Jan. 7, 1941. H. L. HOWE 2,228,230

ELECTRIC SWITCH

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Fig. 1.

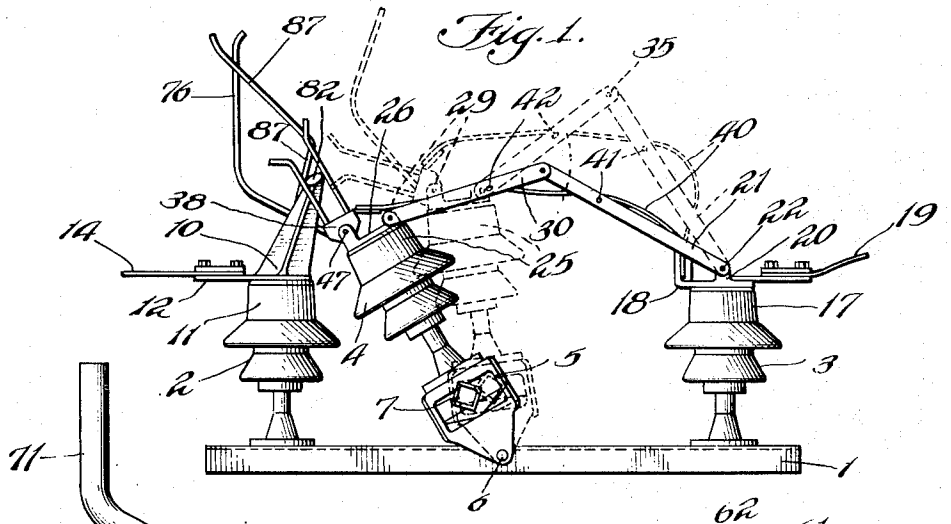


Fig. 2.

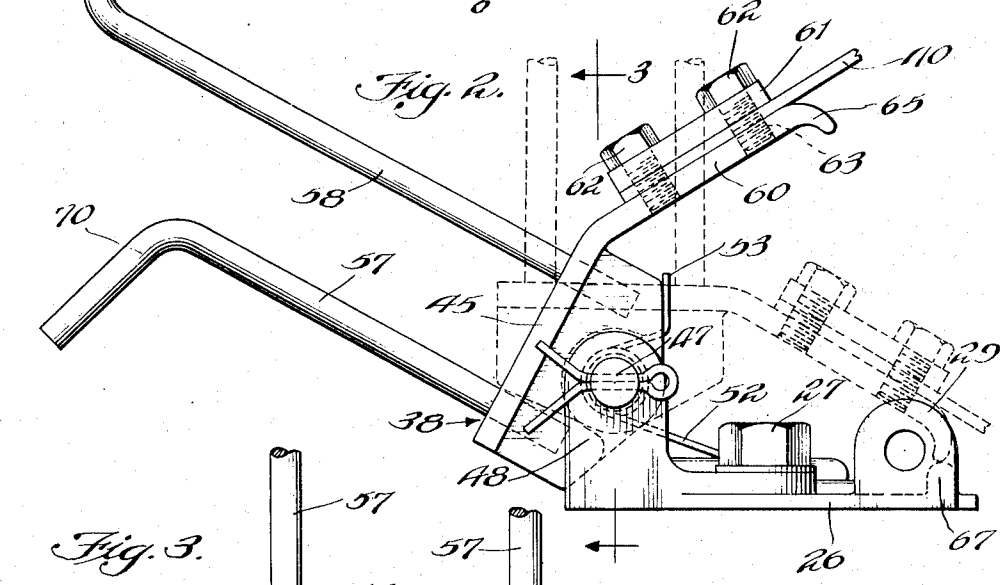
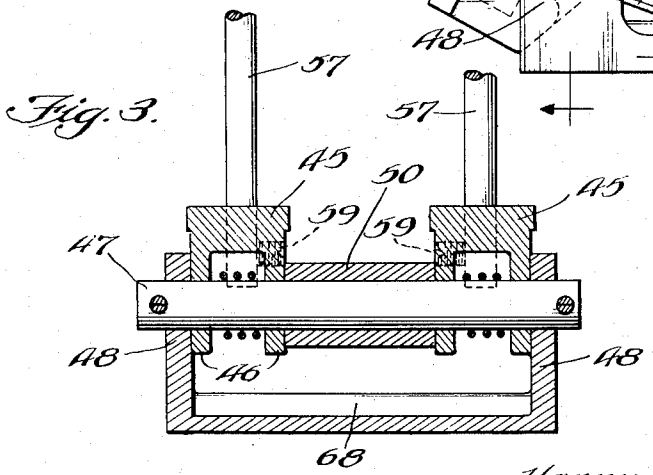


Fig. 3.



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Fig. 4.

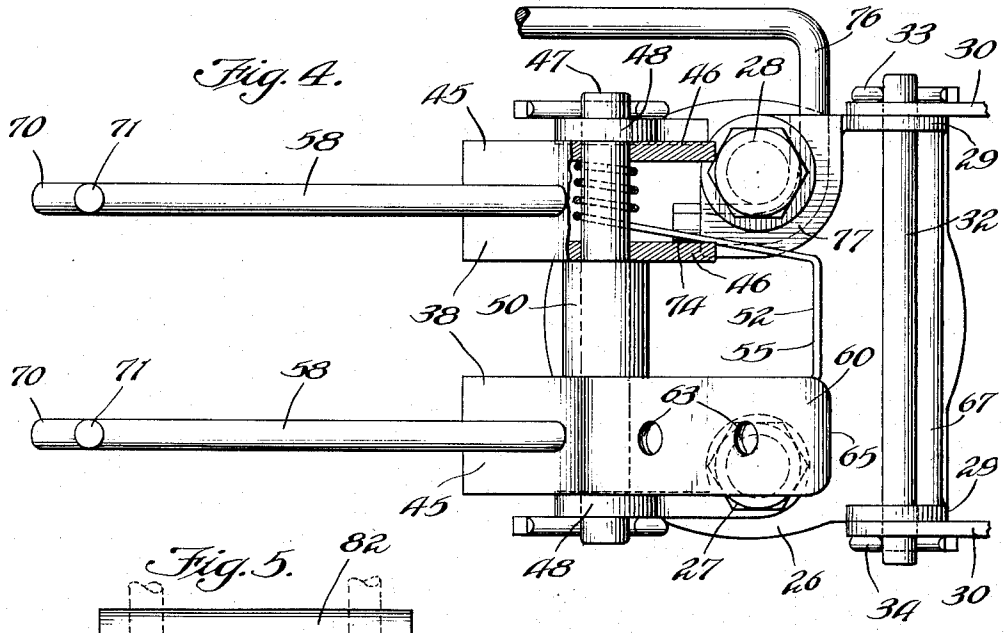


Fig. 5.

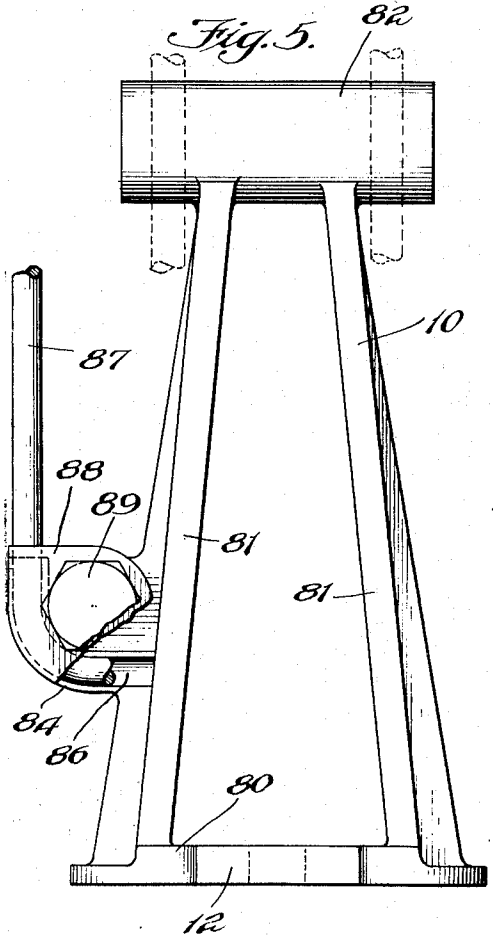
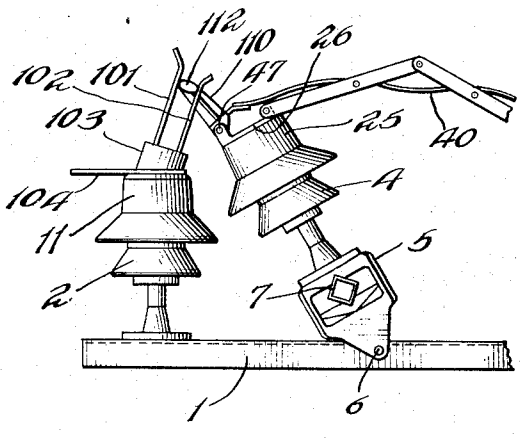


Fig. 6.



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2,228,230

UNITED STATES PATENT OFFICE

2,228,230

ELECTRIC SWITCH

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Application October 15, 1938, Serial No. 235,294

6 Claims. (Cl. 200—48)

This invention relates to electric switches, particularly disconnect switches such as are adapted for mounting outdoors, although the invention is not limited to an outdoor type of switch. In its more specific aspects the present invention is particularly concerned with the construction and mounting of the contact and contact making members.

It is one of the objects of the present invention to provide a switch having an improved switch contact and contact making member so constructed and arranged that the two may be brought into engagement or approximate engagement and then relatively rotated to effect a camming action for providing a high contact pressure. Switches of this type, as heretofore constructed, were either complicated or expensive in construction, or had other objectionable features such as difficulty of making adjustment of the pressure, or difficulty in equalizing the pressure, or undesirable features of operation under certain conditions. In accordance with the teachings of the present invention the contact making structure is exceedingly simple, there being but few parts that are subjected to wear and those parts being readily replaceable from what is generally stock material.

In a disconnect switch of the character herein contemplated it has been recognized that the amount of current that should be carried by the contacts is determined primarily by the pressure between the relatively movable parts and by the number of current paths provided at the contact structure. It has also been found that a small contact area is approximately as effective as a large contact area, since in a switch wherein there is a comparatively large contact area between the two movable parts the pressure is necessarily unequally distributed, there being very few places that receive the maximum pressure and therefore carry practically all of the current. It has therefore been found that increasing the area of contact of two contact making members is of very little effect towards increasing the current carrying capacity of the switch. This can be done most effectively by increasing the number of contacts in engagement rather than by increasing their areas. In accordance with the present invention one of the two relatively movable contacting structures comprises a plurality of comparatively long wires which may be quite stiff so as to exert the necessary pressure and yet sufficiently yielding to permit a camming action between a pair of such wires in order to effect the necessary pressure.

It is a further object of the present invention to provide a switch contact making structure of the above mentioned character which is so constructed that a misadjustment of one pair of contact wires cannot affect the pressure exerted by other contact wires.

It is a still further object of the present invention to provide a high pressure disconnecting switch of the above mentioned character which is simple of construction and yet does not place undue stresses upon the insulators of the switch during the opening or closing operation.

The attainment of the above and further objects of the present invention will be apparent from the following specification taken in conjunction with the accompanying drawings forming a part thereof.

In the drawings:

Figure 1 is an elevational view of one type of switch embodying my present invention, the full lines showing the switch closed position and the dotted lines showing the partially open position;

Figure 2 is an enlarged view of the contact making structure that is mounted upon the movable insulator of the switch of Figure 1;

Figure 3 is a sectional view taken along the line 3—3 of Figure 2;

Figure 4 is a plan view, in partial section, of the contact making structure of Figure 2;

Figure 5 is an enlarged end view of the contact mounted on the stationary structure, said view being taken at right angles to the view of Figure 1; and

Figure 6 illustrates a modified construction.

Reference may now be had more particularly to Figure 1. In this figure I have shown one usual type of outdoor medium high voltage disconnecting switch. This switch comprises a channel-shaped base 1 which is generally grounded and on which are mounted two stationary insulators 2 and 3 with a rocking insulator 4 between them. The rocking insulator is mounted upon a bracket 5 which swings about a pivot pin 6 passing through the base 1. The bracket 5 is rotated by means of an interphase shaft 7 in the usual manner, said shaft interconnecting a plurality of such switches, as is well known in the art. The stationary insulator 2 supports a switch contact structure 10 which is bolted to the cap 11 on the top of the insulator 2. The contact structure 10, which is illustrated more fully in Figure 5 and will be described hereafter, includes a terminal lug 12 constituting an integral part of the switch contact casting, the terminal lug being adapted to receive connections with a line con-

ductor 14, which conductor may be bolted or otherwise suitably secured in firm mechanical and electrical connection with the lug 12.

The insulator 3 is provided with the usual insulator cap 17 to the top of which is bolted or otherwise suitably secured a terminal fitting 18 adapted to receive a connection with a line 19. The fitting is also provided with a pair of ears 20 adapted to receive a pair of non-magnetic links 21 pivoted thereto about a pivot 22.

The rocking insulator 4 has the usual insulator cap 25 suitably secured to the top thereof. A casting 26, of bronze or other non-magnetic material, is bolted to the insulator cap 25 by a pair of bolts 27—28, as is illustrated more fully in Figures 2 and 4. The casting 26 is provided with a pair of ears 29—29 at opposite sides towards the rear thereof, to which ears a pair of non-magnetic links 30—30 are pivoted by means of a pivot pin 32 having a head 33 at one end and a cotter pin or other similar arrangement 34 at the opposite end for preventing retraction of the pivot pin. The links 30 are pivotally connected with the links 21 by a pivot pin 35. A contact making structure 38, to be presently described, is pivoted on the casting 26. A plurality of flexible braided copper or other wires 40, of high electrical conductivity and flexibility, connect the contact making structure 38 with the terminal 18. The wire 40 passes loosely over a pair of pins 41—42 between the links 21 and 30, respectively, and under the pivot pin 35, as is usual in rocking insulator type switches.

A description will now be given of the contact making structure 38 which constitutes the contact making end of the switch blade, for which reference may be had to Figures 2, 3 and 4. The contact making structure comprises a plurality of sets, in this instance two, of members which are identical. Each of these two members comprises a cast copper or bronze yoke 45 having a pair of arms 46—46 which are apertured to receive a pivot pin 47 that passes through the arms 46 and through ears 48—48 of the casting 26. The pin 47 is held in place in any desired manner, as by a pair of cotter pins or the like. A spacer 50 maintains the two yokes 45 suitably spaced apart. The two yokes are each independently swingable about the pivot pin 47. A spring wire 52 is looped around the pivot pin 47 and bears at one end 53 against one of the yokes 45 and at its opposite end against the other yoke 45, the intermediate portion 55 of the spring wire bearing against the casting 26. The spring wire 52 thus serves to maintain the two yokes in the position illustrated in Figure 2, which is the extreme position in one direction, while permitting clockwise rotation from said position through an angle of approximately 60°, each yoke 45 being rotatable independently of the other. A pair of contact making wires 57—58 are pressed into holes in the yoke 45. Each wire is then locked in place by a set screw 59. The outside of the wires is of copper, bronze, or other high conducting material. The wires may be solid throughout, or may be hollow tubes, or may have a steel core which will increase the elasticity of the wires. In any event, the outside copper surface of each wire is in firm electrical engagement with the yoke 45. Each yoke 45 has a rearwardly extending lug 60 for receiving one of the flexible braided conductors 40. The conductor 40 is clamped in place by means of a plate 61 and a pair of bolts 62 that thread in tapped holes 63 in the lug 60. Each lug 60 is slightly turned downwardly at its end, as indicated at 65, so that the nose portion 65 constitutes a stop for limiting the extent of turning of the yoke about the pivot pin 47. The stop 65 abuts against a ridge 67 that extends across the rear end of the casting 26. A similar ridge 68 extending across the forward end of the casting serves as an abutment for the forward end of the yoke, thus limiting its turning movement in the opposite direction. The two wires 57—58 mounted upon the yoke 45 move as a unit with the yoke. Each wire is outwardly flared at its forward end, as indicated at 70—71, the outwardly flared portion serving to guide the wires over the stationary contact, in a manner to be more fully described as this description proceeds.

The casting 26 has an L-shaped groove 74 formed around but spaced from the bolt hole 28. The end of a wire arcing horn 76 lies in that groove and is held in place by a plate 77 through which the bolt 28 passes. The bolt 28 thus not only secures the casting 26 to the cap 25 of the insulator but also serves to secure the arcing horn 76 to the casting 26.

A description will now be given of the construction of the stationary switch contact 10. This contact comprises one unitary casting of bronze or other material of high electrical conductivity and includes a base 80 having a pair of arms 81—81 terminating at their top in a stationary contact 82 which is elliptical or oval in cross section, as may be seen from Figure 1. The portions of the stationary contact 82 on the outside of the arms 81—81 are the parts engaged by the wires of the contact making structure. One of the arms 81 has an apertured ear 84 projecting therefrom, which ear constitutes an integral part of the casting. This ear has an angular groove 86 for receiving a wire arcing horn 87. The end of the wire 87 is bent and lies in the groove 86 and is held in place by a small plate or washer 88 and a bolt 89 which receives a nut at the opposite end.

An explanation will now be given of the mode of operation of the switch thus far described. As the shaft 7 is rotated to rock the insulator 4 from its switch open position to its switch closed position, the contact making wires 57—58 are caused to approach the stationary contact 82. At this time the yokes 45 are in position with reference to the casting 26, as illustrated in Figure 2. The wires 57—58 ride into embracing relationship to the contact 82 and as the insulator continues to rock the wires turn with respect to the elliptical contact 82 so that they are brought from a position embracing the contact 82 along its minor axis to a position embracing the same along its major axis, as illustrated in Figure 1. At this time the yokes 45 pivot about the pivot pin 47, and the wires 57—58 are spread slightly by the contact 82, since the major axis of the contact is longer than the spacing between wires 57—58. This produces a camming action resulting in an exceedingly high pressure between the contact and the wires without requiring the exertion of an excessive force by the insulator to move the contact making structure into that position. It is to be noted that each pair of wires 57—58 on any one yoke acts as a complete unit independently of the action of the wire on any other yoke. Therefore, if the pressure should be too great on any pair of wires, that will not prevent the obtaining of the requisite pressure on all other pairs of wires. It is also to be noted that the tension of each wire 57—58 may be adjusted independently of the other wire

of the pair and entirely independently of the pressure of wires of other pairs. Upon rocking of the insulator 4 to open the switch the pivot axis 47 moves about the pivot pin 6 as a center while the yokes pivot about the pivot pin 47. The wires 57—58 are thus first twisted to bring them into a position embracing the stationary contact on opposite sides of the minor axis thereof, thereby relieving the high pressure engagement between the stationary and movable contacting structures and at the same time breaking away any ice or sleet that may have formed on the contacts. Further switch opening movement of the rocking insulator causes the contact making wires 57—58 to be drawn away from the contact 82. At the instant of ultimate separation of the wires 57—58 from the contact 82 the arcing horns 76 is in engagement with the arcing horn 87 so that the ultimate circuit interruption is between the arcing horn, thereby protecting the contact and contact making structures against burning.

It is to be noted that when the switch is closed the round contact wires 57—58 engage the elliptical contact 82 at an area of contact which is of the order of not substantially in excess of point contact. The contact pressure will therefore be very great, and the rubbing action of the wires as they slide on the contact 82 will assure a thorough cleaning action. As a result, all oxide, soot or dirt will certainly be removed at the place of contact. During the switch opening operation the initial movement of the rocking insulator causes first a relative twisting of the contact wires 57—58 with respect to the stationary contact 82 and then a separating movement. The twisting action relieves the rocking insulator, as well as the stationary insulator 2 of excessive stresses that might otherwise be present if an attempt were made to separate the contacts by a direct swinging action about the center of the pin 6. This is especially true if the contacts happen to be coated with sleet or ice.

In Figure 6 there has been illustrated a modified construction of a switch embodying the present invention. Insofar as this switch is the same as that of Figure 1 similar reference numerals have been used. In this construction the contact wires 101—102, which correspond to the wires 57—58 of the switch of Figure 1, are rigidly mounted on a copper, bronze or other conducting terminal 103 in any desired manner, as for instance in the same manner that the wire 57 is mounted in the yoke 45. The terminal 103 has a terminal lug 104 for receiving a line connection. The rocking insulator 4 has the same insulator cap 25 mounted thereon, to which is secured the same casting 26 as in the switch previously described. A contact making structure 110, which may be of a construction similar to that of the contact 10 of the switch of Figure 1, is pivoted on the casing 26 about the pivot pin 47. This structure may include, as an integral part thereof, a yoke such as the yoke 45 of Figure 3, for pivotally mounting the same. A spring (not shown) is provided in the same manner as the spring 52 of Figure 2 for constantly urging the pivoted contact making structure 110 in a direction counter-clockwise as seen in Figure 6. The contact making structure 110 may be pivoted about its pivot 47 in a clockwise direction against the action of the spring in the same manner as the yoke 45 is pivoted. The contact making structure 110 includes a contact 112 which is oval or elliptical in shape and adapted to engage the pair of contact wires 101—102 along substantially point contact. The major axis of the ellipse is longer than the normal distance between the wires 101—102.

As the rocking insulator of Figure 6 is swung towards its switch closed position the contact 112 enters between the contact wires 101—102 with the major axis of the ellipse or oval of the contact 112 at a substantial inclination to a right angle to the wires 101—102. The oval contact 112 therefore enters freely into the space between the wires 101—102. As the insulator 4 continues to rock, the oval contact 112 approaches a position with its major axis across the gap between the wires 101—102 so that it engages the wires, and further rotation of the rocking insulator causes the contact structure 110 to pivot about the pivot 47 thereby bringing the contact 112 into a position such that its major axis approaches a right angle with the wires 101—102. This causes the contact 112 to spread the wires 101—102. The wires 101—102 flex under their normal resiliency and thereby exert a very great pressure against the contact 112. The small amount of sliding movement of the contact 112 with respect to the wires 101—102 effects a scraping away of any dirt or oxide that may have formed at the place of engagement between the contact 112 and the wires 101—102.

The switch opening movement of this switch is substantially the reverse of the switch closing movement. For the sake of simplicity the arcing horns on the casting 26 and on the terminal 103 have been omitted.

In compliance with the requirements of the patent statutes I have shown a few preferred embodiments of my invention. It is, however, to be understood that the invention is not limited to the precise constructions here shown, the same being merely illustrative of the principles of the invention. What I consider new and desire to secure by Letters Patent is:

1. An electric switch comprising at least two side by side similar yokes pivoted for turning about a common axis independently of one another, side by side contacting members carried by said yokes, a common cooperating contact member, means for moving said first and second mentioned members into and out of embracing engagement with each other, said means including means for turning said yokes about their axes as the members move into full engagement.

2. An electric switch comprising at least two side by side similar yokes pivoted for turning about a common axis independently of one another, side by side contacting members carried by said yokes, a common cooperating contact member, means for moving said first and second mentioned members into and out of embracing engagement with each other, one of said members comprising at least one rod and its engaged member comprising a curved contact finger engaging the rod at substantially a point contact.

3. An electric switch comprising at least two side by side similar yokes pivoted for turning about a common axis independently of one another, spaced wires extending from each yoke with the corresponding wires of the two rows substantially parallel to each other and a common contact finger adapted to be engaged by all of the wires in the switch closed position, said wires being flexed by the contact finger to effect pressure engagement and said yokes being independently movable about their axes.

4. An electric switch blade having contact mak-

ing means at one end thereof comprising a plurality of side by side yokes, a pivot pin joining said yokes to said blade and about which the yokes are independently pivoted, each yoke having flexible contact making wires extending therefrom and adapted to embrace a contact, corresponding wires on the different yokes being parallel to one another.

5. An electric switch comprising a pair of spaced insulators with a tilting insulator between them, line terminals on the spaced insulators, a switch contact on one of the spaced insulators and connected to the terminal on said one insulator, a linkage pivoted at one end on the other spaced insulator, a member rigidly mounted on the rocking insulator and pivotally connected to the opposite end of the linkage, said member having a pair of aligned upstanding ears at opposite sides thereof, a pair of spaced yokes between said ears, each yoke having a pair of depending arms, a pivot pin pivoting said arms to said ears, said arms of each yoke forming a pocket, a biasing spring in each pocket urging the yoke in one direction, said pockets forming weather-shields for said springs, a pair of spaced contact making wires secured to and extending from each yoke, all of said wires being connected through said yokes to the terminal on said other insulator and adapted to be moved into and out of engagement with the first mentioned switch contact, each yoke being pivotally movable independently of the other yoke to permit separate adjustment movement of each pair of contact making wires, said pairs of wires being adapted to embrace the contact and be spread thereby as the rocking insulator approaches its switch closed position.

6. An electric switch comprising a first insulator, a switch contact thereon, a rocking insulator, a member mounted on the rocking insulator and having aligned upstanding ears, a yoke pivoted on said ears, said yoke and ears including means forming a pocket, yoke biasing spring means in said pocket, said pocket forming a weather shield for said spring means, and contact making wires secured to and extending from said yoke and adapted to be moved into and out of embracing engagement with said switch contact by rocking of said rocking insulator, said contact making wires being flexed against their natural resiliency and within their elastic limits by the switch contact as the rocking insulator approaches its switch closed position.

HARRY L. HOWE.