This overtravel feature without rotary movement of the blade is of particular advantage in gang-operated switches since it is possible to have variations in movement of the different poles and yet close all of the poles satisfactorily without extreme refinements in adjustments when the switch is built and is installed.

When the crank 1 is in the final position shown in full lines in Fig. 2, the stop 67 on the crank engages the stop 66 on the brace 10 and prevents further clockwise movement of the crank. Since the crank 1 and the link 38—39 are now in the overcenter position, the switch blade is effectively held in the closed position.

To open the switch, the insulator 8' and the crank 1 attached thereto are rotated counterclockwise as viewed in Fig. 2. As the crank is moved from the full line position through the position 71 to the position 70, the blade is rotated counterclockwise, as viewed in Fig. 9, to release it from the contact structure 2. During this movement of the crank 1, the roller 62 on the element 55 moves downwardly along the edge of the bifurcation 64 and then upwardly along the straight edge portion of the left-hand bifurcation 63 of the arm 54 to effect the counterclockwise rotation of the blade as viewed in Fig. 7. It is hereby noted that while the blade is in the contact position, the spring 51 is practically under its maximum compression to maintain the length of the link 38—39 unchangeable and to hold the switch closed. When the crank 1 reaches the position 70, the nut 53 on the section 38 abuts the shoulder 48 on the section 39, and further movement of the crank to the position 68 rotates the blade 3 clockwise with the hinge element 16 about its pivotal axis 4—4 until the parts are again positioned in the full open position of the switch shown in Fig. 4.

While I have shown and described my invention

in considerable detail, I do not desire to be limited to the exact arrangement shown, but seek to cover in the appended claims all those modifications that fall within the true spirit and scope of my invention.

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

1. An electric switch having in combination, a rotatably mounted operating crank, a stationary contact having a stop adjacent thereto, and a cooperating circuit controlling member having a pivot axis perpendicular to the axis of the crank and intermediate said contact and the axis of rotation of said crank and substantially perpendicular to the longitudinal axis of the member for swinging movement of the free end of the member into engagement with the stop adjacent the contact, said member being mounted for rotary movement about its longitudinal axis to engage said contact when the free end of the member is in engagement with the stop means for effecting said swinging and rotary movements of said member sequentially upon rotation of said crank in one direction whereby to swing the member to bring its free end into engagement with the stop and then to rotate the member to engage the contact, said means comprising an arm rigidly mounted on said member, a rotatably mounted element supported for bodily movement with said member during the swinging movement thereof and engageable with said arm to effect turning thereof when rotated whereby to rotate the member, and a compressible swivel link comprising two relatively rotatable telescoping sections having a compression spring therebetween and respectively pivotally connected to said element and to said crank for swinging the member during a part of the rotary movement of the crank until the free end of the member is in engagement with the stop and thereafter providing a combined yielding telescoping and swivel movement of the sections for rotating the element during a further portion of the rotary movement of the crank whereby to rotate the member to bring its free end into engagement with said contact.

2. An electric switch having in combination, a rotatably mounted operating crank, a stationary contact laterally offset from the axis of the crank, and a cooperating circuit controlling member having a pivot axis perpendicular to the axis of the crank and intermediate said contact and the axis of rotation of said crank and substantially perpendicular to the longitudinal axis of the member for swinging movement of the free end of the member into a position adjacent the contact, said member having cam mechanism carried thereby and provided with an operating shaft having an axis parallel to and offset from the longitudinal axis of the member for effecting rotary movement of the member about its longitudinal axis to engage said contact upon relative rotation of the operating shaft when the free end of the member is in said adjacent position a driving connection between said crank and said offset shaft for effecting said swinging and rotary movements of said member sequentially upon rotation of said crank in one direction whereby to swing the member to bring its free end into said adjacent position and then to rotate the member to engage the contact said connection including a swivel link having two relatively rotatable co-linear sections, one of said sections being universally pivotally connected to said crank for movement about two axes, the first substantially parallel to the axis of rotation of said crank

and the second movable relatively to the first in a plane substantially perpendicular to the axis of rotation of the crank and the other of said sections being universally pivotally connected to said offset shaft for movement about two axes, the first substantially parallel to the longitudinal axis of the member and the second laterally offset relatively to the first for movement in a plane substantially perpendicular to the longitudinal axis of the member.

3. An electric switch having in combination, a rotatably mounted operating crank, a stationary contact having a stop adjacent thereto, and a cooperating circuit controlling member having a pivot axis perpendicular to the axis of the crank and intermediate said contact and the axis of rotation of said crank and substantially perpendicular to the longitudinal axis of the member for swinging movement of the free end of the member into engagement with the stop adjacent the contact, said member being mounted for rotary movement about its longitudinal axis to engage said contact when the free end of the member is in said adjacent position; means for effecting said swinging and rotary movements of said member sequentially upon rotation of said crank in one direction whereby to swing the member to bring its free end into engagement with the stop and then to rotate the member to engage the contact, said means comprising an arm rigidly mounted on said member and having an idling end portion extending therefrom, an element supported for bodily movement with said member during the swinging movement thereof and for rotation about an axis substantially parallel to the axis of rotation of said member, said element upon rotation engaging said arm progressively along the length thereof to effect turning of the arm whereby to rotate the member until said idling portion is reached, and a compressible swivel link comprising two resiliently related and relatively rotatable telescoping sections respectively universally pivotally connected to said element and to said crank for swinging said member during a part of the rotary movement of the crank until the free end of the member is in engagement with the stop and thereafter rotating the element during a further portion of the rotary movement of the crank whereby to rotate the member to bring its free end into engagement with said contact.

4. An electric switch having in combination, a rotatably mounted operating crank, a stationary contact laterally offset from the axis of the crank and having a stop adjacent thereto, and a cooperating circuit controlling member having a pivot axis perpendicular to the axis of the crank and intermediate said contact and the axis of rotation of said crank and substantially perpendicular to the longitudinal axis of the member to bring the free end of the member into engagement with the stop adjacent the contact, said member being mounted for rotary movement about its longitudinal axis to engage said contact when the free end of the member is in engagement with the stop; means for effecting said swinging and rotary movements of said member sequentially upon rotation of said crank in one direction whereby to swing the member to bring its free end into engagement with the stop and then to rotate the member to engage the contact, said means comprising two selective lost motion driving elements, one carried by said member and the other supported for bodily movement with the member during the swinging movement thereof

and for rotation relatively to the member, said elements having operatively interengageable portions to effect rotation of said member throughout a predetermined rotation in one direction of said other element and said one of said elements having an idling portion for preventing further rotation thereof in said direction to rotate the member when said other element is rotated, and means for effecting rotation of said other element when said crank is rotated comprising a compressible swivel link having two resiliently interconnected relatively rotatable telescoping sections respectively universally pivotally connected to said other element and to said crank for swinging the member during a part of the rotary movement of the crank until the free end of the member is in engagement with the stop and providing a combined yielding telescoping swivel movement of the sections upon further rotation of the crank for rotating said other element whereby to rotate the member to bring its free end into engagement with said contact.

5. An electric switch having in combination, a rotatably mounted operating crank, a stationary contact laterally offset from the axis of the crank and having a stop adjacent thereto, and a cooperating circuit controlling member having a pivot axis perpendicular to the axis of the crank and intermediate said contact and the axis of rotation of said crank and substantially perpendicular to the longitudinal axis of the member for swinging movement of the free end of the member into engagement with the stop adjacent the contact, said member being mounted for rotary movement about its longitudinal axis to engage said contact when the free end of the member is in said adjacent position; means for effecting said swinging and rotary movements of said member sequentially upon rotation of said crank in one direction whereby to swing the member to bring its free end into engagement with the stop and then to rotate the member to engage the contact, said means comprising two selective lost motion driving elements, one carried by said member and the other supported for bodily movement with the member during the swinging movement thereof and for rotation relatively to the member, said elements being shaped for interlocking driving relationship throughout a predetermined portion of the rotary movement of said other element in one direction whereby to rotate said member and thereafter to prevent further rotation of the member upon continued rotary movement of said other element in said direction, and means for effecting rotation of said other element when said crank is rotated comprising a compressible swivel link having two resiliently interconnected relatively rotatable telescoping sections respectively universally pivotally connected to said other element and to said crank for swinging the member during a part of the rotary movement of the crank until the free end of the member is in engagement with the stop and providing a combined yielding telescoping swivel movement of the sections upon further rotation of the crank for rotating said other element whereby to rotate the member to bring its free end into engagement with said contact.

6. An electric switch having in combination, a rotatably mounted operating crank, a stationary contact laterally offset from the axis of the crank and having a stop adjacent thereto and a cooperating circuit controlling member having a pivot axis perpendicular to the axis of the crank and intermediate said contact and the axis of rota-

tion of said crank and substantially perpendicular to the longitudinal axis of the member for swinging movement of the free end of the member into engagement with the stop adjacent the contact, said member being mounted for rotary movement about its longitudinal axis to engage said contact when the free end of the member is in engagement with the stop; means for effecting said swinging and rotary movements of said member sequentially upon rotation of said crank in one direction whereby to swing the member to bring its free end into engagement with the stop and then to rotate the member to engage the contact, said means comprising two relatively movable cooperating selective lost motion driving elements, one rigidly mounted on said member and the other supported for bodily movement with the member during the swinging movement thereof and for rotation about an axis substantially parallel to the axis of the member, said elements having interengageable portions to effect rotation of said member when said other element is rotated one of said elements having an idling portion for limiting rotation of the member, and means for effecting rotation of said other element when said crank is rotated comprising a compressible swivel link having two resiliently related and relatively rotatable telescoping sections respectively universally pivotally connected to said other element and to said crank for swinging the member during a part of the rotary movement of the crank until the free end of the member is in engagement with the stop and providing a combined yielding telescoping swivel movement of the sections upon further rotation of the crank for rotating said other element whereby to rotate the member to bring its free end into engagement with said contact.

7. An electric switch having in combination, a rotatably mounted operating crank, a stationary contact offset laterally from the axis of the crank and having a stop adjacent thereto and a cooperating circuit controlling member having a pivot axis perpendicular to the axis of the crank and intermediate said contact and the axis of rotation of said crank and substantially perpendicular to the longitudinal axis of the member for swinging movement of the free end of the member into engagement with the stop adjacent the contact, said member being mounted for rotary movement about its longitudinal axis to engage said contact when the free end of the member is in said adjacent position; means for effecting said swinging and rotary movements of said member sequentially upon rotation of said crank in one direction whereby to swing the member to bring its free end into engagement with the stop and then to rotate the member to engage the contact, said means comprising a bifurcated arm rigidly mounted on said member and extending substantially perpendicularly therefrom and having an idling portion formed at the end of each bifurcation, an element supported for bodily movement with said member during the swinging movement thereof and for rotation about an axis substantially parallel to the axis of rotation of said member, said element upon rotation engaging said arm between the bifurcations thereof progressively along the length of one bifurcation thereof to effect turning of the arm whereby to rotate the member until the corresponding idling portion is reached, and a compressible swivel link comprising two resiliently related and relatively rotatable telescoping sections respectively universally pivotally connected to said element and

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to said crank for swinging said member during a part of the rotary movement of the crank until the free end of the member is in engagement with the stop and thereafter providing a combined resilient telescoping swivel movement of the sections for rotating the element during a further portion of the rotary movement of the crank whereby to rotate the member to bring its free end into engagement with said contact

8. An electric switch having in combination, a rotatably mounted operating crank, a stationary contact laterally offset from the axis of the crank and having a stop adjacent thereto and a cooperating circuit controlling member having a pivot axis perpendicular to the axis of the crank and intermediate said contact and the axis of rotation of said crank and substantially perpendicular to the longitudinal axis of the member for swinging movement of the free end of the member into engagement with the stop adjacent the contact, said member being mounted for rotary movement about its longitudinal axis to engage said contact when the free end of the member is in said adjacent position; means for effecting said swinging and rotary movements of said member sequentially upon rotation of said crank in one direction whereby to swing the member to bring its free end into engagement with the stop and then to rotate the member to engage the contact, said means comprising an arm rigidly mounted on said member and having an idling portion extending therefrom, an element supported for bodily movement with said member during the swinging movement thereof and for rotation about an axis substantially parallel to the axis of rotation of said member, said element upon rotation engaging said arm progressively along a predetermined portion of the length thereof to effect turning of the arm whereby to rotate the member and upon further rotation moving freely along the idling portion of the arm, and a compressible swivel link comprising two resiliently related and relatively rotatable telescoping sections respectively universally pivotally connected to said element and to said crank for swinging the member during a part of the rotary movement of the crank until the free end of the member is in engagement with the stop and upon further rotation of the crank providing a combined yielding telescoping swivel movement of the sections for rotating the element to the end of its driving engagement with said predetermined portion of the length of the arm whereby to rotate the member to bring its free end into engagement with said contact and upon still further rotation of the crank rotating the element freely along the idling portion of the arm whereby to prevent further rotation of the member.

9. An electric switch having in combination, a rotatably mounted operating crank, a stationary contact laterally offset from the axis of the crank and having a stop adjacent thereto, and a cooperating circuit controlling member having a pivot axis perpendicular to the axis of the crank and intermediate said contact and the axis of rotation of said crank and substantially perpendicular to the longitudinal axis of the member for swinging movement of the free end of the member into engagement with the stop adjacent the contact, said member having cam mechanism carried thereby and provided with an operating shaft having an axis parallel to and offset from the longitudinal axis of the member for effecting rotary movement of the member about its longitudinal axis to engage said contact when the

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free end of the member is in engagement with the stop, a driving connection for effecting said swinging and rotary movements of said member sequentially upon rotation of said crank in one direction whereby to swing the member to bring its free end into engagement with the stop and then to rotate the member to engage the contact, said connection comprising a toggle including said crank and a compressible swivel link having two relatively rotatable and longitudinally slidably movable sections, one of said sections being universally pivotally connected to said crank for movement about two axes, the first substantially parallel to the axis of rotation of said crank and the second movable relatively to the first in a plane substantially perpendicular to the axis of rotation of the crank and the other of said sections being universally pivotally related to said offset shaft for movement about two axes, the first substantially parallel to the longitudinal axis of the member and the second movable relatively to the first in a plane substantially perpendicular to the longitudinal axis of the member, and resilient means on said link tending to effect relative sliding movement of the sections away from each other whereby to transmit operating thrust through the link and adapted to be stressed to permit a shortening of the link upon engagement of the swinging circuit controlling member with the stop.

10. An electric switch having in combination, a rotatably mounted operating crank, a stationary contact offset laterally from the axis of the crank and having a stop adjacent thereto, and a cooperating circuit controlling member having a pivot axis perpendicular to the axis of the crank and intermediate said contact and the axis of rotation of said crank and substantially perpendicular to the longitudinal axis of the member for swinging movement of the free end of the member into engagement with the stop adjacent the contact, said member having cam mechanism carried thereby and provided with an operating shaft having an axis parallel to and offset from the longitudinal axis of the member for effecting rotary movement of the member about its longitudinal axis to engage said contact when the free end of the member is in engagement with the stop, a driving connection between said crank and said member for effecting said swinging and rotary movements of the member sequentially upon rotation of said crank in one direction whereby to swing the member to bring its free end into engagement with the stop and then to rotate the member to engage the contact, said connection including a compressible swivel link having two relatively rotatable and longitudinally slidably movable sections, one of said sections being universally pivotally connected to said crank for movement about two axes, the first substantially parallel to the axis of rotation of said crank and the second movable relatively to the first in a plane substantially perpendicular to the axis of rotation of the crank and the other of said sections being universally pivotally related to said offset shaft for movement about two axes, the first substantially parallel to the longitudinal axis of the member and the second movable relatively to the first in a plane substantially perpendicular to the longitudinal axis of the member, and a compression spring interposed between said sections to transmit operating thrust through said link and adapted to be compressed to permit a shortening of the link upon engagement of the member with the stop.

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11. An electric switch having in combination, a rotatably mounted operating crank, a stationary contact laterally offset from the axis of the crank and having a stop adjacent thereto, and a cooperating circuit controlling member having a pivot axis perpendicular to the axis of the crank and intermediate said contact and the axis of rotation of said crank and substantially perpendicular to the longitudinal axis of the member for swinging movement of the free end of the member into engagement with the stop adjacent the contact, said member being mounted for rotary movement about its longitudinal axis to engage said contact when the free end of the member is in engagement with the stop means for effecting said swinging and rotary movements of said member sequentially upon rotation of said crank in one direction whereby to swing the member to bring its free end into engagement with the stop and then to rotate the member to engage said contact, said means comprising an element supported for bodily movement with said member during the swinging movement thereof and for rotation about an axis substantially parallel to the axis of rotation of said member, an arm having a camming edge substantially straight throughout a predetermined portion of its length and a circular connecting portion of a radius substantially equal to the effective lever length of said element and substantially centered in the

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axis of the element upon movement of the arm through a predetermined angle, said element upon rotation in one direction engaging the camming edge of said arm to rotate the arm through said predetermined angle whereby to swing said member with its free end into engagement with the stop and upon further rotation in said one direction engaging said circular portion to prevent further rotation of the member, and means for effecting rotation of said element when said crank is rotated in one direction comprising a compressible swivel link having two relatively rotatable telescoping sections respectively universally pivotally connected to said element and to said crank and provided with a resilient connection between the sections for yielding when the member engages the stop.

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