July 4, 1950 H. E. SEAMAN ET AL 2,514,263

AIR-BREAK SWITCH

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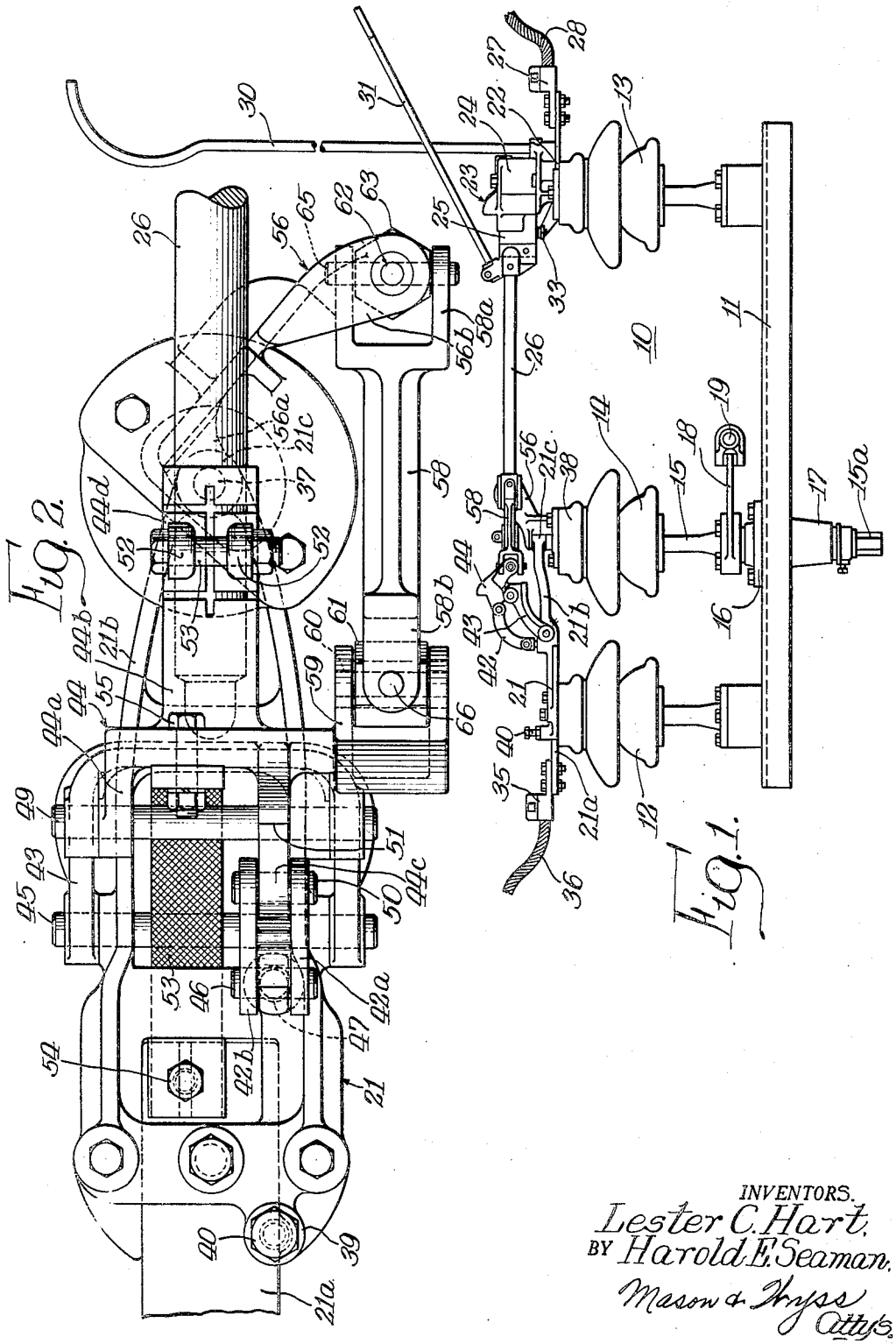


Fig. 2.

Fig. 1.

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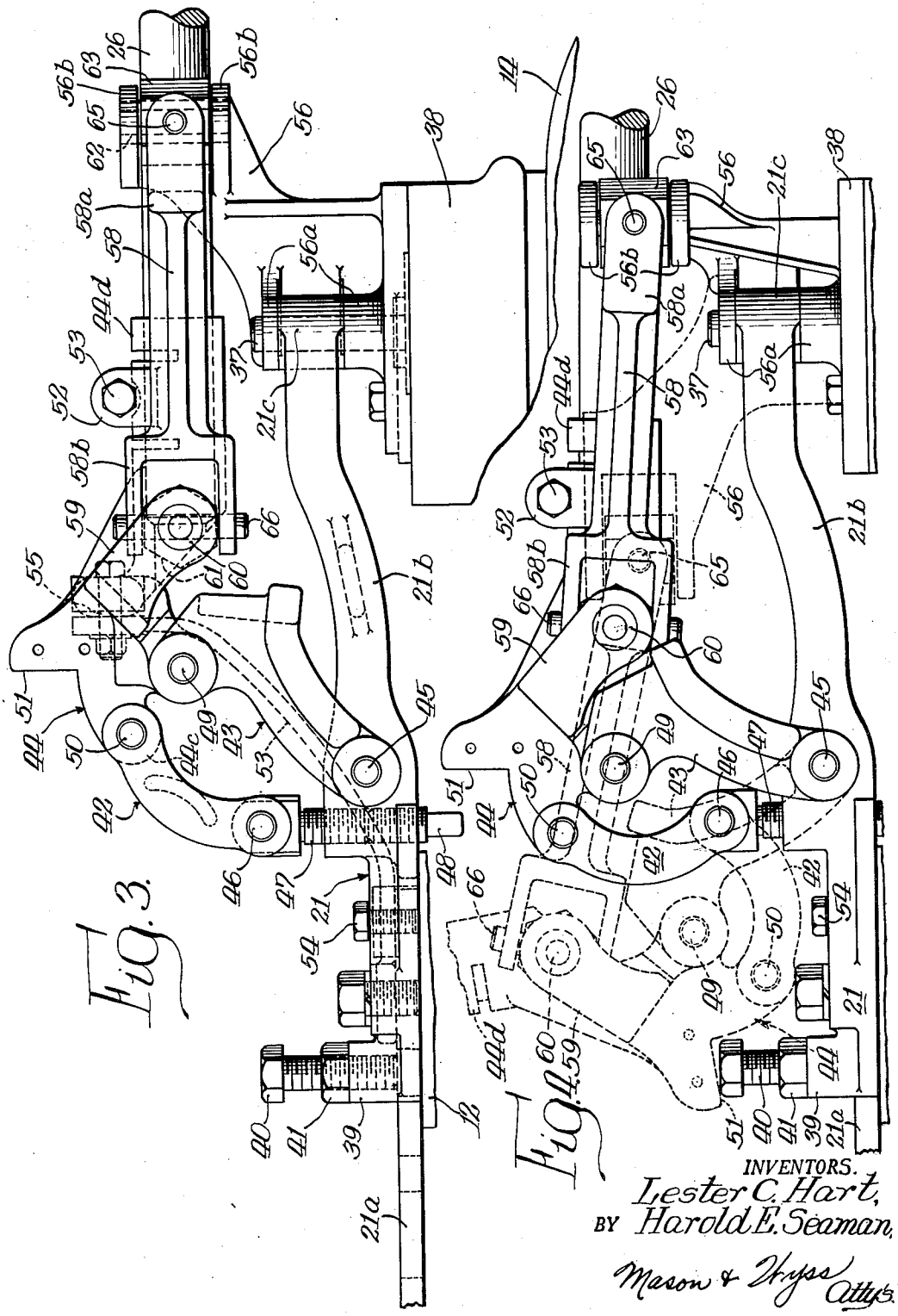


Fig. 3.

Fig. 4.

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UNITED STATES PATENT OFFICE

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AIR-BREAK SWITCH

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6 Claims. (Cl. 200—48)

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The present invention relates to an electric switch and more particularly to an electric switch of the type used to isolate high voltage circuits in high voltage substations and the like.

Specifically the present invention is an improvement on United States Letters Patent 1,829,349 and 1,962,305, both assigned to the same assignee as the present application.

In switches of the type disclosed and claimed in the above mentioned Letters Patent of the United States there is provided a mechanism which causes the switch arm or blade to move endwise along the longitudinal axis thereof at the moment of engagement and disengagement with the stationary contact, thus insuring positive movement under all conditions particularly when covered with snow and ice in the winter time. During the remainder of the cycle of opening or closing operation the switch blade swings about a pivot in a conventional manner.

It is an object of the present invention to provide a simple mechanism for a high voltage switch which moves the switch blade longitudinally when it is near the closed circuit position, which swings the blade in an arc about a pivot point during other portions of its travel, and which gives smooth and positive control of the switch blade at all times.

It is another object of the present invention to provide a simple mechanism for producing the above movement which comprises only a series of pivoted links related in a simple manner.

It is a further object of the present invention to provide a mechanism which may be operated under all conditions of service and in which any requirement for replacement or repair in the operating elements is reduced to a minimum.

Still another object of the present invention is the provision of an improved operating mechanism for a switch in which two distinct movements of the switch blade occur during both the opening and the closing operation of the switch in response to rotary movement of a single insulator connected by a single link with the remainder of the switch blade operating mechanism.

Further objects and advantages of the present invention will become apparent as the following description proceeds and the features of novelty which characterize the invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of the present invention reference may be had to the accompanying drawings in which:

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Fig. 1 is an elevational view of the switch of the present invention shown in the closed circuit position;

Fig. 2 is an enlarged plan view of a portion of the switch of Fig. 1 showing the operating mechanism thereof in the position assumed when the switch is closed;

Fig. 3 is an enlarged elevational view of the operating mechanism of Fig. 1 showing the switch in the closed circuit position; and

Fig. 4 is a view similar to Fig. 3 showing in solid lines the position of the operating mechanism for an intermediate position of the switch and in dotted lines the position of the operating mechanism for the open position of the switch.

It will be understood that the present invention is adapted for use with either single pole or multi-pole operation. To simplify the drawings only a single pole of the switch is illustrated. In a multi-pole switch additional units identical with the unit shown in Fig. 1 of the drawings are provided with links interconnecting the operating mechanisms to insure simultaneous operation of the switch blades.

Referring now to the drawings there is illustrated a switch generally indicated at 10 embodying the present invention. This switch comprises a base member 11 formed of channel iron or any other suitable material, which will provide a rigid member for supporting the switch contacts and operating means. As illustrated the base 11 is disposed in a horizontal position. It should be understood, however, that this base might equally well be disposed in a vertical position and the illustrated position is by way of example only. Secured to the base 11 are a pair of fixed or stationary insulators 12 and 13 mounted in spaced relationship on the base 11, and a movable insulator 14 positioned between the insulators 12 and 13. The insulators 12 and 13 are provided with suitable means for securing them to the base 11. The insulator 14 on the other hand includes a downwardly extending shaft 15 which is adapted for rotation in a suitable bearing 16 mounted on the base 11. The end of the shaft 15 depending below the base 11 is provided with a hexagonal end 15a which may be engaged by a suitable manual operating lever or the like to cause rotation of the insulator 14. Preferably the bearing and shaft depending below the base 11 are provided with a suitable sleet hood 17.

For the purpose of operating the switch 10 as a multi-pole switch one or more crank arms 18 may be provided to rotate with the insulator shaft 15. As illustrated the crank arm 18 is

provided with an operating eye 19 which may be connected to suitable rods for interrelating the operation of the plurality of poles of the multi-pole switch to insure simultaneous operation thereof. It will be understood that where a single pole switch is employed the crank arm 18 may be dispensed with. Also instead of applying a crank to the hexagonal extension 15*a* power for operating the switch may be applied through a suitable link connected to the crank arm 18 as will be understood by those skilled in the art.

In order to support electrical conductors which together with the switch comprise the circuit to be controlled, the insulator 12 has mounted thereon a hinge base and terminal support 21 while the insulator 13 has mounted thereon a contact support 22. It will be understood that the supports 21 and 22 are suitably fastened to their associated insulators 12 and 13 in any conventional manner. Mounted on the support 22 is the stationary contact means or assembly generally designated at 23. The stationary contact itself is not visible in the drawings since it is covered by a sleet hood 24 preferably formed of bronze or the like. It will be understood however that the stationary contact may comprise any suitable contact capable of carrying the currents at the high voltages involved and in general may comprise spring biased contact jaws for engaging and receiving therebetween the blade-like contact portion 25 of a switch blade 26. The support 22 includes an extension to which a suitable terminal 27 may be bolted or otherwise secured which terminal 27 is electrically connected to a suitable conductor 28. Also mounted on the support 22 is a stationary arcing horn 30 which cooperates with a bifurcated multiple arcing horn 31 forming an extension of the switch blade 26. Although the high voltage switch of the present invention is an isolating switch rather than a circuit breaker so that it is not required to interrupt high currents, it may occasionally be necessary to interrupt transformer magnetizing currents which is accomplished at the arcing horns 30 and 31 rather than at the current carrying contacts 23 and 25. The support 22 further includes a contact base guide 33 for supporting and guiding the movable contact 25 fastened to the end of the switch blade 26 in its initial movement during the circuit opening operation and in its final movement during the circuit closing operation, when the switch blade moves endwise along its longitudinal axis thereby guiding the blade during this movement.

The arrangement described thus far is similar to that disclosed in the prior patents referred to above and forms no part of the present invention. The present invention is particularly concerned with the operating mechanism to be described hereinafter associated with the hinge base and terminal support 21. Preferably the support 21 is in the form of a casting having a terminal-like extension 21*a* to which is suitably bolted or otherwise fastened a terminal 35, to which is connected the conductor 36. It will be apparent that the switch 10 provides the control path between the conductors 28 and 36. The casting or hinge support 21 includes a bifurcated portion 21*b* which extends forwardly over the rotatable insulator 14 and terminates in a bearing 21*c* for receiving the shaft 37 extending upwardly from the rotary insulator 14. The shaft 37 is suitably associated, as will be described hereinafter with a top member 38 fastened to the

rotatable insulator 14. The casting or support 21 further includes a raised portion 39, disposed substantially above the insulator 12, for receiving an adjustable cap screw 40, the purpose of which will become apparent as the following description proceeds. A suitable lock nut 41 is provided to lock the cap screw 40 in any desired adjusted position.

In order to provide a simple operating mechanism causing endwise movement of the switch blade 26 for a relatively small portion of the operating stroke as well as movement thereof for the major portion of the stroke there are provided links 42, 43 and 44. The link 43 is a U-shaped member pivoted to the support 21 by means of a pin 45 which extends through suitable openings defined in the ends of the arms of the U-shaped member 43 which are aligned with a suitable opening through the support 21. With this arrangement one end of the link 43 is effectively pivoted about one point on support 21. The link 42 is similarly pivoted with reference to a fixed point related to the support 21. As illustrated the link 42 comprises a pair of link members 42*a* and 42*b*, best shown in Fig. 2 of the drawings, having one end thereof related by a pivot pin 46 with a sort of an "eye bolt" 47 threadedly mounted in the support 21. With this arrangement the vertical position of the pivot pin 46 is adjustable. A suitable lock screw 48 is provided to lock the bolt 47 in any desired adjusted position. With this arrangement corresponding ends of each of the links 42 and 43 are effectively pivoted about two spaced points on the support 21. As illustrated in the drawings the spaced points on the support 21 are so disposed that substantial space exists not only between a pair of vertical lines one through each of the spaced points 45 and 46 but also between a pair of horizontal lines, one through each of the points 45 and 46.

The link 44 is effectively a link interconnecting the other ends of the links 42 and 43 not pivoted to the support 21. Actually however, the so-called "link" 44 is much more than a link, as will become apparent from the following description, and it is preferably referred to hereinafter as movable member 44. As best illustrated in Fig. 2 of the drawings the member 44 comprises a U-shaped portion 44*a* integrally formed with an extension 44*b* connected to the bight of the U-shaped portion. The arms of the U-shaped portion 44*a* of the member 44 are connected by means of a pin 49 with the U-shaped link 43, which latter is provided with extensions from the bight of the U-shaped portion having openings defined therein aligned with openings formed in the ends of the arms of the U-shaped portion 44*a*, to accommodate the pivot pin 49. The movable member 44 is also provided with a portion 44*c* extending in the opposite direction from the portion 44*b* and in effect comprising somewhat of an extension of one of the arms of the U-shaped portion 44*a*. This extension 44*c* is disposed between the link portions 42*a* and 42*b* of the link 42 and is pivotally connected thereto by means of a pivot pin 50 extending through aligned openings in the portions 42*a*, 42*b* and 44*c*. This portion 44*c* of the link 44 also includes an upwardly extending shoulder 51 which is adapted to act as a stop member for engaging the cap screw 40 in the extreme open position of the switch to limit the maximum opening movement of the switch. Consequently the cap screw 40 and the shoulder 51 cooperate

to provide a switch opening stop device. The forwardly extending portion 44*b* of the movable member 44 includes a sleeve or other suitable member 44*d*, preferably integrally formed with the portion 44*b* to receive the relatively fixed end of the switch blade 26. The blade 26 is illustrated as a rod of conducting material having a circular cross section. It will be understood that some other cross section might equally well be employed. The sleeve 44*d* includes a pair of ears 52 for accommodating a clamping bolt 53 whereby the blade 26 may be rigidly clamped to the sleeve 44*d* and consequently the movable member 44. It will be apparent therefore that the blade 26 effectively forms a rigid part of the movable member 44 which in turn is floatingly supported at two spaced points to the ends of the links 42 and 43. It will also be noted from the drawings that the link 43 is a heavy weight-carrying link preferably comprising a heavy casting and is the main supporting link for the movable member 44, whereas the links 42 are light control links for guiding the movement of this member and hence carry little weight which is primarily sustained by the main supporting link 42.

For the purpose of insuring a satisfactory electrical connection from the terminal 21*a* to the switch blade 26 without requiring the current to flow through relatively movable contacting surfaces there is provided a flexible conducting lead or braid 53 having one end clamped as by means of the screw 54 to the support 21. The other end is connected by means of a bolt 55 with the bight section of the U-shaped portion 44*a* of the link 44 as is best shown in Figs. 2 and 3 of the drawings. With this arrangement the conductor 53 is in parallel with the links 42 and 43 to insure a good current conducting path between the movable member 44 and the support 21.

In order to transmit any force causing rotation of the insulator 14 to the operating mechanism of the present invention the member 38 supported on the insulator 14 includes a crank arm 56 which may be an integral casting with the member 38. Preferably the crank arm 56 has a plurality of spaced ears such as 56*a* including aligned openings therein which are also aligned with the bearing 21*c* for receiving the pin or shaft 37. Effectively therefore the bearing 21*c* cooperates with the bearing 15 rotatably to support the insulator 14 at either end thereof. The end of the crank arm 56 is connected to the link 44 by means of a universal link 58 having a universal connection at either end thereof. As best shown in Fig. 2 of the drawings the movable member 44 has integrally formed therewith a second U-shaped portion 59 which has the open end thereof opposite from the open end of the U-shaped portion 44*a*. This second U-shaped portion is preferably disposed laterally from the operating mechanism in the same direction that the crank arm 56 extends from the insulator 14. A member 61, indicated as a hexagonal member, is disposed between the arms of the U-shaped portion 59 and pivotally related thereto by means of an annular pin 60 extending through the arms of the U-shaped portion 59 and the member 61. Similarly the crank 56 is provided with ears 56*b* between which is pivoted by means of an annular pin 62 the hexagonal member 63. The universal link 58 is provided with U-shaped ends 58*a* and 58*b* respectively which ends are displaced from each other by 90° as is apparent from the drawings. The U-shaped end 58*a* is adapted to receive the pivotally supported member 63 between the arms thereof and is pivotally related thereto by means of the pivot pin 65. Similarly the U-shaped end 58*b* is adapted to receive pivotally mounted hexagonal member 61 between the arms thereof and is pivotally related thereto by means of the pin 66. It is apparent therefore that universal movement of the link 58 with reference to either the movable member 44 or the crank arm 56 is provided.

The operation of the present invention may best be understood by reference to the drawings where Figs. 1, 2 and 3 show the position of the operating mechanism for the closed portion of the switch. When a force causing rotation of the insulator 14 in a clockwise direction as viewed in Fig. 2 of the drawings is applied thereto, the crank arm 56 causes this force to be transmitted to the universal link 58 tending to move it to the left as viewed in Figs. 2 and 3 of the drawings. Such movement of the link 58 causes movement of the movable member 44. Due to the particular relationship of the movable member 44 and the links 42 and 43 the initial movement of the link 58 mentioned above causes endwise movement only of the blade 26. During this initial movement the relative vertical positions of the pivot points 49 and 50 of the movable member 44 remain substantially unchanged thus insuring only longitudinal movement thereof. In Fig. 4 of the drawings there is illustrated in solid lines the position of the operating mechanism at substantially the end of such initial endwise movement of the blade during the opening operation of the switch. It is noted that the movable member 44 is in substantially the same position as in Fig. 3 except that it has been moved to the left. Upon continued rotation of the insulator 38 the pivot point 50 moves rapidly downwardly relative to the pivot point 49, thereby causing the switch blade 26 which is effectively integral with the movable member 44 to pivot about the pivot point 49 so as to provide a large isolating gap between the stationary contact means 23 and the contact portion 25 of the blade 26. The position of the operating mechanism at the fully open switch position is indicated in dotted lines in Fig. 4 of the drawings. In this position the shoulder 51 is in engagement with the stop comprising the cap screw 40. It will be observed from the successive positions of the mechanism illustrated in the drawings that during the entire swinging movement of the switch blade 26 that a line through the pivot points 46 and 50 of the control links 42 closely approximates a right angle with respect to the longitudinal axis of the switch blade 26.

During the circuit closing operation it is apparent that the sequence of movements described above will be reversed. The switch blade 26 first effectively pivots about pivot 49 until the solid line position of Fig. 4 is reached whereupon continued closing movement of the switch comprises endwise movement of the blade 26 along the longitudinal axis thereof.

The type of movement provided by the operating mechanism is advantageous for several reasons. Since the swinging or pivotal movement of the switch blade during the switch stroke is completed before the switch blade engages the contact member, the contact member and consequently its supporting insulator 14 is not exposed to the heavy impact ordinarily borne by

such members in many types of switches. Furthermore the engagement and disengagement of the switch blade with the stationary contact means by an endwise movement of the switch arm rather than by a swinging or pivotal movement is advantageous since the leverage of the operating mechanism may be applied to much better advantage thus insuring satisfactory operation during conditions when the switch and operating mechanism are covered with snow and ice. Also since the upper side of the housing 24 for the stationary contact may be closed, and a lateral slot for the contact provided, the construction is much more satisfactory from the standpoint of protection against the entrance of sleet, rain or snow.

With the present invention a very simple construction is provided including only a plurality of links so that the necessity of having a housing for enclosing the mechanism is completely eliminated. Also a very inexpensive construction is provided which is simple to manufacture and which is sturdy and foolproof in operation.

It will be apparent to those skilled in the art that the present invention is not limited to the particular construction and arrangement shown and described but that changes and modifications may be made without departing from the spirit and scope of the present invention. It is aimed in the appended claims to cover all such changes and modifications that fall within the true spirit and scope of the present invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. In an electric switch, a pair of spaced supports mounted on insulating means, stationary contact means mounted on one of said supports, a pair of links each having one end pivotally supported to a different one of two spaced points on the other of said supports, said points being so disposed that a substantially greater separation exists between a pair of horizontal lines one through each of said points than the separation between a pair of vertical lines one through each of said points, a movable conducting member having a plurality of pivot points thereon, one of said links being shorter than the other, means pivotally relating one of said pivot points and the other end of one of said links, means pivotally relating another of said pivot points and the other end of the other of said links, a switch blade rigidly fastened and electrically connected to said member and arranged to move toward and away from said stationary contact means during closing and opening of said switch, and means for applying an operating force to said member to cause movement thereof, said links and member being so related that operation of said last mentioned means causes swinging movement of said switch blade for the major portion of its movement together with an endwise movement of said switch blade along its longitudinal axis when said switch blade is near its closed circuit position.

2. An electric switch comprising a pair of spaced supports mounted on insulating means, stationary contact means mounted on one of said supports, a pair of links comprising a main supporting link and a control link each having one end pivotally supported to a different one of two spaced points on the other of said supports, said control link being shorter than said main link, a movable conducting member having a plurality of pivot points thereon, means pivotally relating one of said pivot points and the other end of one of said links, means pivotally relating another of said pivot points and the other end of the other of said links, a switch blade of circular cross-section rigidly fastened and electrically connected to said member and arranged to move toward and away from said stationary contact means during closing and opening of said switch, and means including a rotatable insulator for applying an operating force to said member to cause movement thereof, said links and member being so related that operation of said last mentioned means causes swinging movement of said switch blade for the major portion of its movement together with an endwise movement of said switch blade along its longitudinal axis when said switch blade is near its closed circuit position, a line through the pivot points of said control link closely approximating a right angle with the longitudinal axis of said blade throughout the swinging movement of said blade.

3. In an electric switch, a pair of spaced insulators, a pair of supports one mounted on each of said insulators, a first link, means pivotally relating one end of said first link and one of said supports, a second link, means pivotally relating one end of said second link to said one of said supports at a point spaced both in a vertical and a horizontal direction from the pivot point of said first link, the spacing in said vertical direction substantially exceeding the spacing in said horizontal direction, a movable member having a plurality of pivot points thereon, one of said links being longer than the other, means pivotally relating one of said pivot points and the other end of said first link, means pivotally relating another of said pivot points and the other end of said second link, a switch blade rigidly fastened and electrically connected to said member and arranged to move toward and away from said stationary contact during closing and opening of said switch in response to movement of said member, a rotatable insulator disposed between said spaced insulators, a crank arm rotatable with said rotatable insulator, and means comprising a universal link interconnecting said crank arm and said member for transmitting an operating force causing rotation of said insulator to said member, said links and member being so related that operation of said last mentioned means causes swinging movement of said switch blade for the major portion of its movement together with an endwise movement of said switch blade along its longitudinal axis when said switch blade is near its closed circuit position.

4. In an electric switch, a pair of spaced supports mounted on insulating means, stationary contact means mounted on one of said supports, a pair of links each having one end pivotally supported to a different one of two spaced points on the other of said supports, said points being so disposed that a substantially greater separation exists between a pair of horizontal lines one through each of said points than the separation between a pair of vertical lines one through each of said points, a movable conducting member having a plurality of pivot points thereon, means pivotally relating one of said pivot points and the other end of one of said links, means pivotally relating another of said pivot points and the other end of the other of said links, a switch blade rigidly fastened and electrically connected to said member and arranged to move toward and away from said stationary contact during closing and opening of said switch, a flexible conductor interconnecting said member and the other of

said supports, and means for applying an operating force to said member to cause movement thereof, said links and member being so related that operation of said last mentioned means causes swinging movement of said switch blade for the major portion of its movement together with an endwise movement of said switch blade along its longitudinal axis when said switch blade is near its closed circuit position.

5. In an electric switch, a pair of spaced insulators, a pair of supports one mounted on each of said insulators, a stationary contact supported on one of said insulators, a control link, adjustable means for pivotally relating one end of said control link and one of said supports, a second main supporting link substantially longer than said control link, means pivotally relating one end of said main supporting link to said one of said supports at a point spaced both vertically and horizontally from the pivot point of said control link, a movable member having a plurality of pivot points thereon, means pivotally relating one of said pivot points and the other end of said control link, means pivotally relating another of said pivot points and the other end of said main supporting link, a switch blade rigidly fastened and electrically connected to said member and arranged to move toward and away from said stationary contact during closing and opening of said switch in response to movement of said member, a rotatable insulator supported for rotation by said one of said supports, a crank arm rotatable with said rotatable insulator, and means comprising a universal link interconnecting said crank arm and said member for transmitting an operating force causing rotation of said insulator to said member, said links and member being so related that operation of said last mentioned means causes swinging movement of said switch blade for the major portion of its movement together with an endwise movement of said switch blade along its longitudinal axis when said switch blade is near its closed circuit position, said operating force being applied to said mechanism in all positions of said switch blade through a lever arm at least as long as the longest of said links.

6. In an electric switch, a pair of spaced insulators, a pair of supports one mounted on each of said insulators, a stationary contact supported on one of said insulators, a first link, means pivotally relating one end of said first link and one of said supports, a second link of different length than said first link, means pivotally relating one end of said second link to said one of said supports at a point spaced from the pivot point of said first link, a movable member having a plurality of pivot points thereon, means pivotally relating one of said pivot points and the other end of said first link, means pivotally relating another of said pivot points and the other end of said second link, a switch blade rigidly fastened and electrically connected to said member and arranged to move toward and away from said stationary contact during closing and opening of said switch in response to movement of said member, rotatable means including a crank arm disposed between said spaced insulators and at least partially supported for rotation by said one of said supports, and means comprising a universal link, interconnecting said crank arm and said member for transmitting an operating force causing rotation of said insulator to said member, said links and member being so related that operation of said last mentioned means causes swinging movement of said switch blade for the major portion of its movement together with an endwise movement of said switch blade along its longitudinal axis when said switch blade is near its closed circuit position, a line through the pivot points of said control link closely approaching the right angle with the longitudinal axis of said blade throughout the swinging movement of said blade.

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