EXPULSION-TYPE INTERRUPTER FOR HIGH VOLTAGE DISCONNECT SWITCH

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Filed Oct. 5, 1964

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Filed Oct. 5, 1964. Ser. No. 401,300

18 Claims. (Cl. 200—146)

This invention relates to improvements in high voltage electric switches and in interrupter devices for preventing open air arcs and preventing burning of the switch contacts when such switches are opened while under load.

High voltage switches in electric distribution systems are of many different forms and the selection of any particular form depends upon a large number of factors, including mounting limitations, environment or weather conditions, electrical load, cost, etc. It is desirable that an arc interrupter be adapted or easily modified for use with all forms of such switches, so that a variety of interrupters need not be stocked. The interrupter and mounting herein described is adaptable for use with a large variety of types of high voltage switches, and its mounting and use with four commonly used switches is described.

In using the interrupter of our invention it is necessary only to modify the hardware that is permanently installed on the switch to receive the interrupter. Such hardware is relatively inexpensive, and the novel mounting means upon the interrupter facilitates the removal and substitution of a new interrupter upon the hardware while the switch is either in the open or closed position and carrying current.

The interrupter itself may be assembled in several ways to adapt it for different mountings, such as right hand or left hand, etc., yet the identical interrupter parts are used.

It is accordingly one of the principal objects of the invention to provide an interrupter for high voltage switches wherein the interrupter is of simple and rugged construction and adapted to be mounted upon switches of various types.

It is another object of the invention to provide a novel mounting for an interrupter for high voltage switches which facilitates the removal and installation of interrupters from the ground by the use of hot line sticks while the high voltage switch is closed and energized, or open and de-energized.

Another important object of the invention is the provision of a novel and rugged arc interrupter for a high voltage switch wherein the contacts within the interrupter are selectively urged to fully closed or fully open position by a single spring which is fully loaded only momentarily during a contact opening or closing operation so that it does not take a permanent set and lose its strength as would be the case if continuously fully loaded.

Another object of the invention is the provision in the combination of a high voltage switch and an arc interrupter of novel means providing a continuous contact between the actuator arm on the moving switch contact and the operating lever on the interrupter that is driven thereby, so that there is no external arc between these parts when the operating lever is snapped to fully open position at the same time that the contacts within the interrupter are separated.

It is another important object of our invention to provide an improved spring drive mechanism for an interrupter wherein a drive lever for a toggle spring, a toggle spring and a lever driven by the spring are the only parts required to snap the contacts to fully open or fully closed position.

Another object of our invention is the provision in a high voltage switch of novel means for resiliently engaging the movable blades with the fixed contact.

Still another object is the provision in a high voltage switch of a resilient stop device to prevent the moving blades from over-running a fully closed position during a switch closing operation.

Other objects will become apparent as the description is read in connection with the claims and the attached drawings, wherein:

FIGURE 1 is a view in side elevation of one form of switch utilizing an embodiment of the invention;

FIGURE 2 is a view in end elevation of the switch of FIGURE 1;

FIGURE 3 is a top plan view of an interrupter showing one embodiment of the invention, with the hanger attached;

FIGURE 3A is a view of the hanger of FIGURE 3 as viewed from the right in FIGURE 3 and showing the interrupter support adapter in outline.

FIGURE 4 is a side elevation, partly in section to the left of line A—B and below the line B—C, of the interrupter of FIGURE 3;

FIGURE 4A is an enlarged view of a portion of FIGURE 4;

FIGURE 4B is a section along the line 4B—4B of FIGURE 4A, looking in the direction of the arrows;

FIGURE 4C is a section substantially along line 4C—4C of FIGURE 4A;

FIGURE 4D is a partial sectional view substantially along line 4D—4D of FIGURE 4C;

FIGURE 5 is a front elevation view of the drive lever within the interrupter shown in side elevation in FIGURE 4;

FIGURE 5A is a view in side elevation of the drive lever of FIGURE 5;

FIGURE 5B is a sectional view of the modified sphere portion of the drive lever of FIGURES 5 and 5A taken along the line 5B—5B of FIGURE 5A;

FIGURE 6 is a view in front elevation of the toggle lever within the interrupter shown in side elevation in FIGURE 4;

FIGURE 6A is a view in side elevation of the toggle lever of FIGURE 6;

FIGURE 7 is a top view of an actuator arm with a spring contact attached;

FIGURE 8 is a top view of an actuator arm with another form of spring contacts attached and a modified form of operating lever;

FIGURE 8A is a top plan view of the actuator arm, spring contacts on operating lever shown in FIGURE 8;

FIGURE 9 is a view in side elevation of a modified form of operating lever which includes a leaf spring for engagement by the actuator arm;

FIGURE 10 is a top plan view of the actuator arm and operating lever of FIGURE 9, and of a portion of the interrupter body;

FIGURE 11 is a view in side elevation of a second form of switch utilizing an embodiment of the invention;

FIGURE 12 is a view in end elevation of the switch of FIGURE 11;

FIGURE 13 is a view in side elevation of a third form of switch utilizing an embodiment of the invention;

FIGURE 14 is a top plan view of a portion of the switch of FIGURE 13;

FIGURE 15 is a view in side elevation of a fourth form of switch utilizing an embodiment of the invention;

FIGURE 16 is a top view of the switch of FIGURE 15;

FIGURES 17 and 18 are enlarged views of portions of FIGURES 15 and 16, showing details adjacent the fixed contact, omitting the interrupter; and

FIGURE 19 is a diagram showing sequential positions of relatively movable portions of the switch of FIGURES 15 and 16 during a switch closing operation, as viewed from the top.
With continued reference to the drawings, wherein like reference numerals are used to indicate the same parts and with particular reference to the embodiment shown in FIGURES 1 and 2, numeral 20 indicates generally a hook stick operated disconnect switch of the type and similar to that shown in FIGURES 1-7 of Gilliland Patent No. 2,803,726, to which reference may be made for specific details of construction, since those details are not important to an understanding of the present invention.

The switch of FIGURES 1 and 2 comprises a pair of vertically spaced insulated stacks 21 and 22 conventionally arranged to form a two sided contact that extends between the spaced upper 27 and 28 and which moveable blade of the switch. The lower ends of the blades 27 and 28 are hinged for rotation by a hinge bolt 31 carried by a pair of spaced legs 32 on the clamp brackets 24 forming the lower portion 36 of terminal contact 25. About mid-point of their length a U-shaped copper bar 33 rigidly secures the blades 27 and 28 together.

The upper terminal contact 34 having bolt holes 38 for connecting the line terminal is clamped to the outer end of the insulator stack 22 by a clamping bracket 35 (FIGURE 2) which carries a latch element not shown but similar to that of FIGURES 1-7 of the aforesaid Gilliland Patent No. 2,803,726. Also, similarly pivoted to the upper end of the movable switch blade by a headed bolt 36 (FIGURE 2) is a hook stick operating ring member 37 adapted to be engaged by a hook stick to first disengage the aforesaid latch member and then to open the switch by pulling the switch blades clockwise as viewed in FIGURE 1 to a substantially horizontal position.

The lower end of the upper contact terminal element 34 is bent outwardly to the right as viewed in FIGURE 1 to form a two sided contact portion 40 which is frictionally engaged between blades 27 and 28 when the switch is closed. A bolt 41 extending through the blades 27 and 28 has compression springs 42 on the outside of the blades to urge them toward each other. A sleeve 43 on the bolt and between the blades 27 and 28 limits the movement of the blades toward each other. The hinge bolt 31 and the headed bolt 36 which carries the operating ring member 37 each have spring cup washers 44 on the outer sides of the blades 27 and 28 to bias the blades toward each other.

The above general description of the hook stick operated disconnect switch of FIGURES 1 and 2 is sufficient for an understanding of the addition to such a switch of the novel expulsion-type are interrupter unit now to be described.

The expulsion-type arc interrupter is indicated generally at 47 in FIGURES 1 and 2 and in enlarged detail in FIGURES 3, 4 and 4A. The interrupter is designed for replacement while the disconnect switch 20 is closed, by use of hot line sticks.

Four pieces of hardware however, are permanently installed, and are not disturbed when an interrupter is being replaced. The first of these is a right angle bracket having one leg 48 clamped between the upper terminal contact 25 and the outer end of the insulator stack 22 by the clamping bracket 35. The other leg 49 is at right angles to leg 48 and extends away from the insulator stack 22. Secured to the leg 49 by a pair of bolts 52 (FIGURES 3 and 3A) threaded into its base 53 is a hanger indicated generally by 54, which is the second of the permanently installed pieces. The hanger 54 has a pair of spaced legs 55 and 56 having respective legs 57 and 58 respectively which receive diametrically opposite pins 61 and 62 protruding from a support adapter 63 on the interrupter 47. The spaced legs 55 and 56 are connected by an integral web 64 which has a threaded bore to receive a bolt 65. Integral with the support adapter 63 is a protruding mounting lug 66 which is bifurcated at its outer end to form a slot 69 so that it can be slipped over the bolt 65 with the single cut bracket 48 in place, and at the same time seating the pins 61 and 62 in the recesses 57 and 58. Tightening of the bolt 65 clamps the lug 66 against the web 64 and rigidly secures the interrupter 47 in place. Removal of the interrupter is by loosening the bolt 65 until the pins 61 and 62 and the bifurcated lug 66 can be disengaged from the hanger 54. As will be explained later, removal or installation of the interrupter assembly 47 from the permanent, installed hanger may be easily accomplished from the ground while the switch is closed by using a pair of hot line sticks.

The third permanently installed item is an interrupter actuator arm 67 (FIGURES 1, 2 and 7) which is secured to the outer side of blade 27 of the switch by four bolts 68 which are threaded into the fixed end of the actuator arm 67 and pass through aligned holes in a clamping plate 72 on the other side of the blade 27.

The fourth permanently installed item is an auxiliary shunting contact 73 secured in place as by bolt 74 to the leg 48 of the angle bracket. The auxiliary shunting contact 73 has sliding frictional engagement with the actuator arm 67 while switch 20 is being opened, maintaining the circuit closed after the switch blades 27 and 28 disengage from the two sided contact portion 40 of the fixed contact and disengaging from contact with the actuator arm 67 just before the interrupter 47 opens to completely open the circuit. Where an arcing horn similar to contact 73 is normally used, it will have to be replaced by an auxiliary shunting contact 73 which will be in position to engage the actuator arm 67. The outer end of actuator arm 67 has affixed to it a spring contact 75 for a purpose to be described.

Referring now to the expulsion-type arc interrupter itself, the details thereof are shown in FIGURES 3 through 6.

Referring particularly to FIGURES 3, 4 and 4A a metallic housing 77 has a protruding cylindrical hollow boss 78 in coaxial alignment with the cylindrical hollow metallic support adapter 63 and a metallic muffler 79 having a central bore at one end, the other end being solid except for a series of gas and heat vent openings 82. Boss 78 and support adapter 63 are rigidly connected by a first hollow cylinder comprising a central tube 83 of a dielectric material having extinguishing characteristics, such as acrylic resin, and an outer cylinder 84 of glass fiber reinforced epoxy resin. The outer cylinder 84 may be formed by using the central tube 83 as a mandrel and wrapping epoxy resin impregnated fiberglass cloth around it until the desired thickness is reached, so that the ends of the outer cylinder will have snug fits in the boss 78 and the support adapter 63. Internal shoulders 85 and 86 in boss 78 and adapter 63 respectively, abut the ends of the outer cylinder 84. The outer end portions of the end of the cylinder are coated with an epoxy cement before the cylinder ends are inserted into the boss 78 and adapter 63.

Adjacent the shoulders 85 and 86 the boss 78 and adapter 63 have annular grooves 87 and 88 respectively. DIametrically opposite tapped holes 89 of boss 78 and adapter 63 permit the force feeding of epoxy cement into the annular grooves 87 and 88 until the grooves are full after which set screws 91 and 92 are inserted into the tapped holes in the boss 78 and similar set screws 93 and 94 are inserted into the tapped holes in adapter 63. All of these set screws are screwed up snugly against the outer cylinder 84 and serve to hold
the parts in alignment while the epoxy cement is curing or hardening. By means of this construction the support adapter 63 may be placed in any angular position with respect to the housing 77 although normally it is placed only in any one of four positions, 90 degrees apart. This adapter supports various installations while using the same components. For example, as viewed in FIGURE 2 the interrupter 47 could be mounted on the opposite side of the switch 20. In FIGURE 4A the adapter is in a position rotated 90 degrees from its position in FIGURE 4 although the set screws 93 and 94 are shown in the same positions as in FIGURE 4 for a clearer showing.

A second hollow cylinder having a central tube 95 and outer cylinder 96 is similar in all respects to the tube 83 and cylinder 84 except that it is shorter. One end of outer cylinder 96 is seated within the other end of adapter 63 and against an internal shoulder 97 therein and the other end is seated within the bore of and against an internal shoulder 98 therein all as described above in connection with the first hollow cylinder.

A stationary contact 108 is mounted within the adapter 63 just to the left of the end of the dielectric central tube 95. A similar stationary contact 109 is mounted in a similar manner within the housing boss 78 just to the left of the end of the first dielectric tube 83. The stationary contact is composed of three equiangularly spaced contact tips 108A (FIGURES 4B to 4D) which are brazed onto legs 110 integral with a cylinder 110a which is seated against the internal shoulder 86 of the adapter 63 and within three equiangularly spaced longitudinal ribs 111 in the adapter that extend radially inwardly. These ribs extend to the right of the internal shoulder 86 as viewed in FIGURE 4D, and are about as long as the cylinder 110a carrying the legs 110. The contact assembly is retained in this position by three screws 120 threaded into the ends of ribs 111 so that their heads engage the edge of the cylinder 110a. Only one of the three screws 120 is shown in FIGURES 4C and 4D. The fixed contact 109 is similar in all respects to contact 108 and is seated and secured in the same manner in the housing boss 78.

An elongated metallic stud 112 extends centrally and axially within the first central tube 83 and is threaded into the right-hand end of a coaxial dielectric rod or follower 113 which extends from within boss 78 to the left end of housing 77. The threads are coated with epoxy cement before assembly. Mounted upon the stud 112 adjacent the right-hand end of follower 113 is a first hollow cylindrical moving contact 114. At the right end of the stud 112 is a second and similar moving contact 115. The two moving contacts are separated by a hollow cylindrical dielectric tube 116 of arc extinguishing material such as acrylic. The contacts are slightly larger in diameter than the tube 116 and their corner edges are rounded. Between the ends of tube 116 and the adjacent moving contacts 114 and 115 are fiber washers 117 (FIGURE 4A), which act as cushions between the hard metal of the moving contacts and the somewhat brittle acrylic tube 116. The right-hand end of study 112 may be peened over the contact 115 to secure the assembly, or a nut may be threaded over the right end of the stud. The stud 112 with the moving contacts is axially shiftable from its left-most position shown in FIGURE 4 and 4A to a right-most position, indicated by the dot-dash outline at 114A of FIGURE 4 by mechanism to be described. When contact 114 is at position 114A contact 115 is within follower 79. When in the left-most position shown, the moving contact 114 is in engagement with stationary contact 109 and the second moving contact 115 engages stationary contact 108. In this position current may flow from adapter 63, stationary contact 108, moving contact 115, stud 112, moving contact 114, stationary contact 109 and boss 78 to the metallic housing 77.

The housing 77 establishes the selector toggle spring mechanism for snapping the stud 112 and associated moving contacts quickly to the right to quickly and simultaneously disengage both moving contacts 114 and 115 from their associated fixed contacts. The same toggle spring mechanism also snaps the stud 112 to the left to engage the contacts, as will be described.

Referring to FIGURES 3 and 4, the housing 77 has a removable metal cover 118 secured to the housing by four screws 119 and the top of the housing and the bottom of the cover meet in a common plane indicated at 122 in FIGURE 4. A shaft 123 is journaled for rotation in the cover 118. One end of shaft 123 protrudes from a boss 124 on the cover and has affixed to it by a pin 125 (FIGURE 3), passing through a boss 125a thereon a triangular shaped operating lever 126 which has spaced studs 127 and 128 projecting laterally from it at the ends of leg 130 which is opposite the shaft 123. A spring washer 131 on the shaft 123 between the boss 124 on the housing cover 118 and the boss 125a on the lever 126 assures good electrical contact therebetween.

Mounted upon the shaft 123 within the cover 118 and affixed to it as by a pin 129 is a toggle spring drive lever 133 which is shown in better detail in FIGURES 5, 5A and 5B. The drive lever 132 has a hollow cylindrical portion 133 which fits over the shaft 123 and has a diametrical hole 134 for the pin 129. Extending from the cylindrical portion 133 are a pair of spaced legs 135 and 136 which are connected to a modified sphere 137 having four equiangularly spaced spherical portions 138 separated by four grooves 139. The inner walls of the housing 77 just below the plane 122 provide stops which engage the outer free swinging end of the drive lever 132 at the modified sphere 137 to limit its clockwise counterclockwise movement. Protruding from diametrically opposite spherical surfaces 138 and parallel to the hollow cylindrical portion 133 are a pair of rounded spring seats 142 upon which are seated the upper end of a toggle spring 143 (FIGURE 4).

A toggle spring driven lever 144 shown in FIGURES 4, 6 and 6A has a pair of spaced legs 145 which have inwardly facing short bearing surfaces 146 on their inner ends. These bearing surfaces 146 are rotatably journaled in split bearing journals in outwardly protruding bosses formed half in the housing 77 and half in the cover 118 at the plane 122 between the top of the housing 77 and the bottom of the cover 118, these bosses being best seen in FIGURES 2 and 10.

The toggle spring 143 has its lower end located by a prong 148 projecting upwardly centrally of a connecting web 149, and seated in seats 150 at the ends of prong 148. At its lower end a pair of spaced legs 153 extend downwardly from the connecting web 149. Each leg has a slot 154 therethrough and a pin 155 (FIGURE 4) passes through these slots and through the left end portion of the dielectric rod or follower 113.

When the toggle spring driven lever 144 is in its left-most position, as shown in solid lines in FIGURE 4, a pair of spaced protrusions 156 on legs 153 engage the inner wall of housing 77 which forms a stop to limit the movement of the toggle lever to the left, and thereby define the leftmost position of the follower 113, at which position the moving contacts 114 and 115 are in full contact with the stationary contacts 109 and 108. When in the rightmost position, indicated by the dot-dash lines of FIGURE 4 a pair of spaced protrusions 157 on the other sides of the legs 153 engage the opposite wall of the housing to stop the movement of the rod 113 to
the right. Moving contact 114 will then be in the position indicated at 114A in dot dash lines. The position of the center line of toggle spring 143 will be at this time as indicated by the reference numeral 143A.

When the toggle spring drive lever 132 is in the rightmost position of FIGURE 4 the toggle spring 143 is slightly misadjusted and the toggle spring driven lever 144 urged firmly to the left, into engagement with the inner left wall of housing 77, as is apparent. When the triangular shaped operating lever 126 is rotated clockwise by means to be described the toggle spring drive lever 132 will be rotated in the same direction. This will further compress the toggle spring 143 until maximum compression is reached as the spring 143 and the legs 135−136 on the toggle spring drive lever 132 reach a parallel alignment. Continued clockwise movement of operating lever 126 and toggle spring drive lever 132 results in the toggle spring applying a counterclockwise force to the toggle spring driven lever 144 which is thereupon snapped to its rightmost position by the release of energy in the toggle spring instantly shifting the moving contacts to their fully open position. The position of the operating lever 126 when the contacts within the interrupter are fully separated is indicated at 126A in FIGURE 4. Counterclockwise rotation of drive lever 132 from its dot-dash position of FIGURE 4 results in a snap action movement of the parts in the opposite direction in a similar manner, back to the positions shown in solid lines in FIGURE 4.

The expulsion type arc interrupter is actuated in the following manner when the hook stick operated disconnect switch 20 is opened. With the switch 20 fully closed there is no current flow through the interrupter 47 even though the movable and fixed contacts are engaged, because although the adapter 63 is connected to the line near the upper switch terminal contact 34 the operating lever 126 has no connection or engagement with the actuator arm 67. The main current flow is from the two side fixed contact 40 of the switch 20 to the two movable switch blades 27 and 28. A smaller current flow occurs from the auxiliary shunting contact 73 to the actuator arm 67 up to the switch blade 27.

As the switch 20 is opened the switch blades 27 and 28 will disengage from the fixed contact 40 but current will continue to flow through the still engaging auxiliary shunting contact 73 and actuator arm 67. With continued opening movement of the switch 20 the actuator arm 67 will reach a position 67A (FIGURE 1) where it will engage stud 128 on operating lever 126. Prior to reaching the position 67A the spring contact 75 on the actuator arm 67 will have a wiping electrical contact with the leg 130 of the lever 126. This will permit current flow through the interrupter 47 via its support adapter 63, fixed contact 108, movable contact 115, stud 112, movable contact 114, fixed contact 109, boss 78, housing 77, shaft 123, lever 126, contact 75 and actuator arm 67. Thus at this time the actuator arm 67 is receiving current both from the interrupter 47 and the auxiliary shunting contact 73.

Continued opening movement of the switch 20 beyond the 67A position of the arm 67 in FIGURE 1 results in clockwise movement of toggle spring drive lever 132 as viewed in FIGURE 4 as arm 67 drives stud 128 to rotate lever 126 counterclockwise in FIGURE 4. Before this drive lever 132 and the toggle spring 143 become parallel, the actuator arm 67 is disengaged from the shunting contact 73, and the only current flowing is that passing through the interrupter to the arm 67. Continued rotation of the operating lever 126 by the actuator arm 67 moves the centerline of toggle spring 143 to the left of toggle spring driven lever 144 and the lever 144 is snapped to the right to simultaneously separate both sets of movable and fixed contacts within the arc extinguishing cylinders 84 and 96 of the interrupter, as previously described.

The arcs resulting from the separation of the movable and fixed contacts occur within the central tubes 83 and 95 of dielectric material having arc extinguishing properties as previously described, and the pressure of the gases therein is relieved through the vent openings 82 in the muller 79.

At the same time that the toggle spring 143 snaps the interrupter to open position it snaps the operating lever 126 away from driving engagement by the actuator arm 67 and the lever 126 stops in the position indicated by dot-dash lines in FIGURES 1 and 4 at 126A by reason of engagement of the protrusions 157 on lever 144 with the inner wall of housing 77. The lever 126 then stops, and the leg 130 of lever 126 after the toggle spring 143 has snapped the stud 128 away from driving engagement by actuator arm 67 and until after the contacts in the interrupter have separated. Otherwise an external arc would occur between stud 128 and actuator arm 67 at the same time as indicated in FIGURE 4, and in series arcs extinguished within the interrupter. In FIGURE 1 an arcuate dotted line 158 shows the path of the outer end of the actuator arm 67 during the opening movement of the blades of switch 20.

In closing the switch 20 the actuator arm 67 will engage against the other stud 127 on operating lever 126, stud 127 now being at the position shown at 127A in FIGURE 1. Continued closing of the switch results in clockwise rotation of operating lever 126. Actuator arm 67 engages with the auxiliary shunting contact 73 before the contacts within the interrupter are snapped to closed position so that the inrush currents do not flow through the interrupter. When the switch 20 is fully closed the arm 67 is disengaged from lever 126 and no current flows through the interrupter. As will be understood, the length of the auxiliary shunting contact 73 is such as to obtain correct opening and closing sequence.

A second form of spring contact to maintain electrical contact between actuator arm 67 and the triangular shaped operating lever 126 is shown in FIGURES 8 and 9A. Here the outer leg 130 having studs 128 and 129 is replaced by a rectangular leg having two long sides 159 and 160 connected by ends 163 and 164. A pair of spring contacts 163 and 166 secured to opposite sides of actuator arm 67 engages the inner walls of the long sides 159 and 160 and respectively of the lever 126. The ends 163 and 164 take the place of studs 127 and 128 of the embodiment of FIGURES 1 to 4, and as is the case with the spring contact 75 of those figures, the spring contacts 163 and 166 are not as wide as the arm 167, as best seen in FIGURE 8A so that it is only the driving engagement against ends 163 and 164 while the contacts have only a wiping electrical contact with the inner walls of the sides 159 and 160.

FIGURES 9 and 10 illustrate another form of operating lever which is driven by the actuator arm 67, pivoted about the hinge bolt 31 of the frame 32. In the operating lever 167 has a pair of legs 168 and 169 diverging from a split collar 170 which clamps a flat spring contact 173 in position between the legs 168 and 169 by means of bolt 174 and nut 175. The actuator arm 67 has a pin 176 projecting toward and beyond the plane of the spaced legs 168 and 169 for engagement with the spring contact 173 which, as shown in FIGURE 10, is wider than the legs 168 and 169. As is the previously described embodiments the operating lever 167 is secured for rotation with shaft 123 on the interrupter by a pin 125.

In FIGURES 9 and 10 the interrupter is opened by counterclockwise rotation of the operating lever 167, and the actuator arm 67 is driven to the left position shown at the bottom of FIGURE 9 in the position it is when the disconnect switch to which it is attached is closed. During opening movement of the main switch the actuator arm 67 moves clockwise with it. When the pin 176 reaches the position 176A.
it engages the flat spring contact 173 before disengaging from the auxiliary shunting contact 73. When this happens, current will commence to flow through the interrupter to the actuating arm 67, which has already been receiving current from the auxiliary shunting contact 73.

Continued movement of arm 67 deflects the flat spring contact 173 toward the leg 169 and when the pin 176 reaches the position indicated in FIGURE 16B the spring contact is in the position 173B, against the spring 172. Further movement of pin 176 results in counterclockwise rotation of the operating lever 167 and the starting of the deflection of the toggle spring 143 within the interrupter housing 77. When the pin 176 has reached the position 176C and the leg 169 is in position 169C the centerline of the toggle spring 143 is in parallel alignment with the toggle spring drive lever 132. Actuator arm 67 has disengaged from the auxiliary shunting contact 73 before this time the current flow is solely from the interrupter to the arm 67. When the pin and leg reach their approximate positions shown at 176D and 169D respectively the toggle spring snaps the toggle spring driven lever 144 within the interrupter housing 77 to snap the movable contacts 114 and 115 to open position. The toggle spring simultaneously shifts the operating lever 167 to the end of its stroke where the legs thereof come to rest at the positions 168E and 169E. Spring contact 173 continues engagement with pin 176 and contact 114 in an external arc and is the contacts when the interrupter and the functioning lever separate, and until the pin reaches the position 176E and the spring contact reaches the position 173E after which continued movement of the pin 176 releases the spring contact and it resumes its normal at rest position at 173F midway between the operating lever legs.

During the closing of the main disconnect switch, and with the actuating arm 67 moving clockwise in FIGURE 9, pin 176 will engage the spring contact 173 at its position 173F and bend it downwardly until it engages the leg 168 at its position 168E, after which continued movement of pin 176 compresses the toggle spring 143 until it snaps the movable contacts within the interrupter into engagement with the stationary contacts. As is the case with the previously described embodiments the actuating arm 67 will engage the auxiliary shunting contact 73 before the interrupter is closed, so that the surge of inrush current is shunted through the contact 73 and then through the interrupter.

Referring to FIGURE 4, the muffer 79 includes a coaxial threaded stud 177 for connection to a cooperating threaded element on a hot line side. This permits the handling of the interrupter unit from the ground or from any safe and convenient working position on the structure upon which the main disconnect switch is mounted, and while such switch is closed or energized, providing the four previously described pieces of hardware have been permanently installed. To remove the interrupter from the main switch the hot line side is threaded and rigidly connected to the stud 177. One person may hold this hot line stick while another, using another hot line stick with a suitable wrench attached, loosens the bolt 65 until the bifurcated mounting lug 66 can be slipped out from under the bolt head and the pins 61 and 62 slipped out of the recesses 57 and 58 in which they are seated. A replacement interrupter may now be installed by using the same hot line sticks. A similar threaded stud 178 is provided at the other end of the interrupter, being formed on a cap 179 that is threaded into the wall of housing 77 coaxial with the first threaded stud 177, and the hot line side is threadedly engaged with stud 177 or 178 depending on the position in which the interrupter is placed in the housing and the relative convenience of using one stud or the other.

The interrupter unit may be used upon all types of high voltage disconnect switches and whether they are horizontally or vertically mounted. For example when used with the hook stick operated switch of FIGURES 1 and 2 the interrupter is horizontal and when used with the twist blade switch of FIGURES 11 and 12 the interrupter is vertical. As previously mentioned the support adapter 63 may be placed in any of four positions 90 degrees apart. If the interrupter were placed on the other side of the switch 20 of FIGURE 1 the support adapter 63 would be 180 degrees from the position of FIGURE 1. Also the position of the housing cover 118 and the shaft 123 would be reversed so that the operating lever 126 would be on the opposite side of the housing 77, and the operating lever would be repositioned on the shaft 123. Thus the interrupter may be used in a variety of installations merely by changing the positions of various components of the interrupter. This results in reduced costs in the manufacture of the interrupter for different types of installations.

FIGURES 11 and 12 show the interrupter 47 applied to a vertical break twist blade switch of the general type shown in U.S. Patent 2,688,666 to which reference may be made for specific details of construction. In the switch of FIGURES 11 and 12 a fixed insulator stack 184 is mounted upon a supporting frame 23 and carries fixed spaced contacts 185 and 186 engageable with a flattened extension 187 on the end of switch blade 188 which is mounted for rotation about its axis in bracket 189. Pivot pin 193 supports the bracket and switch blade 188 for rotation in a vertical plane. When the switch is fully open the blade is at the dot-dash line position shown at 188a in FIGURE 11. Pin 193 is carried by a bracket 194 fixed to the top of a fixed insulator stack 195 mounted on the supporting frame 23. A rotatable insulator stack 196 is also mounted on the frame 23, journaled for rotation in a lower bearing 197 and an upper bearing 198 in a conductor arm 199 connecting the tops of the insulator stacks 196 and 195. The insulator stack 196 is rotated by means of an operating arm 199 to turn a crank 203.

FIGURES 11 and 12 show the switch in its closed position with the switch blade 188 horizontal and its flattened extension 187 also horizontal and spreading the contacts 185 and 186 apart to secure a good electrical contact. Terminals 204 on fixed insulator stack 184 are on the left end of the conductor arm 199 and receive the line terminals, not shown. A fixed auxiliary shunting contact 206 on the terminal 204 cooperates with a movable auxiliary shunting contact 207 carried by the switch blade 188. To open the switch the operating arm 199 is turned, moving crank arm 203 to pull upon a linkage 208 which is connected at one end to operate an assembly indicated generally by 209. Initial movement of linkage 208 rotates the switch blade 188 clockwise as viewed in FIGURE 12, through an angle of 90 degrees, whereupon the flattened portion 187 is parallel to the planes of the fixed contacts 185 and 186. The contacts 185 and 186 are now disengaged from 187 and the switch is open except for the current flowing through auxiliary shunting contacts 206 and 207. This movement also rotates an actuator arm 213 from a vertical position to the horizontal position indicated by dot-dash lines at 213a. Continued movement of the linkage 208 results in the raising of switch blade 188 to the fully open position 188b by movement about pivot pin 193.

Affixed to the top of the insulator stack 184 is an angle bracket 214 to which is secured by a pair of bolts 52 a hanger 54 similar in all respects to the one shown in FIGURES 1 to 3A and securing by a bolt 65 an interrupter 47 also similar in all respects to the one previously described.

During the movement of the switch blade 188 from horizontal to fully open vertical position a leg 212 on the outer end of the actuator arm 213 moves in a vertical plane and its outer end follows a circular path indicated by the dotted line in FIGURE 12, during which time it engages stud 128 on the operating lever 126 and moves...
the lever 126 to snap the interrupter to open circuit position after the two auxiliary shunting contacts 206 and 207 have disengaged, as described in connection with the hinged switch shown in FIGURES 1 and 2. Although it is not shown in FIGURES 11 and 12 the leg 212 of the actuator arm 213 has a spring on it similar to the spring 75 of FIGURES 1, 2 and 7 for engagement with the leg 130 of operating lever 126 while the interrupter 47 is snapping to open or closed position, as previously described. Alternatively the devices of FIGURES 8 and 8A or of FIGURES 9 and 10 can be used. In closing the switch of FIGURES 11 and 12 the leg 212 of actuator arm 213 snaps the interrupter 47 to closed position after the auxiliary shunting contacts 206 and 207 are engaged and before the switch blade reaches a horizontal position and starts to rotate to engage the flattened extension 187 thereon with the fixed spaced contacts 185 and 186.

In the case of the switch of FIGURES 11 and 12 the interrupter is quite easily replaced from the ground while the switch is closed, since the threaded stud 177 on the interrupter and the head of the bolt 65 are both vertical and face downwards for easy access with hot line sticks. FIGURES 13 and 14 show the interrupter 47 applied to a rocker switch of the general type shown in U.S. Patent No. 2,593,436 to which reference may be made for specific details of construction. In this type of switch the supporting frame 23 may be vertical, or horizontal as shown in FIGURE 13. A movable switch insulator unit 217 is mounted for a rocking pivotal movement about a pivot pin 218 carried by a bracket 219 secured to the frame 23. The switch insulator unit 217 includes a supporting member 222 having a clamping jaw 223 tightened by a nut and bolt 224 to clamp a rectangular operating bar, not shown, which is turned to rock the movable switch insulator unit 217 from switch closed to switch open position. Secured to the top of unit 217 is a conducting member 225 which carries the movable switch blade 226 and an actuator arm 227 for the interrupter 47. In the closed position of FIGURES 13 and 14 the switch blade 226 is in engagement with a pair of resiliently yieldable fixed contacts 228 carried by a conducting member 229 secured to the top of a fixed insulator stack 232. A terminal 233 for securing the line terminal is also carried by the conducting member 229.

To the top of the other fixed insulator stack 234 is secured a conducting member 235 including a terminal 236 for the terminal and for connecting one end of a flexible conductor 237, the other end of which is connected to the movable switch blade 226. Counterbalancing pairs of links 238 and 239 are pivotally connected at their adjoining ends and at their other ends are pivotally connected to the conducting members 225 and 235 respectively. The links 238 and 239 are provided with suitable means for supporting the flexible conductor 237. When the movable switch insulator unit 217 is rotated clockwise as viewed in FIGURE 13 to full open position the movable blade 226 comes to rest in the position indicated by dot-dash lines 226.

An angular member having a horizontal leg 242 and a vertical leg 243 has its horizontal leg 242 secured beneath the conducting member 229. A hanger 54 similar to that previously described is secured in the same manner to the vertical leg 243 of the angle member by a pair of bolts 52 and the support and the support and the entire interrupter unit 47 is secured to the hanger 54 by a bolt 65 in the manner previously described.

The interrupter is actuated by the actuator arm 227 during opening and closing movements of the switch in the same manner as described in the previous embodiments, a fixed auxiliary shunting contact 200 shown in FIGURES 1 and 4 on the horizontal leg 242 of the angle member being in engagement with the moving actuator arm 227 after the main switch is open to keep the circuit closed until disengagement of the auxiliary shunting contact occurs just before the contacts within the interrupter snap to open position. Any of the three spring devices, not shown in FIGURES 13 and 14, but previously described, may be used to maintain the thread stud 177 on the leg 130 of the operating lever 126 until after the contacts in the interrupter have opened.

When the supporting frame 23 is horizontal and as in FIGURE 13 the securing bolt 65 and threaded stud 177 both face downwardly for easy access with hot line sticks. If the frame 23 is vertical, either threaded boss 177 on 178 can be used for holding the interrupter while it is being installed or removed.

FIGURES 15 to 19 illustrate the application of the interrupter 47 to a side break switch. The supporting frame 23 is horizontal and has affixed to it a stationary insulator stack 248 carrying at its upper end a support 249 for a member 247 forming an integral two sided fixed switch contact 250 (FIGURES 15 and 17) and a line terminal contact 251. A second insulator stack 252 is mounted for rotation about its vertical axis in a bearing assembly 253 carried by the frame 23. The rotatable insulator stack 252 has a stationary contact 229, as viewed in FIGURE 16 through an angle of approximately 90 degrees by means of a switch opening lever 254, the counter-clockwise or switch opening movement of which is limited by an adjustable fixed stop 255. The stop for limiting the clockwise movement for switch closing operation will be described later.

Affixed to the top of and rotatable with the stack 252 is a switch blade carrier 256 which extends about half way to the fixed switch contact 250 and is held up by supports bolt 257 a pair of switch blades 259 and 260 which engage the opposite edges of the fixed contact 250 when the switch is closed. Springs 262 and 263 assure good frictional and electrical contact between blades 259 and 260 and the carrier 256 at the hinge point 257, and springs 265 and 266 carried by a bolt 267 passing through the switch blades 259 and 260 assure good frictional and electrical contact between these blades and fixed contact 250. A plate 265a is loosely mounted on the bolt 267 between spring 265 and blade 259 and a similar plate 266a is similarly mounted between spring 266 and blade 260. As shown best in FIGURE 17 the right ends of the plates 265a and 266a are not in engagement with their respective switch blades but are spaced slightly outwardly away from them. This is by reason of a pin 270 which passes loosely through both switch blades and a fixed member 270a between the switch blades and also carries a support or seat 270b for a toggle spring 279, to be described. The pin 270 has spaced shoulders 280 which protrude through the switch blades for a distance sufficient to push the right hand ends of plates 265a and 266a away from the switch blades. Beyond the shoulders 280 the pin has reduced end portions which fit loosely in holes in the right ends of plates 265a. The effect of construction is that the left ends of the plates apply substantially all the force of the springs 265 and 266 to the portions of the switch blades 259 and 260 more closely to the point of engagement where they engage the stationary contact 229, as views from the force applied by the springs is localized where it is most effective, rather than in the zone surrounding the bolt 267.

A semi-cylindrical cap 264 is secured to the top of the switch blade carrier 256 as by screws 268 and 269 carrying a vertical side 63 which carries the entire interrupter unit 47 for attaching to a line terminal is journaled upon stud 269 so that it will remain substantially stationary during rotation of the switch blade carrier 256. Also mounted upon stud 269 are a pair of copper bars 273 which are electrically connected to cap 264 as by screws 274. One of the bus contact 224 is mounted on bracket 272 and the other to the bottom to make electrical connection therewith. A cap 275 suitably affixed to the top of stud 269 has an internal compression spring, not shown, that presses downwardly upon the upper copper bar 273 to compress the
bars 273 and bracket 272 against the top of a hollow cylindrical boss 276 integral with the semi-cylindrical cap 272 to assure good electrical contact.

At its outer end the switch blade carrier includes a fixed stop member 277 and an adjustable stop member 278 that limit the rotation of the switch blades 259 and 260 with respect to the switch blade carrier 256 about the switch blade bolt 257.

The operation of the switch during an opening sequence is as follows. Initial counterclockwise movement (FIGURE 16) of the switch blade carrier 256 results in a pivotal movement between itself and the switch blades 259 and 260 by reason of the hinged connection at 257 and the frictional engagement of the hanger as in FIGURE 16, the fixed contact 250. Thus the right ends of the switch blades move downward and to the right as viewed in FIGURE 16, and their left ends move mostly to the right, with a simultaneous slight clockwise twisting about the fixed contact 250. This continues until the toggle spring 279 passes its dead center position and snaps the blades 259 and 260 clockwise to engage the aforesaid adjustable stop 278 on carrier 256. From this point on the switch blades 259 and 260 are carried along by the stop 278 until the switch blade carrier 256 has rotated substantially 90 degrees, the hingepoint 257 has reached the position shown at 279a in FIGURE 16, and the switch blades have reached the position shown at 260a. Also, the switch opening lever below the stack 252 has engaged the stop 255. The toggle spring 279 is mounted between the switch blades 259 and 260 so as to resiliently maintain the switch blades and carrier 256 in the broken or non-aligned positions shown in dot-dash lines in FIGURE 16 or in the aligned positions shown in the same figure when the switch is closed. During switch opening movement this toggle action of spring 279 is overcome by the frictional resistance between the fixed contacts and blades 259 and 260, and by the time the toggled spring has passed its dead center position.

During a switch closing sequence the toggle spring maintains the broken or non-aligned positions of the switch blades and carrier 256 as shown in FIGURE 17 until after the switch blades have engaged the fixed contact 250 whereupon the friction between the blades 259 and 260 and the fixed contact resists movement of the blades as the carrier 256 continues its movement and the toggle action of spring 279 is overcome. The switch blades become aligned with carrier 256 when the blades engage stop member 277 on the carrier. Continued clockwise rotation of the switch blades 259 and 260 by the resiliently held position of FIGURE 16 is prevented by a resilient switch stop 282 mounted on a pivot pin 283 carried by the member 247 forming the integral fixed contact 250 and line terminal contact 251. The outer end of the stop 282 is enlarged to form a hollow cylinder 284 which houses a compression spring 285 (FIGURE 18 only) bearing against a seat 286 on the side of the member forming the integral fixed contact 250 and line terminal contact 251. Stop 282 is therefore resilient, the shock of stopping the moving switch blades being absorbed by the compression spring 285 in cylinder 284. The switch must be closed with a rapid movement so that the switch blades 259 and 260 will fully engage the opposite sides of the fixed contact 250 rather than only partially engage them, and the resilient stop 282 prevents the blades from overrunning the fully closed position as well as absorbing the shock of stopping them.

FIGURES 15 and 16 show an interrupter 47 mounted for cooperation with the side break switch described above. An angle member having a vertical leg 289 has a horizontal leg 290 secured by bolts 291 to the member 247 forming the fixed contact 250 and line terminal contact 251. A hanger 54 (FIGURE 16) is secured to the vertical leg 289 by bolts 292. Instead of the bolt 65 threaded through the web 64 of the hanger as in FIGURE 3, a captive eye bolt 293 is substituted. The end of the threaded shank of the eye bolt where it protrudes through the web 64 of the hanger is peened so that it cannot be removed from the hanger. The shank of the eye bolt has a circular flange 297 which clamps the mounting lug 66 on the support adapter 63 against the web 64 of the hanger. As in the previously described embodiments the mounting lug 66 and the pins 61-62 of the support adapter (FIGURES 3 and 3a) are slipped into position in the hanger 54 and the eye bolt is tightened to secure the interrupter 47 in place. The operating lever 167 is similar to the operating lever of FIGURES 9 and 10, with a flat spring contact 173 positioned between the legs 168 and 169 thereof.

An interrupter blade 135 secured to the switch blade carrier 256 is moved against the contact 167. To open the contacts the flat spring contact 173 of the operating lever 167 is moved to open the contacts in the manner previously described. The position of the operating lever 167 is shown when the interrupter 47 is in open condition is indicated at 173a. An auxiliary shunting contact 296 (FIGURE 15) is secured to the member 247 in position for engagement by the outer end portion of the actuator arm 294 during the initial opening movement of the switch and during the last portion of its closing movement, all in the manner previously described, so that after the fixed contact 250 and the switch blades are separated, current will flow through the auxiliary shunting contact 296 to the actuator arm 294 until after the pin 295 engages spring 173 to send current through the interrupter 47, this engagement of spring 173 and pin 295 continuing until after the contacts in the interrupter have opened.

In the closing operation the actuator arm 294 engages the auxiliary shunting contact 296 before the contacts in the interrupter 47 are closed, so that the initial surge of current does not pass through the interrupter, all as previously described.

FIGURE 19 shows the relative positions of the pin 295 and switch blade 260 and the center line of the carrier 256 and switch blades during a switch closing operation. The switch closed position of the carrier 256, blade 260, actuating arm 294 and pin 295 are shown in solid lines. The fully open position of pin 295 and blade 260 are shown at 295a and 260a. Positions of these elements 295 and 260 during closing is indicated by the letters b to h inclusive. The toggle spring 279 maintains the relative positions of carrier 250 and switch blade 260 at the angle shown until position f is reached, after which the frictional engagement of the switch blades with the fixed contact 250 and their engagement against the resilient stop 282 overcome the toggle spring 279 to align the blades and carrier 256 as the blades engage the fixed stop 277 on the carrier.

During this closing movement the pin 295, when it reaches position h, has not yet engaged the flat spring contact 173 on the operating lever 167, and at position c it has engaged it and started to deflect it.

In the embodiment of FIGURES 15 to 19 the actuator arm 294 is shown affixed to the switch blade carrier 256. However, it could be affixed to the switch blade 260 instead, in which case the relative positions of the pin 295 and switch blade 260 during the closing operation would not be as shown in FIGURE 19. Also, the action of the toggle spring 279 between the switch blades and their carrier 256 should be stronger than the action of the toggle spring 143 within the interrupter housing 77 to assure that the switch blades and the carrier 256 will not be not straightened out or their engagement of toggle spring 143 when the pin 295 on the actuator arm 294 presses the spring 173 against the operating lever 168 to initiate the closing of the contacts within the interrupter.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore
to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by Letters Patent is:

1. An expulsion type arc interrupting device for a high voltage switch comprising:
   (a) a housing;
   (b) a drive lever pivotally mounted within said housing and having a first toggle spring seat adjacent an outer swinging end portion thereof;
   (c) a drive lever pivotally mounted within said housing and having a second toggle spring seat adjacent an outer swinging end portion thereof and facing said first seat;
   (d) a compression toggle spring seated on said seats;
   (e) said housing having stop means therein and said drive lever and said driven lever each being engageable with said stop means to limit their movement in either direction;
   (f) the pivotal axes of said drive and driven levers being so located that said spring seats thereon are closest together when said levers are in coplanar alignment and so that clockwise movement of said drive lever results in a snap action counterclockwise movement of said driven lever after coplanar alignment is passed, and vice-versa;
   (g) means for rotating said drive lever in either direction;
   (h) a hollow tube of arc extinguishing material;
   (i) and a pair of electrical contacts within said tube; and
   (j) said driven lever being connected to one of said contacts to selectively move it with a snap action either into engagement or disengagement with the other contact.

2. The device of claim 1 wherein said housing includes a separable cover mating with said housing in either of two positions 180 degrees apart;
   (a) said pivotal mounting for said drive lever comprising a rotatable shaft affixed to said drive lever, mounted in said cover and having one end protruding through a wall thereof, and
   (b) said means for rotating said drive lever being affixed to the protruding portion of said rotatable shaft in said cover, whereby said means is positionable on either side of said housing by reversing the position of said separable cover.

3. The device of claim 2 wherein said driven lever is journaled by a pair of bearings each mounted half in the housing where it mates with the separable cover, and half in the separable cover whereby the pivotal mounting of said driven lever is secured when said housing and cover are assembled.

4. The device of claim 1 wherein one of said levers is bifurcated with its legs bearing said toggle spring;
   (a) said compression toggle spring is helical,
   (b) and wherein the other of said levers includes a spherical portion facing the seat on said bifurcated lever and fitting within the inside of said helical compression toggle spring at one end portion thereof, and
   (c) whereby there are no moments of force exerted by said toggle spring tending to bend either of said levers in a direction transverse to the planes of their pivotal movement.

5. In an expulsion type arc interrupting device for a high voltage switch having separable contacts;
   (a) a tubular member of arc extinguishing material having a fixed electrical contact therein,
   (b) a movable contact within said tubular member reciprocable between a first position wherein it engages said fixed contact and a second position wherein it is disengaged therefrom,
   (c) a support adapter for said fixed contact and tubular member having a pair of pins protruding from opposite sides thereof and a mounting lug protruding therefrom between said pair of pins, and
   (d) said mounting lug having means for removably securing said device to one side of a high voltage switch.

6. The device of claim 5 including a housing for mechanism connected to said movable contact to shift it within said tubular member;
   (a) said housing having a seat for one end of said tubular member and including a shoulder abutting an end portion of said tubular member to limit its axial position.
   (b) and said support adapter having a seat for the other end of said tubular member and including a shoulder abutting an end portion of said tubular member to limit its axial position, whereby said support adapter may be rotated about a common axis with respect to the seat in said housing to permit adjustment of the position of said pins and mounting lug on the support adapter with respect to said housing.

7. The device of claim 5 wherein a hanger is provided to be fixedly mounted upon one of the separable contacts of a high voltage switch;
   (a) said hanger being provided with a pair of spaced recesses to receive said pair of pins on said support adapter,
   (b) and said hanger also being provided with a web having means to removably secure said mounting lug thereto, whereby said support adapter has a three point mounting within said adapter.

8. In an expulsion type arc interrupting device for a high voltage switch having separable contacts;
   (a) a housing for a toggle spring mechanism,
   (b) a support adapter,
   (c) a hanger,
   (d) a first tube of arc extinguishing material connecting said housing and said support adapter,
   (e) a second tube of arc extinguishing material connecting said support adapter and said hanger,
   (f) said first and second tubes being coaxial,
   (g) fixed contacts within said housing and said support adapter,
   (h) a metallic stud within said first tube having movable contacts simultaneously engageable with said fixed contacts,
   (i) toggle spring mechanism within said housing operable to shift said metallic stud toward and away from said hanger to disengage and engage said movable and fixed contacts,
   (j) a first threaded stud projecting from said hanger for rigid connection with a cooperating threaded element on a hot line stick,
   (k) and a second threaded stud projecting from said housing for rigid connection with a cooperating threaded element of a hot line stick,
   (l) said first and second threaded studs being coaxial with said first and second tubes of arc extinguishing material.

9. The device of claim 8 wherein said support adapter has a pair of pins protruding form opposite sides thereof and a mounting lug protruding therefrom between said pair of pins;
   (a) said mounting lug having means for removably securing said device to one side of a high voltage switch.

10. The device of claim 9, including a hanger adapted to be fixedly mounted upon one of the separable contacts of a high voltage switch;
(a) said hanger being provided with a pair of spaced recesses to receive said pair of pins on said support adapter,
(b) and said hanger also being provided with a web having means to removably secure said mounting lug thereto, whereby said support adapter has a three point mounting within said adapter.

11. An expulsion type arc interrupting device for a high voltage switch comprising:
(a) a housing including a separable cover mating with said housing in either of two positions 180 degrees apart,
(b) a hollow tube of arc extinguishing material connected to said housing and having a pair of separable electrical contacts therein,
(c) snap acting means within said housing operative to snap said pair of contacts apart or together,
(d) a drive lever within said housing for driving said snap acting means in either direction,
(e) a rotatable shaft within said housing separable cover and having one end protruding through a wall thereof,
(f) said drive lever being affixed to said shaft,
(g) and an operating lever affixed to the protruding portion of said rotatable shaft whereby it is positionable on either side of said housing by reversing the position of said separable cover.

12. In combination:
(a) a high voltage switch including a fixed and a movable contact,
(b) a snap action expulsion type arc interrupter mounted upon said switching and having first and second separable contacts,
(c) said first contact being permanently connected to the fixed contact of said high voltage switch,
(d) means for connecting said second contact in the interrupter to the movable contact of said high voltage switch including an actuator arm mounted on said movable contact and an operating lever on said arc interrupter in a position to be driven by said actuator arm on said movable contact during a portion of its stroke,
(e) said operating lever being connected to the snap action mechanism of said arc interrupter and to be snapped out of engagement with said actuator arm by said snap action mechanism upon separation of said first and second contacts in said interrupter, and
(f) means maintaining electrical contact between said actuating arm and said operating lever after they have become disengaged by said snap action mechanism and until after the contacts within the interrupter have separated, thereby preventing an open arc between said actuating arm and said operating lever at the time that the contacts separate within the interrupter.

13. The device of claim 12 wherein said last mentioned means comprises a resilient contact between said actuating arm and said operating lever.

14. The device of claim 12 wherein said operating lever has a stud engageable by said actuator arm to rotate said lever and a leg not engageable by said actuator arm but extending parallel to the plane of movement of said operating lever;
(a) and said last mentioned means comprises a resilient contact on said actuator arm and engaging said leg on said operating lever.

15. The device of claim 12 wherein said operating lever comprises a pair of bifurcated legs in position to be selectively driven in opposite directions by said actuator arm;
(a) and said last mentioned means comprises a flat spring extending midway between said legs and of sufficient length to be engageable by said actuator arm to establish electrical contact between said actuator arm and operating lever before and after said actuator arm drives said operating lever in either direction.

16. In a high voltage side break switch;
(a) a pivotally mounted switch blade carrier,
(b) a switch blade hingedly mounted adjacent the outer end of said carrier,
(c) stops on said carrier limiting the movement of said blade with respect to said carrier,
(d) a fixed contact engageable by the outer end portion of said switch blade,
(e) and a resilient stop mounted on said fixed contact comprising a lever pivoted substantially at its midpoint, one end of said lever being in the path of said switch blade in its closing movement, and a spring connected to the other end of said lever to resiliently oppose its movement.

17. In a side break switch which includes a fixed contact and a movable switch blade hingedly connected to a rotatable switch blade carrier having stops to limit the hinged movement of the blade with respect thereto;
(a) an arc expulsion type interrupter fixedly mounted with respect to and connected to said fixed contact,
(b) an operating lever pivotally mounted upon said interrupter for opening and closing the contacts,
(c) and an actuator arm mounted upon said rotatable switch blade carrier and engageable with said operating lever to operate said interrupter independently of the movement of said movable switch blade with respect to said carrier.

18. In high voltage switch having a fixed contact and a movable switch blade comprising a pair of spaced parallel blades between which the fixed contact is engaged when the switch is closed;
(a) means resiliently urging said spaced blades together to increase the pressure of the engagement between said blades and said fixed contact comprising a bolt passing through said blades in the region of but slightly spaced from said fixed contact and having a head on one end and a nut on the other end,
(b) a helical compression spring between the bolt head and adjoining switch blade,
(c) a helical compression spring between the nut and adjoining switch blade,
(d) means for localizing the pressure of said springs to the region of said fixed contact comprising a plate between each said spring and its adjoining switch blade,
(e) each plate being loosely mounted on said bolt and extending from the region of said fixed contact to a point on the other side of said bolt beyond said springs,
(f) and a pin extending through said switch blades and seated against said plate, and of a length sufficient to raise the ends of the plates away from the switch blades, whereby the force of the springs is concentrated against the switch blades in the region of said fixed contact by the other ends of said plates.

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