

Feb. 3, 1970

J. P. McKINNON

3,493,700

DISCONNECTING SWITCH INCLUDING IMPROVED CONTACT MEANS

Filed Nov. 22, 1967

2 Sheets-Sheet 1

FIG. 1.

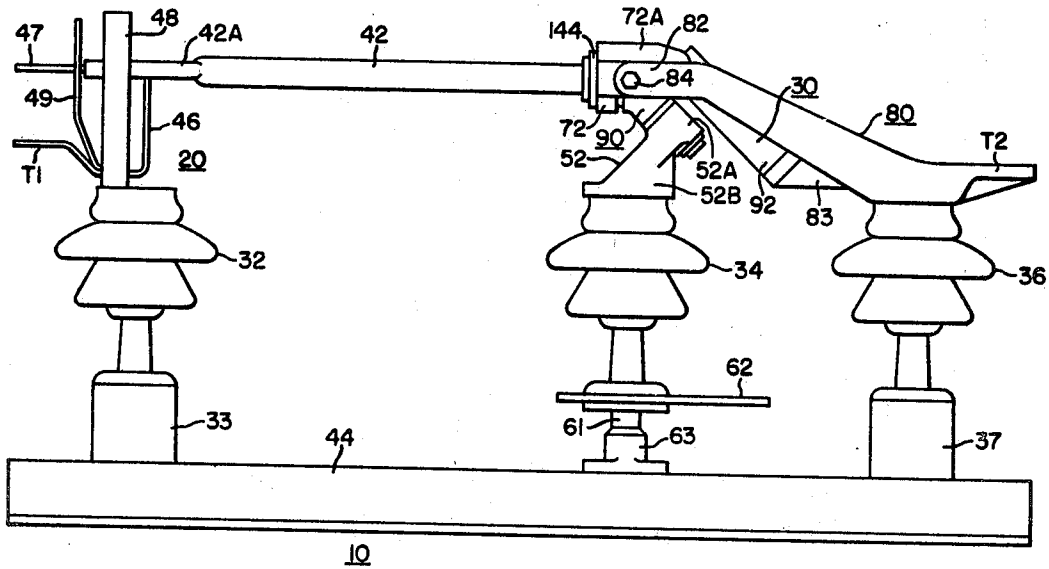
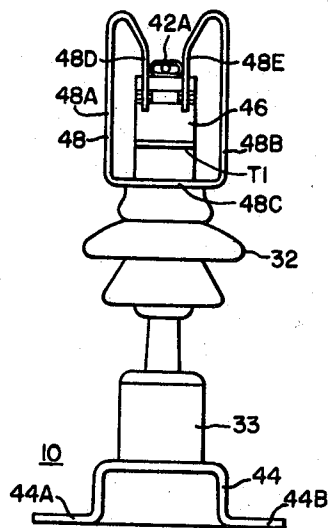


FIG. 2.

WITNESSES

Theodore F. Wrobel
James F. Young

INVENTOR

John P. McKinnon

BY

Clement L. McHale
ATTORNEY

Feb. 3, 1970

J. P. MCKINNON

3,493,700

DISCONNECTING SWITCH INCLUDING IMPROVED CONTACT MEANS

Filed Nov. 22, 1967

2 Sheets-Sheet 2

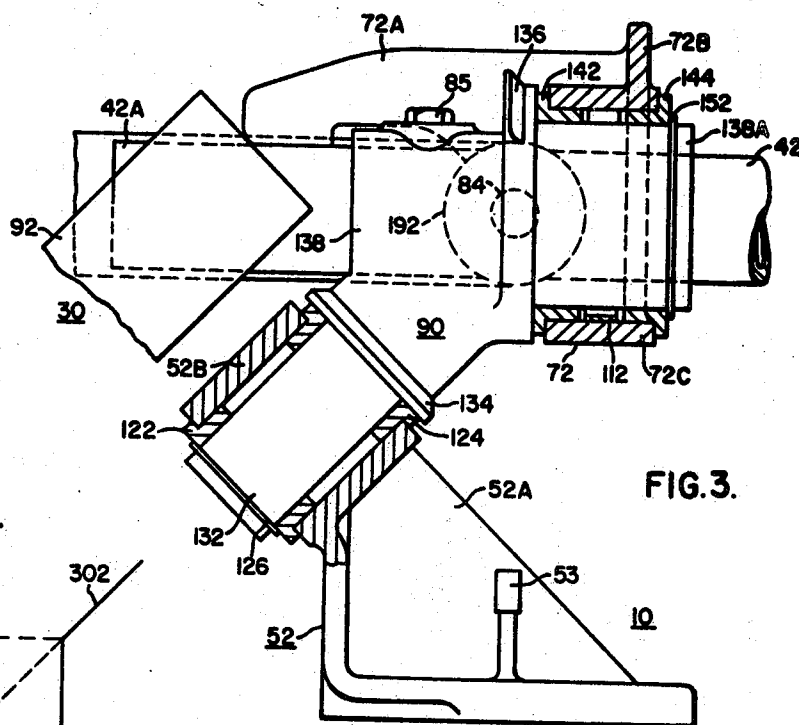


FIG.3.

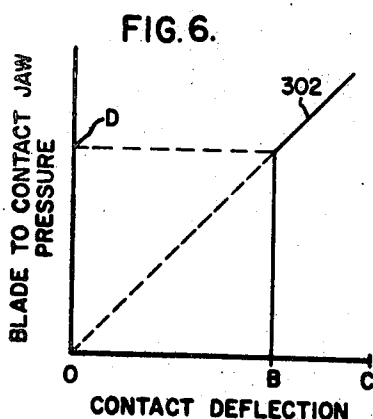
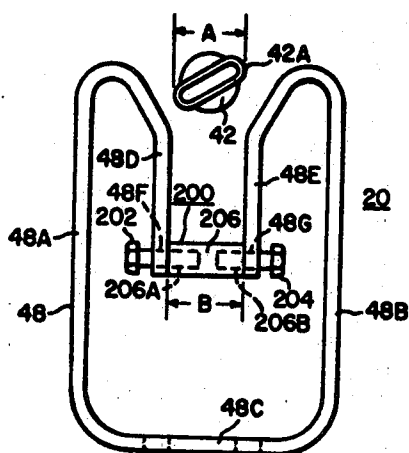


FIG. 4.

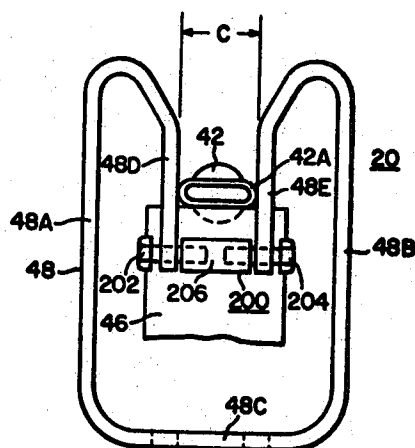


FIG.5.

1

2

3,493,700

DISCONNECTING SWITCH INCLUDING IMPROVED CONTACT MEANS

John P. McKinnon, Monroeville, Pa., assignor to Westinghouse Electric Corporation, Pittsburgh, Pa., a corporation of Pennsylvania

Filed Nov. 22, 1967, Ser. No. 685,135

Int. Cl. H01h 31/26

U.S. Cl. 200—48

5 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to disconnecting switches which includes a switch blade that is movable from an open position with respect to an associated relatively stationary contact assembly through an arcuate path toward a closed position with respect to the contact assembly and which is finally rotated about its own axis to engage the contact jaws of the contact assembly and to establish adequate contact pressure between the free end of the switch blade and the contact jaws of the relatively stationary contact assembly.

In the construction of certain known types of disconnecting switches, such as disclosed in U.S. Patent 2,527,924 which issued Oct. 31, 1950 to T. Fjellstedt et al. and in U.S. Patent 3,079,474 which issued Feb. 26, 1963 to E. F. Beach et al. and which is assigned to the same assignee as the present application, a movable switch blade is actuated through an arcuate path to engage and disengage a pair of associated spaced main relatively stationary contact jaws or break jaws which are disposed in the path of the switch blade to be engaged by the free end of the switch blade during the closing of the switch. During the final portion of a closing operation of such a disconnecting switch, the switch blade is actuated to rotate about its own axis in order to establish adequate contact pressure between the free or contact end of the switch blade and the associated contact jaws of the break jaw assembly. Depending upon the spacing between the contact jaws of the break jaw assembly, the relative size of the switch blade parts, and the amount of rotation of the switch blade about its own axis during the final portion of a closing operation, a problem may arise in a disconnecting switch structure of the type described in achieving adequate contact pressure between the switch blade and the contact jaws of the associated break jaw assembly while at the same time minimizing mechanical wear of the parts which engage when the disconnecting switch is actuated to a closed position. It is therefore desirable to provide a disconnecting switch structure of the type described which includes improved relatively stationary contact means which facilitates the entrance of the associated switch blade during a closing operation while insuring adequate contact pressure between the switch blade and the relatively stationary contact means and at the same time reduces the wear of the mechanical parts that would otherwise result.

It is an object of this invention to provide a new and improved disconnecting switch structure.

Another object of this invention is to provide an improved relatively stationary contact means for disconnecting switches.

A more specific object of this invention is to provide an improved means for facilitating the entrance of the switch blade of a disconnecting switch between the contact jaws of the associated break contact jaw assembly.

Other objects of the invention will, in part, be obvious and will, in part, appear hereinafter.

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

FIGURE 1 is a side elevational view of a disconnecting switch structure embodying the principal features of the invention with the switch structure shown in the closed position;

FIG. 2 is an end elevational view of the disconnecting switch structure shown in FIG. 1;

FIG. 3 is a view, partly in side elevation and partly in section, of a portion of the disconnecting switch structure shown in FIGS. 1 and 2;

FIG. 4 is a view in end elevation of a relatively stationary contact means which forms part of the disconnecting switch structure shown in FIGS. 1 through 3 and the associated switch blade as the switch blade approaches the closed position;

FIG. 5 is a view in end elevation of the relatively stationary contact means shown in FIG. 4 and the associated switch blade which forms part of the disconnecting switch structure shown in FIGS. 1 through 3 with the switch blade shown in the fully closed position with respect to the associated stationary contact means; and

FIG. 6 is a graphical representation which assists in explaining the operation of certain portions of the disconnecting switch structure shown in FIGS. 1 through 3.

Referring now to the drawings and FIGS. 1 and 2 in particular, there is shown a disconnecting switch assembly 10 which is of the general type which is described in detail in copending application Ser. No. 588,530, filed Oct. 21, 1966 by Chester W. Upton, Jr. which has now issued as U.S. Patent 3,366,753 and is assigned to the same assignee as the present application. The disconnecting switch assembly 10 comprises three spaced insulator stacks 32, 34 and 36 mounted upon a common base support 44. The base 44 is preferably a metal channel having a pair of flanges 44A and 44B which extend outwardly from the sides of the intermediate channel portion of the base 44. Each of the insulator stacks 32, 34 and 36 comprises a plurality of insulators which are preferably formed from porcelain or a similar material. The number of insulators required in each of the insulator stacks 32, 34 and 36 depends upon the voltage of the system in which the disconnecting switch 10 is to be applied. The insulator stacks 32 and 36 are mounted upon the fixed pedestals or spacers 33 and 37, respectively, which may be secured in turn to the top of the base 44. The insulator stack 34 is mounted upon a shaft 61 for rotation therewith, the lower end of the shaft 61 being rotatably mounted in a bearing 63 which is secured to the supporting base 44. An operating lever or crank arm 62 may be secured to the shaft 61 to rotate the insulator stack 34 during the operation of the disconnecting switch 10, as will be explained hereinafter.

The disconnecting switch 10 includes a first main stationary contact assembly or break jaw assembly 20 which is mounted on and secured to the top of the insulator stack 32, as shown in FIGS. 1 and 2, by suitable means such as a plurality of bolts (not shown). More specifically, the stationary contact assembly 20 comprises a break contact jaw member 48 which as shown in FIGS. 4 and 5 includes a pair of laterally spaced outer contact jaws 48A and 48B which are structurally interconnected by a base portion or bight portion 48C that is secured to the top of the insulator stack 32 by suitable means, such as bolts. The break contact jaw member 48 is of the reverse loop type and includes a pair of inner laterally spaced contact jaws 48D and 48E which are interconnected with the outer contact jaws 48A and 48B, respectively, at the tops of the latter outer contact jaws with the inner contact jaws 48D and 48E extending down-

wardly toward the base or bight portion 48C of the break contact jaw member 48 as shown in FIGS. 4 and 5. Since the break contact jaw member 48 is of the reverse loop type, the break contact jaw member 48 has the characteristics of magnetically forcing the associated switch blade 42 downwardly between the break jaws 48D and 48E in a direction toward the base portion 48C which interconnects the contact jaws 48A and 48B and against the blade stop 46 as will be described hereinafter when a relatively high momentary current flows through the disconnecting switch 10. The contact or break jaws 48A, 48B, 48D and 48E are preferably formed from a suitable material which combines relatively high electrical conductivity with excellent spring characteristics, such as zirconium copper or cadmium chrome copper. The resilient nature of the contact jaws 48A, 48B, 48D and 48E substantially eliminates the need for additional or separate spring or biasing means to bias the contact jaws 48D and 48E toward one another for gripping or frictionally retaining the free end of the associated switch blade 42 when the switch blade 42 is actuated to engage the contact jaws 48D and 48E.

A terminal pad T1 which is adapted to receive a terminal connector is also secured to the top of the insulator stack 32 and includes a generally vertical extension, as indicated at 46, which may be formed integrally therewith and which acts as a stop for the movement of the associated switch blade 42 into engagement with the break contact jaw member 48. In addition, a relatively stationary arcing horn 49 may be also secured to the top of the insulator stack 33 as shown in FIGS. 1 and 2 by suitable means, such as the bolts which secure the break contact jaw member 48 to the top of the insulator stack 32.

In order to facilitate the entrance of the switch blade 42 into the break contact jaw member 48 during a closing operation of the disconnecting switch 10, the main stationary contact assembly 20 also includes a spacer member 200, as best shown in FIGS. 4 and 5, which is disposed to extend laterally between the break jaws 48D and 48E of the break contact jaw member 48 adjacent to the lower ends of the break jaws 48D and 48E and to extend through substantially aligned openings provided in the break jaws 48D and 48E, as indicated at 48F and 48G, respectively, in FIG. 4.

More specifically, the spacer member 200 includes a generally cylindrical member 206 which is disposed between the break jaws 48D and 48E and includes a pair of axially extending, internally threaded openings at the opposite ends thereof, as indicated at 206A and 206B in FIG. 4, with said openings being substantially aligned with the adjacent openings in the break jaws 48D and 48E, respectively. It is to be noted that the cross-sectional size or area of the generally cylindrical member 206 is relatively larger than that of each of the openings 48F and 48G in the break jaws 48D and 48E, respectively, so that the lower ends of the break jaws 48D and 48E resiliently bear against the ends of the generally cylindrical member 206 which form shoulders or bearing surfaces when assembled with the break jaws 48D and 48E. In order to retain the generally cylindrical member 206 in assembled relation with the break jaws 48D and 48E and, as illustrated, to permit a limited deflection of the break jaws 48D and 48E during the operation of the disconnecting switch 10, as will be explained hereinafter, a pair of bolts or studs 202 and 204 are assembled into the opposite ends of the generally cylindrical member 206. More specifically, the inner ends of the bolts 202 and 204 project axially into the openings 206A and 206B, respectively, at the opposite ends of the generally cylindrical member 206 with the inner ends of the bolts 202 and 204 being threaded to engage the internally threaded openings of the generally cylindrical member 206. It is to be noted that the cross-sectional area or size of each of the shanks of the bolts 202 and 204 is relatively smaller than that of each of the openings 48F

and 48G provided in the break jaws 48D and 48E, respectively, to permit the break jaws 48D and 48E to move or deflect outwardly on the bolts 202 and 204 until the break jaws 48D and 48E engage the enlarged ends or heads of the bolts 202 and 204 respectively, to thereby limit the maximum deflection of the break jaws 48D and 48E away from one another during a closing operation of the disconnecting switch 10, as will be explained hereinafter. It is to be noted that the axial dimension of the generally cylindrical member 206 of the spacer member 200 is selected to establish a minimum spacing between the break jaws 48D and 48E as indicated at B in FIG. 4 which is relatively larger than the undeflected spacing between the break jaws 48D and 48E in the absence of the spacer member 200 so that the break jaws 48D and 48E of the break contact jaw member 48 are resiliently deflected or placed in a stored energy condition prior to the entrance of the switch blade 42 into the break contact jaw member 48 during a closing operation of the disconnecting switch 10.

The disconnecting switch 10 also includes a second main stationary contact assembly 30 which is mounted on a generally U-shaped relatively stationary support frame 80, as disclosed in greater detail in the copending application previously mentioned. The support frame 80 is mounted on top of and secured to the insulator stack 36 by suitable means, such as a plurality of bolts, and is formed or cast from a suitable material which combines relatively high electrical conductivity with sufficient structural strength, such as an aluminum-bronze alloy. The support frame 80, as illustrated, includes a terminal pad 86 which may be formed integrally therewith and which is adapted to receive a terminal connector. The second main stationary contact assembly or main hinge contact assembly 30 includes a pair of laterally spaced contact jaws 92 which are interconnected by a base portion or bight portion which may be secured to a central shoulder or bracket portion of the support frame 80 as indicated at 83 in FIG. 1 by suitable means, such as bolts. Similarly to the break contact jaw member 48, the contact jaws 92 are preferably formed from a suitable material which combines relatively high electrical conductivity with excellent spring or resilient characteristics, such as the materials previously mentioned, to eliminate the need for additional spring means or biasing means to bias the contact jaws toward one another to provide sufficient contact pressure with the adjacent end of the associated switch blade 42 when the switch blade 42 engages the contact jaws 92.

In order to electrically bridge the spaced main stationary contact assemblies 20 and 30 just described when the disconnecting switch 10 is in the closed position shown in FIGS. 1 and 2, the movable switch blade 42 is disposed to engage both of the stationary contact assemblies 20 and 30 along an axis which extends between the contact assemblies 20 and 30 when the switch 10 is in the closed circuit condition shown in FIG. 1 and which substantially coincides with the axis of the switch blade 42 in the closed circuit condition. As illustrated, the switch blade 42 is generally tubular in configuration with the opposite ends being shaped to provide high pressure contact areas which engage the associated contact jaws 48 and 92 of the contact assemblies 20 and 30, respectively. More specifically, as shown in FIGS. 4 and 5, the free end of the switch blade 42 which engages the break contact jaw member 48 is shaped to be generally rectangular in cross-section, as indicated at 42A in FIGS. 4 and 5, with the thickness of the blade contact portion 42A being relatively less than the maximum width of the blade contact portion 42A. In order to facilitate the interruption of magnetizing or charging currents during the opening of the switch 10, a movable arcing horn 47 may be mounted at the free end of the blade 42 to cooperate with the stationary arcing horn 49 during such an opening operation,

In order to support the switch blade 42 for rotation about its own axis and for arcuate movement about an axis which extends generally transversely with respect to the longitudinal axis of the switch blade 42, the laterally spaced arms 82 of the support frame 80 are disposed on opposite sides of the right end of the switch blade 42, as viewed in FIG. 1. The hinge member 72 is pivotally supported between the arms 82 of the support frame 80 by the bolts 84 which pass through aligned openings in the arm 82 and the hinge member 72 with the hinge end of the switch blade 42 being disposed to pass through the central tubular portion 72C of the hinge member 72 to engage the associated contact assembly 30 when the disconnecting switch 10 is in the closed position shown in FIG. 1. It is to be noted that the hinge member 72 is rotatable about an axis which extends through the bolts 84 and which intersects the longitudinal axis of the switch blade 42 at substantially a right angle, as explained in greater detail in the copending application previously mentioned.

In order to actuate the switch blade 42 between opened and closed positions with respect to the associated contact assemblies 20 and 30, the connecting link member 90 is secured to the switch blade 42 for movement therewith as best shown in FIG. 3. In particular, the connecting link 90 includes a first portion 138 which is secured to the switch blade 42 by suitable means, such as the bolt 85 which passes through substantially aligned openings in the first portion 138 of the connecting link 90 and the switch blade 42. The first portion 138 of the connecting link 90 which is generally tubular in configuration to receive the switch blade 42 includes a portion indicated at 138A which is concentrically disposed between the hinge member 72 and the switch blade 42 and which projects axially along the blade 42 to the right of the hinge member 72, as viewed in FIG. 3. In order to rotatably support the switch blade 42 along with the first portion 138 of the connecting link 90 in the central portion of the hinge member 72, the flanged sleeve bearing members 142 and 144 are disposed between the first portion 138 of the connecting link 90 and the hinge member 72, as shown in FIG. 3. The flanged sleeve bearing members 142 and 144 are axially spaced from one another along the switch blade 42 and are formed from a suitable material, such as bronze, which is coated with a material having a relatively low coefficient of friction, such as the material polytetrafluoroethylene which is sold under the trademark "Teflon." The bearing members 142 and 144 are maintained in assembled relationship with the associated hinge member 72 and the connecting link 90 by the flange portion 136 which is provided on the first portion 138 of the connecting link 90 and the retaining ring 152 which is disposed in a circumferential groove provided adjacent to the end of the portion 138A of the connecting link 90 on the other side of the hinge member 72. The connecting link 90 is also provided with an arm portion 132 which is generally tubular in configuration and which projects from the first portion 138 of the connecting link 90 at an angle of substantially 45° with respect to the first portion 138 of the connecting link 90 and with respect to the longitudinal axis of the switch blade 42. The axis of the arm portion 132 of the connecting link 90 also intersects the axis of rotation of the switch blade 42 which extends between the bolts 84 as previously indicated.

In order to actuate the arm portion 132 of the connecting link 90 and, in turn, the switch blade 42, the crank member 52 is mounted on top of and secured to the insulator stack 34 by suitable means, such as bolts. The crank member 52 includes a base portion 52A and a bearing portion 52B which is adapted to receive the arm portion 132 of the connecting link 90. In order to rotatably support the connecting link 90 in the bearing portion 52B of the crank member 52, a pair of flanged sleeve bearing members 122 and 124 are disposed at the opposite ends of the bearing portion 52B of the crank member 52 between

the arm portion 132 of the connecting link 90 and the inner surface of the bearing portion 52B of the crank member 52. In order to maintain the bearing members 122 and 124 in assembled relationship with the associated arm portion 132 of the connecting link 90 and the bearing portion 52B of the crank member 52, the flange portion 134 is provided on the connecting link 90 and a retaining ring 126 is disposed on the lower end of the arm portion 132 of the connecting link 90 in a circumferential groove provided adjacent to the lower end of the arm portion 132. It is to be noted that the crank member 52 is rotatable with the insulator stack 34 about an axis which substantially intersects the longitudinal axis of the switch blade 42, the axis of rotation of the hinge member 72 and the axis of rotation of the arm portion 132 of the connecting link 90 which also intersects the longitudinal axis of the switch blade 42 at an angle of substantially 45° and intersects the axis of rotation of the crank member 52 at an angle of substantially 45°, as best shown in FIG. 2.

In order to limit the arcuate travel or movement of the switch blade 42 from the closed position shown in FIG. 1 to the open position which is angularly displaced from the closed position shown in FIG. 1 by an angle of substantially 90° about the axis of rotation of the hinge member 72, the stop member 53 is mounted on the base portion 52A of the crank member 52 and may be formed integrally therewith to engage the lower end of the switch blade 42 when the switch blade 42 is actuated to the open position.

In order to assist the actuation of the switch blade 42 from the open position which is angularly displaced from the closed position shown in FIG. 1 by substantially 90° as just mentioned, when the mechanical advantage of the hinged conducting structure just described is substantially at a minimum, a cam member or projecting portion (not shown) may be mounted on or formed integrally with the bearing portion 52B of the crank member 52 and disposed to engage one end of an arm 72A which extends from the flange portion 72B on the hinge member 72 toward the contact assembly 30 and the contact jaws 92, as best shown in FIG. 3. When the switch 10 is actuated from the open position, the cam portion (not shown) on the crank member 52 which is disclosed in detail in the copending application previously mentioned engages the arm 72A on the hinge member 72 from about 10° to 20° of the rotation of the insulator stack 34 during the initial rotation of the insulator stack 34 towards the position which corresponds to the closed position of the switch 10 to transmit a driving torque to the switch blade 42 directly from the crank member 52 to the hinge member 72 and the switch blade 42.

In order to maintain an electrically conducting path between the switch blade 42 and the support frame 80 during an opening movement of the switch blade 42, a generally C-shaped conducting member 112 is disposed generally concentrically between the hinge member 72 and the first portion 138A of the connecting link 90, as best shown in FIG. 3, and as described in greater detail in the copending application previously mentioned. The conducting member 112 engages both the inner surface of the central tubular portion 72C of the hinge member 72 and the outer surface of the portion 138A of the connecting link 90 at a plurality of points to prevent any burning or arcing at the hinged conducting structure of the disconnecting switch 10 previously described. The conducting member 112 is preferably formed from a material which combines relatively high electrical conductivity with excellent spring or resilient characteristics, such as phosphorus-bronze or a zirconium-copper alloy.

In the overall operation of the disconnecting switch 10, when the insulator stack 34 is rotated by an external operating mechanism (not shown) through the crank member or operating lever 62, from the position shown

in FIGS. 1 and 2, the switch blade 42 is first actuated through the crank member 52 and the connecting link 90, as guided by the hinge member 72, to rotate about its own longitudinal axis until the contact pressure between the contact surfaces or portions provided at the free end of the switch blade 42, as indicated at 42A, and the break jaws 48D and 48E of the break contact jaw member 48 is reduced or relieved. Simultaneously or subsequently, the switch blade 42 is rotated in an arcuate path about the axis which extends through the bolts 84 from the closed position indicated in FIGS. 1 and 2 to the open position which is displaced from the closed position by an angle of substantially 90° in a clockwise direction as viewed in FIG. 1 about the axis which extends through the bolts 84. During the opening movement of the switch blade 42 from the closed position shown in FIG. 1, both ends of the switch blade 42 will be disengaged from the associated contact assemblies 20 and 30 and after the right end of the switch blade 42 as viewed in FIG. 1 is disengaged from the contact assembly 30, the conducting member 112 maintains an electrically conducting path from the switch blade 42 to the electrically conducting support frame 80 which extends from the switch blade 42, through the connecting link 90 which is also formed from an electrically conductive material, the conducting member 112, the electrically conducting hinge member 72, the electrically conducting bolts 84 and the contact areas provided on the arm portion 192 of the hinge member 72 which are generally circular in configuration, as best shown in FIG. 3. As previously mentioned, the stop member 53 provided on the base portion 52A of the crank member 52 limits the arcuate travel of the switch blade 42 from the closed position shown in FIGS. 1 and 2 to the open position which is angularly displaced from the closed position by an angle of substantially 90°.

In a closing operation of the disconnecting switch 10, the insulator stack 34 is rotated through the crank member or operating lever 62 from the position which corresponds to the open position of the disconnecting switch 10, as described in greater detail in the copending application previously mentioned, to thereby actuate the switch blade 42 from the open position through the crank member 52 and the connecting link 90 as guided by the hinge member 72 to the closed position shown in FIGS. 1 and 2. As previously mentioned, during the initial rotation of the insulator stack from the position which corresponds to the open position of the disconnecting switch 10, the arm 72A provided on the hinge member 72 is engaged by a cam surface (not shown) on the bearing portion 52B of the crank member 52 to actuate the switch blade 42 initially from the open position when the mechanical advantage of the drive system which includes the insulator stack 34, the crank member 52, the connecting link 90 and the hinge member 72 is substantially at a minimum to insure proper operation of the disconnecting switch 10 during a closing operation. It has been found that the driving torque or forces exerted on the switch blade 42 through the cam member (not shown) and the arm 72A of the hinge member 72 are effective during a closing operation of the switch blade 42 from about 10° to 20° of the initial rotation of the insulator stack 34 from the position which corresponds to the open position of the disconnecting switch 10 toward the position of the insulator stack 34 which corresponds to the closed position of the disconnecting switch 10.

It is important to note that during the final arcuate movement of the switch blade 42 to the closed position shown in FIG. 1, the blade 42 is rotated about its own axis to insure adequate contact pressure between the contact surfaces at the opposite ends of the blade 42 and the associated contact jaws 48 and 92. More specifically, as the blade contact portion 42A of the switch blade 42 reaches an operating position adjacent to the break contact jaw member 48, as shown in FIG. 4, the

blade contact portion 42A of the switch blade 42 has an effective width in the direction of movement of the switch blade 42 toward the break jaws 42D and 42E, as indicated at A in FIG. 4, which is less than the maximum dimension of the blade contact portion 42A as indicated at C for the blade contact portion 42A which is shown in the fully closed position in FIG. 5. Since the minimum spacing established by the spacer member 200 between the break jaws 48D and 48E is relatively larger than the effective width of the blade contact portion 42A (as indicated at A in FIG. 4), as the blade contact portion 42A enters the break contact jaw member 48, the entrance of the blade contact portion 42A is facilitated by the lack of engagement between the blade contact portion 42A and the break jaws 48D and 48E until the blade contact portion 42A engages the blade stop member 46. After the blade contact portion 42A engages the stop member 46 and is further rotated about the axis of the switch blade 42, the blade contact portion 42A will engage both of the break jaws 48D and 48E and force the break jaws 48D and 48E to deflect farther apart with the corresponding spacing between the break jaws 48D and 48E increasing after engagement by the blade contact portion 48 to the distance indicated at C in FIG. 5 when the switch blade 42 reaches the fully closed position.

It is also important to note that as the switch blade 42 is rotated about its own axis to increase the contact pressure between the blade contact portion 42A and the break jaws 48D and 48E, the break jaws 48D and 48E are deflected out of engagement with the ends of the generally cylindrical member 206 as shown in FIG. 5. As previously mentioned, due to the presence of the spacer member 200 which includes the generally cylindrical member 206 and which establishes a minimum spacing between the break jaws 48D and 48E, as indicated at B in FIG. 4, the break jaws 48D and 48E are both resiliently deflected under the influence of the spacer member 200 prior to the entrance of the blade contact portion 42A of the switch blade 42 between the break jaws 48D and 48E which are therefore in a stored energy condition or considered as spring members in a charged condition. After the break contact portion 42A engages the stop member 46 and then rotates about its own axis to initially engage the break jaws 48D and 48E, the blade to contact jaw pressure increases abruptly as indicated graphically in FIG. 6 to a value as indicated at D as soon as the break jaws 48D and 48E are deflected away from engagement with the ends of the generally cylindrical member 206. As the blade contact portion 42A is further rotated about the axis of the switch blade 42, and as indicated by the curve 302 in FIG. 6, the pressure between the break contact portion 42A and the break jaws 48D and 48E increases in a substantially linear manner until the blade contact portion 42A is rotated to the fully closed position shown in FIG. 5 which corresponds to a spacing between the break contacts 42D and 48E as indicated at C in FIG. 5. The contact deflection or spacing as indicated at B in FIG. 6 therefore corresponds to the minimum spacing indicated at B in FIG. 4 which is established by the spacer member 200 and the maximum contact pressure shown graphically in FIG. 6 corresponds to the maximum normal deflection between the break jaws 48D and 48E which corresponds to the spacing indicated at C in FIG. 5. It is to be noted that the enlarged ends of the threaded members 202 and 204, where provided, may also function as stop members or means for limiting the maximum deflections of the break jaws 48D and 48E during any closing operation in which the switch blade 42 may be actuated to the closed position abruptly or with unusual force such as during adverse weather conditions when ice and snow may be present.

It is to be understood that the teachings of the applicant's invention may be applied to other known discon-

necting switch structures of the type in which a switch blade is actuated through an arcuate path during a closing operation to a position adjacent a relatively stationary contact means and is then rotated about its own axis to establish adequate contact pressure between the free end of the switch blade and the associated relatively stationary contact means, such as disclosed in U.S. Patent 3,079,474 which issued Feb. 26, 1963 to E. F. Beach et al. and which is assigned to the same assignee as the present application. It is also to be understood that the teachings of the applicant's invention may be applied to other types of disconnecting switch structures which do not include a break jaw assembly of the reverse loop type but which include instead a pair of laterally spaced contact jaws which are either separately or inherently biased toward one another to grip the free end of an associated switch blade during a closing operation and which includes both arcuate travel of the switch blade and rotation about its own axis to establish adequate contact pressure between the switch blade and the break jaw assembly. Finally, it is to be understood that the enlarged ends of the threaded members 202 and 204 may be omitted in a particular application where it is not necessary or desirable to limit the maximum deflections of the associated break jaws as disclosed.

The apparatus embodying the teachings of this invention has several advantages. For example, in a disconnecting switch structure of the type described, the entrance of the blade contact portion at the free end of the switch blade between the break jaws of the associated break contact assembly is facilitated without reducing the final contact pressure that may be attained when the switch blade reaches a fully closed position to thereby reduce the mechanical wear of the relatively movable parts. In addition, the initial contact pressure between the switch blade and the associated break jaw assembly as disclosed may be determined by the selection of the axial dimension of the generally cylindrical portion of the spacer member as disclosed to permit the switch blade to engage an associated stop member before the switch blade is rotated and the blade contact portion at the free end of the switch blade engages the associated break jaws of the break contact jaw assembly. Finally, the disconnecting switch structure as disclosed may include means for limiting the maximum deflection of the break jaws of the break jaw contact assembly by providing means such as the enlarged ends of the threaded members 202 and 204 to thereby limit the maximum deflection of the break jaws during all closing operations which may result in relatively large mechanical forces from actuating the blade to a closed position in an abrupt manner such as during adverse weather conditions.

Since numerous changes may be made in the above described apparatus 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. An electric switch comprising relatively stationary contact means including a pair of spaced contact jaws formed from resilient conducting material and having substantially aligned openings extending therethrough, a switch blade movable in an arcuate path about an axis spaced from the contact means between a first position and a second position in which the free end of the blade is disposed between the contact jaws and rotatable about its own longitudinal axis in the latter position to engage and to resiliently deflect the contact jaws to thereby increase the space between the contact jaws, each of said contact jaws being of the reverse loop configuration and

having an inner free end which is laterally spaced from that of the other contact jaw to assist in retaining the switch blade in the second position when said blade and contact jaws are carrying relatively large currents, the free end of the blade being generally rectangular in cross-section, and a spacer member having an intermediate portion extending laterally between the contact jaws and opposite end portions extending through the openings in the respective contact jaws, the size of said intermediate portion being larger than the openings in said contact jaws at least adjacent to the contact jaws to define a pair of spaced shoulders against which the contact jaws bear to thereby establish a minimum spacing between the contact jaws into which the free end of the blade may freely move prior to the engagement of the contact jaws by the free end of the blade during rotation about its own axis, said minimum spacing between said contact jaws established by said intermediate portion prior to the engagement of said contact jaws by the free end of said switch blade being sufficient to cause each of the contact jaws to be in a stored energy condition.

2. The combination as claimed in claim 1 wherein an additional stationary contact means is disposed in spaced relation along a first axis which substantially coincides with the axis of the switch blade when the blade is in the second position to be engaged by the blade in the second position, a conducting stationary frame is disposed adjacent to the end of the blade away from the free end of the blade and has said additional contact means mounted thereon, a conducting hinge member is pivotally supported on the frame for rotation about a second axis which intersects the first axis at substantially a right angle, the adjacent end of the blade being disposed to pass through and being radially spaced from the hinge member, a connecting link is secured to the blade adjacent to the last-mentioned end and having a first portion rotatably supported between the blade and the hinge member and an arm projecting at an angle of substantially 45° with respect to the first axis, and a crank member is provided which is rotatable about a third axis which substantially intersects said first and second axes and which includes a bearing portion adapted to rotatably receive the arm of the connecting link.

3. The combination as claimed in claim 1 wherein a relatively stationary stop means is disposed in the path of movement of the switch blade adjacent to the contact jaws to limit the arcuate movement of the free end of the switch blade into its second position between the contact jaws.

4. The combination as claimed in claim 1 wherein the intermediate portion of the spacer is generally cylindrical in configuration and includes an axially extending threaded opening at each end thereof and each of the end portions comprises a bolt having an enlarged head at the outer end thereof with the other end being at least partially threaded to project into one end of the intermediate portion of the spacer member.

5. The combination as claimed in claim 1 wherein the end portions of the spacer member are relatively larger at the outer ends than the openings in the contact jaws to limit the maximum deflection of the contact jaws during the arcuate and rotational movement of the switch blade.

References Cited

UNITED STATES PATENTS

3,182,145 5/1965 Gorman.
3,366,753 1/1968 Upton.

ROBERT K. SCHAEFER, Primary Examiner
H. J. HOHAUSER, Assistant Examiner