

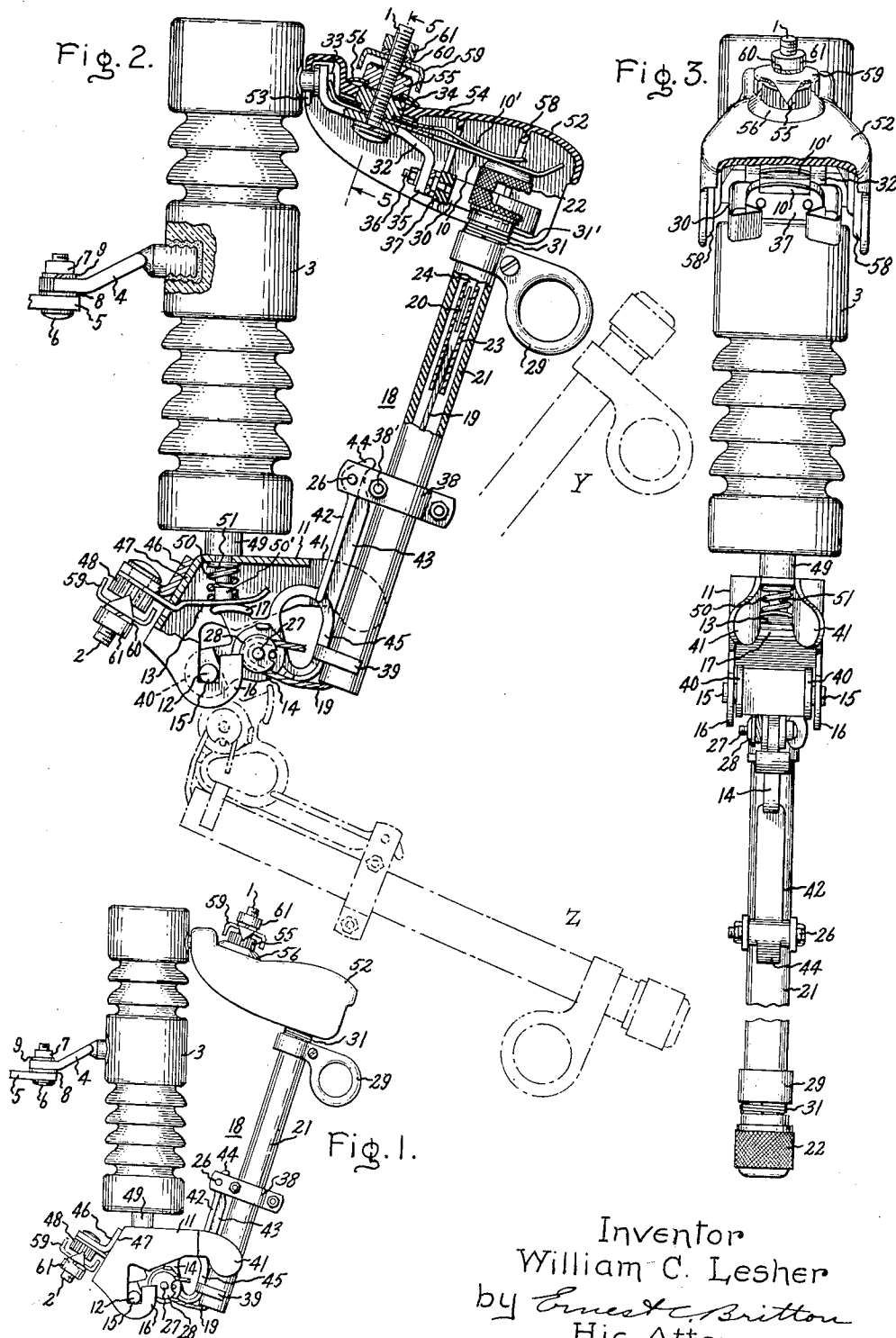
Nov. 6, 1951

W. C. LESHER
ELECTRIC SWITCH

2,574,401

Original Filed Aug. 1, 1947

2 SHEETS—SHEET 1



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W. C. LESHER

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ELECTRIC SWITCH

Original Filed Aug. 1, 1947

2 SHEETS—SHEET 2

Fig. 4.

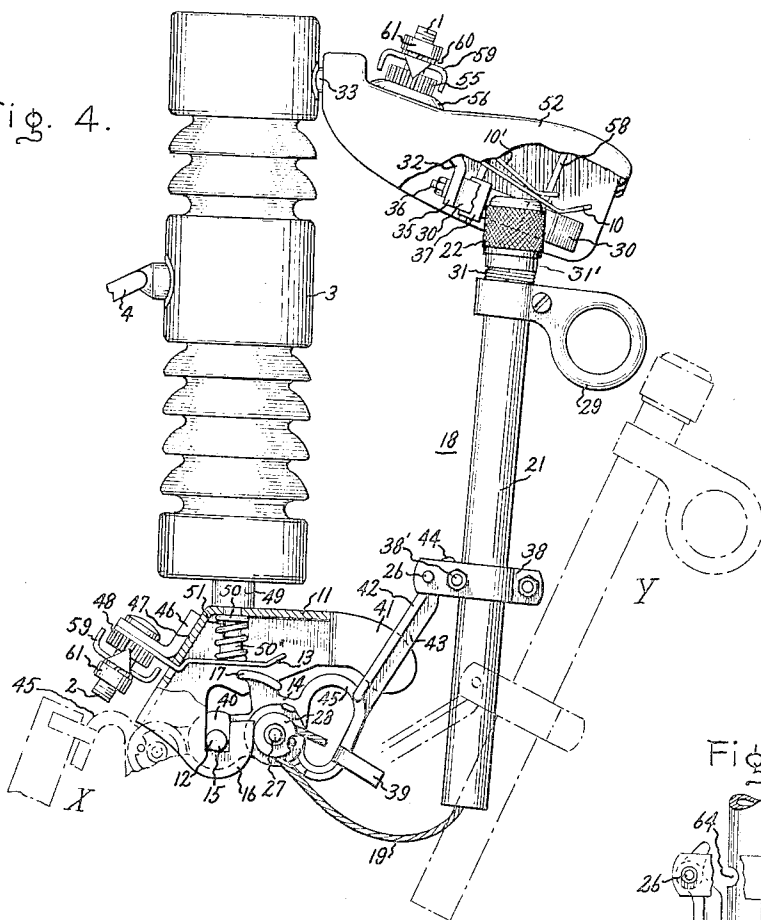


Fig. 6.

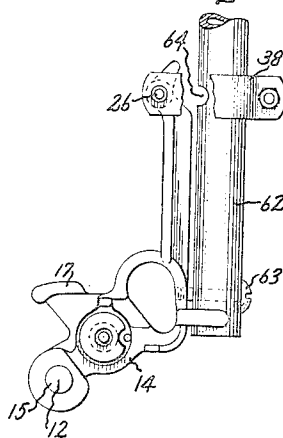
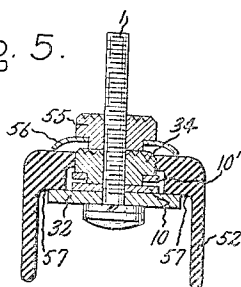


Fig. 5.



Inventor
William C. Leshner
by *Ernest C. Britton*
His Attorney

UNITED STATES PATENT OFFICE

2,574,401

ELECTRIC SWITCH

William C. Leshner, Pittsfield, Mass., assignor to
General Electric Company, a corporation of
New York

Original application August 1, 1947, Serial No.
765,369. Divided and this application Decem-
ber 29, 1948, Serial No. 68,016

1 Claim. (Cl. 200—114)

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My invention relates to improvements in electric switches intended primarily for outdoor installation on distribution systems and more particularly to improvements in disconnecting switches and especially fuse disconnecting switches of the open dropout type.

This application is a division of my copending application for "Electric Switch," Serial No. 765,369, filed August 1, 1947 and assigned to the same assignee as the instant application.

Fuse disconnecting switches of the open dropout type, with which I am familiar, have been subject to false operations in consequence of animals such as birds, squirrels, etc., getting on the exposed metal parts and causing short circuits. These false operations result in interruptions to the much desired continuity of service. To avoid such interruptions, the terminal portions at the ends of the supporting insulator have been mounted outwardly from the insulator at distances from each other and from the possibly grounded metallic band support which are sufficient to provide the dielectric strike and creepage values required to meet the basic insulation level of the voltage classification for which the switches are designed.

In fuse disconnecting switches of the type having an expulsion tube sealed at one end and open at the other end, the expulsion effect of the blowout action tends to move the fuse tube and the parts connected thereto in a direction away from the open end so forcibly as to produce material shock which has to be absorbed and transmitted through the attachment of the parts to the insulator and thence to the insulator mounting. In prior art fuse disconnecting switches of the open type embodying the metallic band support, the effect of this expulsion force has been magnified many times by leverage, since the expulsion tube is mounted at considerable distance from the insulator in order to provide sufficient dielectric strike distance from the metallic band support to the fuse in the expulsion tube or to the uninsulated solid disconnecting blade it is customary to furnish as an alternative to the fused expulsion tube. These magnified forces result in application to the insulator of stresses such as bending for which the usually employed ceramic structure is ill adapted. In order to meet even current interrupting abilities required on normal distribution circuits without breaking the porcelain insulator or bending the terminals or supporting members so they are no longer usable, it has been proposed to have both ends of the expulsion tube open. However, the expulsion of

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hot ionized conducting arc gases from the energized end of the tube creates a hazard from arcover to nearby grounded parts or even between associated, electrically energized overhead lines or apparatus terminals. In view of this hazard, various methods have been proposed to limit the range of currents at which expulsion action occurs at both ends or to direct the expelling of the gas away from associated lines or apparatus. Each of these expedients only slightly lessens the hazard. The only positive corrective measure is to seal the end of the expulsion tube which remains energized after the arc is extinguished in the tube since tests have shown that the hot conducting arc gases expelled from the tube can cause flashover to ground members, or those excited at a different potential, even when located from five to six feet from the terminal on the energized end of the expulsion tube whereas no flashover will occur to such grounded or energized members even when located only six inches from the end of the tube which is deenergized by the arc extinguishing action of the tube.

An object of my invention is to provide an improved electric switch structure, particularly of the open fuse type, such that the possibility of short circuits and false operations in consequence of birds and other wild life getting across the exposed energized metal parts of the switch is so materially reduced as to be practically eliminated. Another object of my invention is to provide an improved electric switch structure, especially of the open fuse type, with the insulator supporting member so secured to the insulator as to permit positioning the expulsion tube in such a way that the stresses on the support caused by the expulsion or blowout effect are not magnified by extended supporting arms or terminals. Also an object of my invention is to provide an improved electric switch structure, particularly of the open type, which is compact, sturdy, and of pleasing appearance.

My invention will be better understood from the following description when considered in connection with the accompanying drawings, and its scope will be pointed out in appended claim.

In the accompanying drawing, Fig. 1 is a side elevation of a fused disconnecting switch of the open dropout type embodying my invention and shown in the circuit closed position; Fig. 2 is an enlarged view similar to Fig. 1 with some parts broken away for clearness of illustration and in addition showing in broken lines some intermediate positions of the movable parts; Fig. 3 is a

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front elevation of the switch shown in Fig. 2 with the switch shown in the full open position; Fig. 4 is a view similar to Fig. 1 illustrating the switch with the parts in position just prior to dropout and also showing in broken lines the fuse tube in an intermediate position following the blowout of the fuse and in its extreme open position; Fig. 5 is an enlarged sectional view taken on the line 5-5 of Fig. 1 illustrating the upper switch terminal structure and its mounting; and Fig. 6 illustrates a modification of my invention wherein the switch is purely a disconnecting switch without a fuse and without dropout action.

For the purpose of illustrating my invention, I have shown in Figs. 1 to 4, inclusive, a fuse disconnecting switch of the open dropout type wherein the line terminals 1 and 2 and associated contact structures are mounted adjacent the ends of a suitable substantially cylindrical insulator 3. In order to have a compact structural arrangement whereby to avoid multiplying the expulsion recoil forces as they stress the porcelain and supporting member and also to avoid false operations in consequence of short circuits produced when birds and other wild life contact conducting parts of a switch, such as the terminals, for example, the insulator supporting arm 4 is mounted so a portion near one end thereof is within the cylindrical surface of the insulator 3 at the rear thereof and approximately midway of the ends of the insulator. With the supporting arm 4 thus extending directly from the insulator in a direction opposite to the contact structure hereinafter described, a more effective strike-over distance to the fuse 19 in tube 21 or to the metallic tube 62 shown in Fig. 6, when substituted for the tube 21, is insured with the tubes 21 or 62 located closer to the insulator 3 than has been possible with the heretofore used metallic band support around the outside of the middle portion of the insulator. Thus, in my construction, I combine mounting of the support 4 in the insulator 3 at the rear thereof and the location of the tube 21 or 62 closer to the insulator 3. This provides a more economical construction for open type switches and insures not only an interrupting ability comparable with that of switches of the enclosed type but also, with minor modifications of the expulsion tube 21 and associated parts comprising current conducting means 18, a device with an interrupting ability nearly double that of the normal interrupting ability and with the end of the tube 21, which is normally energized after arc extinguishing, sealed by the cap 22 so as to prevent strike-over to associated lines of apparatus. As illustrated in Figs. 1 and 2, arm 4 is secured to a support such as a pole-mounted bracket 5 by suitable fastening means shown as a bolt 6 provided with a nut 7, a bearing washer 8 and a lockwasher 9.

Adjacent one end of the insulator 3 and supported therefrom in conductive relation with the terminal 1 and so as to extend transversely of the insulator in a direction oppositely to that of the support 4 is a first relatively stationary contact means 10. Inasmuch as the tube 21 can be located closer to insulator 3, as hereinbefore described, the stationary contact means 10 is relatively shorter than heretofore possible in devices of the prior art thus decreasing the leverage which multiplies the recoil forces from expulsion action. Supported from the other or lower end of the insulator 3, in line with the longitudinal axis thereof is a hinge means comprising a hook type bearing member 11, the bearing axis 12 of which is substantially perpendicular to the longi-

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tudinal axis of the insulator and displaced from the insulator axis oppositely to the displacement of the contact means 10. At the other or lower end of the insulator 3, there is mounted on the bearing member 11 a second relatively stationary contact means 13 in current conducting relationship with the terminal 2. For completing a conducting path between the stationary contact means 10 and 13 and consequently the terminals 1 and 2, I provide a hinge element 14 having trunnions 15 adapted to be inserted in the hooks 16 of the bearing element 11 and carrying a contact 17 movable into and out of engagement with the lower contact means 13 upon rotation of the hinge element. Also, I provide current conducting means indicated generally by 18 and carried by the hinge element 14 and rotatable therewith counterclockwise, as viewed in the drawings, about its bearing axis 12 to the circuit closed position to establish the conducting path between the lower and upper contact means 10 and 13.

As shown in Figs. 1 to 4, inclusive, the current conducting means is of the expulsion fuse type comprising a conductor 19 having a portion 20 fusible at a predetermined value of current and an expulsion tube 21 having a conducting cap 22 connected to one end of the conductor and engageable with the upper stationary contact means 10. The fusible portion 20 of the conductor 19 is mounted within a cylindrical casing 23 of insulating material and is connected to the cap 22 through a stud 24 which carries the casing 23 and a button head, not shown, engageable by the cap 22, as is well known to the art, when sealing the fuse tube 21 is practical in the light of the required interrupting duty. As shown, the tube 21 is pivotally mounted at 26 on the hinge element 14 constituting therewith a toggle which is held in the rigid condition shown in Figs. 1 and 2 by tightening the conductor 19 around a thumb screw 27 in the hinge element 14 and then clamping the conductor between the element and a locked-against-turning nut 28. When the toggle is thus held rigid, the switch can be closed by inserting a switch hook in an operating eye member 29 mounted on the fuse tube 21.

For maintaining the switch in the closed circuit position after turning the rigid toggle counterclockwise, as viewed in the drawings, to the closed circuit position shown in Figs. 1 and 2, there is provided a holding means which, as illustrated, comprises a U-shaped resilient member 30, the outer ends of the legs of which are bent inwardly and then outwardly to provide, in V-shaped formation, flared ends which yield sufficiently to permit entrance of the cap 22 and thereupon close over the cap to prevent reverse movement except when enough pull is exerted on the eye member 29 to expand the legs of the U-shaped member 30 sufficiently for exit of the cap.

In order to reduce static interference of radio equipments and the like, a coiled spring-like conductor 31 is placed around the fuse tube 21 between the eye member 29 and the bottom of a threaded sleeve 31' onto which the cap 22 is threaded whereby to have the eye member at the same potential as the terminal 1.

Referring now more particularly to other features of the heretofore described structure, the upper stationary contact means comprises in addition to the leaf contact spring 10 a leaf backing spring 10'. Both of these springs, as shown more clearly in Fig. 2, are carried by a bracket 32

extending outwardly from the insulator 3 and

supported therefrom on a stud 33 mounted in the insulator. For simplicity in mounting, the contact structure 10, 10' is secured to the bracket 32 by the terminal bolt 1 which is provided with a shouldered cylindrical nut 34 having a ridged periphery. The smaller diameter portion of the nut 34 fits into a hole in the spring member 10' and clamps the spring contact 10 against the bracket 32, as shown in both Figs. 2 and 5, thereby establishing electrical contact with the spring contact 10. The inner end of the spring 10 is notched and curved upwardly to engage the stud 33 whereby to prevent turning movement. The inner end of the backing spring 10' bears on the curved portion of the contact spring 10, and the smaller diameter portion of the nut 34 is somewhat longer than the thickness of the backing spring 10' so as to provide greater freedom of movement of the backing spring. Also, the front end of the bracket is bent downwardly so that the contact spring 10 can follow the cap 22 during the first part of the dropout action of the switch, as shown in Fig. 4, whereby to maintain continuity of contact until the expulsion action of the fuse and arc interruption in the tube 21 have occurred. The extreme end of the bracket 32 is further curved downwardly at 35 to provide a support for the U-shaped holding member 30, the base of which is secured to the bracket by suitable means such as a bolt 36 provided with a shock-absorbing head 37 of suitable resilient material to absorb the closing impact. As the switch opens during the dropdown action of the fuse tube, particularly under small currents which effect slow melting of the fuse and weak expulsion action, the cap 22 remains in conducting engagement with the holding member 30. This provides some delay without circuit interruption at the top whereby to insure arc clearing in the tube 21.

The fuse tube 21 is supported in a clamp 38 which is pivotally secured to the hinge element 14 at 26. For lateral stability relatively to this element, the lower end of the tube 21 is held between side arms 39 on the element. In order that the toggle comprising the hinge element 14 and the tube 21 may, when held rigid, swing in substantially a true plane and thus align the cap 22 with a relatively narrow entrance of the holding member 30 so as to be suitable for covering with a hood 52, the hinge element is provided with bearing shoulders 40 which ride against the inside surfaces of the hooks 16 and from which the trunnions 15 protrude outwardly since this structure is mechanically simple to machine. Also, in order to increase the manufacturing limits for this simple machine operation and for the hooks 16 to those of normal low cost manufacture, the bearing member 11 is provided with flared wing guides 41 with which cooperates a relatively close fitting flange 42 on a supporting leg 43 of the hinge element. The relatively large distances between the trunnions 15 and between the guides 41 makes a more positive guide for directing the cap 22 into the relatively narrow entrance of the holding member 30 than has been achieved in prior art constructions with which I am familiar. To limit the angular movement of the tube 21 relatively to the hinge element 14 during the dropout action, the upper end of the supporting leg 43 is provided with an extension 44 which bears against a clamping screw 38' after a predetermined amount of dropout movement has occurred. The hinge element 14 is also provided with an eye member 45 by which

the element and the tube 21 can be removed when in the open or vertically down position for inspection, fuse replacement, etc., with the aid of the usual switch hook.

As shown, the lower stationary leaf spring contact 13 is supported on a bracket 46 which is suitably secured to the outside of the rear wall 47 of the bearing member 11. For holding the contact on the bracket 46, the terminal bolt 2 extends through the outstanding leg of the bracket and is provided with a cylindrical clamping nut 48 which has a ridged periphery and which bears against the contact 13. The contact 13 extends through an opening in the rear wall of the bearing member 11 so as to be engaged by the contact 17 on the hinge element 14 when the switch is closed. The bearing member 11 is supported on a stud 49 extending axially downward from the lower end of the insulator 3 substantially in line with the axis thereof and also substantially in line with the point of engagement of the contacts 13 and 17. Shock-absorbing means is provided and positioned adjacent the lower end of the insulator and yieldable substantially in the direction of the axis of the insulator for absorbing the effect of the expulsion force transmitted to the hinge element 14 and thence through stud 49 and insulator 3 to supporting arm 4 so the insulator 3 is essentially in compression substantially along the axis thereof upon rupture of the conductor 19 as at the fusible portion 20 thereof. As illustrated, this means comprises a helical compression spring 50 which is positioned around a reduced diameter portion 51 of the stud 49 and between the inside of the upper wall of the bearing member 11 and the upper surface of the contact 13.

Also a resilient bumper 50', of rubber or the like, is inserted inside the spring 50 and arranged so as to be compressed between the stud 51 and the upper surface of the contact 13 after the spring 50 has been compressed a predetermined amount. The length of the reduced portion of the stud 49 and the resilient bumper 50' is such that, even though the hinge element is forcibly lifted by the expulsion shock, the contact 13 will strike and compress the bumper 50' a predetermined amount against the end of the stud 49 so as to cushion the impact and stop the upward movement before the trunnions 15 are raised far enough to be movable out of the hooks 16, and also before the upward movement of the tube 21 under the action of the recoil forces has overstressed the terminal 1 and acting through said terminal has imposed a slightly amplified bending stress on the insulator 3.

Since the bearing axis 12 of the hinge element 14 is to the left of the axis of the insulator 3, the line of action of the force exerted on the hinge element by the compression spring 50 through the contact spring 13 and the contact 17 is such that this force tends to maintain a high contact pressure between the contacts 13 and 17. Also, because of the direction of application of this force, it tends to move the hinge element 14 to the circuit open position whereby to accelerate the opening action when the conductor 19 is ruptured. Also, in order to protect the parts associated with the terminal 2 from the elements, the bearing member 11 is preferably in the form of a hood with only the front and lower sides open. In order to limit the angular opening movement of the hinge element under the expulsion action, the rear wall 47 of the bearing member 11 extends downwardly into the path of

movement of the eye portion 45 of the hinge element, as more clearly indicated by the broken line position X in Fig. 4.

For sheltering the upper contact structure against the elements and also to make this contact structure practically inaccessible to wild life, I provide an improved hood structure which is readily and simply attachable to and detachable from the switch. As shown, this structure comprises a hood 52 preferably of insulating material which may be formed by molding or otherwise. For ease in mounting, the bottom of the hood is open and also the front in order to allow passage of the cap 22 to and from the circuit closed position. Also for simplicity in mounting, the rear wall of the hood 52 is notched at 53 to fit over the stud 33 between the insulator 3 and the fixed end of the bracket 32, and the top wall 54 is provided with an opening just large enough to slip over and register with the periphery of the cylindrically headed nut 34 on the terminal bolt 1. In order to prevent turning of the hood 52 about the head of the nut 34 the interior of the hood is arranged to engage the bracket 32. For clamping the hood in place and also keeping water from entering the hood, I provide a clamping nut 55 and a cupped spring washer 56, as shown more clearly in Figs. 1 and 5. In order to avoid bending strains on the top wall of the hood 52 under the clamping action, the inside of the top wall is provided adjacent the hole in the wall with transversely extending thick bearing portions 57 which seat on the bracket 32, as shown most clearly in Fig. 5. These portions take in compression the clamping force consequent on tightening the nut 55. Also the hood 52 may be provided with internal stiffening ribs 58, as shown. For securing line conductors to the terminals 1 and 2, each is provided with a wire clamp 59, a lock washer 60 and a nut 61, as shown.

From the foregoing, it will be apparent that in consequence of having the supporting arm 4 extend outwardly from the insulator oppositely to the contact structure without the use of a band surrounding the middle of the insulator, it is possible to bring the contact structure in closer to the insulator without danger of wild life effecting short circuits between the contact structure and the supporting arm 4, which is often grounded. Also, because of the compact structure, less room is available for perching birds and the like to alight on the switch and have any material freedom of movement without having to take off. This practically eliminates the possibility of two birds alighting on the switch at the same time and fighting with each other with resultant possibility of a short circuit across the line. Likewise, the probability of a bird being able to perch on the contact structure and reach around to the supporting arm 4 is greatly minimized. Also, with the contact structure closer into the insulator, the construction is materially stronger and less stress is placed on the insulator due to the decrease in the lever arms. Also, the compactness of structure provides a more pleasing appearance which is further enhanced by the use of the protecting hood 52.

It will be observed that the expulsion type circuit interrupter, comprising the tube 21 and the conductor 19, in the closed position bridges the upper and lower stationary contacts 10 and 13 in a direction forming a relatively small acute angle within a range of 10 to 30 degrees with the longitudinal axis of the insulator 3. The expulsion force on interruption is thus applied to the

top and bottom of the insulator 3 through relatively long and short lever arms, respectively. But since this expulsion force is largely absorbed by the spring 50 and the bumper 50' and the upper travel is limited by the bumper 50' and the stop 51, very little of the force is left to produce bending stresses at the top of the insulator 3 and the effect of this little is eased by the resilient action of the spring contact means 10, 10'.

Assuming the switch in the circuit closed position, as shown in Figs. 1 and 2, with the toggle comprising the tube 21 and the hinge element 14 held in the rigid condition against the bias of the contact springs, the helical spring 50 and gravity by the conductor 19, then if sufficient current flows through the switch to melt the fusible portion 20 of this conductor, the toggle is free to collapse under its bias as soon as the fuse parts. When this occurs, the parts assume the full line condition shown in Fig. 4 with the fuse tube initially being urged downwardly by the resilient action of the contact means 10, 10' and 13 and the helical spring 50. The cap 22 at the upper end of the fuse tube, however, rides downwardly inside of the holding means 30 until the conductor 19 is blown from the fuse tube 21 whereupon the tube assumes the position Y shown in broken lines in Fig. 4 and also in Fig. 2. Under the force of gravity and the biasing impulse initially imparted to the tube, the hinge element 14 and the parts associated therewith move in a clockwise direction until the eye 45 of the hinge element contacts the rear wall 41 of the bearing member, as indicated by the broken line position X in Fig. 4 and then finally swing back to a vertical position below the insulator under the effect of gravity.

When it is desired to re-fuse the switch, the hinge element 14 is lifted out of the bearing member 11 by using a switch hook or the like in the eye 45. A new fusible element is inserted in the tube 21 after first removing the cap 22 and then restoring it to lock the fuse head at the top of the tube as is well known to the art. The new fused conductor 19 is then inserted around the clamping bolt 27 and this bolt tightened to lock the fuse so as to hold the toggle rigid. The tube with a new fused conductor 19 in the toggle retaining position is shown in broken lines in Fig. 2 in the position Z just after restoring the hinge element 14 in the bearing member 11. The switch may then be closed by inserting a switch hook in the eye 29 and moving the rigid toggle about the bearing axis 12 into the position shown in full lines in Fig. 2 where the switch is maintained by the holding means 30 as long as the toggle is held rigid.

The embodiment of my invention shown in Fig. 6 is an adaptation of the fuse dropout switch shown in Figs. 1 to 5, inclusive, for use as a disconnecting switch nonresponsive to current conditions or for use as a non-dropout type of fuse disconnecting switch by fastening the fuse tube 21 to the hinge element 14 by a screw 63 as shown in Fig. 6. In the case of a disconnecting switch, as shown in Fig. 6, the fuse tube 21 is replaced by a tubular conducting member 62 which is attached to the hinge element 14 in a manner similar to the arrangement shown in the other figures except that, since no relative movement is to take place between the hinge element and the conducting tube 62, the lower end of the tube is also secured to the hinge element to prevent movement about the pivot 26. For this purpose, any suitable means such as a screw 63 projecting

through the tube 61 and threaded into the hinge element may be used. To prevent any twisting action of the tube 62, the tube may be notched at 64 so as to seat one of the clamping bolts, not shown, of the clamping means 38. In this modification of my invention, of course, both the circuit opening and circuit closing movements are to be performed manually by means of a switch hook slipped in the eye, not shown, on the tubular member 62.

While I have shown and described my invention in considerable detail, I do not desire to be limited to the exact arrangements shown, but seek to cover in the appended claim all those modifications that fall within the true spirit and scope of my invention.

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

An electric switch comprising a substantially cylindrical insulator any cross section of which normal to the longitudinal axis thereof is circular in shape, a first contact means mounted on said insulator adjacent one end thereof and extending transversely of the insulator, a second contact means mounted on the other end of said insulator, circuit interrupting means including an expulsion tube and a rupturable fusible element mounted within said tube for electrically interconnecting said first and second contact means and positioned in spaced relationship with said insulator, means for maintaining said insulator on a supporting structure comprising a sup-

porting arm in engagement with said insulator intermediate said two contact means and at a point diametrically opposite the point of mounting of said first contact means, and means axially positioned adjacent said other end of said insulator to transmit the expulsion force upon rupture of said fusible element to said insulator as a compressive stress in the portion thereof between said other end and said supporting arm, said supporting arm extending in a direction diametrically opposite to that of said transversely extending contact means and having one end thereof and a portion adjacent thereto mounted directly within the cylindrical surface of said insulator whereby said compressive stress is transmitted to said arm with practically no bending of said insulator.

WILLIAM C. LESHER.

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