Feb. 2, 1932. G. A. MATTHEWS 1,843,573

OUTDOOR DISCONNECTING SWITCH

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Fig. 6.

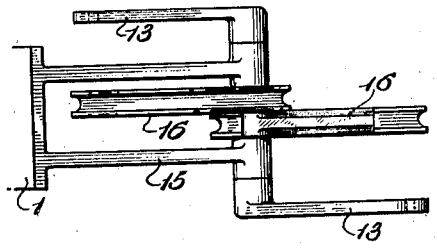


Fig. 1.

Fig. 5.

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OUTDOOR DISCONNECTING SWITCH

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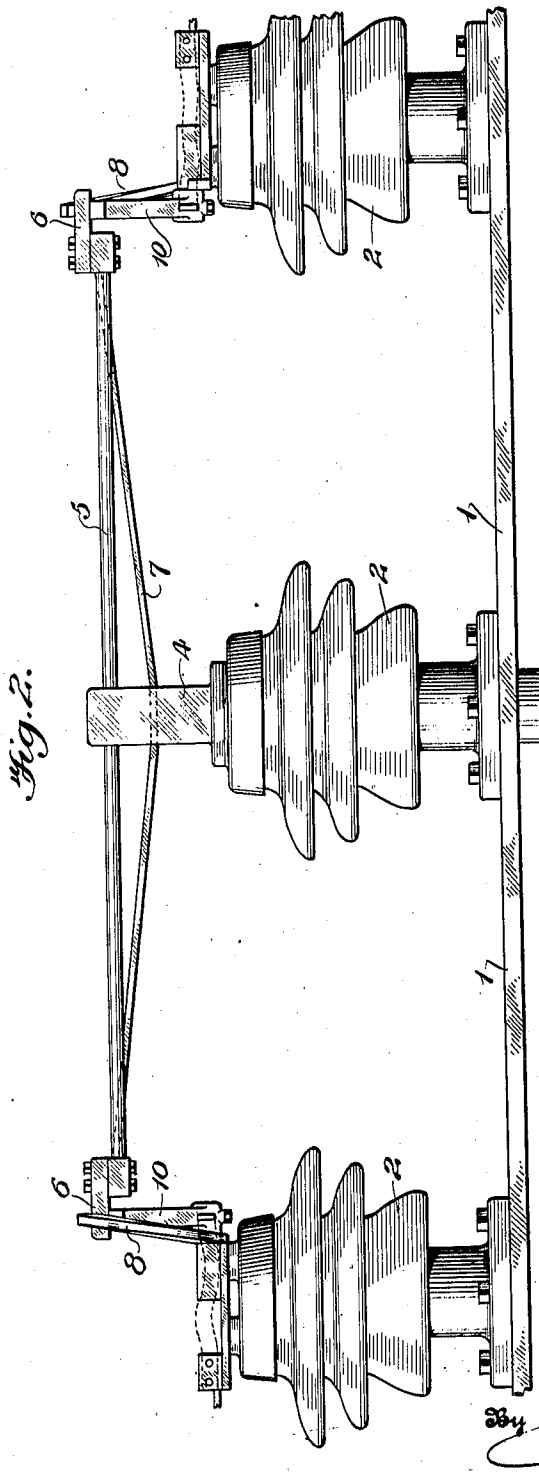


Fig. 2.

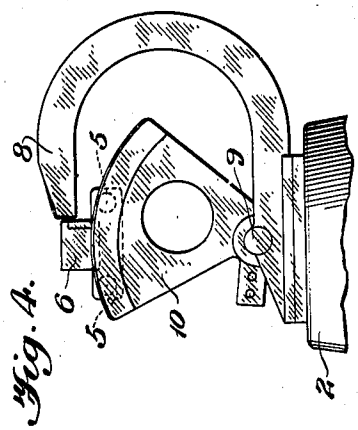


Fig. 4.

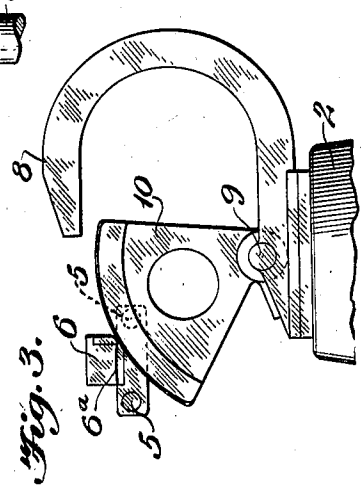


Fig. 3.

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OUTDOOR DISCONNECTING SWITCH

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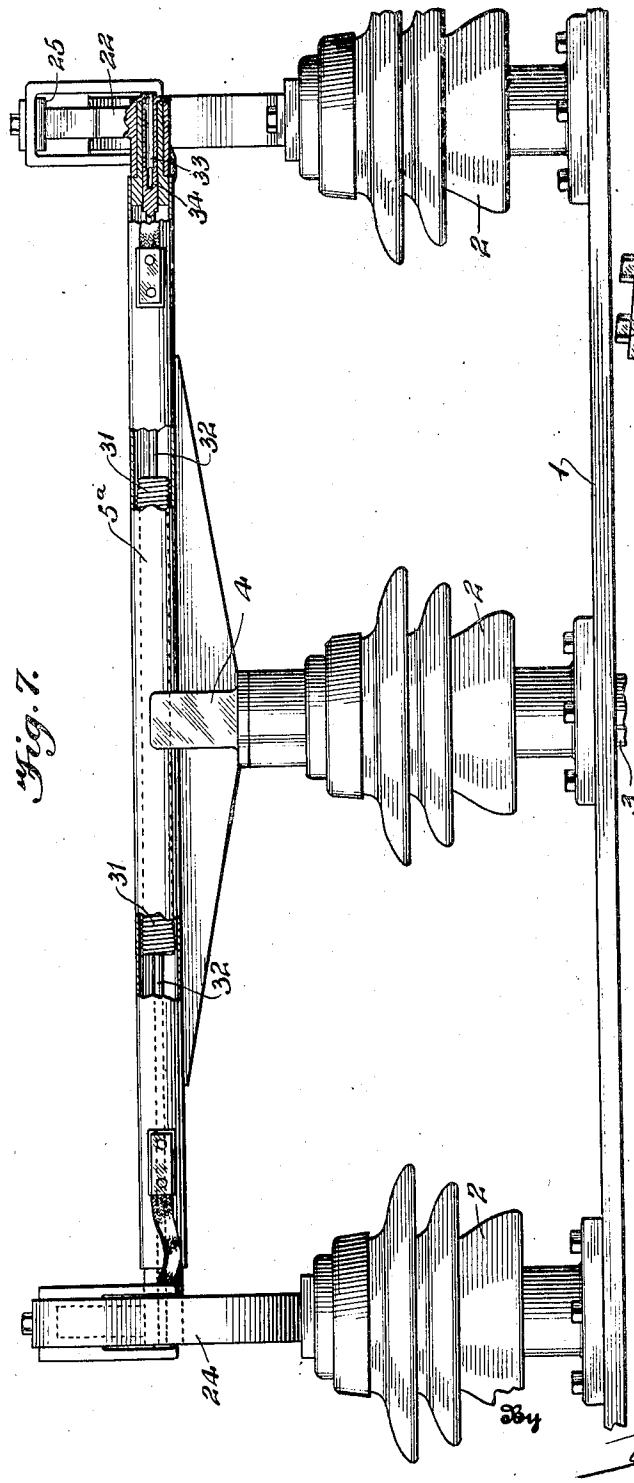


Fig. 7.

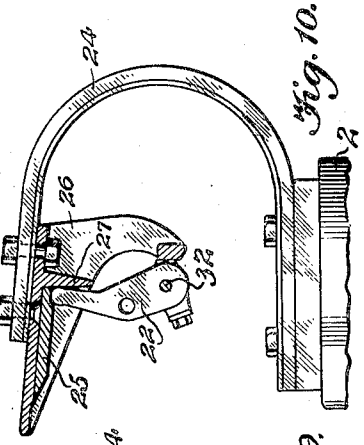


Fig. 10.

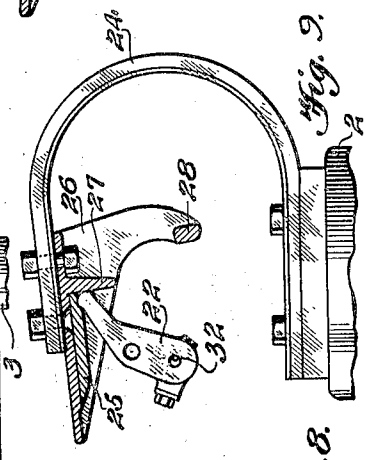


Fig. 9.

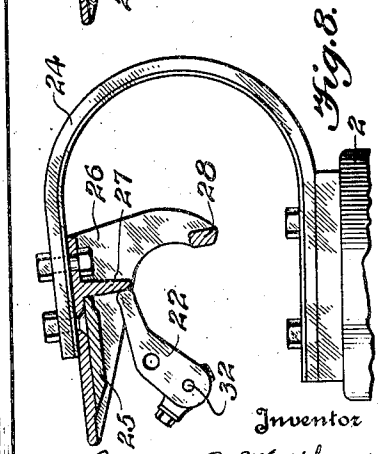


Fig. 8.

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UNITED STATES PATENT OFFICE

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OUTDOOR DISCONNECTING SWITCH

Application filed January 18, 1929. Serial No. 333,362.

This invention relates to outdoor high voltage disconnecting switches and has for its object to provide a rugged mechanism requiring a minimum of adjustment and service, and admitting of easy and reliable operation irrespective of weather conditions to which the device may be subjected in use.

The invention also contemplates the minimizing of sliding friction between contacts in opening and closing, although providing for a relative movement between contacting surfaces which will operate to break any corrosive or other seal between the surfaces which might otherwise interfere with effective electrical contact between the said surfaces; and provision is also made for insuring adequate pressure contacts when the switch is closed.

A further object of the invention is to provide a positive stop and self-locking function in the contact mechanism so that proper closing of the switch will be determined and maintained in a manner which does not detract from the ready opening of the switch when desired and which does not involve excessive mechanical resistance in closing the switch.

It is further proposed to provide, in a disconnect switch of the type referred to, for a striking action between the contacts prior to their assuming their final closed relation, which action will be effective in promoting a condition operating to remove ice or other objectionable accumulation from between the contacting surfaces during the effecting of the movement of the contacts into their final closed position, and make it possible to omit protective hoods over the contacts such as have hitherto been usually provided and which have, contrary to their intention, been actually a cause of sleet and ice accumulation preventing proper switch operation.

The invention further contemplates, in a device of the type referred to, wherein one contact has a closing movement against a second contact, the provision for a rocking movement between these contacts during completion of the closing movement after impingement, and against yieldable mechanical resistance, beyond a point at which a moment of forces exists whereupon one of the contacts engages a stop and the said contacts are so locked in their fully closed position.

Still further objects or advantages subsidiary or incidental to the aforesaid objects, or resulting from the construction or operation of the invention as it may be carried into effect, will become apparent as the said invention is hereinafter further disclosed.

In carrying the invention into effect, I may provide a vertically flexible switch arm swinging horizontally about its center, said arm having contacts at its ends and contact blocks arranged in the paths of the first mentioned contacts, said blocks being in the form of pivoted vertically swingable quadrants against the arcuate surfaces of which said contacts impinge in their closing movement, the continued closing movement of said contacts swinging said contact blocks on their pivots, whereby said contacts are raised against the yielding resistance of said arm, by the upward swinging of the contact blocks, until the said contacts pass beyond the pivot centers of the blocks, whereupon a more or less locking engagement of the contacts with the blocks results, suitable stops being provided to limit the closing movement of the contacts.

Conversely, the contact blocks may be of a fixed nature, so far as pivotal movement is concerned, and the contacts capable of rotating movement on the arm with similar self-locking features to the arrangement referred to in the preceding paragraphs.

All of the foregoing is more particularly described and ascertained hereinafter, by way of example, having reference to the accompanying drawings wherein:

Figure 1 is a sectional elevation of a disconnecting switch and operating mechanism embodying my improvements;

Figure 2 is a side elevation of the same, the operating mechanism being excluded;

Figure 3 is a detail end elevation of the switch contacts shown in their pre-closing position;

Figure 4 is a similar view to Figure 3 showing the contacts fully closed;

Figure 5 is a fragmentary view taken on

a plane indicated by the line 5x—5x of Figure 1;

Figure 6 is a plan of the sheave assembly forming part of the operating mechanism;

Figure 7 is a similar view to Figure 2 of a modified form of switch; and

Figures 8, 9, and 10 are detail sectional elevations of the switch contacts of the arrangement of Figure 7 in progressive positions of operation.

Referring first to Figures 1 to 6 inclusive. Mounted on any suitable supporting structure 1 are three insulators 2, the center insulator carrying axially a rotatable rod 3 which has secured at its upper end and rotatable therewith a block 4 carrying horizontal arms 5. These arms are mounted intermediate of their length in the said block 4 and are flexible vertically, but offer appreciable resistance to such flection, the ends of the arms carrying contacts 6 which are electrically connected together as by a copper ribbon 7.

The lower end of the rod 3 carries arms 11 whereby said rod may be rotated through an angle of, say, 90° in one or other direction to effect the swinging of the said arms to like extent as will be readily understood. Although many methods may be adopted for accomplishing this movement, a very satisfactory form of actuating mechanism is shown in Figure 1 and will be later described.

On each of the two outer insulators is fixedly mounted a stop 8 in the form of an arcuate member, the upper extremity of which forms an abutment to receive the corresponding contact 6 when the switch is closed against the stop; and somewhat forward thereof is a pivot 9 on which is mounted a contact block 10 in the approximate form of a quadrant vertically swingable on the said pivot, as clearly shown in Figures 3 and 4.

The arcuate face of this contact block lies in the normal path of the contact 6 so that as the said contact 6 is closed upon the stop 8, by the swinging of the arms 5 in required direction, it first engages the arcuate surface of the contact block 10, as shown in Figure 3, whereby the continued closing of the contact on its block rotates the contact block on its pivot 9 to the position shown in Figure 4. It will be clearly seen that this movement of the contact block 10 by the contact 6, from the position shown in Figure 3 to that shown in Figure 4, is accompanied by an appreciable raising of the contact 6 above the normal plane of its path by block 10, this raising being effected against the mechanical resistance of the resilient arms 5. This resistance may be such, for example, as to result in a pressure, between the contact surfaces of the contacts 6 and 10, of from 200 to 1000 pounds.

The relative movement of the contact 6 on the block 10 after its first impingement therewith is of a rocking nature and under the pressures exerted is very effective in breaking through any corrosive seal or objectionable coating which may have accumulated on the contact surfaces, thus insuring excellent electric contact between the members when the switch is closed.

The underside of the contact 6 is preferably curved, as at 6a, in counterpart of the curvature of the arcuate face of the contact block, so that, in the closed position of the contact, its curved face will fit the opposed surface of the contact block. This is not in all cases essential, as the stop 8 may be the means determining the closing point.

It will be noted that there is a marked absence of sliding friction between the contact and contact block, such as is usually characteristic of switches of this type where a contact blade enters between other contact blades and is subject to considerable friction. It will be also apparent that the opening of the contact is effected against the yielding resistance of the arms 5 only during that portion of the movement necessary to carry the contact outwardly beyond the vertical plane of the pivot 9, which is a matter of only a few degrees, whereupon the resistance of the said arms then assists in the further outward movement of the contact from the stop 8. Obviously, also, the two arms 5 being slightly flexible, a slight twisting movement of the contact 6 may be permitted, assisting the effective seating on the contact block in its closed position.

The illustration shows a double break switch with similar contact mechanism at each end of the arms 5, but it will be readily understood that it is not limited to such an arrangement as one contact mechanism may be utilized alone if so desired, or additional arms and contact mechanisms may be provided in other instances.

In the arrangement shown in Figures 1 to 4, the center insulator is in tension and the outer insulators in compression in the closed position of the switch.

A very satisfactory operating mechanism is illustrated, in which the lower operating arms 11 are connected by rods 12 to similar arms 13 operably secured to a shaft 14 carried by a block 15 mounted on the structure 1. This shaft 14 also has secured thereto a pair of sheaves 16 over which cables 17 pass, the lower ends of the said cables being secured to the extremities of further arms 18 mounted on a shaft 19 which is adapted to being rotated in a bracket 20 by an operating handle 21.

The shape of the sheaves is such that, in the position shown in Figure 1, which is the closed position of the switch, the cables 17

are appreciably spaced from the shaft 14 thereby providing considerable leverage at this stage, whereas the cables approach the said shaft 14 as the switch is opened and the sheaves move towards a vertical position thus reducing the leverage.

The opening of the switch is not simply accompanied by such reduction of the leverage on shaft 14, however, but by an increase in relative speed of movement of the switch arms, so that, for a constant speed of movement of the operating lever 21, the opening of the switch is first slowly effected with considerably leverage during such initial movement and its speed of opening increased thereafter with reduced leverage. This not only provides for easy operation of the switch, but has a definite safety factor inasmuch as the switch is not rapidly thrown open until opportunity has been had to determine whether or not a heavy power arc is being set up between the contacts. With a rapid opening switch, such power arc might be developed to an extent which is dangerous to the equipment, but in the present instance the slow initial opening permits its detection and the reclosing of the switch before such damage may be done.

This desirable varying speed in operation is due in considerable part to the relative arrangement of the arms 18 to the sheaves 16, whereby they are at an appreciable angle to one another in their final positions of movement, as shown in Figure 1 wherein, in the closed position of the switch, the sheaves extend in a substantially horizontal plane and the arms 18 more or less closely approach the vertical.

In Figures 7 to 10 a modified form of the switch is shown, in which the switch arm 5^a may be rigid in contradistinction to the flexible nature of the arms 5 of the previously described construction. The arm 5^a is tubular and has at each end a contact finger 22 mounted on a pin 23 capable of rotation in the end of the said arm 5^a. A suitable coil spring 31 within the arm 5^a is utilized to hold the contact finger in the depressed position shown in the Figure 8, which is the normal inoperative position of the said contact finger. This coil spring 31 is shown in Figure 7 as being connected to each finger by a rod 32, and it will be noted that one of the said rods 32 is connected to its finger through the medium of an extension 33, the inner end of which extension fits into a socket 34 on the outer end of the said rod. This socket, in assembling the parts carried by the arm 5^a, may be utilized to receive a socket wrench or other turning instrument for the purpose of providing any initial tension in the spring 31, as will be readily understood. The outer insulators 2 each carry a horseshoe spring 24, one leg of which is fixed to the insulator and the other leg extends thereover and carries a contact plate 25 together with a contact block in the form of a shroud 26 including an abutment 27 and a stop 28.

The abutment 27 extends into the path of the end of the contact finger 22 so that, upon the closing of the switch, the end of the said contact strikes the lower part of the said abutment 27, as indicated in Figure 8. The continued closing movement of the switch causes the end of the finger to slide upwardly on the said abutment 27, turning the contact finger to the position shown in Figure 9, against the resistance of the spring within the arm 5^a. Thus the said contact finger is brought into engagement with the contact plate 25. The further continued closing movement of the switch arm 5^a carries the contact finger 22 by toggle action to press upwardly against the said contact plate 25 and elevate the free end of the spring 24, as shown in Figure 10, and the pivot center of the contact finger passes beyond the point of contact of the end of the finger with the contact plate, thus causing the pivot end of the said finger to engage the stop 28, in which position it is held by the reaction of the spring 24 in much the same manner as the contact 6 of the first described device is held against its stop by the reaction of the spring arms 5. The same snap locking effect is obtained in both cases.

The arrangement shown in Figures 7 to 10 also has self-cleaning qualities and the freedom from fouling by snow or ice on the contact surfaces, as the sliding of the contact finger over the face of the abutment 27 into contact position tends to clean any corrosion or accumulation which might exist on the contact surface of the finger; and the turning of the end of the finger against the contact plate, while raising the free end of the spring 24 which is strong enough to exert a considerable pressure on the contact finger during this movement, effectually ensures the establishing of clean electrical contact between these surfaces.

Also the raising of the free end of the spring in the manner described upon closing switch enlarges the opening between the two legs of the said spring and provides ample space for the operation of the contact finger, irrespective of any ice or snow that may have accumulated on the lower leg of the spring or insulator cap.

Furthermore, the contact surface of the member 25 is presented downwardly to the contact finger and is protected by the shroud 26 which extends thereover and also downwardly of each side thereof.

The same operating gear which is shown in Figures 1, 5, and 6, is applicable to the operation of the switch shown in Figures 7 to 10, the same advantages of slow initial opening and high initial leverage obtain together with that of easy operation.

So far as the operating gear is concerned, it will be quite apparent that such mechanical equivalents as elliptic gears may be employed in place of the eccentric sheaves 16 to obtain the same effect, and the invention as a whole, may be developed within the scope of the following claims without departing from the essential features of the said invention, wherefor it is desired that the specification and drawings be read as being merely illustrative, and not in a limited sense, except that as necessitated by the prior art.

What I claim is:

1. In a switch, a plurality of conductors, one of said conductors comprising a rotatable cam surface, the other of said conductors being mounted upon an arm and swingable horizontally to a line contacting position with said cam surface, further swinging of said conductors horizontally also affecting rotation of said cam surface, and vertical displacement of said arm, said arm being placed under tension by said vertical displacement, and a stop for said conductors, said arm forming a locking means against said stop due to the tension therein.

2. In a switch, a plurality of conductors, one of said conductors comprising a swinging quadrant, the other of said conductors comprising a rotatable arm, said arm upon rotation establishing a line contact with said quadrant, further rotation of said arm also rotating said quadrant whereby said arm is disaligned and placed under tension against said quadrant, and a stop for said arm.

3. In a switch, a plurality of conductors, one of said conductors comprising an oscillatable quadrant, the other of said conductors being carried by two arms, said arms being rotatably mounted whereby the conductor carried thereby may be swung to contact said other conductor, said arms upon further rotation thereof forcing the conductor carried thereby to ride upwardly against rotation of said other conductor whereby said arms are displaced upwardly and subjected to bending stress, still further rotation of said arms to a point astride the pivot center of said quadrant thereby relieving torsional strain therein, and a stop, said arms locking said conductors against said stop due to tension therein and to their resistance to torsion.

4. In a switch, a vertically yieldable arm rotatably mounted in an insulated bearing, conductor plates mounted on each end of said arm, an electrical connection between said plates, conductors located at a distance from said insulated bearing equal to half the length of said arm whereby said conductor plates may be swung to contact said conductors, said conductors comprising pivotally mounted quadrants, said plates being adapted to ride upwardly on said quadrants against vertical yielding of said arm whereby the contacting surfaces between said plates and said quadrants is increased and whereby said surfaces are forced together by the resistance of said arm to vertical displacement, and a stop for said plates at the point of maximum contact between said plates and said quadrants.

5. In a switch, a vertically yieldable arm rotatably mounted in an insulated bearing, a conductor plate rigidly mounted on each end of said arm and secured to both of said bars, an electrical connection between said plates, conductors located at a distance from said bearing equal to half the length of said arm whereby said plates may be swung to contact said conductors, said conductors comprising pivotally mounted quadrants, said conductor plates under further swinging after initial contact being adapted to ride upwardly on said quadrants against yielding resistance of said arm whereby pressure between the contacting surfaces is greatly increased, said bars being also subjected to torsion until attainment of a point where the vertical center line through the pivot of said quadrant bisects the distance between said bars, said plates being locked in said position due to resistance of said bars to torsion, and a stop for said plates and said quadrants at said position.

6. In a disconnector, a conductor having an arcuate face, an arm swingably mounted to engage said conductor and carrying a plate having a face formed as the counterpart of the face of said conductor, said plate when swung around by said arm first engaging said conductor in line contact, further swinging of said plate causing said arcuate faces to interengage whereby a locking means is formed to resist displacement of said plate with respect to said conductor.

7. In a switch, a vertically yieldable arm rotatably mounted in an insulated bearing, conductor plates having arcuate faces mounted on each end of said arm, an electrical connection betweeen said plates, conductors located at a distance from said insulated bearing, said conductors comprising pivotally mounted quadrants, said plates being adapted to ride upon said quadrants against vertical yielding of said arm whereby the contacting surfaces between said plates and said conductors is raised to a maximum due to the pressure exerted by said arm, said plates in riding upon said quadrants setting up torsion in said arm, said arm being relieved of torsion upon the arcuate faces of said plates attaining complete seating against said quadrants thereby forming a locking means against displacement of said plates.

8. In a switch, a vertically yieldable arm rotatably mounted in an insulated bearing, conductor plates having arcuate faces mounted on each end of said arm, an electrical connection between said plates, con-

ductors located at a distance from said insulated bearing, said conductors comprising pivotally mounted quadrants, said plates being adapted to ride upon said quadrants against vertical yielding of said arm whereby the contacting surfaces between said plates and said conductors is raised to a maximum due to the pressure exerted by said arm, said plates in riding upon said quadrants setting up torsion in said arm, said arm being relieved of torsion upon the arcuate faces of said plates attaining complete seating against said quadrants thereby forming a locking means against displacement of said plates, and a positive stop for said plates in the vicinity of the locked position preventing said plates passing over the locking position under momentum of said arm while initially establishing contact.

9. In combination with a resilient contact element rotatable about an axis perpendicular to its lengthwise extent, a pair of relatively fixed segmental contact members insulatedly supported in positions to be operatively engaged by the corresponding terminals of said resilient contact element when the latter is appropriately swung to circuit-closing position, the engagement of the respective terminals with one another being of a rolling character which effects the flexed displacement of said resilient contact element proportional to the degree of frictional engagement of the terminals thereof with the surfaces of the respective segmental contact members.

10. In a disconnect switch, a laterally resilient switch arm rotatable about an axis substantially perpendicular to its lengthwise extent, a rotatable contact member having a curved surface so intersecting the path of travel of the switch arm that the latter may be swung into rolling engagement therewith, and that upon continuance of such rolling movement the switch arm will be laterally flexed by the curved surface of the contact member to increase their frictional engagement.

11. In a disconnect switch, a laterally resilient switch arm rotatable about an axis substantially perpendicular to its lengthwise extent, a rotatable contact member having a curved surface so intersecting the path of travel of the switch arm that the latter may be swung into rolling engagement therewith, and that upon continuance of such rolling movement the switch blade will be laterally flexed by the curved surface of the contact member to increase their frictional engagement, and the contacting portion of the switch arm being curved conformably to the curvature of the surface of the contact member to increase the area of their mutual engagement.

12. In a disconnect switch, a swingable switch arm, a contact member having an arcuate surface and limitedly rotatable about an axis substantially perpendicular to that of the switch arm, said switch arm being laterally resilient and normally traveling in a path nearer the axis of the contact member than the effective portion of the arcuate surface of the latter, whereby upon movement of the switch arm and contact member into mutual engagement, the former may be rolled upon the arcuate surface of the latter, thereby yieldably laterally flexing the switch arm to establish frictional engagement between them.

13. In combination with a laterally resilient switch arm rotatably about an axis substantially normal to its lengthwise extent, a rollable contact member having a curved surface so intersecting the path of travel of the switch arm that the latter may be swung into engagement therewith, and upon continuance of such swinging movement the contacting portion of the switch arm will be yieldably laterally flexed by the contact member to increase the frictional engagement between them.

14. In a switch, a pair of contacting members rotatable about axes substantially perpendicular to each other, one of said contacts being formed with a segmental contacting surface, and the other contacting member being resiliently movable laterally of its axis and swingable thereupon in a path normally intersecting that described by the segmental contact surface of the other and passing nearer the axis of the segment than its contacting surface, whereby upon swinging the contacts together the laterally resilient member rolls upon and with the segmental member and is laterally flexed to increase the frictional engagement between them.

15. In a switch, a plurality of contacting members, one of said contacts being resilient and rollable upon another to establish line contact between them, and to laterally and yieldably flex the resilient contact thereby enabling placing the contacts under frictional engagement which is increased both in pressure and the area of mutual engagement of the contacts during such rolling movement.

In testimony whereof I affix my signature.

GEO. A. MATTHEWS.