Dec. 14, 1954 J. B. OWENS 2,697,144

HIGH VOLTAGE SWITCH

Filed Sept. 27, 1950 3 Sheets-Sheet 1

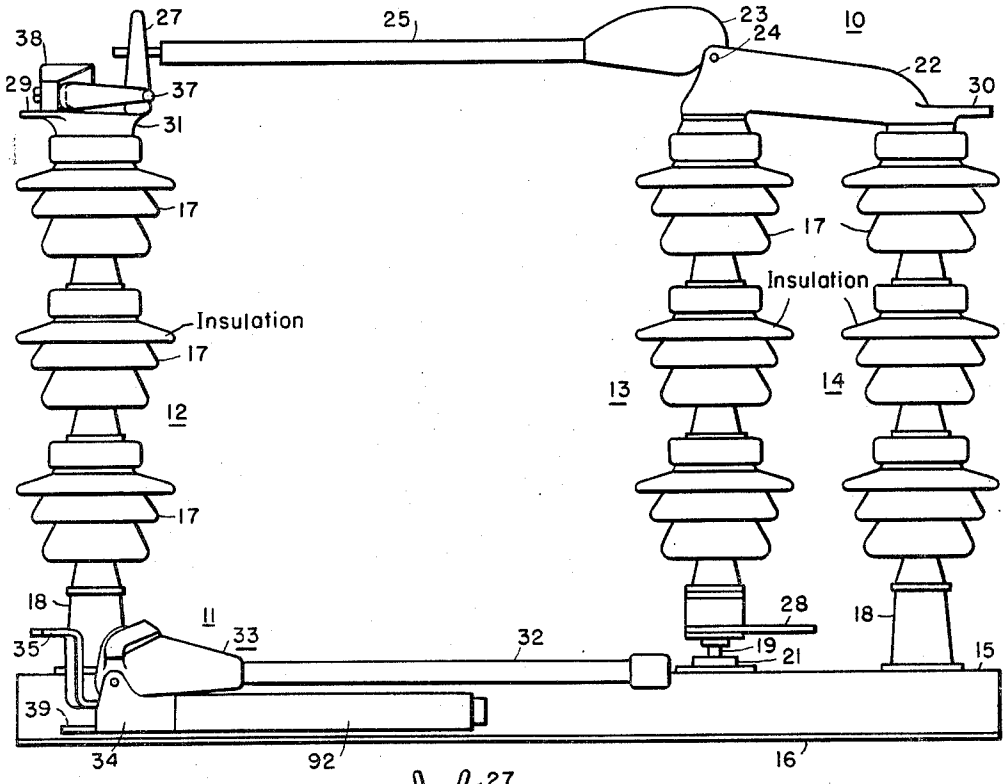


Fig.1.

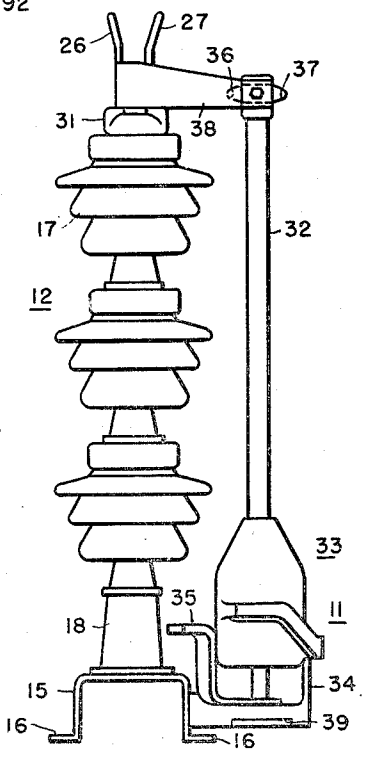


Fig.2.

WITNESSES:

E. A. McCaskey.

Wm. L. Groome

INVENTOR

James B. Owens.

BY Thos. Whitcroft

ATTORNEY

Dec. 14, 1954 J. B. OWENS 2,697,144

HIGH VOLTAGE SWITCH

Filed Sept. 27, 1950 3 Sheets-Sheet 2

Fig.3.

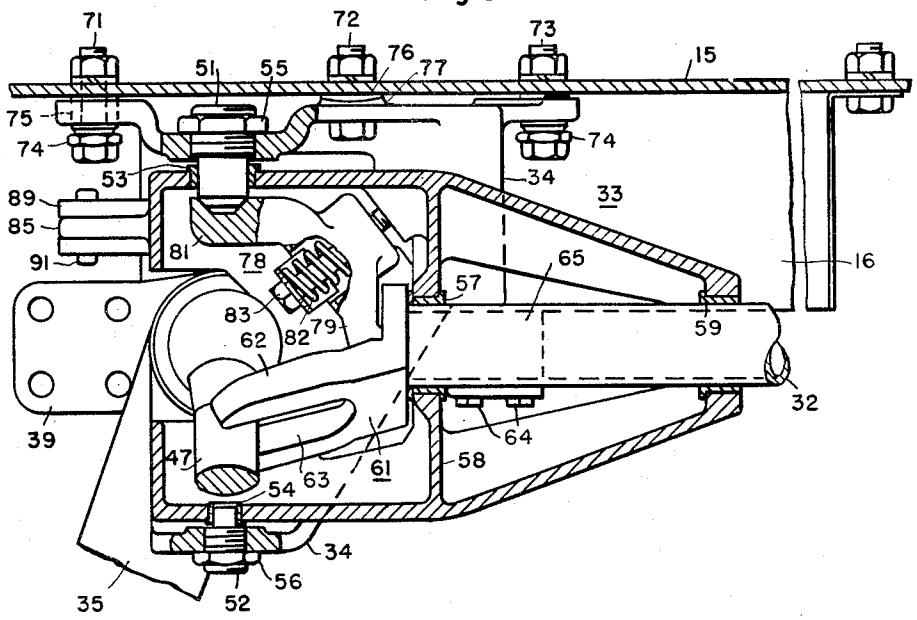
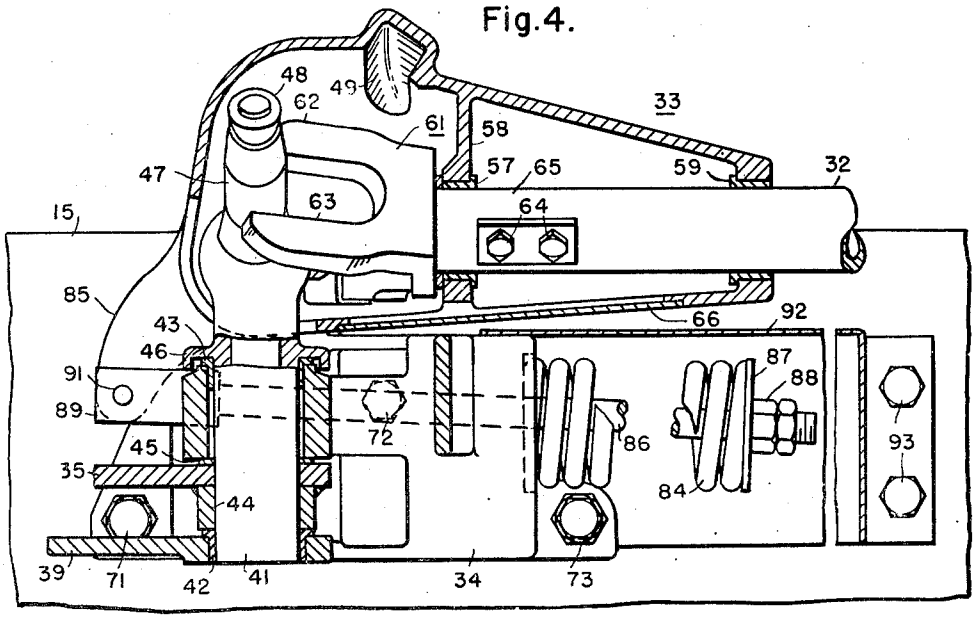


Fig.4.



WITNESSES:

E. A. McCloskey.

Wm. C. Groome

INVENTOR

James B. Owens.

BY

ATTORNEY

Dec. 14, 1954 J. B. OWENS 2,697,144

HIGH VOLTAGE SWITCH

Filed Sept. 27, 1950 3 Sheets-Sheet 3

Fig.5.

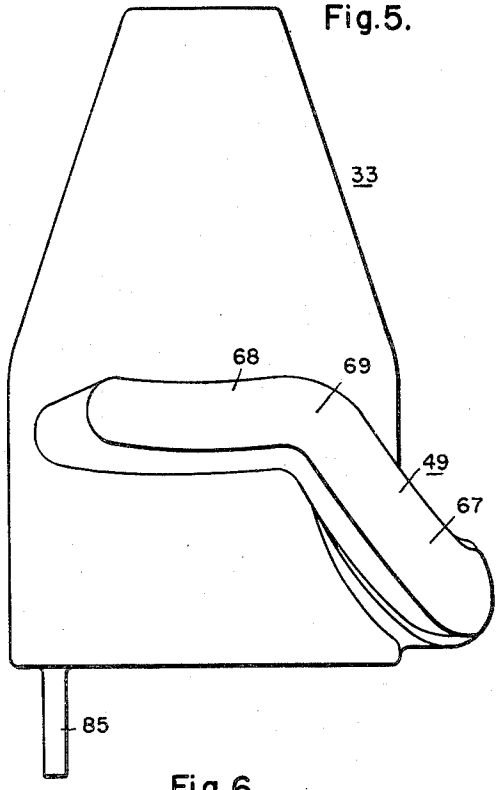


Fig.7.

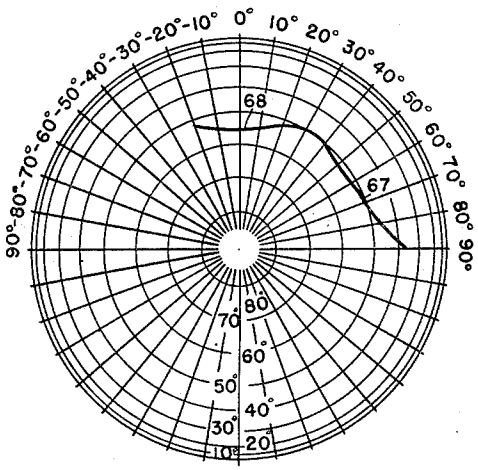


Fig.6.

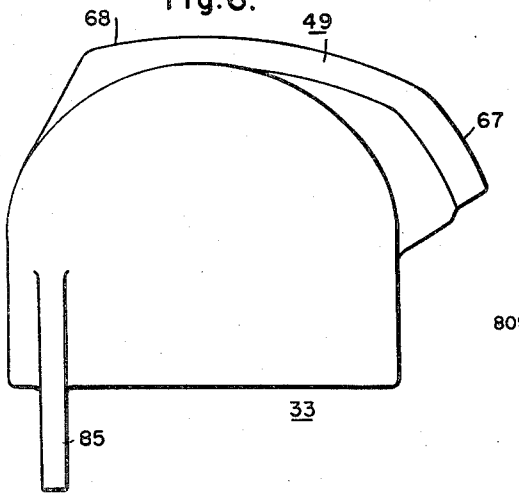
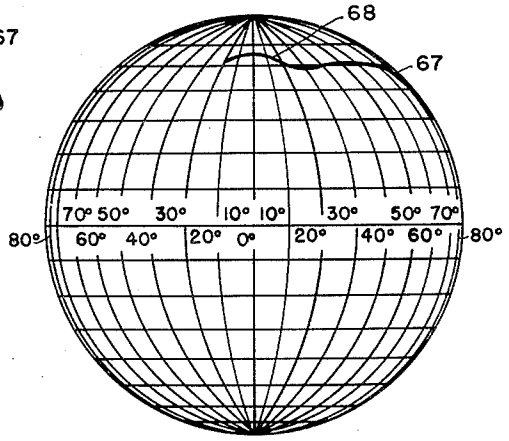


Fig.8.



WITNESSES:

E. A. McCloskey.

Wm. L. Groome

INVENTOR

James B. Owens.

BY R. K. Whitcomb

ATTORNEY

United States Patent Office 2,697,144 Patented Dec. 14, 1954

2,697,144

HIGH VOLTAGE SWITCH

James B. Owens, East McKeesport, Pa., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application September 27, 1950, Serial No. 186,945

9 Claims. (Cl. 200—48)

My invention relates, generally, to high voltage switches and, more particularly, to switches commonly known as grounding switches.

In the operation of electric power systems, disconnecting switches are utilized to isolate transmission lines and high voltage electrical apparatus before handling for inspection or repair. It is desirable to ground the line or apparatus after it has been isolated to drain off any static charge that may remain and to prevent injury to personnel in the event that the apparatus becomes reenergized. To accomplish the grounding, it is the usual practice to equip the isolating switches with auxiliary grounding blades.

Heretofore, the grounding switches have usually been simple knife switches with low pressure contacts. No provision was made for removing contact pressure before moving the blade out of the grounding position and the operating effort was high. In general, no ice breaking means was provided and difficult operation was encountered during ice storms. Also, current was conducted around the hinge members of the switches by flexible shunts which were susceptible to corrosion and subsequent breakage.

An object of my invention, generally stated, is to provide a grounding switch which shall be simple and efficient in operation and which may be economically manufactured and installed.

A more specific object of my invention is to provide a grounding switch suitable for cooperating with a disconnecting switch in isolating and grounding high voltage circuits and apparatus.

Another object of my invention is to provide for adjusting the plane in which the blade of a switch swings during operation of the switch.

A further object of my invention is to mount a grounding switch on the same base with its associated disconnecting switch.

Still another object of my invention is to simplify the structure of the actuating mechanism for a grounding switch.

A still further object of my invention is to provide for conducting current from a rotatable switch blade through a pivotal supporting member by means of a nonflexible bridging member.

Other objects of my invention will be explained fully hereinafter or will be apparent to those skilled in the art.

In accordance with my invention, a grounding switch blade is rotatably disposed in a housing which is pivotally mounted on a support member adjustably attached to the same base which supports the disconnecting switch with which the grounding switch cooperates. The switch is actuated by a manually operable arm driving a spherical cam which is incorporated into the mechanism housing.

For a better understanding of the nature and objects of the invention, reference may be had to the following detailed description, taken in conjunction with the accompanying drawings, in which:

Figure 1 is a view, in side elevation, of a disconnecting and grounding switch structure embodying the principal features of the invention;

Fig. 2 is a view, in end elevation, of the structure shown in Fig. 1, the grounding switch being closed;

Fig. 3 is an enlarged view, partly in plan and partly in section, of the grounding switch actuating mechanism;

Fig. 4 is an enlarged view, partly in side elevation and partly in section, of the mechanism shown in Fig. 3;

Fig. 5 is an enlarged view, in plan, of a cam housing for the actuating mechanism;

Fig. 6 is an enlarged view, in end elevation, of the cam housing, and

Figs. 7 and 8 are views showing the method of laying out a cam track on a spherical surface.

Referring to the drawings, and particularly to Figs. 1 and 2, the structure shown therein comprises a disconnecting switch assembly **10** and a grounding switch assembly **11**. The disconnecting switch assembly **10** may be of the type described in Patent No. 2,363,360, issued November 21, 1944 to H. L. Rawlins, and assigned to the same assignee as this application.

As shown, the switch structure comprises three spaced insulator stacks **12**, **13** and **14** which are mounted upon a base **15**. The base **15** is preferably a metal channel having flanges **16** extending outwardly from the sides of the channel. Each insulator stack comprises a plurality of insulators **17** which are preferably composed of porcelain or similar material. It will be understood that the number of insulators required in each stack depends upon the voltage of the system in which the switch structure is utilized. The stacks **12** and **14** are mounted upon fixed pedestals **18** which may be secured to the top of the base **15**. The stack **13** is mounted upon a shaft **19**, the end of which is rotatably mounted in a bearing **21** which is secured to the base **15**.

An insulator bracing member and blade support **22** spans the insulator stacks **13** and **14**. A housing **23** is pivotally mounted on the support **22** by means of pivot pins **24**. As described in the aforesaid patent, a disconnecting switch blade **25** may be actuated into and out of engagement with spaced contact jaws **26** and **27** by operating a lever **28** to rotate the insulator stack **13**.

As shown in Fig. 1, the switch blade **25** is in the closed position and is in engagement with the contact jaws **26** and **27**. The operating mechanism for the disconnecting switch is so constructed that the switch blade is first rotated to disengage the end of the switch blade from the spaced contact jaws **26** and **27** and is then pivotally actuated from the horizontal position to a substantially vertical position. Thus, a power conductor (not shown) which may be connected to a terminal **30** on the member **22** is disconnected from a conductor (not shown) which may be connected to a terminal **29** on a plate **31** to which the contact jaws **26** and **27** are connected.

As explained hereinbefore, it is desirable to ground the line or apparatus which may be connected to the terminal **29** after it has been isolated in order to drain off any static charge that may remain and to prevent injury to operating personnel in the event that the apparatus accidentally becomes reenergized. The grounding switch **11** is provided to perform the grounding operation.

As shown, the grounding switch **11** comprises a switch blade **32** which is rotatably mounted in a housing **33**. The housing **33** is pivotally mounted in a frame **34** which is attached to one side of the base **15** in a manner more fully described hereinafter. The blade **32** may be actuated from a position substantially parallel to the base **15** to a position substantially perpendicular to the base **15** by operating a lever **35**.

As will be described more fully hereinafter, the operating mechanism for the grounding switch **11** is so constructed that the switch blade **32** is first pivotally actuated about a transverse axis through the pivot supports for the housing **33** to raise the switch blade to a position between spaced contact jaws **36** and **37**. The jaws **36** and **37** are the legs of a U-shaped member having its base attached to a bracket **38** which, in turn, is attached to the plate **31**. After the end of the switch blade **32** enters the jaws **36** and **37**, it is then rotated about its longitudinal axis by continuing movement of the lever **35** to cause the switch blade **32** to engage the contact jaws **36** and **37** with a high pressure.

When it is desired to open the grounding switch, the lever **35** is operated in the opposite direction and the blade **32** is first rotated to disengage it from the contact jaws **36** and **37** and is then lowered to the horizontal position shown in Fig. 1. The twisting motion of the blade

wipes the contact members clean on each operation and also is effective in breaking any ice formations which would otherwise bind the blade to the contact members and make the switch inoperative.

Under normal operating conditions, the disconnecting switch blade 25 is opened prior to the closing of the grounding switch blade 32. However, under extreme conditions such as the formation of ice in the jaws 36 and 37, which would prevent the closing of the switch blade 32, the blade 25 may be left in the closed position to function as a brace for the insulator stack 12 while the blade 32 may be swung against the contact jaws 36 and 37 to break the ice formation. In this manner the insulator stack 12 is braced by the disconnecting switch blade 25 to prevent injury to the insulator by the lateral forces imposed by the switch blade 32 striking the ice on the contact members 36 and 37.

A terminal 39 is provided on the frame 34 which may be connected to ground through a conductor (not shown). Thus, the apparatus or line which is connected to the terminal 29 may be grounded by closing the grounding switch 11.

It will be noted that the operation of the grounding switch 11 differs from the operation of the disconnecting switch 25 in that the switch blade 32 rises from a position parallel to the base 15 and then twists into contact engagement with the contact members 36 and 37. The disconnecting switch 25 must twist while in a position parallel to the base 15 and then rise to a position perpendicular to the base 15. Accordingly, the mechanism for operating the grounding switch 11 must be different from the mechanism for operating the disconnecting switch 10.

As shown most clearly in Figs. 3 and 4, the operating mechanism for the grounding switch comprises a shaft 41 which is rotatably mounted in bearings 42 and 43 disposed in the frame 34. The operating lever 35 is secured to the shaft 41 to rotate the shaft. A spacing member 44, which surrounds the shaft 41, may be welded to the operating lever 35. As shown, a spacing washer 45 may be provided on top of the operating lever 35. A grooved collar 46 is formed on the shaft 41 to protect the top bearing 43.

As shown, an angularly extending crank 47 may be formed integrally with the shaft 41. A roller 48 is mounted on the end of the crank 47 and this roller is disposed in a track 49 which extends outwardly from a portion of the housing 33 which has a spherical surface.

As explained hereinbefore, the housing 33 is pivotally mounted in the frame 34. As shown most clearly in Fig. 3, the housing is supported by pivot studs 51 and 52 which are adjustably disposed in the frame 34. Bearing members 53 and 54 are provided in the housing 33 for the studs 51 and 52, respectively. Lock nuts 55 and 56 are provided on the studs 51 and 52, respectively, for retaining the studs in their properly adjusted position.

As previously explained, the switch blade 32 is rotatably mounted in the housing 33. As shown, one end of the blade 32 is supported by a bearing 57 disposed in a partition 58 which is formed integrally with the housing 33. A bearing 59 is also provided at one end of the housing 33 for supporting the blade 32.

A fork 61, having arms 62 and 63 which straddle the crank 47, is attached to the end of the blade 32 by means of bolts 64 which engage a stub end 65 of the fork 61 which is inserted into the end of the blade 32. A cover plate 66 is removably attached to the bottom of the housing 33 to provide access to the interior of the housing. It will be noted that the cover plate 66 is on the bottom of the housing 33 when the switch blade 32 is in the horizontal position, which is the position in which the switch remains most of the time while in service. Thus, the possibility of moisture entering the switch around the cover plate 66 is precluded.

As shown in Figs. 5 and 6, the cam track 49 may be so laid out that a portion 67 of the track extends at an angle to the plane of movement of the actuating roller 48 on the crank 47, and a portion 68 of the track extends in a horizontal plane in the horizontal path of movement of the roller 48. The manner of laying out the cam track may be understood by referring to Figs. 7 and 8 in which the angular position of the track on the surface of a sphere is shown. The two portions 67 and 68 of the track are so joined at 69 that the roller 48

gradually passes from one portion to the other, thereby permitting substantially uniform rotation of the crank 47. The cam track 49 is so arranged that the line of contact of the roller 48 with the track is equi-distant from the center of the spherical surface, which center is located at the intersection of the axis of the shaft 41 and the axis of the angular arm 47.

It will be understood that upon rotation of the shaft 41 and the crank 47 in a clockwise direction, as viewed in Figs. 3 and 4, the roller 48 will travel first in the portion 67 of the cam track 49, thereby causing the housing 33 and the switch blade 32 to be pivotally actuated about a transverse axis extending through the pivot supports for the housing 33. In this manner the switch blade 32 is actuated from a position parallel to the base 15 to a position perpendicular to the base 15 where it stops between the contact jaws 36 and 37. As the shaft 41 continues to rotate, the roller 48 on the crank 47 travels in the portion 68 of the cam track 49 without imparting any further swinging action to the blade 32. However, the crank 47 engages the fork 61 to cause the switch blade 32 to be rotated about its longitudinal axis, thereby causing the end of the blade 32 to engage the jaws 36 and 37 with a high contact pressure. In this manner high contact pressure is obtained between the contact members of the switch with substantially no lateral bending stress on the insulator stack 12 which is weaker in bending than in compression. This completes the closing operation of the grounding switch.

When it is desired to open the grounding switch, the operating lever 35 is actuated in a counterclockwise direction. The switch blade 32 is first rotated to disengage the end of the blade from the contact jaws 36 and 37, and the switch is then actuated from a perpendicular position to a horizontal position substantially parallel with the base 15.

It will be noted that it is necessary for the blade 32 to swing in a plane which passes between the contact jaws 36 and 37 in order that the end of the switch blade will enter the contact jaws. Since the position of the contact jaws 36 and 37 is determined by the contact jaws 26 and 27, which must be so positioned that the disconnecting switch 25 will enter these jaws, it is necessary to adjust the grounding switch 11 to secure the desired plane of movement of its blade 32.

As shown in Figs. 3 and 4, the frame 34 which supports the housing 33 is adjustably attached to the side of the base 15 by means of three mounting bolts 71, 72 and 73 which are so disposed that they form a tripod support for the frame 34. The bolts 71 and 73 extend through bushings 74 which are threaded into openings 75 in the supporting arms of the frame 34. As shown, pads 76 and 77, which may have engaging curved surfaces, are provided on the base 15 and the frame 34, respectively. The bolt 72 extends through openings provided in these pads.

In this manner, the bolt 72 acts as a fixed point of support, and the bolts 71 and 73 function as adjustable points of support, the adjustment being obtained by means of the threaded bushings 74. Thus, the plane of movement of the switch blade 32 may be varied to cause the blade to enter the contact jaws 36 and 37. In this manner, it is not necessary to incur expensive machining of the mounting supports for the switch mechanism in order to secure accurate adjustment of the switch. Furthermore, one switch may be replaced by another and proper adjustment readily obtained.

In order to conduct current from the switch blade 32 to the terminal 39, without the use of flexible shunts, a bridging member 78 is provided. As shown most clearly in Fig. 3, one arm 79 of the bridging member engages the fork 61 which, as explained hereinbefore, is inserted into the blade 32, and the other arm 81 engages the pivot stud 51 which is threaded into the frame 34. The terminal 39 may be formed integrally with the frame 34.

The pressure of the arms 79 and 81 of the bridging member on the fork 61 and the stud 51, respectively, may be adjusted by means of a spring 82 which may be compressed against the bridging member by a bolt 83 which is threaded into the housing 33. In this manner, current is conducted from the switch blade 32 through the bridging member 78 to the stud 51 and thence through the frame 34 to the terminal 39.

In order to assist the cam mechanism in raising the switch blade 32 from the horizontal to the vertical position, a spring 84 is connected to an arm 85 on the housing

33, by means of a bolt 86. As shown most clearly in Fig. 4, the spring 84 surrounds the bolt 86 and is compressed between the frame 34 and a washer 87 disposed on the bolt 86. The pressure of the spring 84 may be adjusted by means of a nut 88 on one end of the bolt 86. The other end of the bolt 86 is connected to the arm 85 by means of a clevis 89 and a pin 91. The spring 84 is shown compressed in Fig. 4. Thus, the force of the spring will aid in raising the switch blade 32. The spring may be protected by means of a cover 92 which is attached to the side of the base 15 by bolts 93.

It will be seen that the spring 84 and its housing 92 extend along and are parallel to the switch blade 32 when it is in its open position. Furthermore, neither the spring nor its housing extends below the base 15 to interfere with other apparatus, and they do not bridge across the insulators 17 to reduce the electrical clearance between high potential members and ground.

From the foregoing description it is apparent that I have provided a grounding switch which is so operated by a spherical cam mechanism that the switch blade is first pivotally actuated about a transverse axis through its pivot supports and is then rotated about its longitudinal axis during the closing operation of the switch. Thus, a high contact pressure is obtained without imposing lateral forces upon the insulator which supports the fixed contact members of the switch. The switch is so constructed that it may be mounted upon the same base which supports the disconnecting switch with which the grounding switch cooperates, and the cam mechanism is such that the grounding switch is disposed substantially parallel to the base when in its open position. No part of the actuating mechanism extends below the base and the mechanism is so disposed that it does not reduce the electrical clearance to other apparatus. Furthermore, the switch is so constructed that moisture is precluded from entering the switch mechanism while in its opened position. The mounting supports for the switch may be readily adjusted to vary the plane of movement of the switch blade to cause the blade to enter the fixed contact jaws. Current is conducted from the movable switch blade to a fixed terminal member without requiring flexible shunts.

Since numerous changes may be made in the above-described construction and different embodiments of the invention may be made without departing from the spirit and scope thereof, it is intended that all matter contained in the foregoing description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim as my invention:

1. In a switch structure, in combination, a base, an insulator secured to the base, spaced contact jaws secured to the insulator, a switch blade, pivot means supporting the switch blade, mechanical means for pivotally actuating the switch blade about a transverse axis through the pivot means for the blade, and mounting means disposed in a tripod arrangement to form a three-point support for adjustably attaching the frame to the base to vary the plane of movement of the switch blade to cause it to enter said contact jaws when actuated by the mechanical means.

2. In a switch structure, in combination, a base, an insulator secured to the base, spaced contact jaws secured to the insulator, a switch blade, a housing supporting one end of the switch blade, a frame pivotally supporting the housing, crank means rotatably mounted in the frame for pivotally actuating the switch blade about a transverse axis through the pivot supports for the housing, a mounting bolt for attaching the frame to the base and adjustable means disposed on opposite sides of said bolt to form a three-point support for varying the plane of movement of the switch blade to cause it to enter said contact jaws when actuated by the crank means.

3. In a grounding switch, in combination, a base, an insulator secured to the base, contact members secured to the insulator, a switch blade, a supporting housing enclosing one end of the switch blade, bearing means mounted in the housing for rotatably supporting the switch blade, a frame secured to the base for pivotally supporting the housing, crank means rotatably mounted in the frame and extending into the housing for first pivotally actuating the switch blade from a position parallel to the base to a position perpendicular to the base and then rotating the switch blade about its longitudinal axis to engage the contact members when said crank means is rotated in one direction, bridging means disposed inside the housing for conducting current from the switch blade to the frame.

4. In a grounding switch, in combination, a base normally at ground potential, an insulator secured to the base, contact members secured to the insulator, a switch blade, a supporting housing enclosing one end of the switch blade, bearing means mounted in the housing for rotatably supporting the switch blade, a frame secured to the base, pivot means in the frame for supporting the housing, crank means rotatably mounted in the frame and extending into the housing for first pivotally actuating the switch blade from a position parallel to the base to a position perpendicular to the base and then rotating the switch blade about its longitudinal axis to engage the contact members when said crank means is rotated in one direction, and a rigid bridging member disposed inside the housing for engaging the switch blade and the pivot means in the frame to conduct current from the switch blade to the frame.

5. In a grounding switch, in combination, a base normally at ground potential, an insulator secured to the base, contact members secured to the insulator, a switch blade, a supporting housing enclosing one end of the switch blade, bearing means mounted in the housing for rotatably supporting the switch blade, a frame secured to the base, pivot means in the frame for supporting the housing, crank means rotatably mounted in the frame and extending into the housing for first pivotally actuating the switch blade from a position parallel to the base to a position perpendicular to the base and then rotating the switch blade about its longitudinal axis to engage the contact members when said crank means is rotated in one direction, and a generally V-shaped bridging member adjustably mounted inside the housing for engaging the switch blade and the pivot means in the frame to conduct current from the switch blade to the frame.

6. In a grounding switch, in combination, a base normally at ground potential, an insulator secured to the base, contact members secured to the insulator, a switch blade, a supporting housing enclosing one end of the switch blade, bearing means mounted in the housing for rotatably supporting the switch blade, a frame secured to the base, pivot means in the frame for supporting the housing, crank means rotatably mounted in the frame and extending into the housing for first pivotally actuating the switch blade from a position parallel to the base to a position perpendicular to the base and then rotating the switch blade about its longitudinal axis to engage the contact members when said crank means is rotated in one direction, a generally V-shaped bridging member having one end engaging the switch blade and the other end engaging one of the pivot means in the frame for conducting current from the switch blade to the frame, a spring for biasing the bridging member against the switch blade and the pivot means, and adjustable means for varying the force of the spring.

7. In a grounding switch, in combination, a switch base, an insulator stack mounted upon and disposed perpendicularly to the base, spaced contact members secured to the top of the insulator stack, a switch blade disposed substantially parallel to the base when in its open position, a housing rotatably supporting one end of the switch blade, part of said housing having a generally spherical surface, a frame secured to the base and pivotally supporting the housing, a track formed integrally with the spherical surface of the housing, crank means rotatably mounted in the frame and having one end disposed in said track for pivotally actuating the switch blade about a transverse axis extending through the pivot supports for the housing, said track having a first portion extending at an angle to the plane of movement of said one end of the crank means and a second portion extending in a horizontal plane in the horizontal path of movement of said end of the crank means, a fork secured to one end of the switch blade and engaging said crank means to rotate the switch blade about its longitudinal axis, said crank means and said track cooperating to actuate the switch blade from its position parallel to the base to a position substantially parallel to the insulator stack between said contact members when the crank means is travelling in the first portion of the track, said crank means and said fork cooperating to rotate the blade to engage the contact members with high contact pressure and substantially no

lateral stress on the insulator stack when the crank means is travelling in the second portion of the track, and spring means extending along and substantially parallel to the switch blade when the blade is in its open position for assisting in the pivotal movement of the switch blade.

8. In a grounding switch, in combination, a switch base, an insulator stack mounted upon and disposed perpendicularly to the base, a U-shaped contact member secured to the top of the insulator stack with the plane of the U disposed perpendicular to the axis of the insulator stack, a switch blade pivoted at the bottom of the insulator stack and disposed substantially parallel to the base when in its open position, a housing rotatably supporting one end of the switch blade, part of said housing having a curved surface, a frame secured to the base and pivotally supporting the housing, a track formed integrally with the curved surface of the housing, crank means rotatably mounted in the frame and having one end disposed in said track, said track having a first portion extending at an angle to the plane of movement of said one end of the crank means and a second portion extending in a horizontal plane in the horizontal path of movement of said end of the crank means, a fork secured to one end of the switch blade and engaging said crank means, said crank means and said track cooperating to pivotally actuate the switch blade from its position parallel to the base to a position substantially parallel to the insulator stack between the legs of the U-shaped contact member when the crank means is travelling in the first portion of the track, said crank means and said fork cooperating to rotate the blade to engage the contact member with high contact pressure and substantially no lateral stress on the insulator stack when the crank means is travelling in the second portion of the track, a housing member extending along and substantially parallel to the switch blade when the blade is in its open position, and spring means disposed in said housing member for assisting in the pivotal movement of the switch blade.

9. In a grounding switch, in combination, a switch base, an insulator stack mounted upon and disposed perpendicularly to the base, a U-shaped contact member secured to the top of the insulator stack with the plane of the U disposed perpendicular to the axis of the insulator stack, a switch blade pivoted at the bottom of the insulator stack and disposed substantially parallel to the base when in its open position, a housing rotatably supporting one end of the switch blade, part of said housing having a curved surface, a frame secured to the base and pivotally supporting the housing, a track formed integrally with the curved surface of the housing, crank means rotatably mounted in the frame and having one end disposed in said track, a first portion of said track forming a gradually increasing angle with the direction of movement of the end of the crank means, a second portion of the track extending in the direction of movement of the end of the crank means, a fork secured to one end of the switch blade and engaging said crank means, said crank means and said track cooperating to pivotally actuate the switch blade about a transverse axis from its position parallel to the base to a position between the legs of the U-shaped contact member when the end of the crank means is travelling in the first portion of the track, said crank means and said fork cooperating to rotate the blade about its longitudinal axis to engage the contact member with high contact pressure and substantially no lateral stress on the insulator stack when the crank means is travelling in the second portion of the track, and spring means disposed below the transverse axis for assisting in the pivotal movement of the switch blade, said spring means extending along and substantially parallel to the switch blade when the blade is in the open position.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,711,770	Bocek	May 7, 1929
2,363,360	Rawlins	Nov. 21, 1944
2,420,485	Kast	May 13, 1947
2,456,502	Graybill	Dec. 14, 1948