

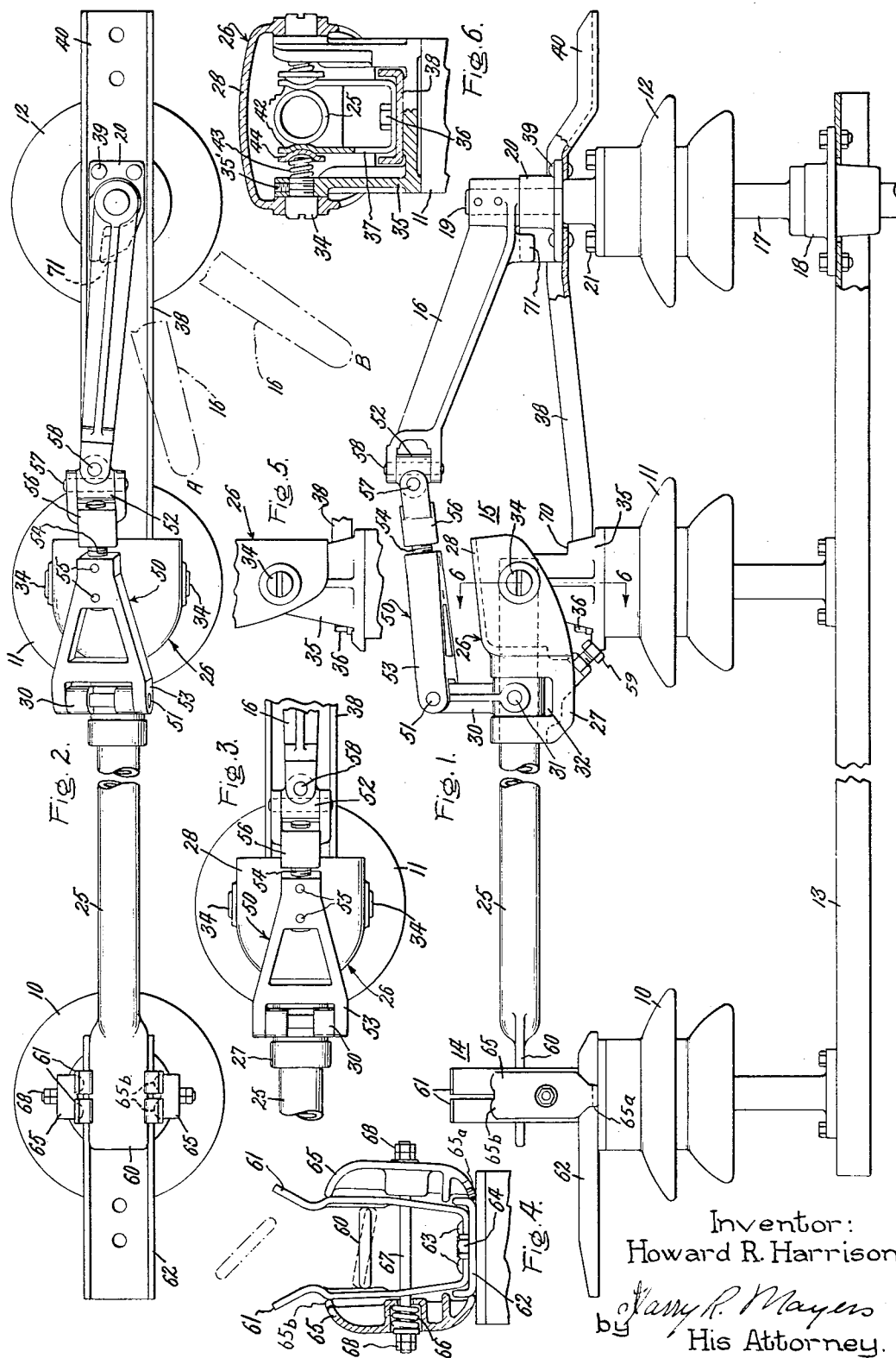
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## DUAL AXIS ROTATABLE BLADE SWITCH

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## DUAL AXIS ROTATABLE BLADE SWITCH

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The invention relates to electric circuit disconnecting switches of the dual axis rotatable blade type such as disclosed in the Scheuermeyer Patent 2,531,165 assigned to the assignee of the present invention.

In operation, the rotation of the switch blade in the opening direction on its longitudinal axis twists a flat contact at one end of the blade out of edgewise engagement between stationary jaw contacts. Then rotation of the blade on a transverse axis adjacent the other end thereof produces the necessary wide separation of the flat contact end of the blade from the stationary jaw contacts for high voltage power line disconnecting service. In reclosing the switch, the reverse rotation of the blade on the transverse axis is first produced by means of suitable crank mechanism and then the rotation on the longitudinal axis forces the flat contact end of the blade into its edgewise engagement between the stationary jaw contacts with sufficiently high pressure to crack and break any sleet or ice likely to be encountered in outdoor service. Thus the dual axis disconnecting switch is particularly adapted for connecting and disconnecting high voltage power lines under icing conditions in outdoor service.

For such high voltage service the stationary jaw contacts, the switch blade dual axis mounting, and the operating crank mechanism of the dual axis type of disconnecting switch usually are mounted on separate high voltage insulators. Hence improvements in the construction of each of these parts are desirable so as to reduce as far as possible the maximum stresses and strains that might damage the insulators upon operation of the switch under the most severe icing conditions. Also where a plurality of dual axis disconnecting switch units are to be gang-operated, it is desirable to provide for separate adjustment of the operating crank mechanism of each unit as well as to provide for some overtravel of the operating crank to insure successful joint operation of the switch units to and from the circuit closing position in case of any misalignment or inaccuracy in manufacture or installation.

Thus the principal object of the present invention is to provide an improved dual axis rotatable blade switch construction having cooperating adjustable parts that will more effectively reduce the stresses and strains produced in operation under severe icing conditions.

A particular object is to afford more effective protection against ice blocking of both the mechanical and current conducting parts at the dual axis mounting end of the blade.

Another object is to provide an adjustable and expandible threaded screw jack connection between the operating crank and the switch blade operating arm to enable the crank to be operated overcenter in completing the rotation of the flat contact end of the blade about its longitudinal axis into powerful ice breaking engagement with the jaw contact after the completion of the rotation about the transverse axis as well as start the reverse rotation about the longitudinal axis to produce a power-

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ful ice breaking action somewhat before starting the reverse rotation of the blade about the transverse axis.

Another object is to provide an improved form of laterally flexible equalized high pressure jaw contact for more effectively cooperating with the flat end of the blade in conducting the power currents as well as loosening and breaking up the ice and sleet formations encountered in outdoor service.

In all these ways the several improvements of the present invention cooperate to produce high pressure engagement of the switch contacts while reducing the maximum stresses and strains that would otherwise be imposed upon the high voltage insulators and the other switch parts under the severe icing conditions as well as to provide for ready adjustment of the throw of the operating crank required to effect the full sequential completion of the rotation of the switch blade about each axis and thereby facilitate gang operation.

Further objects and advantages will appear in the following description of the accompanying drawing in which Fig. 1 is a side view of a dual axis high voltage, high contact pressure circuit disconnecting switch mechanism embodying the several improvements of the present invention. Fig. 2 is a top view of the improved switch structure shown in Fig. 1. Fig. 3 is a fragmentary top view showing the relative positions of the switch parts after the rotation of the switch blade about the transverse axis is completed and just prior to completion of the rotation about the longitudinal axis. Fig. 4 is a fragmentary view showing the improved form of laterally flexible equalized high pressure jaw contacts that enable the blade to effectively conduct power currents as well as be operated under severe icing conditions. Fig. 5 is a fragmentary view showing the relative position of the transverse axis hinge mounting parts with the switch blade in the fully open position. Fig. 6 is a cross-sectional view along the line 6—6 of Fig. 1 looking in the direction of the arrows and showing the improved constructions of the ice and sleet protective bearing housing and trunnion transverse pivot bearing that enable the current conducting contact yoke to be mounted inside the trunnion under the housing for engaging the blade substantially in alignment with both the transverse and longitudinal pivot axis.

As shown in Fig. 1, three high voltage insulators 10, 11 and 12 are pin mounted in alignment in accordance with the usual practice on a supporting channel 13 for respectively carrying the improved stationary switch jaw contacts 14, the improved dual axis blade mounting mechanism 15 and the improved operating crank mechanism 16. The supporting pin 17 of insulator 12 is rotatably mounted in the bearing 18 for angular movement by a suitable manual or motor switch operating mechanism, and the crank 16 is fixed on the end of the coaxial shaft 19 that extends through the bearing 20 and is fixedly secured to the top of the insulator 12 by the mounting screws 21 so as to rotate the crank 16 jointly therewith.

The switch blade 25 is shown of elongated tubular construction flattened at one end to form the contact 60. The other cylindrical end of blade 25 is mounted in the dual axis protective bearing housing 26 having the slotted portion 27 provided with spaced apart bearings for supporting blade 25 for rotation about its longitudinal axis and having the channel portion 28 straddling the end of the blade 25 and provided with spaced apart bearings for rotation of the blade 25 on an intersecting transverse axis at right angles to the longitudinal axis. A radial blade operating arm 30 is fixedly secured to the blade 25 by the pin 31 to extend obliquely to the plane of the flattened end 60 and cooperates with the sides of the slot 32 in the bearing portion 27 to prevent endwise movement of blade 25.

As more clearly shown in the cross-sectional view of Fig. 6, the channel housing 28 is pivotally supported on a pair of spaced apart bearing screws 34 that are threaded into the spaced apart legs of the trunnion cradle 35 and secured in position by suitable lock screws 35'. The trunnion cradle 35 is fixedly mounted on top of the pin type insulator 11 by the holding screws 36 that also secure the contact yoke 37 in conducting engagement with one end of the channel current conductor 38 that is fixed adjacent its opposite end to the bearing 20 by the rivets 39. Thus conductor 38 serves as a brace to maintain alignment between the pin type insulators 11 and 12 and withstand the necessary forces that may be required to effect operation of the switch under severe icing conditions. The projecting end 40 of the channel conductor 38 serves as one line connection terminal for the switch.

In the improved dual axis blade mounting construction of the present invention shown in Fig. 6, the contact yoke 37 is provided with the semi-spherical projections 42 for current conducting straddling engagement with the end of the switch blade 25 in alignment with both the transverse and longitudinal axis of rotation thereof. The compression springs 43 are mounted on the reduced end sections of the bearing screws 34 and operate through the semi-spherical spring seats 44 to maintain high pressure contact between the contact yoke 37 and switch blade 25 in all positions thereof.

In further accordance with the present invention one end of an extensible jack screw 50 is pivotally connected to the end of the radial switch operating arm 30 by the pin 51 and the other end of the jack screw 50 is connected by a universal double pivot coupling 52 to the crank arm 16. In order to withstand the necessary operating forces with minimum weight the jack screw 50 has a tapering clevis part 53 that widely straddles the end of the blade operating arm 30 and is pivoted on pin 51 and has the screw 54 non-rotatably fixed to the other end of the clevis part 53 by the pins 55. The internally threaded screw block 56 is rotatably mounted on the screw 54 and pivotally connected by pin 57 with the universal double pivot coupling 52 to which the crank arm 16 also is pivotally connected by pin 58 at right angle with the jack screw pivotal connection pin 57. Thus the operating length of the jack screw 50 is readily adjustable simply by turning the block 56 on the screw 54 when one of the pivot pins of the universal double pivot coupling 52 is removed. This materially facilitates either factory or field adjustment of the interconnected switch parts for proper cooperation in gang operation with an adjustable stop 59 that limits the rotation of blade 25 about the transverse axis bearing screws 34. Also, as pointed out more fully hereinafter, an automatic variation in the length of the jack screw 50 is obtained which enables the crank arm 16 to be operated over center to complete the rotation of the switch blade 25 to the circuit closing position about its longitudinal axis after the completion of the rotation of blade 25 about its transverse axis. In this way, the maximum stresses and strains imposed upon the insulators and other cooperating parts of the switch mechanism during operation under severe icing conditions can be substantially reduced.

The free end of the elongated tubular switch blade 25 is flattened so as to form a flat contact end 60 for co-operation with the improved laterally flexible but high pressure jaw contacts 14 mounted on the insulator 10. As shown in Figs. 2 and 4, the jaw contacts 14 consist of a pair of juxtaposed contact yokes 61 that are fixedly mounted at the right in current conducting relation with the channel conductor 62 by means of the rivets 63. The channel conductor 62 is secured to the top of the insulator 10 by the mounting screws 64 so that the projecting end of conductor 62 serves as the other line connection terminal of the switch.

The contact yokes 61 preferably are formed of quite resilient conductive material. But the ends of each yoke

61 are maintained in equalized high pressure engagement with the edges of the flat blade contact 60 by means of a pair of contact pressure equalizers 65. These equalizers 65 have lower rounded ends 65a pivotally mounted in engagement with the channel conductor 62 and forked upper ends 65b strongly biased into engagement with the outer sides of the two juxtaposed contact yokes 61 adjacent the ends thereof by means of the compression springs 66, one on each equalizer, and the through tensile bolt 67 extending loosely between the yokes 61 and having the lock nuts 68 adjustable on the opposite ends thereof for compressing the springs 66. In this way, the equalizers 65 utilize their three point bearing to insure lateral flexibility for breaking up ice and sleet formations while maintaining equalized relatively high contact pressure between the edges of the blade contact 60 and the ends of each contact yoke 61 when the switch blade 25 is forced into or out of the fully closed position as shown in Figs. 1 and 2 and by the full lines in Fig. 4.

When the insulator 12 is bodily rotated to move the crank arm 16 in the switch opening direction from its over center position in which it is shown in Fig. 2, i. e. in the counterclockwise direction as viewed in Fig. 2, the jack screw 50 is carried bodily counterclockwise about the longitudinal axis of blade 25 since the axis of operating crank 16 is offset perpendicularly to the transverse axis of pivot pins 34 and intersects an extension of the longitudinal axis of the blade 25 in the circuit closing position thereof. Consequently the rotation of crank 16 will start the rotation of the flat contact end 60 about the longitudinal axis of the blade from its horizontal position shown by full lines in Fig. 4 into its adjacent dotted line tilted position with a powerful force to crack and break loose any ice or sleet that may have accumulated on the laterally flexible jaw contacts 14 and equalizers 65 under severe icing conditions. Such ice breaking action is materially facilitated by the lateral flexibility of these parts. The longitudinal rotation of blade 25 will continue until the crank 16 reaches its dot and dash line position A indicated in Fig. 2, thereby further tilting the blade contact 60 between the high pressure jaw contact yokes 61 into a position wherein the contact pressure on the blade contact is materially reduced. Thus when the crank 16 is moved from position A towards the full open position B, the rotation of switch blade 25 about its transverse pivot axis 34 to the upright position shown in Fig. 5 can be accomplished without imposing severe strains and stresses on the mechanism or the insulators since the blade contact 60 is practically free of the high pressure contact yokes 61, when the position B of the crank 16 is reached. The switch blade 25 can then be raised into substantially the vertical position and the channel portion 28 of the bearing housing 26 will engage with the notch 70 formed in the trunnion bearing 35 so as to arrest further movement of the blade as shown in Fig. 5.

During the initial longitudinal rotation of switch blade 25 about its longitudinal axis, the arm 30, and its connected clevis bracket 53 together with the screw 54 are rotated relative to the internally screw threaded block 56, thereby contracting the length of the screw jack 50 so as to effectively prevent any substantial rotation of the switch blade 25 about its transverse axis during the rotation of the blade on its longitudinal axis. The opposite action is obtained when the crank 16 is operated from the dash-dot-dot line position B in a clockwise direction to close the switch. During the movement of the crank from position B to position A, the rotation of blade 25 is principally about its transverse axis through the bearing pins 34, thus maintaining the blade contacts 60 in the tilted dash-dot line position shown in Fig. 4 so as to freely enter between the contact finger yokes 61 before the rotation of the blade 25 about its longitudinal axis is produced by movement of the crank 16 from the dotted line position A to its over center position limited by stop 71 as shown in Fig. 2. This will twist the blade contact 60

into equalized high pressure engagement with each independently laterally flexible contact yoke 61 so as to break loose any accumulated ice or sleet without any substantial movement of the blade about its transverse axis.

No matter what the position of blade 25 may be, the conductor yoke 37 is always maintained in firm current conducting straddling relation therewith and that relationship is effectively maintained even under severe icing conditions due to the fact that the conducting parts are substantially enclosed inside of the straddling trunnion cradle 35 and the straddling portion 28 of the ice and sleet protective bearing housing 26.

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

1. A circuit disconnecting switch having in combination a blade having a flat end, jaw contacts for engaging the flat end of the blade edgewise therebetween, a radial arm fixed adjacent the other end of the blade to extend obliquely to the plane of the flat end thereof, means for mounting the other end of the blade for rotation to and from the circuit closing position jointly about a transverse axis and the longitudinal axis of the blade, and means for rotating the blade about the transverse and longitudinal axes including a crank having an extensible screw threaded jack provided with a universal double pivot coupling with the end of the crank and a pivotal connection with the radial arm for extending the screw jack upon movement of the crank to rotate the blade to engage the flat end thereof between the jaw contacts.

2. A circuit disconnecting switch having in combination a blade having a flat end, jaw contacts for circuit closing engagement with the flat end of the blade, a radial operating arm fixed to the blade adjacent the other end thereof, means for mounting the other end of the blade for rotation to and from the circuit closing position jointly about a transverse axis and a longitudinal axis, stop means for limiting the rotation of the blade each way about the transverse axis, an operating crank having an axis offset perpendicularly to the transverse axis and intersecting an extension of the longitudinal axis of the blade in the circuit closing position thereof and provided with stop means for limiting the over center rotation of the crank, and a screw threaded jack having a universal double pivot coupling with one end of the crank and a pivot connection with the radial operating arm for adjustably varying the length of the jack to effect the completion of the rotation of the flat end of the blade about the longitudinal axis into edgewise high pressure engagement with the jaw contacts at the limit of rotation of the crank.

3. A circuit disconnecting switch having in combination a blade having a flat end, cooperating stationary jaw contacts for circuit closing engagement with the flat end of the blade, a radial operating arm fixed to the blade adjacent the other end thereof, means for mounting the other end of the blade for rotation to and from the circuit closing position jointly about a transverse axis and a longitudinal axis, an operating crank having an axis offset perpendicularly to the transverse axis and intersecting an extension of the longitudinal axis of the blade in the circuit closing position thereof, and a screw threaded jack having a universal double pivot coupling with one end of the crank and a pivot connection with the radial operating arm for elongating the jack to effect the completion of the rotation of the flat end of the blade about the longitudinal axis into edgewise high pressure engagement with the jaw contacts after the completion of the rotation of the blade about the transverse axis upon angular movement of the crank over center and thereby insure the starting of the opposite rotation of the blade about the longitudinal axis before the starting of the opposite rotation of the blade about the transverse axis in disengaging the flat end of the blade from the jaw contacts.

4. A circuit disconnecting switch having in combination a cylindrical blade having a flat end and jaw contacts

for circuit closing engagement therewith, a radial arm fixed adjacent the other end of the blade to extend obliquely to the plane of the flat end thereof, a trunnion straddling the other end of the blade, a housing pivotally mounted on and straddling the trunnion and having bearings for mounting the blade for rotation about the longitudinal axis thereof, a contact yoke mounted inside the trunnion under the housing for straddling engagement with the blade substantially in alignment with the trunnion axis, and means for rotating the blade about the trunnion axis and the longitudinal axis including a crank having an extensible screw threaded jack provided with a universal double pivot coupling with the end of the crank and a pivotal connection with the radial arm for extending the screw jack upon movement of the crank to rotate the blade to engage the flat end thereof between the jaw contacts.

5. A circuit disconnecting switch having in combination a dual longitudinal and transverse axis rotatable blade having a flat contact end, a pair of juxtaposed laterally resilient contact yokes mounted at the bight for current conducting engagement of the insides of the yoke with the edges of the flat contact end upon rotation of the blade on the longitudinal axis inside the yokes, a pair of pivotally mounted pressure equalizers each engaging the outsides of the two contact yokes, and a tensile member extending between the equalizers and provided with resilient means for biasing the equalizers to effect equalized high pressure engagement of each yoke with the edges of the flat contact end of the blade.

6. A circuit disconnecting switch having in combination a dual longitudinal and transverse axis rotatable blade having a flat contact end, a pair of juxtaposed laterally resilient contact yokes, a support for said yokes, means for mounting said yokes on said support for current conducting engagement with the edges of the flat contact end upon rotation of the blade on the longitudinal axis inside the yokes, a pair of pressure equalizers pivotally engaging said support and having portions in engagement with the outsides of both the contact yokes, and a tensile member extending between the equalizers and having an adjustable spring connection with each equalizer for effecting equalized high pressure engagement of each yoke with the edges of the flat contact end of the blade.

7. A circuit disconnecting switch having in combination a dual axis rotatable blade having a flat end, a pair of juxtaposed laterally resilient contact yokes mounted at the bight for current conducting engagement with the edges of the flat contact end upon rotation of the blade on the longitudinal axis inside the yokes, a pair of pivotally mounted pressure equalizers having forked ends in engagement with the outer sides of both the yokes, and a through bolt extending between the equalizers and having a compression spring connection with the equalizer at each end thereof for effecting equalized high pressure engagement of each yoke with the edges of the flat contact end of the blade.

8. A circuit disconnecting switch having in combination a dual axis rotatable blade having a flat contact end, a pair of juxtaposed laterally resilient contact yokes having a support at the bight for effecting conducting engagement of the edges of the flat contact end with the yokes adjacent the ends thereof upon rotation of the blade on the longitudinal axis inside the yokes, a pair of contact pressure equalizers on the outsides of the yokes, each equalizer having one end forked and engaging both the yokes and the other end rounded and pivotally engaging the support, and a tensile member extending laterally through the yokes and equalizers and having an adjustable compression spring connection with each equalizer for effecting equalized high pressure engagement of each yoke with the edges of the flat contact end of the blade.

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