Feb. 26, 1957 D. W. SAMUEL ET AL 2,783,322

QUICK-BREAK SWITCH

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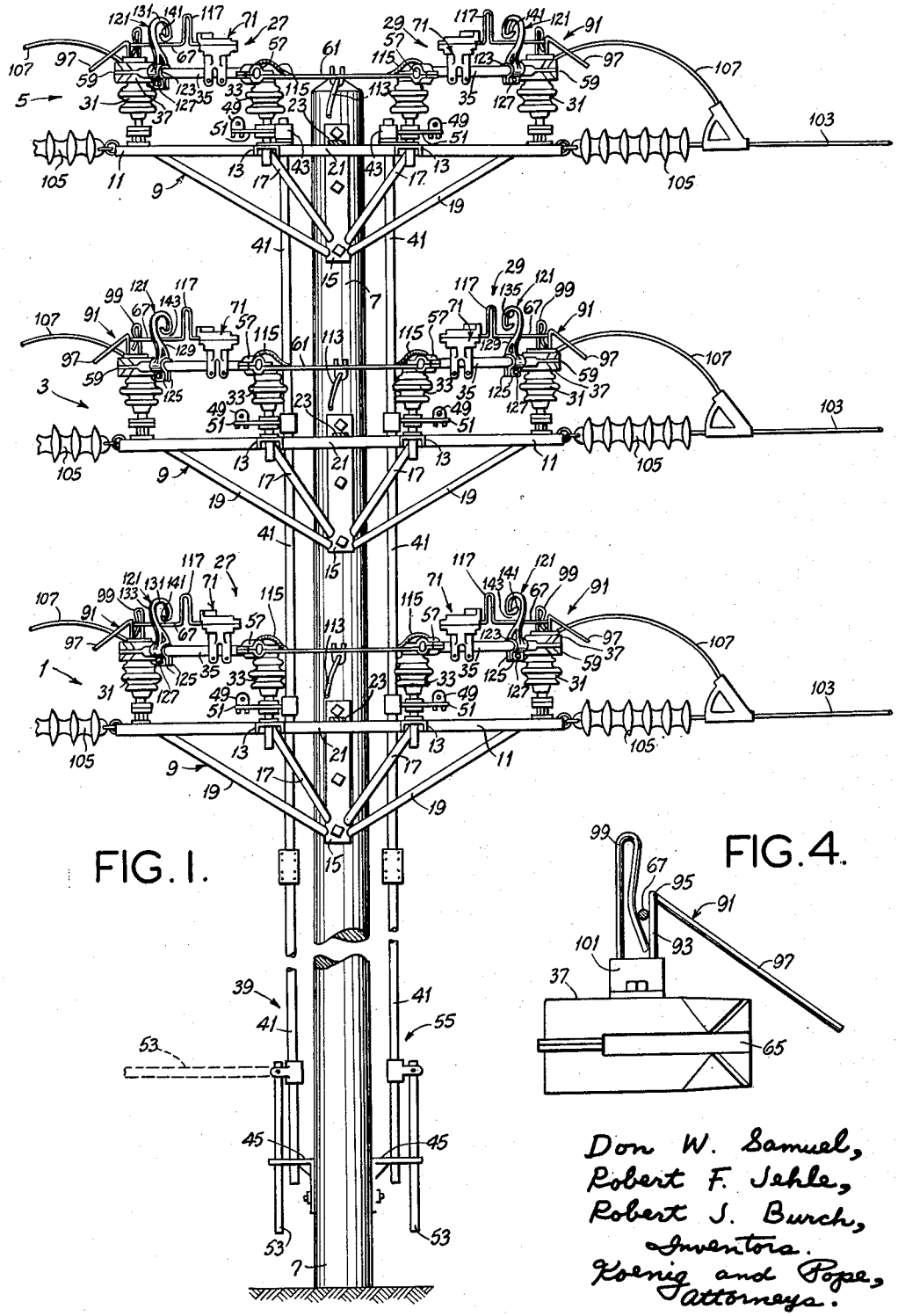


FIG. 1.

FIG. 4.

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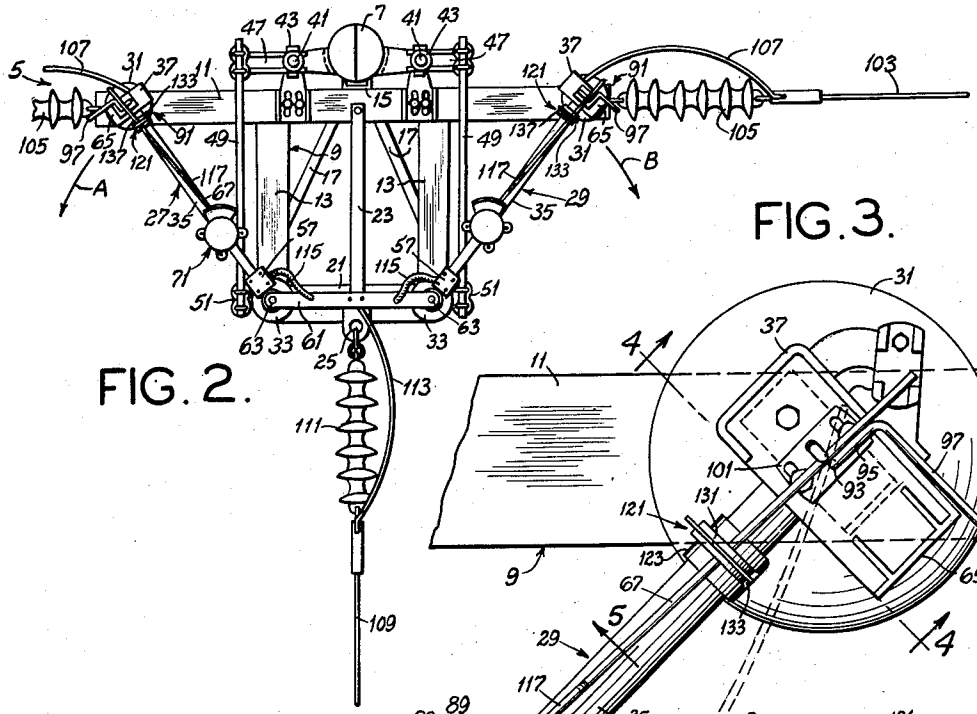


FIG. 2.

FIG. 3.

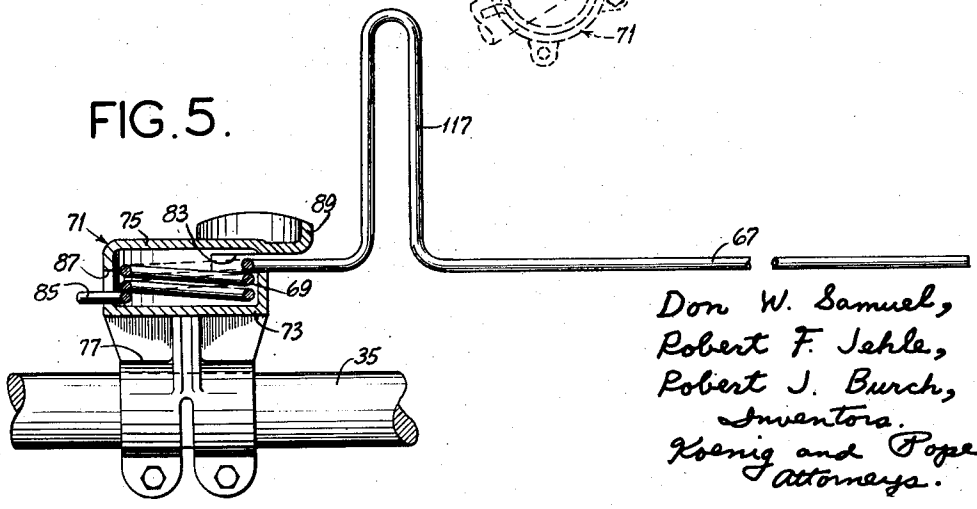


FIG. 5.

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FIG. 6.

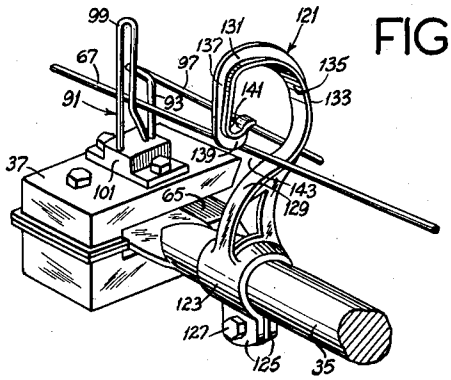


FIG. 7.

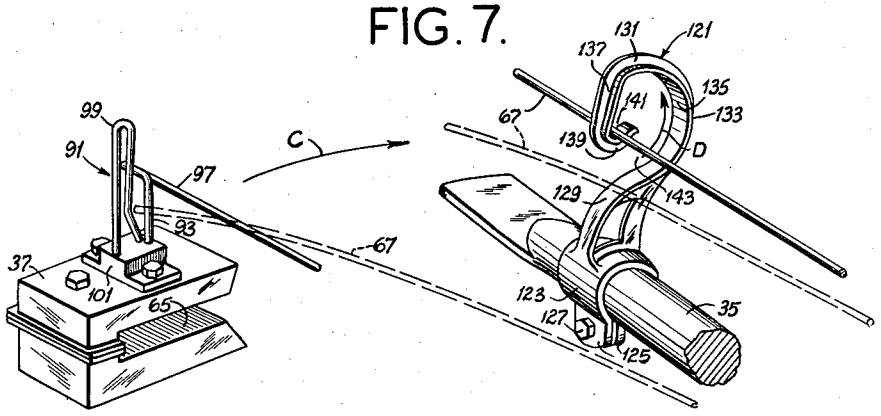
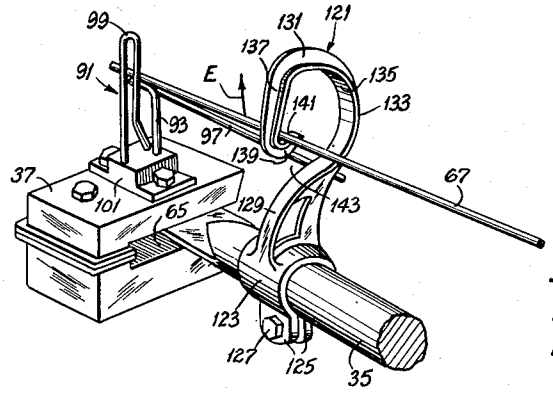


FIG. 8.



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QUICK-BREAK SWITCH

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Application September 30, 1953, Serial No. 383,181

4 Claims. (Cl. 200—62)

This invention relates to quick-break switches, and more particularly to such switches for use in gang operated air break switching devices such as are used in power distribution systems.

This invention involves an improvement upon the switches disclosed in the two copending coassigned applications of John L. Turner, both entitled Quick-Break Switch, Serial No. 158,854, filed April 28, 1950, and Serial No. 247,320, filed September 19, 1951, both now abandoned. In each of these copending applications there is disclosed a switch which, in general, comprises a pivoted switch blade, a fixed contact positioned for engagement by the blade when the blade is swung to closed position, an arcing horn fixed on the blade comprising an electrically conductive inherently resilient cantilevered spring whip arm, and an arcing horn on the contact comprising a detent for the whip arm, for maintaining electrical contact between the arm and the detent as the blade is moved to open position and to tension the whip arm by bending it until the blade is moved far enough for disengagement of the arm from the detent, whereupon the arm whips out of contact with the detent. This invention involves the provision in such a switch of means for snubbing the whip arm as it whips out of contact with the detent with the object of preventing the arm from oscillating back toward the detent and restriking an arc. Other objects and features will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the constructions hereinafter described, the scope of the invention being indicated in the following claims.

In the accompanying drawings, in which one of various possible embodiments of the invention is illustrated,

Fig. 1 is a view in elevation of a pole having mounted thereon three gang operated air break switching devices each including a pair of switches of this invention;

Fig. 2 is a plan view of Fig. 1;

Fig. 3 is an enlarged plan view of a fragment of one switch per se;

Fig. 4 is a fragmentary vertical section taken on line 4—4 of Fig. 3;

Fig. 5 is a vertical section taken on line 5—5 of Fig. 3;

Fig. 6 is a fragmentary perspective illustrating the position of parts when the switch is closed;

Fig. 7 is a view similar to Fig. 6 illustrating the operation of parts on opening the switch; and,

Fig. 8 is a view similar to Fig. 6 illustrating the operation of parts on reclosing the switch.

Similar reference characters indicate corresponding parts throughout the several views of the drawings.

Referring to the drawings, Fig. 1 illustrates three switching devices 1, 3 and 5, each including a pair of switches incorporating this invention, mounted one above another on a pole 7. Each of the switching devices is identical, and a description of one will suffice for all. As shown, each switching device comprises a supporting frame 9 secured to the pole. The frame comprises a horizontal cross

arm 11 and a pair of horizontal arms 13 (Fig. 2) extending forward from the cross arm on opposite sides of the pole but spaced inward from the ends of the cross arm. At 15 is shown a channel member to which the cross arm is secured and by means of which the entire frame 9 is secured to the pole. Inclined struts 17 extend from near the lower end of the member 15 to near the outer ends of the arms 13, and inclined struts 19 extend from near the lower end of the member 15 to near the ends of the cross arm 11 for bracing purposes. A horizontal brace 21 connects the outer ends of the arms 13. A strap 23 extends from the center of the cross arm 11 across the center of the brace and has an eye 25 at its outer end. Strap 23 is fastened both to the cross arm 11 and the brace 21.

Each switching device comprises two switches generally designated 27 and 29. The two switches 27 and 29 are identical and a description of one will suffice for all. As shown, each switch comprises an insulator 31 of the pin, post or equivalent type fixed to extend vertically upward at one end of the cross arm 11, and a rotary insulator 33 also of the pin, post or equivalent type at the outer end of the adjacent arm 13 extending vertically upward and rotatable on a vertical axis. A switch blade 35 is fixed at one end to the upper end of the rotary insulator 33 for swinging movement in a generally horizontal plane with its free end adapted to engage a contact 37 fixed on the upper end of the fixed insulator 31.

The switches 27 of the three switching devices 1, 3 and 5 are adapted to be operated in unison by mechanism generally designated 39 including a vertical shaft 41 mounted on one side of the pole 7 in bearings 43 carried by the cross arms 11 of the three switching devices and also in a lower bearing 45 attached to the pole 7 near the ground. For each of the three switches 27, there is a crank arm 47 on the shaft connected by a link 49 to a crank arm 51 on the rotary insulator 33 of the respective switch 27. A handle 53 is pivoted to the shaft 41 near its lower end to swing from the retracted vertical position shown in solid lines in Fig. 1 to the horizontal operative position shown in dotted lines in Fig. 1 for manually rotating the shaft 41 for opening or closing all three switches 27 in unison. Provision may be made for locking the handle in retracted position to prevent tampering. The three switches 29 of the three switching devices 1, 3 and 5 are adapted to be operated in unison by a mechanism generally designated 55 which is a duplicate of the mechanism 39 on the other side of the pole 7.

Each switch blade 35 comprises an electrically conductive bar, as illustrated a bar of circular cross section, having one end fixed to the upper end of the respective rotary insulator 33 by a clamp 57. The free end of each switch bar 35 is horizontally flattened as indicated at 59 in Fig. 1 to enter the respective contact 37. An electrically conductive bar 61 is mounted at its ends on the upper ends of the two rotary insulators 33, these insulators having threaded studs extending from their upper ends through openings in the bar 61, with nuts 63 threaded on the studs above the bar to hold it in place while permitting the insulators to rotate.

Each contact 37, which is of conventional construction, is fixed on its respective insulator 31 to extend generally at right angles to the line joining the insulator 31 and the related rotary insulator 33, and with the mouth 65 of the contact opening outward to receive the flattened end 59 of the respective switch blade 35. Fig. 2 shows the closed positions of the switch blades wherein their flattened ends 59 are entered in the contacts. It will be seen that each switch blade extends diagonally from its pivotal axis at the outer end of the respective arm 13 to the contact 37 at the adjacent outer end of the cross arm 11. To open the switches 27, their blades 35 are swung counterclockwise as indicated by the arrow A

in Fig. 2. To open the switches 29, their blades 35 are swung clockwise as indicated by the arrow B in Fig. 2.

Mounted on each switch blade 35 is an arcing horn 67. This comprises a cantilevered spring whip arm formed of a resilient electrically conductive rod having one end coiled into a helical coil spring 69 with the axis of the spring transverse to the length of the arm. The spring 69 is housed in a spring housing 71 attached to the switch blade. The housing is made in two parts of electrically conductive material, comprising a cup-shaped base 73 and a cup-shaped cover 75. The base is provided with a clamp 77 whereby it is clamped on the switch blade in position above the latter and intermediate its ends. At the rims of the base and cover are outwardly extending ears 79 receiving bolts 81 for holding the base and cover together (Fig. 3). The rim of the cover is notched to provide a slot 83 in the circular side wall of the housing adjacent the top of the housing, the slot opening generally toward the free end of the switch blade. As shown, one end of this slot is positioned approximately in line with the switch blade and the slot extends from this one and rearward as regards the direction of opening movement of the switch blade for about 60° (see Fig. 3).

The spring 69 is positioned vertically in the housing, in electrical contact therewith, with the arm 67 extending from the upper end of the spring through the slot toward the free end of the switch blade. The spring is formed with an outwardly bent finger 85 at its lower end which is received in a vertical slot 87 in the side wall of the housing base 73 to anchor the end of the spring in the housing. The housing cover 75 is formed with a shield 89 projecting outward from the region of the cover above the slot 83 to keep ice from clogging the slot.

Mounted on each contact 37 is an arcing horn 91 formed as a detent for the spring arm 67 of the respective switch blade 35. As shown, each horn 91 comprises a length of electrically conductive rod bent to have a vertical leg 93 extending upward from the contact, a horizontal reach 95 extending from the upper end of the horizontal leg generally radially with respect to the pivot axis of the switch blade, and a leg 97 inclined downward from the outer end of the horizontal reach 95 extending in the direction of the mouth of the contact. The high end of the inclined leg 97 of the horn 91 is located above the normal level of the spring arm 67 so that, when the switch blade is swung from open to closed position, the outer end of the arm 67 is cammed upward by the upper camming edge or surface of the inclined leg 97 until it rides off the high end, whereupon it springs down behind the vertical leg 93 (see Figs. 1, 3 and 4). Rearward of the vertical leg 93 of the horn 91 is a catch comprising a looped length of rod 99 extending upward from the contact 37. Rod 99 is so formed and positioned with respect to leg 93 that the free end of the arm 67 becomes wedged between them when it springs down behind the leg 93 (see Fig. 4). The horn 91 and the rod 99 are attached to the contact by a fastening means such as indicated at 101.

Power lines 103 are shown attached to insulators 105 at the ends of the cross arm 11. Leads 107 electrically connect lines 101 to the contacts 37 at the respective ends of the cross arm. A power line 109 is attached to an insulator 111 connected to the eye 25 at the end of strap 23. A lead 113 electrically connects line 109 to the bar 61. Leads 115 electrically connect the two switch blades 35 to the bar 61 in each switching device 1, 3 and 5.

The spring whip arm 67 is provided with a U-shaped loop 117 adjacent its coil spring end. This loop extends vertically upward in the plane transverse to the plane of movement of the switch blade 35.

When any one of the switch blades 35 is swung to its closed position, wherein its flattened free end 59 engages in its contact 37, as it nears its closed position, the outer free end of the spring arm 67 on the blade engages the inclined leg 97 of the arcing horn 91 and rides upward on the upper edge of the leg 97, which acts as a cam edge or surface for lifting the arm over the outer end of the leg 93 of horn 91, until the free end of the spring arm springs downward behind the vertical leg 93 (Fig. 4). The length of the spring arm is such that, when the switch blade 35 is in closed position, the spring arm extends beyond the vertical leg 93 of the horn 91, as shown in solid lines in Fig. 3. Also, when the switch blade is in closed position, the arm 67 extends through that end of the slot 83 which is forward in respect to the direction of opening movement of the blade. The free end of the spring arm is resiliently wedged between the catch 99 and the leg 93 in electrical contact with these elements and hence in electrical conductive relation to the contact.

As the switch blade 35 is swung open, its flattened free end 59 leaves the contact 37, but the free end of the spring arm 67 initially remains in engagement with the detent leg 93, the latter defining a shoulder to keep the free end of the arm initially from swinging out with the blade. Thus, even though the blade moves out of contact with the contact 37, the circuit initially remains completed through the part of the blade from its pivot end to the clamp 77, the spring housing 71, the spring 69 and the arm 67, the leg 93 and the contact 37. As the blade swings outward, the free end of the spring arm wipes on the leg 93 and the spring arm 67 becomes tensioned, mainly in its coiled spring portion 69 and to some extent by bending (see the dotted line position of arm 67 illustrated in Fig. 3). Ultimately, the blade is swung far enough outward to the point where the free end of the arm 67 escapes from behind the leg 93, whereupon the arm springs or whips out of contact with the leg, thereby breaking the circuit with a fast snap action quickly to extinguish any arc that may form.

The loop 117 acts to cushion the shock on the whip arm as it completes its whipping action, and this cushioning action tends to prevent the whip arm from taking a permanent set in bending at the point P indicated in Fig. 3. Without the loop, and with some materials, there is a tendency for the whip arm to become permanently bent out of its original position at the point P with the result that the whip arm may not be capable of relatching behind the vertical leg 93 of the detent 91 when the switch blade 35 is swung to closed position.

In accordance with this invention, the blade 35 of each switch is provided with means for snubbing the whip arm 67 as it whips out of contact with the leg 93 of the respective horn or detent 91 to prevent the whip arm from whipping back toward horn 91 and restriking an arc. As shown best in Figs. 6–8, this snubbing means comprises a hook-shaped catch, generally designated 121, attached to the blade toward its free end, extending upward from the blade, and formed to trap the whip arm as the latter whips out from behind the leg 93 in such manner as to prevent the arm from whipping back, while allowing the arm to return behind the leg 93 when the blade 35 is swung to closed position. The catch 121, which as herein illustrated may consist of a one-piece metal casting, has its lower end formed as a split ring clamp 123 with ears 125 for receiving a clamp bolt 127 for clamping the catch on the blade 35. Above the clamp 123, the catch is shaped to provide a ramp 129. The catch is clamped on the blade 35 in position extending upward from the blade with ramp 129 sloping upward in the direction of opening movement of the blade (denoted by the arrow C in Fig. 7). The ramp 129 intersects the plane in which the whip arm 67 moves as it whips out from behind the leg 93 of the horn 91. Above the ramp the catch has a downwardly open return loop 131 which starts at the upper end of the ramp and curves back over the ramp

and downward. The back reach **133** of return loop **131** has a curved inside face **135** which constitutes a continuation of the ramp. The downwardly extending front reach **137** of the return loop **131** has a lip **139** at the inside of its lower end, this lip being inclined upward toward the back reach of the return loop **131** to provide an upwardly open notch **141** inside the loop. The bottom of the lip is spaced above the ramp **129** and the end of the lip is spaced from the back reach of the loop **131** to provide a mouth **143** for passage of the whip arm **67** to and from the notch **141**.

As illustrated in Figs. 1 and 6, when the blade **35** is in fully closed position the whip arm **67** extends generally horizontally above the blade through the mouth **143** of the catch **121**, the free end of the arm being wedged between member **99** and the leg **93** of horn **91**. The whip arm is engaged against the ramp **129** in a position below the bottom of the lip **139** and offset from the lip in the direction of opening movement of the blade (which is toward the right as viewed in Fig. 6). The bottom of the notch **141** is below the top of the legs **93** and **97** of the horn **91**.

When the blade **35** is swung open, the catch **121** moves freely away from the whip arm, the latter, in effect, exiting from the catch via the mouth **143**. Thus, the whip arm is left behind as the blade swings open to become tensioned as previously described. When the free end of the whip arm escapes from behind the leg **93** of horn **91**, the end of the whip arm snaps toward the catch **121**, as illustrated in dotted lines and by the arrow C in Fig. 7. The whip arm enters the mouth **143** of the catch and strikes against the ramp **129**. Due to the previous tensioning of the whip arm, it has such energy that it rides up the ramp **129** and around upon the inside face of the return loop **131**, as indicated by the arrow D in Fig. 7, into the notch **141**. By the time it reaches the notch, its energy has been sufficiently dissipated that it comes to rest in the notch, as illustrated in solid lines in Fig. 7. Thus, it is prevented from whipping back toward the horn **91** and restriking an arc.

When the blade **35** is returned to closed position, the end of the whip arm rides up the inclined leg **97** of horn **91**, being assisted by the lip **139**. Thus the whip arm is raised out of the notch **141**, as indicated by the arrow E in Fig. 8, and springs down behind the leg **93** of horn **91** as the blade **35** completes its closing movement and the lip **139** moves away from under the arm (compare Figs. 6 and 8).

The gang operated air break switching device herein disclosed is capable of safely clearing line charging currents on extremely long lengths of high tension line. This is because each switch is capable of attaining a wide separation of the end **59** of its blade **35** from its contact **37** before the whip arm **67** disengages from the leg **93** of horn **91** and snaps toward and catches up with the blade, because the whip arm snaps away from the horn **91** at great speed, and because the catch **121** prevents the whip arm from oscillating back toward the horn **91** to prevent restriking an arc. It will also be observed that with catch **121** extending upward from the blade **35**, no part of the catch is any closer to the horn **91** than the blade, so that the provision of the catch does not reduce the effective amount of separation attainable on opening the blade before the whip arm catches up with the blade. Another significant advantage attained by the provision of the catch is that, as the blade **35** is swung to closed position, the lip **139** of the catch, engaging behind the whip arm **67**, pushes the arm up the inclined leg **97** of horn **91** to prevent the arm from hanging up on the leg **97**, as may occur particularly if the blade is swung slowly. This insures that the whip arm **67** always returns to its normal position behind the leg **93** of horn **91** when the blade is closed.

It will be understood that the principles of the invention are applicable to switches operating in planes other than horizontal.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As many changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

We claim:

1. In a switch comprising a pivoted switch blade, a fixed contact positioned for engagement by the free end of the blade when the blade is swung to closed position, an arcing horn comprising an inherently resilient electrically conductive whip arm mounted at one of its ends on the blade and extending on one side of the plane of swinging movement of the blade toward the free end of the blade, an arcing horn comprising an electrically conductive detent extending from the fixed contact on said side of the plane of swinging movement of the blade across the path of movement of the whip arm as it moves with the blade, the free end portion of the whip arm extending behind the detent when the blade is in closed position and being thereby restrained from movement as the blade is swung open until the blade is swung far enough for disengagement of the end of the whip arm from behind the detent, whereupon the arm snaps away from the detent toward the blade, and the detent having a camming portion for engagement by the arm as the blade is swung to closed position and on which the arm rides to be lifted over the outer end of the detent to return behind the detent, the provision of a catch on the blade toward its free end having a notch for trapping the arm as it snaps away from the detent to prevent the arm from oscillating back in the direction toward the detent, the arm being disengageable from the notch as it rides on the camming portion of the detent when the blade is swung to closed position, the notch opening in the direction away from the plane of snap movement of the arm and being located outward of said plane, and the catch having a ramp on which the arm rides as it snaps away from the detent, the ramp directing the arm into the notch.

2. In a switch as set forth in claim 1, the catch being in the form of a hook having a return loop opening toward the blade with the notch on the inside of the end of the loop, and the inside face of the loop constituting a continuation of the ramp.

3. In a switch comprising a switch blade pivoted for swinging movement in a generally horizontal plane, a fixed contact positioned for engagement by the free end of the blade when the blade is swung to closed position, an arcing horn comprising an inherently resilient electrically conductive whip arm mounted at one of its ends on the blade and extending generally horizontally above the blade toward the free end of the blade, an arcing horn comprising an electrically conductive detent extending upward from the fixed contact, the arm extending behind the detent when the blade is in closed position and being thereby restrained from movement as the blade is swung open until the blade is swung far enough for disengagement of the end of the arm from behind the detent, whereupon the arm snaps away from the detent toward the blade in a generally horizontal plane, the detent having a downwardly inclined camming portion for engagement by the arm as the blade is swung to closed position up which the arm rides to be lifted over the upper end of the detent to return behind the detent, the provision on the blade toward its free end of a catch for the whip arm extending upward from the blade having a ramp sloping upward in the direction of opening movement of the blade and intersecting the plane of snap movement of the arm, a downwardly open return loop starting at the upper end of the ramp and curving back over the ramp in the direction of closing movement

of the blade and downward, the loop having a downwardly extending front reach the lower end of which is spaced above the ramp to provide a mouth for passage of the arm and which is formed to provide an upwardly open notch inside the loop, the bottom of the notch being below the upper end of the detent and above the plane of snap movement of the arm, the arm extending through the mouth when the blade is in closed position, the catch moving away from the free end of the whip arm as the blade is swung open, the whip arm entering the mouth as it snaps away from behind the detent, striking the ramp, and being directed by the return loop into the notch, the whip arm being lifted out of the notch by the camming portion of the detent as the blade is swung to closed position.

4. In a switch as set forth in claim 3, the notch being formed by a lip on the inside of the lower end of the front reach of the loop inclined upward toward the back of the loop, said lip being adapted upon switch closure to push the whip arm up the inclined camming portion of the detent.

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