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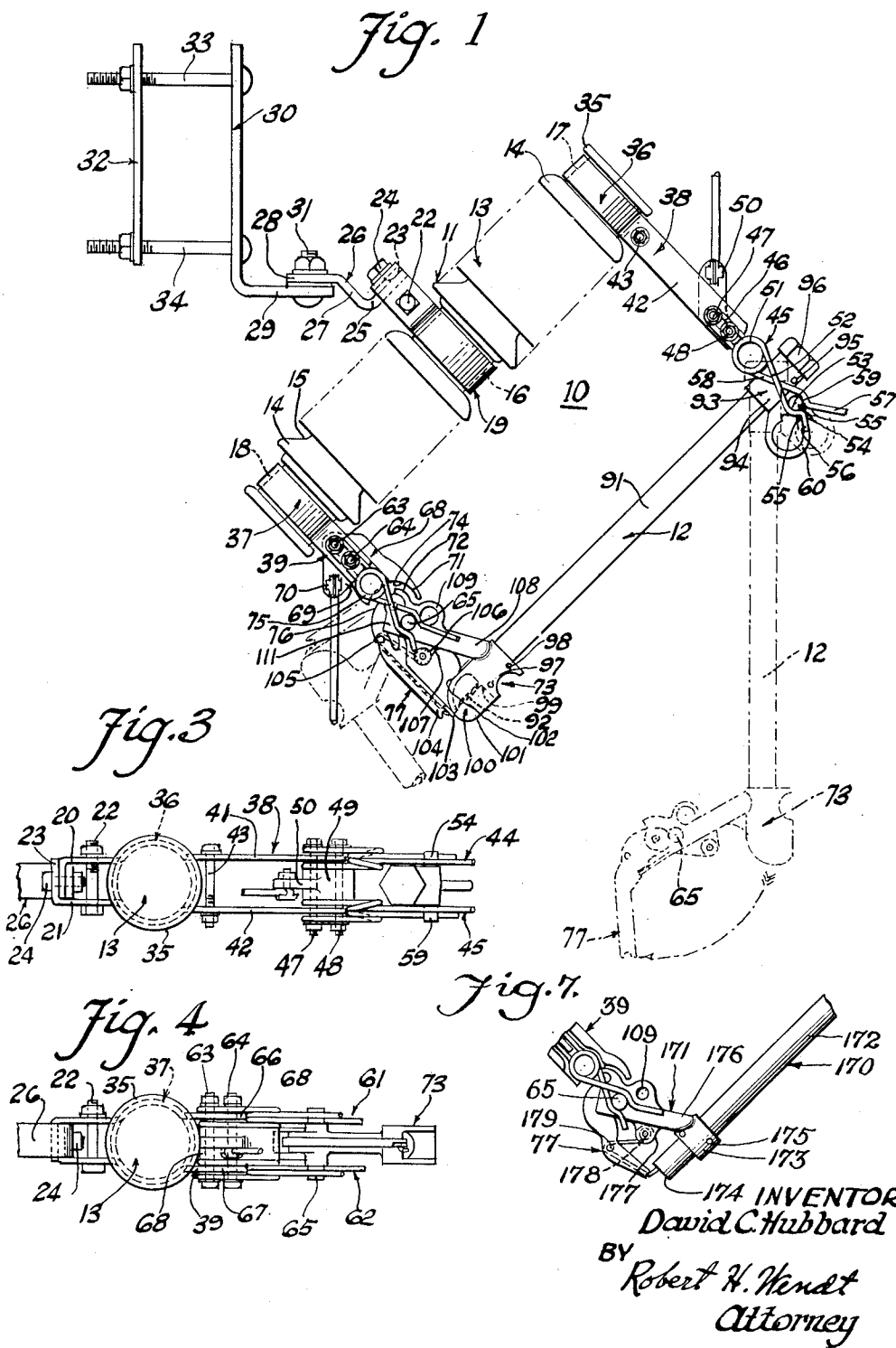
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FUSE DROP-OUT CUTOUT

Filed Feb. 26, 1948

2 SHEETS—SHEET 1



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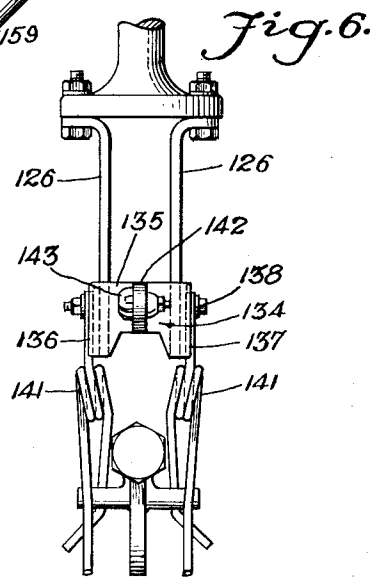
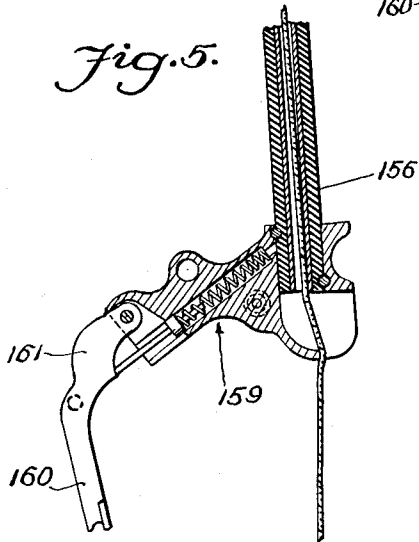
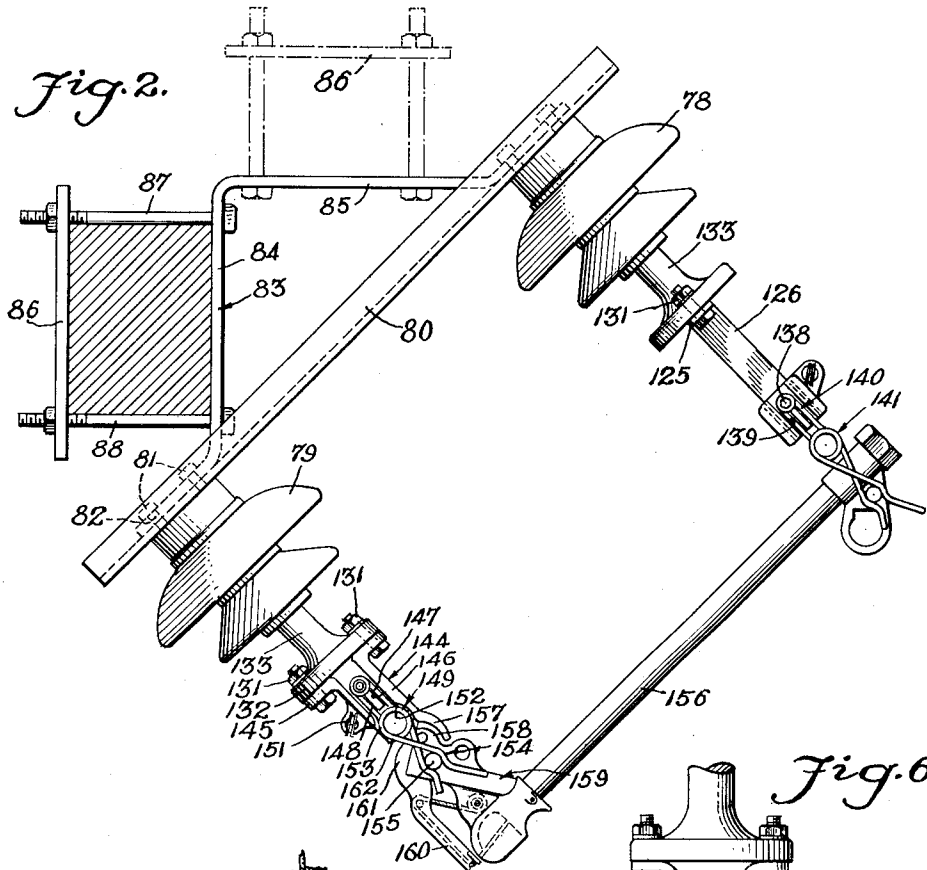
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2 SHEETS—SHEET 2



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FUSE DROP-OUT CUTOUT

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The present invention relates to fuse drop-out cut-outs and is particularly concerned with automatic fuse devices of the type adapted to be used upon transmission lines for interrupting the flow of current when the current exceeds a pre-determined amount, the interruption being accompanied by the melting of the fuse and the expulsion of the parts of the fuse, accompanied by the automatic mechanical opening of the circuit, after the circuit is broken, to assure the permanent breaking of the circuit until it is manually closed, and to give an indication of the condition of the circuit.

One of the objects of the invention is the provision of an improved drop-out type fuse cut-out adapted to utilize the standard universal fuse links and provided with a fuse tube, which is closed at the top and open at the bottom and so constructed that the lower contact of the fuse tube is ejected from the bottom contact of the circuit, so that the fuse tube will hang with its opening downward before and after operation, thus protecting the fiber liner of the fuse tube from all adverse weather conditions.

Another object of the invention is the provision of an improved fuse drop-out cut-out in which the actual parting of the lower contacts upon rupture of the fuse link is delayed until after the arc has been extinguished inside the fuse tube.

Another object is the provision of an improved device of the class described in which the ejector arm travels over a predetermined arc before unlatching the lower contact, so that the actual mechanical opening of the circuit will be delayed until the arc has been definitely extinguished within the fuse tube.

Another object is the provision of an improved device of the class described in which there is a wiping contact between the contacts on the fuse tube and those on the support so that the contacts may be kept in good condition and so that the wiping contact at the lower contact of the fuse tube may be used during the unlatching of the fuse tube to assist in delaying the mechanical opening of the circuit until the arc has been extinguished within the tube.

A further object of the invention is the provision of an improved drop-out fuse construction in which the jet action from the opening at the lower end of the fuse tube reacts with the upper trunnion to produce a torque that tends to swing the lower end of the fuse tube inward towards its contact to hold the lower contact in engaged position during the blast of the arc so

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as to delay the mechanical opening until the arc has been extinguished.

Another object of the invention is the provision of an improved construction for devices of the class described in the form of the resilient contact springs and the provision of stops which protect the springs during jet action to prevent the straining of the springs and to cause the forces to react in such manner that the top trunnion of the fuse tube is also held in closed position during the violent jet action from the lower end of the fuse tube.

Another object is the provision of an improved ejector construction adapted to pull the fuse link from the fuse tube quickly at all times even though the rupturing currents are too light to generate sufficient gases within the fiber tube to eject the link rapidly, thus assuring the extinguishment of the arc in a minimum time.

Another object of the invention is the provision of an improved fuse tube drop-out cut-out, the parts of which are protected from the weather at all times and which is also adapted to be operated in a conventional way as a disconnect by permitting the manual disengagement of the upper contacts by merely pulling outward on this end of the tube, leaving the tube supported by its lower contacts and indicating that it has been manually operated as a disconnect.

Another object of the invention is the provision of an improved fuse construction which is adapted to be re-fused and operated in accordance with conventional procedure so that the operators will already be familiar with the mode of handling the device.

Another object of the invention is the provision of an improved fuse drop-out cut-out which is "trip free" even during the manual closing of the circuit so that when the fuse tube unit is being connected with its contacts, the operator cannot force the closing of the circuit during the existence of an overload, but while the operator is swinging the upper contact into closed position and holding it, the device may nevertheless open at the bottom contact automatically if a short circuit exists at that time.

Another object of the invention is the provision of an improved fuse tube unit which is provided with means for guiding and diverting the molten elements and the major force of the blast which takes place on fusing, away from the operator, so as to provide limited but effective protection for the operator and particularly for his face.

Another object is the provision of an improved device of the class described having a mechanism

that is unaffected by accumulations of ice and which is adequately protected from such accumulations as may occur.

Another object is the provision of a device of the class described which gives a visual indication in the open position whether the device has been operated automatically, indicating the existence of a fault, or whether the device has been opened manually, indicating the purposeful deenergizing of the circuit for repairs or other reasons.

Another object is the provision of an improved contact structure which is self-aligning with relation to the trunnions on the fuse tube unit and the provision of stops and buffers to arrest the reaction that is due to the jet action and to prevent over-stressing the contact springs.

Another object is the provision of an improved fuse tube unit and support therefor, which is so constructed that the forcible closing of the contacts by slamming the fuse tube into position, tends to force the ejector arm against the bottom of the fuse tube rather than to cause the arm to place additional tension on the fuse link element, thus eliminating the shocks that are imparted to the fragile fuse link in the devices of the prior art.

Another object of the invention is the provision of an improved drop-out cut-out in which suitable contact pressures are obtained for good electrical connection of both ends of the fuse tube unit without subjecting the fuse tube to endwise compressive forces, which may eventually result in the bending of the fuse tube, thereby eliminating any tendency toward the bending or deformation of the tube after a long period of use.

Other objects and advantages will be apparent from the following description and the accompanying drawings, in which similar characters of reference indicate similar parts throughout the several views.

Referring to the two sheets of drawings accompanying the specification,

Fig. 1 is a side elevational view of a fuse drop-out cut-out embodying the invention showing the assembly in the fused position in full lines and showing two alternative positions of the fuse tube unit in dotted lines;

Fig. 2 is a similar elevational view of an alternative construction in which the contact arms are supported upon two insulators instead of one insulator;

Fig. 3 is a fragmentary top plan view of the assembly omitting the cross-arm bracket;

Fig. 4 is a similar bottom plan view of the assembly;

Fig. 5 is a side elevational view of the fuse tube unit in partial section on a plane determined by the axis of the tube showing the parts in the position which they assume after the fuse has blown; and

Fig. 6 is a fragmentary top plan view showing the upper end of the fuse tube unit and its supporting contact arm.

Fig. 7 is a fragmentary side elevational view of a modification utilizing a simpler type of fuse tube unit, which does not have a baffle for directing gases from the tube.

Referring to Fig. 1, 10 indicates in its entirety the fuse drop-out cut-out assembly, which preferably includes a supporting structure 11 and fuse tube unit 12 carried thereby. The support-

ing structure 11 may be embodied in the single insulator type shown in Fig. 1 or the two insulator type shown in Fig. 2. The single insulator type of Fig. 1 has a porcelain insulator 13, which is formed with a multiplicity of peripherally extending skirts 14 separated by grooves 15, and the insulator preferably has a reduced cylindrical portion 16 adjacent at its middle, and additional reduced cylindrical portions 17 and 18 at each end. The middle cylindrical portion 16 of the insulator is surrounded by a metal band 19, the ends of which are provided with two laterally projecting attaching flanges 20 and 21, having a screw bolt 22 passing through them and clamping them together.

One of the attaching flanges 21 has a side extension 23 provided with an aperture for receiving another screw bolt 24, which passes through the attaching flange 25 of an offset bracket 26 securing it to the clamping band 19. The offset bracket 26 has its body 27 extending at right angles to the attaching flange 25 and has another attaching flange 28 extending at an obtuse angle to the body 27.

Attaching flange 28 is secured to the supporting flange 29 of a cross-arm clamping member 30 by means of a screw bolt 31. The cross-arm clamping member 30 is adapted to engage one side of a cross-arm, the other side being engaged by a clamping plate 32, and the two clamping members 30 and 32 are drawn together by longer screw bolts 33, 34 passing through suitable apertures and located, one above the cross-arm and the other below it.

Thus the insulator 13 is adapted to be supported from a horizontal cross-arm in a tilted position, so that the fuse tube unit 12 will extend diagonally upward and away from the cross-arm in such manner that whenever the fuse tube unit hangs only from the upper contact arms, it hangs in a vertical position by gravity. By reason of this position of the insulator and fuse tube unit, the fuse tube unit is so supported that it may pivot upon either the upper trunnions or the lower trunnions by gravity to a position which it will retain by gravity.

The reduced cylindrical portions 17 and 18 at each end of the insulator 13 are bordered by one of the insulator skirts 14 on one side and a radially projecting rib 35 on the other side, forming a groove for receiving the clamping bands 36 or 37 of the upper and lower contact supporting arms 38, 39. These contact supporting arms comprise elongated narrow straps of sheet metal each having a partially cylindrical portion 36 or 37, which embraces the insulator, and each having a pair of parallel laterally projecting portions 41, 42, for supporting the spring contacts.

The parallel portions 41, 42 are provided with aligned apertures for receiving the clamping screw bolt 43, by means of which the cylindrical portion 36 or 37 is clamped on the insulator.

The contact supporting arm 38 is adapted to support a pair of fixed contact springs 44, 45, one being on each side of the arm 38, and the two other contact springs 44, 45 being spaced sufficiently from each other to receive the fuse tube unit 12 between them.

The contact springs 44 and 45 may be identical, and each is preferably formed with a U-shaped portion 46 that serves for its attachment to the arm 38. The U-shaped portion 46 has its legs separated sufficiently to receive a pair of screw bolts 47 and 48, which pass between the legs of

this U-shaped portion and are provided with washers for engaging the U-shaped portion 46.

The bolts 47 and 48 also pass through suitable apertures in each of the flanges 41, 42 of the supporting arm 38, and are used to clamp a similar spring contact 44 on the other side of the flange 41. The flanges 41, 42 are preferably spaced from each other by a metal spacer 49 having parallel apertures for the bolts 47, 48; and the spacer 49 may be provided with a connector 50 adapted to be used to secure a line conductor to the upper contact arm 38.

This connector comprises an apertured bolt passing through a flange and provided with a nut to clamp a conductor in said aperture against said flange.

The U-shaped portion 46 of the contact spring 45 has each of its legs provided with a circular turn 51 to add to the resiliency of the contact; and the circular turn 51 supports a diagonally extending straight portion 52, which extends outward and downward, and is provided with a partially circular groove 53 having substantially the same radius as the cylindrical trunnion 54 on the fuse tube unit which it engages.

From the curved trunnion engaging portion 53 the spring contact 45 is bent outwardly at 55, and has its extreme end 56 flaring downwardly away from a similar flared end portion 57 on the upper portion of the spring contact 45. The other leg of the U-shaped portion 46 also has a circular turn and a diagonally upwardly extending portion 58, which has a partially circular trunnion engaging portion 59. Thus the two diagonal portions 52 and 58 cross each other, and are so shaped that they engage the opposite side of the trunnion 54; and the springs are so initially tensioned that they come together at the outward bends 55, closing up when the trunnion 54 is not in between the springs.

The flaring end portions 56 and 57 are adapted to guide the trunnion 54 into the position of Fig. 1, when the fuse tube unit is supported by the operator by means of a clamp stick or fuse cut-out pole having an end fitting engaged in the ring 60.

The upper flaring portion 57 of each contact spring is preferably made longer to increase the length of the surface against which the trunnions 54 are to be engaged by the operator when he lifts the fuse tube unit 12 upwardly into engagement with the contact springs 44, 45.

The U-shaped portions 46 are adapted to be firmly anchored to the straps 41 and 42 by the two bolts 47 and 48; and the circular turns 51 engage the ends of the straps 41 and 42 and prevent the springs from sliding backwardly on the bolts 47, 48.

The spring contacts 44, 45 may be made of any suitable material, such as wire or rod, depending on the size of the device; and may be constructed of spring copper or spring bronze having suitable resilient and electrical conducting characteristics.

Referring to Figs. 1 and 4, the lower contact springs 61 and 62 may be substantially similar in construction to contact springs 44 and 45 just described, and may be secured to the lower contact supporting arm 39 in the same way by bolts 63, 64. The lower contact supporting arm 39 is preferably shorter than the arm 38 at the top for the reason that the fuse tube unit has such a construction at its lower end that the trunnion 65 is located closer to the insulator 13.

The two attaching flanges 66, 67 of the contact supporting arm 39 are spaced from each other by means of a metal spacer 68, which also

has apertures for the screw bolts 63, 64. Spacer 68 may be provided with a downward extension 69 having an electrical connector 70 for attachment of the line wire similar to that indicated at 50 on the upper contact arm and described above. Spacer 68 also has a forwardly projecting stop lug 71, which extends over a stop surface 72 on the contact casting 73 carried at the lower end of the fuse tube unit 12.

Stop surface 72 is preferably convex so that it may engage a concave stop surface 74 on the stop 71, tending to retain the lower contact casting 73 in the position of Fig. 1 when the jet action of the blowing of the fuse urges the lower end of the fuse tube unit 12 upward and to the left. This action serves to delay the mechanical opening of the circuit at the lower trunnion 65 until the arc has been extinguished in the fuse tube unit 12.

The spacer 68 is also provided with a curved cam abutment 76 on the end toward the fuse tube unit 12 to be engaged by the cam surface 76 on the fuse ejector lever 77, so that the cam 76 on this lever may be used to push the trunnion 65 downwardly toward the right out of its place between the contact springs 61 and 62.

Referring now to Fig. 2, this illustrates the construction of the supporting structure when it is provided with two insulators 78, 79, instead of the single insulator 13. In such case the insulators are preferably supported by means of a channel supporting bracket 80, the web of which has apertures for passing the screw bolts 81, which are threaded into metal fittings firmly anchored in the upper end of each insulator. The screw bolts 81 also pass through apertures in the attaching flanges 82 of an angle bracket 83 which has two body portions 84 and 85 at right angles to each other. Either body portion 84 or 85 may be used with a clamping plate 86 and a pair of embracing bolts 87, 88, to clamp the bracket 83 on a cross-arm or some other structural member, depending on the angular position of the part to which the bracket 80 is to be secured.

The upper flange of the bracket 83 will be used with the plate 86, shown in dotted lines, to secure the bracket to a structural member which extends horizontally, instead of having its edge extending vertically.

The insulator pins 133, carried by the insulators 78, 79, have attaching flanges 132 provided with apertures for screw bolts 131, by means of which the upper and lower contact arms are supported. A pair of steel straps 126 have their laterally turned ends 125 secured to the attaching flange 132 of the upper pin 133 with the straps extending parallel to each other.

A casting 134 is carried by the ends of the straps 126, and the casting 124 is of substantially U-shape, having a central yoke 135 and two side walls 136, 137. The straps 126 engage the inside of the side walls 136, 137 to which they are secured by screw bolts 138.

The outer surface of the side walls 136, 137 is formed with a groove 139 of substantially U-shape in elevation and adapted to receive the U-shaped end 140 of the upper contact spring 141. With the upper contact spring socketed in the casting 124, it may be clamped in place by the same screw bolt 138 which secures the casting 134 to the strap 126.

Casting 124 also has a transversely projecting flange 142 provided with an apertured screw bolt connector 143 for securement to a tap wire or line conductor. The yoke 135 of the U-shaped casting 134 has a clearance with respect

to the edge of the straps 126, so that the casting 134 may have a limited pivotal movement on the straps 126. This makes the upper contacts adjustable as a unit to provide for vertical self-adjustment between the upper and lower contacts.

Each of the contact springs 141 may consist of one unitary spring wire member formed as previously described, and shown in Figs. 2 and 6. The lower contact arm, which is carried by lower insulator pin 133, may consist of a casting 144 which has an attaching flange 145 for securement to the attaching flange 132 by bolts 131. This contact supporting casting 144 again has its sides 143 formed with a U-shaped groove 147 for receiving the U-shaped supporting part 143 of the lower contact springs 149.

Casting 144 has depending from one of its sides a connector flange 150, provided with an apertured screw bolt 151 within which a conductor may be inserted and clamped to connect the device to a line conductor or to a tap wire.

The sides of the casting 144 are also recessed at 152, to provide space for the coils 153 of the contact springs 154 which are used on the casting 144. These contact springs are two in number and they project longitudinally from the body of the casting 144, in position to engage the trunnion 155 of the fuse tube unit 156, which may be identical with that previously described.

The shape and construction of the contact springs 154 may be similar to that previously described. The casting 144 also has a depending curved stop flange 157, which extends over a complementary abutment 158 on the lower contact fixture 159. The abutment or stop 157 is engaged by the part 158 when the fuse blows to resist the distortion of the spring contacts by the force of the blast reacting on the fuse tube unit 156.

The ejector lever 160 again has the cam shaped formation 161 for engaging the end 162 of the casting 144, when the fuse ejector 162 pivots in a clockwise direction, thus forcing the contacts 155 out from their closed circuit position and from engagement with the springs 154.

The fuse tube unit 12 preferably comprises an elongated hollow tube of a suitable insulating composition, such as phenolic condensation compound, or a fibrous tube suitably impregnated with such a compound. The insulating tube 91 is adapted to house a standard fuse link having a fusible portion and a pig tail lead 92. The tube 91 supports metal castings or fittings 73 at the bottom and 93 at the top, preferably made of a copper alloy or other highly electrical conducting metal. The upper tube fitting 93 comprises a cylindrical, tubular body 94, the bore of which receives the tube 91 to which it is anchored by a plurality of transversely extending pins 95, Fig. 1.

The upper end of the tubular body 94 is threaded to receive a threaded cap 96, which clamps the head of the fuse against an annular shoulder in the fitting 93. Thus the upper end of the fuse is anchored in the tube fitting 93 and the fuse extends downwardly and out of the open end of the tube 91.

The upper fitting 93 also has a forward extension provided with a pair of cylindrical trunnions 54, one on each side, for engagement with the contact springs 44 and 45, as shown in Figs. 1 and 3. The forward extension also supports the integral ring 60, by means of which the fuse tube unit is manipulated.

The lower fuse tube fitting 73 also has a tubular portion 97 for receiving the lower end of the insulating tube 91, to which it is anchored by a plurality of transverse pins 98. The pins are riveted in the fitting and engage in grooves in the tube 91, whereby they prevent rotation of the fitting on the tube and anchor it against longitudinal movement.

The tubular portion 97 is open at 99, its lower end, but it preferably supports a discharge-directing baffle 100, which is intended to divert the molten and gaseous products downwardly and to the right away from the operator, who will be standing on the pole toward the left. This is important where the fault that caused the blowing of the fuse has not yet been corrected and the fuse blows again while the operator is installing a re-fused unit. The baffle 100 consists of a pair of parallel side walls 101 and a curved back wall 102, the inner surface of which curves downwardly and forwardly to direct the gases which come out of the open end 99 of the lower fitting 73.

The rear baffle wall 102 may have an aperture or groove for passing the leader 92 from the fuse, which also extends into a groove 103 in the end of the ejector lever 77. The outside of the ejector lever 77 may have a groove 104 in which the leader 92 extends and a pin 105, preferably provided adjacent the pivot point for the ejector lever, about which the leader 92 extends, to be finally anchored under a thumb nut 106 on the lower fitting 73.

The thumb nut 106 is carried by an integral web 107, which is also joined to a diagonally extending tubular spring housing 108. The web 107 and spring housing 108 also support an integral ring 109 on the lower fitting 73, which is used with a suitable operating stick to lift the fuse tube unit into engagement with its support. At that time the fuse tube unit, being supported from the lower ring 109, the tube 91 will hang downwardly in a position similar to the lower dotted line position of Fig. 1.

The ejector lever has its rear end adjacent the stop member 72 provided with a flat portion adapted to be received between parallel flanges 111 carried by web 107 and the ejector lever 77 is pivotally mounted on the fixture 73 by means of a pintle 110a. The location of this pintle 110a is concentric to the inner curved surface of the stop 72.

The tubular spring housing 108 of the lower fixture 73 carries a pair of laterally projecting trunnions 65, which are adapted to be received between the spring contacts 51 and 52 in the same manner as the trunnions 54 are received by springs 44 and 45. Tubular spring housing 108 has a bore 110 receiving a helical compression spring 112, which bears upon a forked push rod 113 engaging in a groove 114 in the edge of the ejector lever 77, urging the ejector lever in a clockwise direction.

The operation of the cut-out is as follows:

A fuse is first located in the tube 91, having the cap at its end clamped by the fuse cap 96. The leader 92 of the fuse extends out of the open end 99 and it is guided into the groove 103 in the ejector lever 77, which is moved clockwise until it engages the outside of the blast chute 100. The leader of the fuse is then passed around the pin 105 and clamped by the thumb screw 106 under tension.

The purpose of passing the leader about the pin 105 is to have the point of its attachment to the ejector lever 77 close to the point of pivot

110 of the lever so that there will be less tendency for the cable to slide across the end groove 103 of the ejector lever as the ejector lever pivots outward. Such sliding of the cable on the end of the levers causes friction which might interfere with the ejector lever action and the sliding can be wholly eliminated by attachment of the cable in alignment with the pivotal axis of the ejector lever. The passing of the cable around the pin 105 approximates this desirable position.

The fuse tube unit 12 now having been refused, it is supported upon a clamp stick or fuse stick, which passes through the ring 109 and the tube 91 then hangs downward in approximately the lower dotted line position of Fig. 1. It may then be lifted by the operator and the trunnion 65 brought into engagement with the spring contacts 61, 62 with the lower fixture 73 between the contacts and the trunnions between the flaring portions of each contact.

A push on the pole supporting the fuse tube unit will cause the flaring portions of the contacts to spread and permit the trunnions 65 to move into the groove, which will retain the trunnions 65 on the lower contact arm 60. The operator may then remove his pole from the ring 109 and insert it in the ring 60, and by means of the tool he may swing the fuse tube unit upward at its free end, pivoting about the trunnions 65 which are carried by the lower contact arm 68.

In this pivotal movement the upper trunnions 54 will come into substantial registry with the flaring ends 56, 57 of the upper contacts 44, 45 and the upper trunnions 54 may then be pushed in between the contacts into the grooves provided for the trunnions 54, where the trunnions will then be retained.

The fuse tube unit is now connected in circuit, but assuming that a fault still existed on the line when the upper trunnions 54 were pushed into engagement with the upper contacts 44, 45, the fault would not interfere with this motion, but at the same time if the fuse blew, such action would take place at the lower end of the fuse tube unit 12 and would result in the trunnions 65 being made free of the lower contact arm 68. Thus the final act of connecting the fuse tube unit in circuit does not interfere with the working of the drop-out, which may take place at the same time if a fault still exists.

When there is a surge of current of sufficient amount to melt the fuse, the fuse in the tube 91 melts and the resulting combustion and gases and explosion cause the melted parts of the fuse and the cable leader 92 to be ejected from the lower end of the tube 91. The melted metal, gases and other materials ejected from the lower end of tube 91 are diverted away from the operator by the blast chute 100, which protects the face and person of the operator standing on the pole to the left of Fig. 1.

As soon as the fuse has melted, the tension on the leader 92 is then relieved and the ejector lever 77 is urged clockwise by its spring 112, pulling out the loose end of the cable 92 and aiding in extinguishing the arc inside the tube 91. The forces exerted on the fuse tube unit 12 by the ejection of gases and fuse parts from the blast chute 100 urges the lower end of the tube upward and toward the left until the stop surface 72 engages the stop 74, thus preventing further strain on the spring contacts.

This same force, being held against further movement in the stops 72, 74, causes the upper trunnions 54 to tend to move backward into the

upper contacts 44, 45, and does not tend to release the upper trunnion 54 from its contacts, thus the construction assures the retention of the upper trunnions by the upper contact arm 38, and while the blast is going on the lower trunnions 65 are also retained by the lower contact arm 39. This also effects a delay in the mechanical opening of the lower contacts until after the arc is definitely extinguished.

As the ejector 77 moves clockwise its camming surface 76 engages the forward end of the spacer 68 and the ejector 77, having an increasing radius, cams the lower end of the fuse tube unit 12 downward and to the right until the trunnions pass out from between the parts of the contact springs 61, 62. Since the tube hangs in a tilted position and is pivoted at its upper end, the releasing of the lower end by the contacts 61, 62 permits it to pivot by gravity until it hangs almost vertically from the upper contact arm 38 with the circuit definitely broken between the lower contact fixture 73 and the contacts 61, 62. The hanging of the fixture in this dotted line position, shown at the right of Fig. 1, indicates that the circuit was broken due to a short circuit or other fault on the line.

Referring to Fig. 7, this is a fragmentary side elevational view of a modification similar to Fig. 1, but which employs a fuse tube unit 170 of a simpler construction. In this case the lower contact fixture 171 does not have a blast chute or baffle for directing the gases.

In this embodiment of the invention the supporting structure, comprising an insulator and the upper and lower contact supporting arms 38 and 39, may be exactly the same as previously described.

The same is true of the upper and lower contacts and the upper contact fixture 93 on fuse tube 172. The lower contact fixture comprises a tubular body 173, which is mounted on the fuse tube 172 at a point that is slightly spaced from the lower end 174 of the tube.

The tubular collar 173 is again secured by means of a plurality of transverse riveted pins 175, which engage grooves in the fuse tube 172. The collar 173 supports the diagonally extending tubular spring housing 176, which has the same ring 109 for engagement with a disconnect pole.

The tubular spring housing 176 contains the same compression spring, which urges the fuse throw-out lever 77 in a clockwise direction. The spring housing member 176 also supports the same trunnions 65; and the structure of the fuse throw-out lever or fuse ejector 77 is the same as in Fig. 1. A relatively small web 177 depends from the spring housing member 176 and has a clamping nut 178 for clamping the end of the leader cable, which passes around a pin 179.

The fuse tube 172 has its lower end extending slightly beyond the collar 173 in order to bring the open end 174 adjacent the end of the ejector lever 177.

For all practical purposes the lower contact fixture 171 is again located substantially at the lower end of the fuse tube 172.

The present embodiment is exemplary of another form of fuse tube unit embodying my invention and having contact fixtures at each end of a tube.

The present fuse cut-out is also adapted to be used as a simple disconnect switch, and this may be done at any time by pulling on the ring 60 until the trunnions 54 are pulled out of engagement with the upper contacts 44, 45, the

fuse tube unit 12 pivoting on its lower trunnions 65, which are kept in engagement with the lower contacts 61, 62. The fuse tube unit 12 will then swing by gravity to the dotted line position shown at the left of Fig. 1, which is also the position that the fuse tube assumes in the course of its being remounted, as previously described. This left-hand dotted line position of Fig. 1 is an indication that the circuit was broken purposefully by the operator instead of being broken automatically by the blowing of a fuse.

It will thus be observed that I have invented an improved fuse drop-out cut-out which has the following advantages:

1. It is adapted to use standard universal fuse links of any manufacturer and to be handled according to conventional practise.

2. The lower contact of the fuse tube is ejected from the bottom contact arm upon rupture of the fuse link so that the fuse tube will hang with its opening extending downward after operation, thus protecting the interior of the fuse tube from all adverse weather conditions.

3. The construction of the mechanism is such that the mechanical opening of the lower contacts is delayed until the arc has been definitely extinguished.

4. The jet action from the lower end of the tube tends to keep the upper end of the fuse tube in its proper position and to hold the lower end in position until after the blast, thus delaying mechanical opening until the arc has been extinguished.

5. The resilient spring contacts with their wide flaring ends are adapted to register with the trunnions of the fuse tube units, even though the dimensions may vary due to manufacturing tolerances and the contacts may give sufficiently to become self-aligning as they engage the trunnions.

6. Any undue strain on the spring contacts is prevented by the provision of stop surfaces which take the thrust that is caused by jet action during rupture of a fuse.

7. The present fuse unit may be operated as a disconnect switch, but when so operated its automatic mechanism is still "trip free," so that a fault on the line will open the lower contacts even while the operator is closing and holding the upper contacts.

8. The device gives a visual indication at all times whether it is actively in the circuit or whether the circuit has been broken purposefully at the top or automatically by rupture of a fuse at the bottom.

The present fuse construction and that of the assembly is relatively simple, sturdy, capable of economical manufacture, and adapted to be used for a long period of time without necessity for repair or replacement of any of its parts.

While I have illustrated a preferred embodiment of my invention, many modifications may be made without departing from the spirit of the invention, and I do not wish to be limited to the precise details of construction set forth, but desire to avail myself of all changes within the scope of the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States, is:

1. In a fuse drop-out cut-out the combination of an insulating support with a pair of contact arms carried in spaced relation to each other by said support, each of said contact arms carrying a pair of resiliently supported contact assem-

blies and each of said assemblies including a pair of diverging contact members leading to a pair of opposed curved portions adapted to receive and to retain for rotative motion a trunnion carried by a fuse tube unit, and each of said contact assemblies comprising a resilient wire bent backwardly upon itself and clamped to the contact arm, the two legs of each contact being formed with circular coils intermediate their point of attachment and the curved portions which engage the trunnions.

2. In a fuse drop-out cut-out the combination of an insulating support with a pair of contact arms carried in spaced relation to each other by said support, each of said contact arms carrying a pair of resiliently supported contact assemblies and each of said assemblies including a pair of diverging contact members leading to a pair of opposed curved portions adapted to receive and to retain for rotative motion a trunnion carried by a fuse tube unit, and a fuse tube unit comprising an insulating tube adapted to receive a fuse and having metal contact fixtures at each end, each fixture being provided with a pair of oppositely extending trunnions for engaging with said contact members.

3. In a fuse drop-out cut-out the combination of an insulating support with a pair of contact arms carried in spaced relation to each other by said support, each of said contact arms carrying a pair of resiliently supported contact assemblies and each of said assemblies including a pair of diverging contact members leading to a pair of opposed curved portions adapted to receive and to retain for rotative motion a trunnion carried by a fuse tube unit, and a fuse tube unit comprising an insulating tube adapted to receive a fuse and having metal contact fixtures at each end, each fixture being provided with a pair of oppositely extending trunnions for engaging with said contact members, said fixtures each being provided with lifting rings for engagement with a pole line tool.

4. In a fuse drop-out cut-out the combination of an insulating support with a pair of contact arms carried in spaced relation to each other by said support, each of said contact arms carrying a pair of resiliently supported contact assemblies and each of said assemblies including a pair of diverging contact members leading to a pair of opposed curved portions adapted to receive and to retain for rotative motion a trunnion carried by a fuse tube unit, and a fuse tube unit comprising an insulating tube adapted to receive a fuse and having metal contact fixtures at each end, each fixture being provided with a pair of oppositely extending trunnions for engaging with said contact members, the said tube being open at its lower end and the lower fixture being provided with a fuse-held mechanism for ejecting the trunnions from their engagement with the contacts at the lower end, whereby both in the fused condition and in the ruptured condition the tube is held with its open end downward and closed end upward to protect the interior of the tube from weather conditions.

5. In a fuse drop-out cut-out the combination of an insulating support with a pair of contact arms carried in spaced relation to each other by said support, each of said contact arms carrying a pair of resiliently supported contact assemblies and each of said assemblies including a pair of diverging contact members leading to a pair of opposed curved portions adapted to receive and to retain for rotative motion a trun-

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nion carried by a fuse tube unit, and a fuse tube unit comprising an insulating tube adapted to receive a fuse and having metal contact fixtures at each end, each fixture being provided with a pair of oppositely extending trunnions for engaging with said contact members, one of the contact fixtures on said fuse tube unit having a stop surface located below an adjacent stop surface on a contact arm, whereby the upward reaction of the fuse tube unit due to the jet action of a blast caused by rupture of a fuse is resisted by the stopping surfaces, which prevent overstraining of the spring contacts.

6. In a fuse drop-out cut-out the combination of an insulating support with a pair of contact arms carried in spaced relation to each other by said support, each of said contact arms carrying a pair of resiliently supported contact assemblies and each of said assemblies including a pair of diverging contact members leading to a pair of opposed curved portions adapted to receive and to retain for rotative motion a trunnion carried by a fuse tube unit, and a fuse tube unit comprising an insulating tube adapted to receive a fuse and having metal contact fixtures at each end, each fixture being provided with a pair of oppositely extending trunnions for engaging with said contact members, the said fuse tube unit having its lower fixture provided with a blast chute which directs the force of the blast from the fuse tube downwardly and away from the normal position of the operator with respect to the cut-out.

7. In a fuse drop-out cut-out the combination of an insulating support with a pair of contact arms carried in spaced relation to each other by said support, each of said contact arms carrying a pair of resiliently supported contact assemblies and each of said assemblies including a pair of diverging contact members leading to a pair of opposed curved portions adapted to receive and to retain for rotative motion a trunnion carried by a fuse tube unit, and a fuse tube unit comprising an insulating tube adapted to receive a fuse and having metal contact fixtures at each end, each fixture being provided with a pair of oppositely extending trunnions for engaging with said contact members, the said trunnions being so located with respect to the direction of discharge of the blast resulting from the rupture of a fuse from the lower end of the fuse tube that the reaction from the blast urges the trunnions into engagement with their contacts, thereby delaying mechanical opening until the blast has finished and the arc is therefore extinguished.

8. In a fuse drop-out cut-out the combination of an insulating support with a pair of contact arms carried in spaced relation to each other by said support, each of said contact arms carrying a pair of resiliently supported contact assemblies and each of said assemblies including a pair of diverging contact members leading to a pair of opposed curved portions adapted to receive and to retain for rotative motion a trunnion carried by a fuse tube unit, and a fuse tube unit comprising an insulating tube adapted to receive a fuse and having metal contact fixtures at each end, each fixture being provided with a pair of oppositely extending trunnions for engaging with said contact members, the said lower fixture being provided with a spring pressed, pivotally mounted, fuse ejector arm having a cam engaging the adjacent contact arm to force

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the trunnions out of engagement with the lower contacts upon rupture of the fuse.

9. In a fuse tube unit for a fuse drop-out cut-out the combination of a tube of insulating material having a bore adapted to receive a fuse with its leader, metal fixtures carried by each end of said fuse tube, each of said fixtures being provided with a pair of laterally extending cylindrical trunnions, one of said fixtures being provided with means for securing the end of the fuse in the tube and for closing the tube and the other of said fixtures being provided with an open end for discharge of the gases from the tube, the said open end being provided with baffle means for directing the blast which is caused by the rupture of a fuse away from the position of the operator who may be working near the fuse tube unit.

10. In a fuse tube unit for a fuse drop-out cut-out the combination of a tube of insulating material having a bore adapted to receive a fuse with its leader, metal fixtures carried by each end of said fuse tube, each of said fixtures being provided with a pair of laterally extending cylindrical trunnions, one of said fixtures being provided with means for securing the end of the fuse in the tube and for closing the tube and the other of said fixtures being provided with an open end for discharge of the gases from the tube, the said open end being provided with baffle means for directing the blast which is caused by the rupture of a fuse away from the position of the operator who may be working near the fuse tube unit, the other of said fixtures also having a spring pressed ejector lever pivotally mounted thereon and provided with a cam adapted to engage a part carried by an adjacent contact arm, whereby the release of the ejector lever due to the rupture of a fuse causes the cam to react against the contact arm, to separate the adjacent trunnions from their contacts.

11. In a fuse tube unit for a fuse drop-out cut-out the combination of a tube of insulating material having a bore adapted to receive a fuse with its leader, metal fixtures carried by each end of said fuse tube, each of said fixtures being provided with a pair of laterally extending cylindrical trunnions, one of said fixtures being provided with means for securing the end of the fuse in the tube and for closing the tube and the other of said fixtures being provided with an open end for discharge of the gases from the tube, the said open end being provided with baffle means for directing the blast which is caused by the rupture of a fuse away from the position of the operator who may be working near the fuse tube unit, the other of said fixtures also having a spring pressed ejector lever pivotally mounted thereon and provided with a cam adapted to engage a part carried by an adjacent contact arm, whereby the release of the ejector lever due to the rupture of a fuse causes the cam to react against the contact arm, to separate the adjacent trunnions from their contacts, the leader of the fuse extending out of the lower end of the fuse tube unit and across the end of the ejector lever and being carried about an abutment on the ejector lever, which is adjacent the point of pivot of the ejector lever to minimize the sliding of the leader across the end of the ejector lever.

12. In a fuse tube unit for a fuse drop-out cut-out the combination of a tube of insulating material having a bore adapted to receive a fuse with its leader, metal fixtures carried by each end of said fuse tube, each of said fixtures being

provided with a pair of laterally extending cylindrical trunnions, one of said fixtures being provided with means for securing the end of the fuse in the tube and for closing the tube and the other of said fixtures being provided with an open end for discharge of the gases from the tube, the said open end being provided with baffle means for directing the blast which is caused by the rupture of a fuse away from the position of the operator who may be working near the fuse tube unit, the other of said fixtures also having a spring pressed ejector lever pivotally mounted thereon and provided with a cam adapted to engage a part carried by an adjacent contact arm, whereby the release of the ejector lever due to the rupture of a fuse causes the cam to react against the contact arm, to separate the adjacent trunnions from their contacts, the said other fixture being provided with a tubular spring housing, and a helical spring in said housing, said spring engaging a forked push rod which acts upon the ejector lever.

13. A fuse tube unit for a drop-out cut-out comprising a tube of insulating material and a contact fixture carried by its upper end, said fixture having a bore for receiving a fuse tube and having a pair of laterally projecting trunnions for providing a pivotal mounting at its upper end, a lower contact fixture carried adjacent the other end of the tube, said contact fixture having a bore for receiving the insulating tube, and having a laterally projecting arm, a spring biased fuse ejector lever pivotally mounted on said arm, said lever having its end located to engage a fuse leader coming from the lower end of the insulating tube, and a pair of trunnions carried by said laterally projecting arm on said lower fixture, the said lower contact fixture having a downwardly extending wall extending beyond the end of the insulating tube and open only on the side away from the operator, said wall having its rear inner surface shaped to direct discharge gases and parts of the fuse downwardly and laterally away from the operator.

14. In a fused disconnect switch, the combination of an insulating support with a pair of contact supporting arms extending in substantially the same direction from said support and spaced from each other, each of said arms being provided with a plurality of pairs of contact members, and each pair of contact members including parts opposing each other and formed with opposed trunnion retaining formations and diverging guide formations, so that the trunnions of a fuse tube unit may be releasably held by either or both of said contact arms and may be forcibly engaged or disengaged with the pairs of contact members, said insulating support being disposed at an angle to the vertical, so that the fuse tube unit, when released by the lower contact arm, may pivot on the upper contact arm to a vertical position, and when the fuse tube unit is released by the upper contact arm, it may pivot on the lower contact arm to the vertical position, these two vertical positions depending from the upper contact arm or the lower contact arm, respectively, indicating two different modes of disconnection to the user.

15. In a fused disconnect switch, the combination of an insulating support with a pair of contact supporting arms extending in substantially the same direction from said support and spaced from each other, each of said arms being provided with a plurality of pairs of contact members, and each pair of contact members includ-

ing parts opposing each other and formed with opposed trunnion retaining formations and diverging guide formations, so that the trunnions of a fuse tube unit may be releasably held by either or both of said contact arms and may be forcibly engaged or disengaged with the pairs of contact members, said insulating support being disposed at an angle to the vertical, so that the fuse tube unit, when released by the lower contact arm, may pivot on the upper contact arm to a vertical position, and when the fuse tube unit is released by the upper contact arm, it may pivot on the lower contact arm to the vertical position, these two vertical positions depending from the upper contact arm or the lower contact arm, respectively, indicating two different modes of disconnection to the user, and a fuse tube unit comprising an insulating tube housing a fuse and a conducting fixture carried by each end of said insulating tube and electrically connected to the ends of said fuse, each of said fixtures being provided with a pair of oppositely extending cylindrical trunnions for simultaneous engagement between the pairs of contact members carried by either contact arm.

16. In a fused disconnect switch, the combination of an insulating support with a pair of contact supporting arms extending in substantially the same direction from said support and spaced from each other, each of said arms being provided with a plurality of pairs of contact members, and each pair of contact members including parts opposing each other and formed with opposed trunnion retaining formations and diverging guide formations, so that the trunnions of a fuse tube unit may be releasably held by either or both of said contact arms and may be forcibly engaged or disengaged with the pairs of contact members, said insulating support being disposed at an angle to the vertical, so that the fuse tube unit, when released by the lower contact arm, may pivot on the upper contact arm to a vertical position, and when the fuse tube unit is released by the upper contact arm, it may pivot on the lower contact arm to the vertical position, these two vertical positions depending from the upper contact arm or the lower contact arm, respectively, indicating two different modes of disconnection to the user, and a fuse tube unit comprising an insulating tube housing a fuse and a conducting fixture carried by each end of said insulating tube and electrically connected to the ends of said fuse, each of said fixtures being provided with a pair of oppositely extending cylindrical trunnions for simultaneous engagement between the pairs of contact members carried by either contact arm, and automatic means operated responsive to the rupture of the fuse, for ejecting the trunnions from engagement with the lower contact members, the tube pivoting about its upper trunnions to a position depending from the upper contact members.

17. In a fused disconnect switch, the combination of an insulating support with a pair of contact supporting arms extending in substantially the same direction from said support and spaced from each other, each of said arms being provided with a plurality of pairs of contact members, and each pair of contact members including parts opposing each other and formed with opposed trunnion retaining formations and diverging guide formations, so that the trunnions of a fuse tube unit may be releasably held by either or both of said contact arms and may be forcibly engaged or disengaged with the pairs

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of contact members, said insulating support being disposed at an angle to the vertical, so that the fuse tube unit, when released by the lower contact arm, may pivot on the upper contact arm to a vertical position, and when the fuse tube unit is released by the upper contact arm, it may pivot on the lower contact arm to the vertical position, these two vertical positions depending from the upper contact arm or the lower contact arm, respectively, indicating two different modes of disconnection to the user, and a fuse tube unit comprising an insulating tube housing a fuse and a conducting fixture carried by each end of said insulating tube and electrically connected to the ends of said fuse, each of said fixtures being provided with a pair of oppositely extending cylindrical trunnions for simultaneous engagement between the pairs of contact members carried by either contact arm, and automatic means operated responsive to the rupture of the fuse, for ejecting the trunnions from engagement with the lower contact members, the tube pivoting about

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its upper trunnions to a position depending from the upper contact members, said automatic means being operable while the switch is being re-fused, when the fuse unit is being pivoted on its lower trunnions in an upper direction into engagement with the upper trunnions.

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