July 21, 1931. A. ALSAKER ET AL 1,815,283

SWITCH

Original Filed Nov. 3, 1927 3 Sheets-Sheet 1

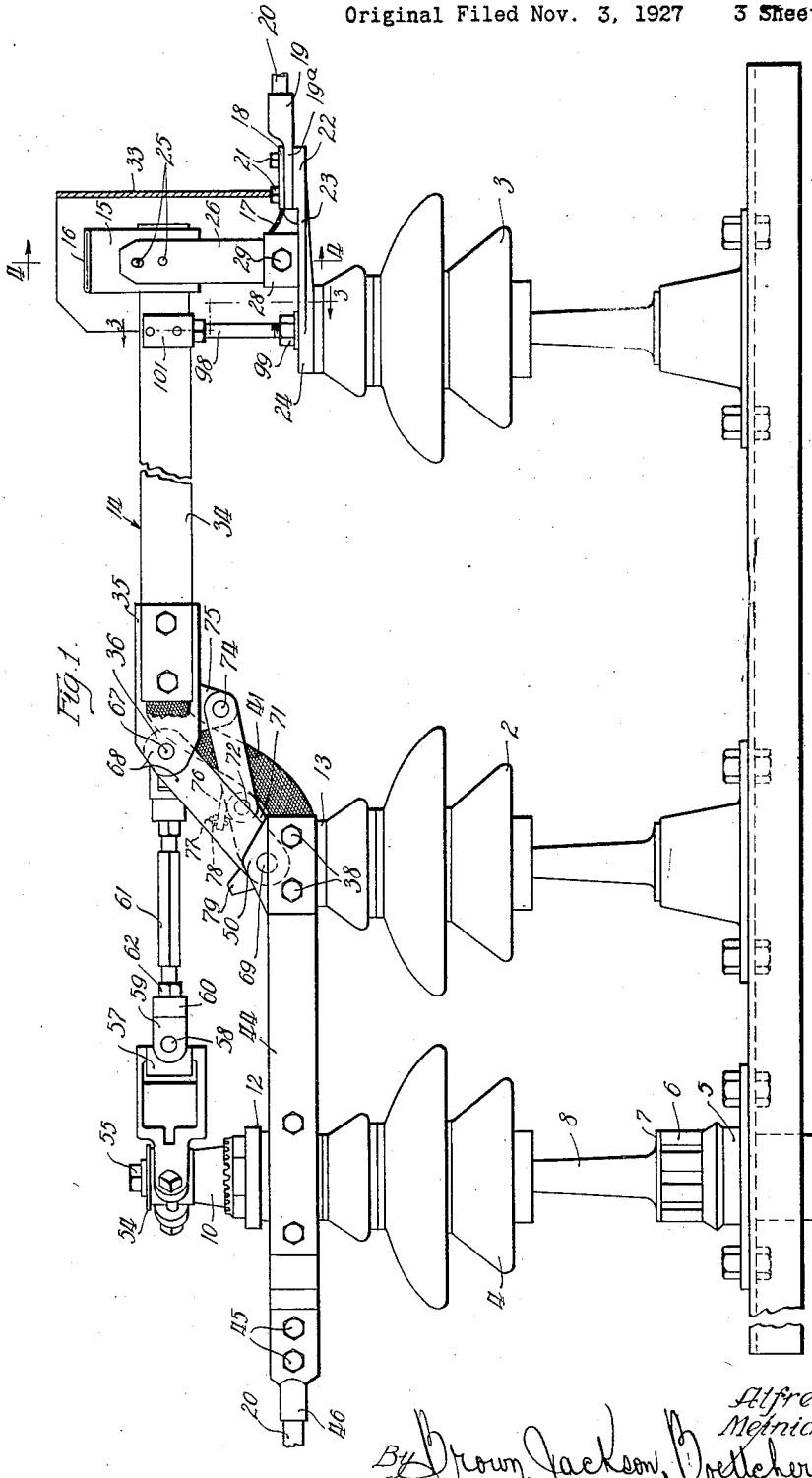


Fig. 1.

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Original Filed Nov. 3, 1927 3 Sheets-Sheet 2

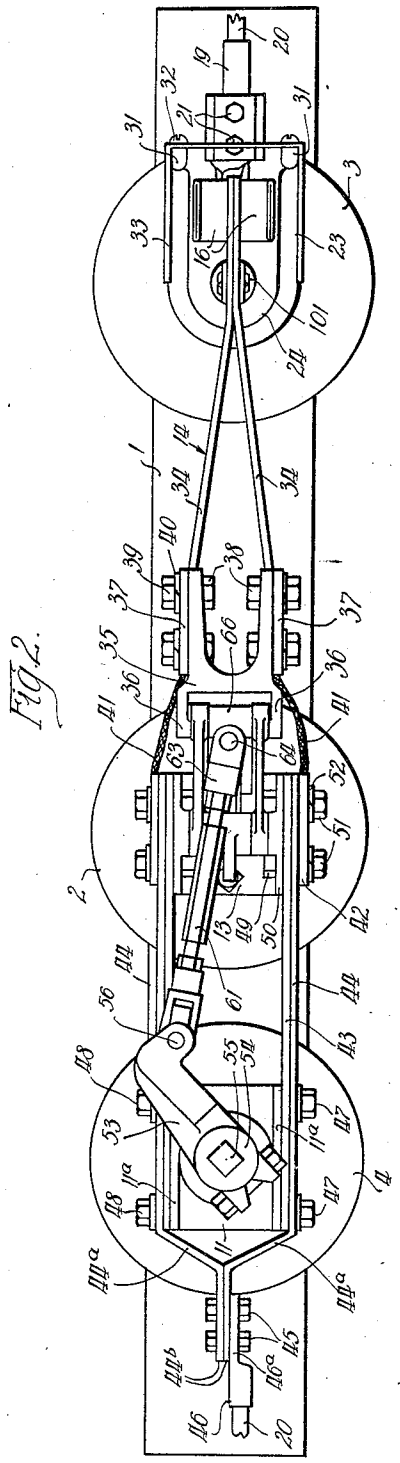


Fig. 2.

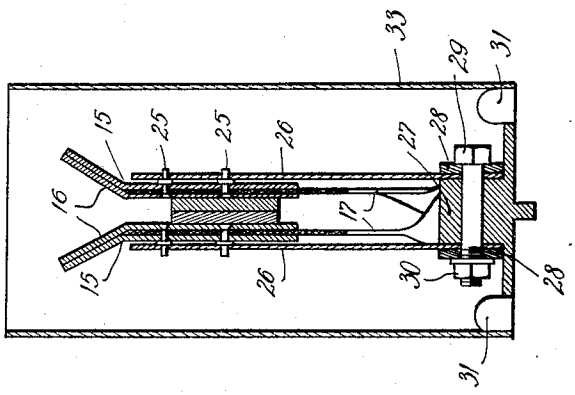


Fig. 4.

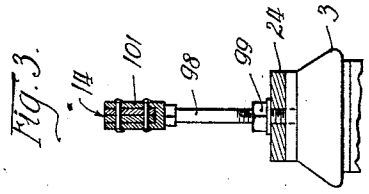


Fig. 3.

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SWITCH

Original Filed Nov. 3, 1927 3 Sheets-Sheet. 3

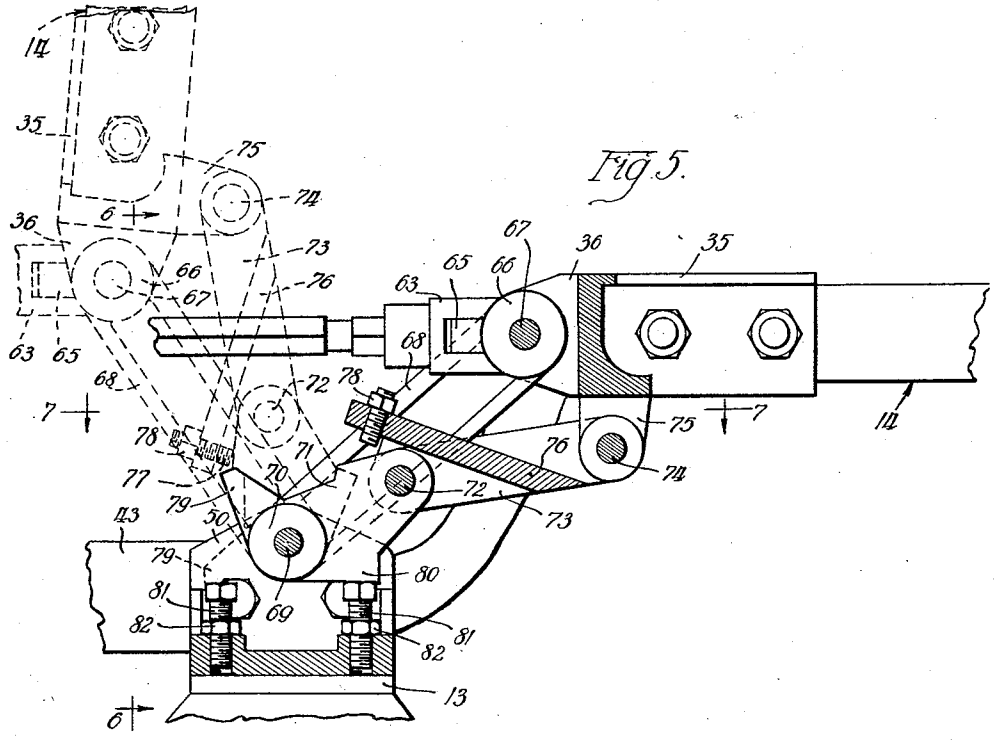


Fig. 5.

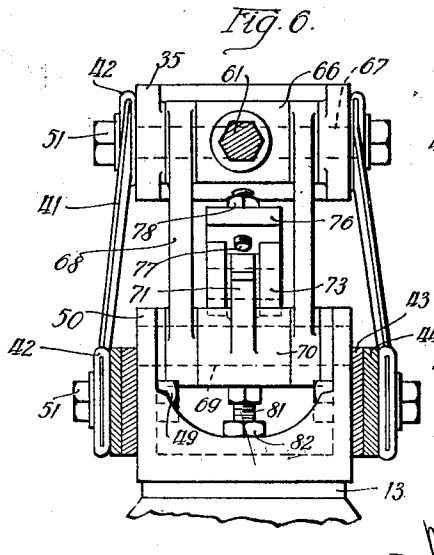


Fig. 6.

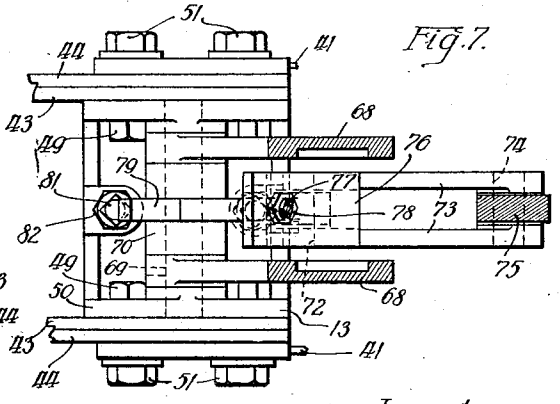


Fig. 7.

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Patented July 21, 1931

1,815,283

# UNITED STATES PATENT OFFICE

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## SWITCH

Original application filed November 3, 1927, Serial No. 230,759. Divided and this application filed March 27, 1929. Serial No. 350,172.

This application is a division of our pending application, Serial No. 230,759, filed November 3, 1927.

This invention relates to disconnect switches of the vertical break type. Such switches, according to present practice, are gang operated and the movable members or blades are of appreciable length to provide a long break or air gap necessitated by the high voltages commonly used.

In switches of this type, as the length of the arm or blade increases, the leverage effect due to friction between the blade and the contact, or freezing, increases so that appreciable power is required to open the blade which, if opened with a single swinging movement is subjected to undesirable strain. We have found that this objection can be overcome by providing means whereby the blade is initially subjected to a rocking movement between the contacts so as to be broken away or freed therefrom, in the opening operation, and is then withdrawn from the contacts and swing into full open position.

This greatly facilitates opening of the switch when the blade is frozen to the contacts by sleet or ice, or when the contacts and the blade have become oxidized to such an extent as to produce appreciable friction to oppose relative movement between the blade and the contact.

Switches which are similar, in their broader aspects, to our switch are disclosed in the copending applications of Alfred Alsaker and Eric Nordhem, filed September 27, 1926, and May 27, 1927, and serially numbered 137,925 and 194,608, respectively. In the switch of the first mentioned application, the blade is opened by a combined pull and lifting effect exerted at the pivoted end thereof through the medium of operating links pivoted at their upper ends to the blade and pivoted intermediate their ends to a support, means being provided for exerting a pulling or pushing effect at the lower end of the links for swinging the blade in an arc into open or closed position. There is also a spring connection between the links and the blade for returning the blade to its original relation to the links after the blade has been withdrawn from the jaws or contact. By this arrangement the blade is opened by being first pulled out of the contact with a substantially rectilinear movement, and then swung in an arc into full open position, in which position it is held by the spring connection between the links and the blade. In this form of switch the operating links and associated parts are subjected to considerable stresses and there is no positive connection between the support and the blade for holding the blade open.

In the switch of the second application above identified, the pivoted end of the blade is connected to the support by links pivoted at their upper ends to the blade and at their lower ends to the support. The blade has an upwardly projecting member and suitable operating means is connected to this member above the blade for exerting a pulling or pushing effect thereon for opening or closing the blade. The blade is opened and closed by a combined swinging and plunging movement, and the links carry a locking member which cooperates with locking means on the support and actuated by the operating means for locking the blade in open position. In this form of switch the blade is subjected to considerable stress when opening it, particularly when the blade is of great length as in high tension switches, due to the application of the opening pull to the blade above and adjacent the pivoted end thereof, and considerable attention and care is required in the machining, adjustment and timing of the locking means.

Our switch is distinguished from the switches above discussed in the manner of operating the blade and securing it in open position. In addition to the main operating links we provide a second linkage connection between the blade and the support which forms a positive connection therebetween and serves to lock the blade in open position. This linkage connection is in the nature of a toggle and after the contacts are separated exerts a lifting effect on the blade at a point in advance of the pivotal connection thereof to the main operating links, causing the blade to swing about such connection in its continued

opening movement into full open position, in which position the blade is disposed substantially vertically.

The toggle is broken in proper direction to lock the blade to the support, in conjunction with the main links, as it reaches full open position thus locking the blade open. This causes the blade to swing as a unit with the operating links and the toggle during closing so that it is closed with a single swinging movement, the toggle being broken in proper direction to release the blade from the support as it reaches full closed position. A further distinguishing feature of our switch is that the pull exerted in opening the blade is applied directly to the blade and in the plane thereof, avoiding subjecting the blades and links and associated parts to undue stresses.

Our switch includes means whereby the blade is caused to be swung vertically into full open position after being first broken free of the contacts and withdrawn therefrom, this swinging movement of the blade occurring in the plane of the corresponding phase conductor, thus preventing likelihood of interference between phases, as in a three phase system, by opening or closing of the switch blade.

While the switch illustrated is intended and more particularly as a high tension disconnect switch, it is also adapted for other uses such as, in example in a low tension high ampere switch where large areas of contact are involved with consequent resistance to movement of the blade out of the contact. By our invention, we provide means whereby the end of the blade remote from the contact is raised slightly at the initiation of opening movement of the blade, thus exerting a powerful leverage effect at the contact end of the blade which serve to very effectively break the blade free of the contact, so that it may be readily withdrawn therefrom. It is also possible, by providing suitable arcing horns and increasing the length of the blade, to use this switch as a load break switch.

We also contemplate applying our invention to an underhung switch in a novel manner whereby any undesirable strain, due to dropping of the switch blade after withdrawal of the same from the contact, is avoided. It will be understood, therefore, that our switch is not necessarily limited to any one particular use and our invention can be applied to switches of various types, the type herein shown being merely illustrative of the practical application of our invention. Further objects and advantages of our invention will appear from the detailed description.

In the drawings:

Fig. 1 is a side view of a switch constructed in accordance with our invention;

Fig. 2 is a plan view;

Fig. 3 is a section taken substantially on line 3—3 of Figure 1;

Fig. 4 is a section taken substantially on line 4—4 of Figure 1;

Fig. 5 is a section through the blade supporting member and the adjacent end portion of the blade, parts being shown in elevation;

Fig. 6 is a section taken substantially on line 6—6 of Figure 5; and

Fig. 7 is a section taken substantially on line 7—7 of Figure 5.

Our switch is somewhat similar, in its broader aspects, to the switch disclosed in the co-pending application of Alfred Alsaker and Eric Nordhem, Serial No. 194,608 filed May 27, 1927, but is distinguished therefrom in that no springs are employed for connecting the blade to the operating means therefor and by the linkage means for locking the blade to the main operating links for movement therewith after it has been opened to a predetermined extent and during the closing movement of the blade. The switch structure is mounted on a base 1 of channel construction. Two fixed insulators 2 and 3 of known type are rigidly secured on the base 1 in spaced relation, insulator 2 supporting the switch blade and associated parts and insulator 3 supporting the fixed contact and associated parts. A third insulator 4 is mounted on base 1 in spaced relation to insulator 2, this third insulator being also of known construction and mounted for oscillatory movement about a vertical axis in any suitable or known manner, such as that illustrated in the application of Alfred Alsaker for rotary insulator, Serial No. 137,926, filed September 27, 1926. At its lower portion the insulator 4 is mounted for turning movement through a suitable anti-friction or ball bearing structure 5, above which is provided a member 6 which is pinned or otherwise suitably secured to a flange 7 at the lower end of a neck or stem 8 of the insulator. This neck or stem is held against endwise movement by a through pin 9 secured therein and extending through the member 6 and bearing structure, provided adjacent its lower end with suitable collars or equivalent elements threaded or otherwise adjustably secured on the lower portion of stem 6 whereby the ball bearings may be adjusted to avoid undesirable looseness or play and insure ease of operation of the oscillatory insulator. An operating member 10 is secured on the upper end of the insulator 4 in a known manner and is pinned or otherwise secured thereto for turning movement with the insulator. This operating member extends through a supporting and connecting member 11 which is substantially square in outline, a ball bearing structure 12 of suitable type being interposed between the member 11 and the operating member 10, so as to insure ease of turn-

ing of the latter. The member 6 is adapted to receive on its upper portion, above the ball bearing structure 5, an operating arm (not shown) which may be secured thereto in any suitable or well known manner. In practice, in three phase work, the arms of the three movable insulators of the three switches are connected to be operated in gang in a known manner.

A substantially square blade supporting member 13 is secured on the top of insulator 2 and provides a support for a blade 14 through suitable linkage connections. This blade cooperates with contact jaws 15 (Fig. 4) provided at their upper ends with downwardly converging lips or guide elements 16 for directing the blade between the jaws. These jaws may be of any suitable construction, but we prefer to employ jaws constructed in the manner disclosed in the copending application of Alfred Alsaker for self cleaning contacts, Serial No. 224,069, filed October 5, 1927. As fully set forth in said copending application, each of the jaws is formed from a suitable length of copper tubing which is flattened under pressure on the end portions of flexible lead 17 formed from braided copper. The other ends of these leads are secured in a terminal member 18 which is also formed from a suitable length of copper tubing, flattened under pressure upon the ends of the leads. This terminal member 18 is disposed upon the flattened portion 19*a* of a terminal lug 19, secured upon one end of a wire or conductor 20. Tap screws 21 pass through the terminal member 18 and element 19*a* and thread into a thickened portion 22 of an arm 23, which extends from a cap member 24 secured on the upper end of insulator 3. Each of the jaws is provided with two outwardly projecting studs 25 which extend through openings adjacent the upper ends of supporting leaf springs 26. The lower one of these openings receives its cooperating stud snugly, the upper opening being appreciably larger than its cooperating stud, permitting a certain amount of desirable looseness of the jaws in order that they may properly align themselves so as to obtain maximum contact with the end portion of blade 14. The springs 26 are secured, at their lower ends, between a block 27 which projects from the upper face of arm 23, and clamping plates 28, securing bolts 29 being passed through the plates and block and the plates being drawn tight against the lower portions of the springs by nuts 30 threaded onto the bolts. Preferably, the plate 23 is provided, adjacent its outer end, with suitable lugs 31 which are bored and threaded for reception of screws 32 by means of which a suitable housing 33 is secured to the plate or arm 23 in position to extend about the contact jaws and associated parts, it being noted, however, that this housing is open at its inner or front side and at its top.

The blade structure includes two blade elements 34. The outer ends of these elements 34 seat in recesses formed in the outer faces of the arms of a U-shaped blade carrying frame or bracket 35, each arm of which is provided with a rearwardly projecting ear 36.

Terminal members 37 are disposed at the outer or side faces of the blade elements 34 and are forced into close contact therewith by screws 38 passing through the arms of the bracket 35 and through the elements 34 and terminal members 37, nuts 39 being threaded onto these screws and bearing against spring washers 40 confined between the nuts and the terminal members. This provides simple and efficient means for securing the blade to the frame 35 and also insures proper contact between the terminal elements 37 and the elements of the blade. Each of the terminal elements 37 is formed from a suitable length of copper tubing which is flattened upon one end of a flexible lead 41 formed from flat copper braid. A similar terminal element 42 is flattened upon the other end of each of the leads.

The members 11 and 13 are connected by spacing strips 43 formed from pieces of galvanized steel of suitable gauge. Copper contact strips 44 extend along the outer faces of the spacing strips 43 and have their outer ends bent inwardly toward each other as at 44*a* and then outwardly into parallelism to form attaching elements 44*b* which are provided with aligned openings for reception of securing screws 45 which pass through the flattened portion 46*a* of a terminal lug 46, in which is secured the end of the wire or conductor 20 in which the switch is interposed. Securing screws 47 extend through the strips 43 and 44 and through the member 11 transversely thereof, this member being provided with lateral flanges 11*a* to obtain contact with the strips 43 throughout the width thereof. Nuts 48 are threaded onto the bolts 47 and co-operate with spring washers disposed between the heads of the bolts and the nuts, and the contact strips or terminal bars, to insure proper contact between the strips, the spacing strips 43 serving to maintain the members 11 and 13 in proper relation. Securing screws 49 pass through lateral flanges 15 of the supporting member 13 and through the inner or forward end portions of the strips 43 and 44. The screws 49 also pass through the terminal elements 42 of the leads 41 and receive nuts 51 threaded thereon and bearing against spring washers 52 confined between the nuts and the terminal strips 44. The spacing strips and the terminal strips are thus tightly secured to the supporting member 13 and proper electrical contact between the terminal elements 42 and the strips

44 is secured. This completes the electrical connection between the cable or conductor 20 and the blade 14 of the switch structure.

An operating arm 53 of suitable shape is provided at its outer end with a split collar by means of which it is adjustably clamped about the operating member 10. A disc 54 is secured upon the upper end of member 10 by a screw 55 and serves to eliminate possibility of the arm becoming detached from this member. The forward or inner end of arm 53 is angularly disposed and is pivotally connected at 56 on a vertical axis to a block 57 which is pivotally connected at 58 on a horizontal axis to a clevis 59. This provides a universal connection between the clevis and the arm. The clevis is provided at its forward portion with a collar 60, which is threaded for reception of the threaded end portion of an operating rod 61, which is held in adjustment in the clevis by a jam nut 62. The inner or forward end of rod 61 is similarly secured to a clevis 63, which is pivoted on a vertical axis at 64 to a lug 65 extending from a sleeve 66, which is mounted for turning movement on a pin 67 secured through the rearwardly extending ears 36 of the arms of frame 35. The arm is thus connected to the outer end of the blade for urging the same in opening and closing direction, in accordance with turning of the insulator 4. When the insulator is turned in a counter clockwise direction, as considered in Fig. 2, the operating rod 61 exerts a pull on the outer end of the blade in a direction away from the fixed contact consisting of the jaws 15, so as to withdraw the blade from such contact. At the initiation of this opening movement of the blade, the blade is subjected to a toggle effect, which exerts a powerful leverage at the contact end of the blade so as to break it free of the jaws and permit it to be withdrawn therefrom, as will be explained.

The pin 67 passes through the upper ends of a pair of main operating links 68, the lower ends of which are rockably mounted on a pin 69, which is secured through the flanges 50 of supporting member 13 centrally thereof. At their upper ends the links 68 are confined between the ends of sleeve 66 and ears 36 of the blade brackets 35. The lower ends of the links are confined between the end of a sleeve 70 loose on the pin 69 and the flanges 50 of the supporting member 13. A link 71 extends from sleeve 70 and is pivotally secured by a pin 72 to the outer end of a link 73, the upper inner end of which is pivotally secured by a pin 74 to a lug 75 depending from the blade carrying bracket 35. The link 73 straddles the link 71 and the lug 75, the side elements of this link being connected by a web element 76 which projects rearwardly beyond pin 72. A set screw 77 is threaded through the rearwardly projecting portion of the web 76 and is secured in adjustment by a jam nut 78. This set screw limits relative movement between the links 71 and 73 as the blade approaches full open position. The sleeve 70 is further provided with stop elements 79 and 80 disposed to contact with cap screws 81 having threaded engagement with the support 13, these screws being secured in adjustment by jam nuts 82. The stop elements co-operate with the screws to limit turning movement of sleeve 70 about pin 69 during opening and closing of the switch blade.

When the switch blade is in full closed position the links occupy the positions illustrated in Figs. 1, 2 and 5. To open the switch blade, the insulator 4 is turned in a counter clockwise direction as considered in Fig. 2. This exerts a pull on the blade endwise thereof away from the fixed contact through the pin 67 and operating rod 61 and associated parts. As a result of this pull at the upper end of the links 68, the main operating links are rocked about the pin 69. At the initiation of this movement, the end of the blade remote from the fixed contact, which has been termed the outer end for convenience of description, is raised since the links 68 move about pin 69 so as to move the pin 67 backward and forward. It is to be noted that the link 68 and the blade constitute a toggle, the pin 67 being at the joint of this toggle and the inner or contact end portion of the blade being retained by friction between the jaws of the contacts. As a result of this construction, the blade acts as a lever to exert a powerful leverage effect at the contact of the blade so as to break it free from the contact jaws at the initiation of the opening movement of the blade. After the blade has thus been broken free from the jaws, it can be readily withdrawn therefrom and swung into full open position. This leverage effect exerted by the blade at the contact is of great assistance in opening the blade in cases where the contact jaws at the blade are coated with sleet or ice so as to be frozen together, or in cases where the jaws and the blade are oxidized or are of such area as to present appreciable frictional resistance to opening of the blade. Continued pull on the pin 67 results in swinging the blade upwardly through an arc into full open position, due to the combined action of the links 68 and the links 71 and 73. It is to be noted that the links 71 and 73 also constitute a toggle. During the first part of the opening movement of the blade, after it has been broken free from the fixed contact in the manner described, which movement is substantially rectilinear, link 71 is turned about the pin 69 in a counter clockwise direction as considered in Fig. 5 due to the connection of the inner end of link 73 to lug 75. This movement of the link 71 continues until the element 79 contacts with the co-operating

screw 81, which serves to positively limit movement of link 71. Continued pull on pin 67 then causes the blade to be swung upwardly in an arc into full open position, since the pivot pin 72 is held against further outward movement. The set screw 77 is so adjusted that, as the blade reaches full open position, the upper end of link 73, which is connected to the pin 74, passes rearwardly beyond aligned or dead center position, so that the toggle formed by the links 71 and 73 is broken and the line of pressure exerted by the weight of the blade and associated parts passes inside of the axis of pin 69, the extent to which the toggle is broken being limited by contact of the screw 77 with link 71, as will be clear from Fig. 5 in which the relative positions of the parts when the blade is in full open position is indicated in dotted line. Since the pin 67 is held against forward movement by the operating rod 61 and associated parts, the blade is thus effectively locked in open position. To close the blade, the insulator 4 is turned in clockwise direction as considered in Fig. 2, subjecting the pin 67 to a push effect, which urges the blade inwardly or toward the contact. Since the toggle formed by the links 71 and 73 is locked, the blade moves with the linkage structure as a unit and swings inwardly about the pin 69 into closed position, entering between the contact jaws by a swinging movement. It will thus be seen that the movement of the blade when being closed is different from its movement when being opened in that in opening the blade, it is first subjected to a rocking movement to break it free from the contact and is then moved through an appreciable distance by a substantially rectilinear movement, so as to withdraw it from the contact, after which the blade is swung upwardly into open position. In closing the blade, on the contrary, it is moved from full open position into full closed position by a single arcuate swinging movement, which is very effective. As the blade approaches full closed position, element 80 of sleeve 70 contacts with the head of the inner cap screw 80 stopping movement of link 71 about pin 69 and acting, in the slight continued movement of the blade into full closed position, to break the toggle upwardly and outwardly and to raise the set screw 77 out of contact with the link 71 into the position illustrated in Figure 5. This serves to return all parts of the linkage system to their original relative positions, so that the blade can be readily moved into open position in the manner previously described.

In the form illustrated in Figure 1, the switch is shown as mounted in horizontal position. In practice, however, this form of switch is more commonly mounted vertically with the sleet hood or housing 33 uppermost, in which position the hood acts to best advantage to protect the jaws and the contact portion of the blade from sleet and other foreign materials.

As above indicated, and as will be understood, various changes in construction and arrangement of parts of our invention may be resorted to without departing from the field and scope of the same, and we intend to include all such variations as fall within the scope of the appended claims, in this application in which the preferred form only of our invention is disclosed.

What we claim is:

1. In a switch structure of the character described, two spaced insulators, a support on each insulator, one of said insulators being fixed and the other insulator being mounted for oscillatory movement, a second fixed insulator, a contact carried by the second fixed insulator, a blade cooperating with said contact, connections between the blade and the movable insulator for urging the blade toward and away from the contact in accordance with movement of said movable insulator, connections between the blade and the support on the first fixed insulator for opening and closing the blade in accordance with urging thereof away from and toward the contact, said connections including operating links pivoted at one end to the blade and at the other end to the blade support, spacing strips secured to the opposite sides of the support, contact strips secured to the spacing strips, flexible conductors connecting the blade to one end of the contact strips, the other ends of the contact strips being bent towards and into contact with one another, and a terminal lug connected to said other ends of the contact strips.

2. In an electric switch, a stationary supporting insulator, a blade supporting member rigidly mounted on the insulator, said member having a pair of parallel projecting flanges, a pair of links pivotally mounted at one end between said flanges, an operating rod extending between and pivotally connected to end of said links, a blade supporting frame having a pair of ears between which the links extend, and a pin pivotally connecting the supporting frame and the links.

3. In an electric switch, a stationary supporting insulator, a blade supporting member rigidly mounted on the insulator, said member having a pair of parallel projecting flanges, a pair of links pivotally mounted at one end between said flanges, an operating rod extending between and pivotally connected to said links, a blade supporting frame having a pair of ears between which the links extend, a pin pivotally connecting the supporting frame to the connecting rod and to the links, and an additional pair of links between the blade supporting frame and the blade supporting member for rotating the frame with respect to the first men-

tioned links upon the operation of those links.

4. In an electric switch, a stationary supporting insulator, a blade supporting member rigidly mounted on the insulator, said member having a pair of parallel projecting flanges, a blade supporting frame having a pair of projecting ears, the distance between the ears being substantially the same as the distance between the flanges, a pair of links pivotally connected at one end to the flanges and at the other end to said ears, a rotary insulator, and an operating rod extending from the rotary insulator to the point of connection between the links and the ears on the blade supporting frame for operating the switch.

5. In an electric switch, a stationary supporting insulator, a blade supporting member rigidly mounted on the insulator, said member having a pair of parallel projecting flanges, a blade supporting frame having a pair of projecting ears, the distance between the ears being substantially the same as the distance between the flanges, a pair of links pivotally connected at one end to the flanges and at the other end to said ears, a rotary insulator, an operating rod extending from the rotary insulator to the point of connection between the links and the ears on the blade supporting frame for operating the switch, a supporting member mounted on said rotary insulator by means including a bearing, spacing strips secured to said supports, contact strips secured to said spacing strips, a switch blade, means securing the blade to the blade supporting frame, and flexible conductors secured to the blade by said means, the opposite ends of said conductors being secured to the contact strips.

6. A switch including a stationary insulator, a rotary insulator, a supporting member rotatably mounted on the rotatable insulator, a second supporting member mounted on the stationary insulator, each of said members having two opposite substantially parallel sides, spacing strips connecting the corresponding two opposite sides of the two supporting members whereby the stationary insulator braces the rotary insulator, contact strips extending lengthwise of the spacing strips, said contact strips being electrically secured together at both ends, a line terminal secured to the contact strips at one end thereof, a switch blade mounted on one of the supporting members and connected to the opposite end of the contact strips, and switch actuating means adjacent the other supporting member for actuating the switch.

7. A switch of the type wherein a relatively long blade is pivoted to two links adjacent one end thereof, one of the links being pivoted to swing about a stationary pivot and the other link being pivoted to swing about a movable pivot, and a lost motion, including abutment means, is provided between the second mentioned link and its movable pivot for permitting a limited swinging of said link about its pivot and thereafter moving the pivot with the link to swing the switch blade about the first mentioned pivot, characterized in that means is provided for adjusting the point of abutment of the abutment means, thereby adjusting the point of commencement of the swinging movement of the blade.

In witness whereof, we hereunto subscribe our names this 25th day of March, 1929.

ALFRED ALSAKER.
MEINICH SKAU.