

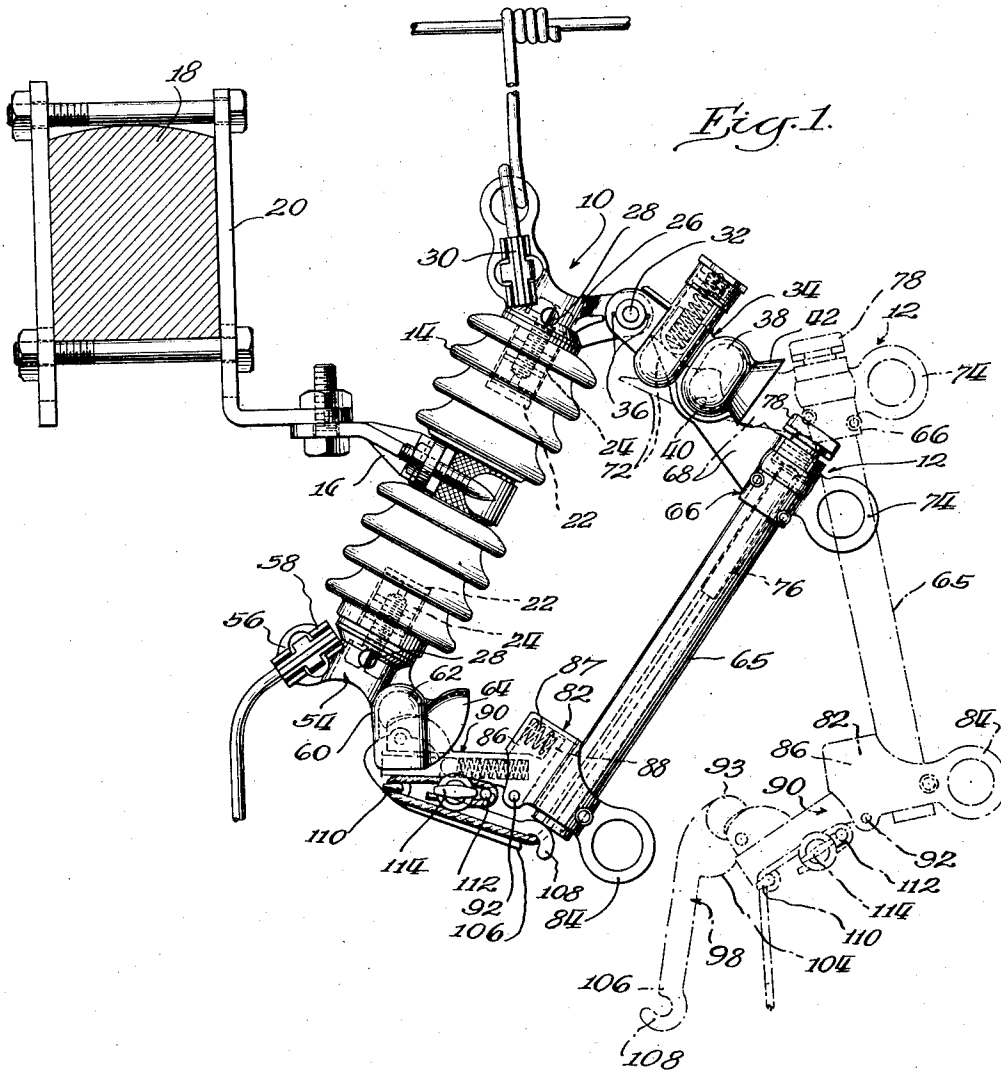
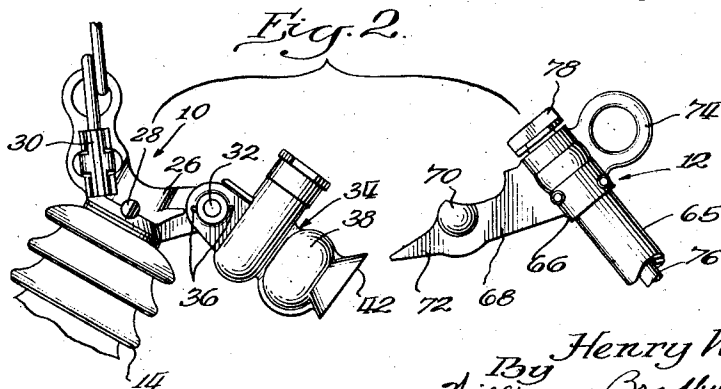
Aug. 27, 1940.

H. W. BODENDIECK  
FUSED DISCONNECT SWITCH

2,212,633

Filed April 16, 1938

2 Sheets-Sheet 1



Inventor  
Henry W. Bodendieck  
By *William, Bradbury, McCles & Hinkle*  
Attys.

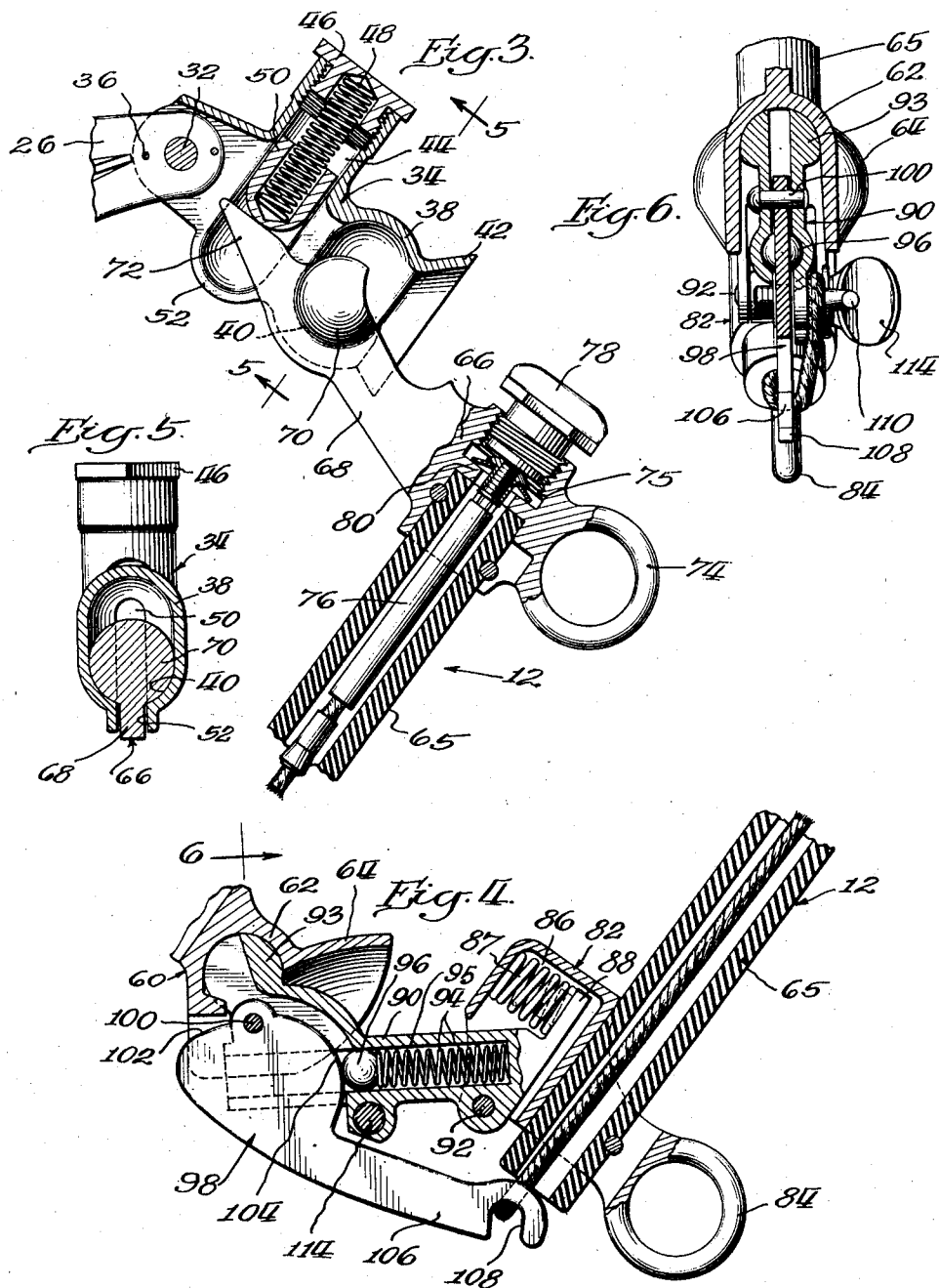
Aug. 27, 1940.

H. W. BODENDIECK  
FUSED DISCONNECT SWITCH

2,212,633

Filed April 16, 1938

2 Sheets-Sheet 2



Inventor.

Henry W. Bodendieck  
By  
William A. Bradbury, Inc. Chas. F. Nutter  
Attys.

## UNITED STATES PATENT OFFICE

2,212,633

## FUSED DISCONNECT SWITCH

Henry W. Bodendieck, Taylorville, Ill., assignor  
to Tips Tool Company, Inc., Taylorville, Ill.,  
a corporation of Illinois

Application April 16, 1938, Serial No. 202,409

11 Claims. (Cl. 200—114)

My invention contemplates and provides a novel and advantageous fused disconnect switch. The operating arrangement, while I have shown it adapted for cross arm use, can be arranged to perform equally as well on any other type of mounting, or in an enclosed porcelain box, or it may be used in any other manner where fuse protection is required. In conventional protective switches of this type, sometimes known as drop-out switches, the fuse cartridge automatically disengages from the upper contact and drops down into a substantially horizontal position when the fuse is blown. The present switch, however, disengages or kicks out from the lower contact when clearing itself upon the blowing of the fuse, thereby giving certain advantages to be pointed out later.

A fused disconnect switch of this type when functioning in a distribution outlet is provided to protect the electrical equipment and branch circuits from destruction in the event of a short circuit within the equipment protected or in the branch circuit. It also protects the electrical equipment and branch circuits from overheating due to currents in excess of the capacity for which the equipment or branch circuits were designed to carry. Such fused disconnect switches also sometimes serve to provide a means for manually opening the circuit whenever it is found desirable or necessary to do so.

Besides having the ability to clear the circuit satisfactorily in the event of a severe short circuit, these switches should be able to carry their rated load without overheating, and should have sufficient insulation to prevent current leakage and corona discharge even under bad weather conditions. Also, such a device should be as free as possible from small moving parts which are apt to fail under adverse conditions, as when the device is covered with sleet. Whatever moving parts as are necessary should be well protected from the weather.

Although a device of this nature must operate to clear the circuit quickly enough to prevent damage, the faster this operation is, the greater is the safety factor. Thus, although cutouts of this nature generally operate in from three cycles for the smaller sizes to twelve cycles on the larger sizes (a cycle being usually  $\frac{1}{60}$  of a second) faster operating speeds than these are considered as highly desirable plus values.

To aid in maintenance of the cutouts, they should be so constructed that a standard tool found on any service truck may be used either manually to open the switch, or to replace the fuse after the fuse has become ruptured. Also, when the fuse is blown, such fact should be readily discernible at a distance, since otherwise inspection may be difficult due to the presence of hot wires in the vicinity of the fuse.

In view of the above, it is a salient object of this invention to provide a novel fused disconnect switch having all of the above described valuable characteristics.

A further object of this invention is to provide a novel device of this character in which the contact break is made at the bottom of the cut-out instead of at the top thereof.

It is a further object of this invention to provide a novel fused switch of this character in which the contacts are very heavy and self-aligning, thereby providing good contacts at both ends of the fuse tube at all times.

Another object of this invention is to provide a means for quickly removing the fuse pigtail when the fuse becomes ruptured, thereby quickly extinguishing the arc within the fuse tube.

A further object is to provide a novel device of this character in which all operating springs are adequately shunted to prevent overheating.

An additional object of this invention, is to provide an electrical cutout in which the fuse tube kick-out mechanism does not depend upon gravity for its operation.

Another object is to provide a novel cutout in which the fuse tube may be readily removed for re-fusing.

Another object is to provide a novel fuse tube so constructed that continued operation of the device as a switch will put no considerable strain on the fuse element.

Another object is to provide a device of this character such that rupture of the fuse element causes the fuse tube to throw the melted metal and ionized gases away from other nearby apparatus.

A further object of this invention is to provide a device of this character in which the spring pressure completing the contact between the fuse tube and the other elements of the cut-out acts independently of the tension on the fuse element itself, so that the strains occasioned by manually opening and closing the switch are not imposed upon the fuse link.

Other objects and advantages will become apparent from a reading of the following description of a preferred embodiment of this invention.

In the drawings in which like parts are designated by like numerals throughout the several views,

Figure 1 is a side elevation of a device comprising this invention shown attached to a cross arm. In this view the fuse tube is shown in the closed or operating position, while the position of the fuse tube after the fuse has blown, is shown in broken lines.

Fig. 2 is a side elevation showing the top portion of the apparatus with the fuse tube separated from its supporting socket;

Fig. 3 is a central vertical sectional view of the top portion of Fig. 1 showing the operating mechanism in greater detail;

Fig. 4 is a central vertical sectional view of the lower portion of Fig. 1 showing in greater detail the operating mechanism at the lower end of the cutout;

Fig. 5 is a sectional view taken in the direction of the arrows along the line 5-5 of Fig. 3;

Fig. 6 is a sectional view taken in the direction of the arrows along the line 6-6 of Fig. 4.

Referring first to Fig. 1 of the drawings, the cutout comprising this invention may, for convenience, be divided into two elements. One of these elements 10 forms an insulating bracket which is attached to the cross arm, while the other unit is composed of a fuse tube for containing the fuse link and connectors at each end for connecting to the bracket 10.

The first of these elements, the bracket 10, consists of an insulator 14 provided with a clamp 16 around its mid portion to provide a means for securing the cutout to a cross-arm 18 through the medium of a cross-arm clamp 20. This clamp 16 should support the insulator at an angle of about 30 degrees from the vertical. The insulator 14 is provided at each of its ends with recesses 22 into which inserts 24 are cemented.

By means of the insert 24 at the top of the insulator 14, a casting 26 is attached rigidly to the insulator by means of a bolt 28. This casting has two wings, one of which carries a connecting clamp 30 for providing an electrical connection to one side of the circuit. The other wing of the casting 26 is flattened in a vertical plane and has a hole therethrough for the purpose of securing a fuse tube connector 34 to the casting 26 by means of a bolt 32. It will be seen that this connection provided between the parts 34 and 26 is such that the casting 34 may be moved slightly either upwardly or downwardly around this hinge bolt 32. This is done so that in constructing the cutout any variation in the length of the insulators 14 or in the several castings used in the construction of this cutout may be adjusted for by moving the part 34 upwardly or downwardly so as to bring the distance between the connector at the outward end of the casting 34 and the connector at the lower end of the insulator within a certain standardized distance from each other. Thus, although there may be some variation in the sizes of the component parts used in manufacturing this cutout, still in the assembled article, the fuse tube connectors will in all instances be the same distance apart, thereby promoting interchangeability between any number of these brackets and their cooperating fuse tubes.

After this necessary adjustment has been made and the bolt 32 tightened, holes may be drilled through both the castings 34 and 26. Pins 36 may then be driven into these holes so as to lock the castings 34 and 26 into a rigid unit.

The outward portion of the fuse tube connector 34 has a recess 38, the lower portion of which forms a hemispherical socket 40. In order to protect the socket 40 from the weather, the outermost portion of the casting is flared outwardly to provide a shield 42. This shield 42 also aids in properly locating the connector on the upper end of the fuse tube when this connector is inserted into the recess 38.

Adjacent the recess 38, the casting 34 is provided with a cylindrical opening 44 extending

vertically therethrough almost to the bottom of the casting 34.

The top of this opening 44 is threaded and provided with a screw cap 46 which confines the upper end of a spring 48, the lower end of which urges a piston 50 downwardly. The lower surface of the piston 50 is rounded and functions to urge the fuse tube into a substantially vertical position when the fuse link becomes ruptured, as will be explained later. The lower portion of the casting 34 is provided with a slot 52 which extends longitudinally of the casting from the bolt 32 to the shield 42 and connects the recesses 38 and 44.

The lower end of the insulator 14 carries a lower fuse connector 54 which is secured to the insulator in a manner similar to that used in securing the insulator to the casting 26. This connector 54 is constructed with two wings one of which 56 carries a clamp 58 for providing connection to the other side of the electrical circuit, while the other wing 60 provides a hemispherical socket 62 which is shielded from the weather by a projecting lip 64.

It will thus be seen that at each end of the insulator 14, the cutout is provided with brackets having hemispherical sockets into which balls provided at each end of the fuse tube may be clamped to complete the circuit between the connecting clamps 30 and 58.

The circuit between these two hemispherical sockets is completed by means of the fuse tube 12 which comprises a composite tube 65 consisting of a Bakelite outer portion with a liner of horn fiber. A tube of this nature is very well adapted for this use because the Bakelite is strong and has good dielectric properties, while the fiber liner has a deionizing effect and aids in rapidly quenching the arc which forms when the fuse element ruptures.

The upper end of this tube 65 is provided with a casting 66 having an outwardly extending blade 68, provided with a ball 70 for seating in the hemispherical socket 40. The blade 68 projects somewhat beyond the ball 70 thereby forming a finger 72 for engaging the lower surface of the piston 50. The side of the casting 66 opposite the blade 68 forms a ring 74 by means of which the fuse tube may be raised at the end of a hook stick, and placed with the ball 70 in its hemispherical socket 40. It should be noted that this ring 74 is so located that when the fuse tube is suspended from this ring, it hangs in exactly the position in which the ball is most easily inserted into the recess 38. With the fuse tube 12 hanging vertically, that is, in the position which it assumes after the fuse has blown or before the lower end of the fuse tube has been swung into latching position, the finger 72 need not touch the lower end of the piston 50. However, when the fuse tube is swung into locking relation with the socket at the lower end of the insulator 14, this finger 72 engages the piston 50 and compresses the spring 48.

The upper end of the casting 66 has a threaded recess 75 through which a fuse link 76 may be inserted into the composition tube 65. After the insertion of this fuse link 76, the threaded recess 75 is closed by means of a threaded plug 78 which when screwed tightly in place forms a good contact between the casting 66 and the fuse link 76 by forcing the head of the fuse link against a shoulder 80 at the bottom of the recess 75.

The lower end of the Bakelite tube 65 is provided with a casting 82. On one side of the tube 75

65 this casting 82 is supplied with a ring 84 for engagement with a hook stick for opening and closing the cutout. On the other side of the tube 65, the casting 82 provides a boxlike recess 86 containing a spring 87. This spring 87 is positioned in the recess 86 approximately at right angles to the axis of the tube 65 and bears against one end of a lever 88 thereby tending to force this end of the lever toward the Bakelite tube. This lever 88 is a portion of a casting 90 which is hinged at 92 to the casting 82 and extends outwardly in the direction of the connector 60 when the fuse tube is supported in its socket 40.

The outward end of this casting 90 is provided with a ball 93, so positioned that this ball may be pushed into the socket 62 by slight rotative movement of the casting 90 around the hinge point 92. That is, after the ball 70 at the upward end of the fuse tube 12 has been supported in the socket 40, and the hook stick moved to engage the ring 84 at the lower end of the fuse tube, then by swinging the lower end of this fuse tube in toward the insulator 14, the ball 93 may be forced into the socket 62 by slight compression of the spring 87. This spring 87 is designed to insure a good connection between the balls 93 and 70, and their respective sockets 62 and 40 by forcing them into these sockets with a pressure of approximately 24 pounds.

The outwardly extending portion of the casting 90 is hollow and provides a tube 95 containing a spring 94 which urges a ball 96 outwardly. The lower portion of this tube 95 is slotted as is a portion of the ball 93, and contains a cam lever 98 suitably pivoted at 100 so that when this lever is moved about the pivot 100, a portion of the camming surface 102 bears against the casting 60, and upon further movement forces the ball 93 from the socket 62. This lever 98 has a rounded portion 104 which bears against the ball 96 and compresses the spring 94 when this lever 98 is moved in the opposite direction from that just described. It will be seen from this that the compressed spring 94 acting through the ball 96, will push the lever 98 outwardly and disengage the ball 93 from the socket 62 unless this lever 98 is restrained against this movement. One end 106 of this lever 98 extends to the opening at the lower end of the Bakelite tube 65 and is there provided with a hook 108 for a purpose to be described.

When using the device, the screw plug 78 is removed from the upper end of the fuse tube and a standard pigtail type fuse inserted through the recess 75. The plug 78 is then replaced and screwed tightly against the upper end of the fuse link. The lever 98 is then moved to bring the hook 108 opposite the end of the Bakelite tube 65 and is held in place while the fuse pigtail is hooked through the hook 108 and brought downwardly toward the end of the casting 90 and bent around a second hook 110 secured near the outward end of this casting. The pigtail is then brought upwardly again and wrapped around another hook 112 and finally secured beneath a thumb screw 114 which is threaded in the casting 90.

From this it will be seen that this fuse pigtail serves to hold the hooked end of the lever 98 in a position adjacent the lower end of the Bakelite tube 65, in which position the camming surface 102 does not come in contact with the lower connector 60. The spring 94 is so proportioned that in this position the spring pressure tending to move this lever 98 outwardly, produces a pull

of approximately three pounds on the pigtail. This tension on the pigtail is sufficient to prevent the fuse from hanging on when the circuit becomes overloaded, while at the same time the strain is not great enough to endanger breaking small capacity fuse links. It will also be seen that the movement of the ball 93 inwardly and outwardly in making and breaking connection with the socket 62 acts against the spring 87 and does not increase the strain on the fuse pigtail while so doing.

After the fuse tube 12 has been re-fused in the above-described manner, the service man lifts this tube by the ring 74 at the end of a hook stick and inserts the ball 70 in the recess 40. The hook stick is then transferred to the lower ring 84 and the lower end of the fuse tube swung inwardly toward the insulator 14, so that the ball 93 is forced into the socket 62. In this position the fused cutout is ready for operation, and it should be noted that since the connectors at both ends of the fuse tube are of the ball-and-socket type, these contacts are self-aligning and provide a large contact area, in fact, it has been found by tests that the resistance of the ball and socket contacts are exceptionally low. It should be noted also, that all of the springs used in this device are adequately shunted by the several castings to prevent over-heating.

When this cutout becomes overloaded, the fuse link within the Bakelite tube ruptures, whereupon the lever 98 flies outwardly because of the spring 94, and whips the pigtail from the lower end of the Bakelite tube 65. This rapid removal of the pigtail from within the tube 65 quickly quenches the arc formed therein. As this lever 98 flies outwardly, the camming surface 102 is brought in contact with the casting 60 and forces the ball 93 from its socket 62, thus causing the lower end of the fuse tube to fly outwardly into a vertical position where it is prevented from returning toward the insulator 14 by the spring 48. Thus, by the position of the fuse tube, the line man can determine whether or not the fuse has been blown.

Another feature which brings about a rapid breaking of the circuit and also prevents the ionized gases and melted metal from being thrown onto other nearby apparatus is the fact that this fuse tube on swinging outwardly causes the metal and ionized gases to be thrown downwardly from the bottom of the tube, rather than ejecting these materials more or less in a horizontal direction as is the case when the fuse tube disengages at the top and drops downwardly as is the usual practice in this art.

To reservice the device, the service man merely inserts his hook stick into the ring 74 and lifts the fuse tube from its socket 40, re-fuses this tube and replaces it in the manner previously described.

To open the switch manually, it is merely necessary to engage the lower ring 84 with a hook stick and pull the lower end of the fuse tube outwardly.

Tests conducted on a 5,000 volt circuit with a cutout comprising this invention fused for 50 amperes with standard fuses gave the following results on five successive tests without touching the cutout between shots excepting to replace the fuse link. The device interrupted 1,300 R. M. S. amperes at 5,000 volts in an average time of two-thirds of a cycle. In none of these five tests did the time of interruption exceed one and one-third cycles.

In a similar test on a 5,000 volt circuit fused for 100 amperes, the device interrupted 2,000 R. M. S. amperes in an average time of 3.2 cycles or  $\frac{1}{16}$  second.

At the conclusion of these tests, the condition of the cutout was excellent, there was no evidence of burning or arcing, the fuse tubes were not thrown from the cutout, nor was there any sign of strain at the insulator inserts. High speed fuse links were not used, nor were the bores of the fuse tubes cleaned between successive tests.

Although I have described a preferred embodiment of my invention, it should be understood that departures may be made therefrom without departing from the scope of this invention, and that this description is for the purpose of illustration only.

What I claim as new and useful and desire to protect by Letters Patent is:

1. In a fused disconnect switch, the combination comprising: upper and lower connectors having sockets therein, a fuse tube, balls at the ends of said fuse tube to fit said sockets, means resiliently to force said balls into the sockets, and kick-out mechanism to force the lower ball from the socket in the lower connector when the fuse blows.

2. In a fused disconnect switch, the combination comprising: upper and lower connectors having sockets therein, a fuse tube, balls at the ends of said fuse tube to fit said sockets, means resiliently to force said balls into the sockets, a fuse link in said fuse tube having a pig-tail at one end thereof, kick-out mechanism to force the lower ball from the socket in the lower connector, and means coacting with said fuse pig-tail to restrain the operation of the kick-out mechanism.

3. In a fused disconnect switch, spaced connectors, a fuse tube, contacts at the ends of the fuse tube to engage said connectors, means resiliently to force said contacts and said connectors into engagement, spring urged impact producing means on said fuse tube adapted when released to impinge against one of said connectors so that by its reactive force it will push the associated contact away from its connector, and means to release the impact producing means when the fuse blows.

4. In a fused disconnect switch, spaced connectors, a fuse tube, contacts at the ends of the fuse tube to engage said connectors, spring biased impact producing means on the fuse tube adapted when released to knock the lower of said contacts free from its connector, the impact producing means adapted to be restrained by a fuse link in the fuse tube, means on said fuse tube for engagement by a switch stick or similar device for opening and closing a circuit through the switch by separating and engaging said lower contact and its connector, the separating and engaging of the last said contact and its connector adapted to impose no substantial additional strain on said fuse link.

5. In a protective device, the combination comprising: an insulator having hemispherical sockets at each end, a fuse tube, a ball at the top of said fuse tube, said ball adapted for engagement in one of said sockets, a second ball at the opposite end of said fuse tube, the said second ball adapted for engagement in the other of said sockets, resilient means to force said balls into tight engagement with the sockets, and kick-out

mechanism to force one of said balls from its socket when the fuse blows.

6. In a fused disconnect switch, the combination comprising: upper and lower connectors having sockets therein, a fuse tube, balls at the ends of said fuse tube, resilient means to urge said balls into tight engagement with said sockets, cam means to force one of said balls from its socket, said cam means adapted to be restrained by a fuse link in said fuse tube.

7. In a device of the class described the combination comprising, upper and lower connectors, a fuse tube, means on said fuse tube for resiliently engaging said upper and lower connectors, a fuse link in said fuse tube, and means on said fuse tube coacting with said fuse link to push the lower end of the fuse tube out of engagement with the lower connector upon rupture of the fuse link.

8. In a fused disconnect switch, the combination comprising: an insulator supported in an inclined position, upper and lower connectors on said insulator, a fuse tube, means on said fuse tube for removably engaging said connectors and supporting said fuse tube substantially parallel to said insulator, a fuse link in said fuse tube, kick-out mechanism on said fuse tube coacting with said fuse link to separate the lower end of said fuse tube from said lower connector when the fuse link ruptures, and resilient means to urge said fuse tube into a vertical position upon the operation of the kick-out mechanism.

9. In a protective device, the combination comprising: upper and lower connectors, a fuse tube adapted for engagement in said connectors, a pig-tail fuse in said fuse tube, kick-out mechanism on said fuse tube to force the fuse tube from the lower connector and to whip the pig-tail from the fuse tube when the fuse ruptures, said kick-out mechanism comprising a rotatable cam having a surface to engage a portion of said connector and to push said fuse tube from said connector as said cam is rotated.

10. In a fused disconnect switch, upper and lower connectors, a fuse tube, contacts secured to said fuse tube and adapted for resilient engagement with said connectors, means on said fuse tube for engagement by a switch stick to push the lower of said contacts into engagement with its associated connector or to pull said contact out of engagement with said connector to operate the device as a switch, a fuse link extending between said contacts and extending through said fuse tube, impact producing means on said fuse tube, spring means to urge said impact producing means against the lower of said connectors to push the lower contact therefrom, and means engaged by the fuse link to restrain the movement of the impact producing means.

11. In a fused disconnect switch, an insulator, upper and lower connectors on said insulator having sockets therein, a fuse tube, upper and lower balls on said fuse tube adapted for engagement with the sockets, means resiliently to force said balls into said sockets, means to kick out the lower ball of the fuse tube from the lower socket, a pig-tail fuse in the fuse tube, said kick-out mechanism adapted to be restrained by the fuse pig-tail, and the fuse tube adapted to be refused when removed from the connectors.

HENRY W. BODENDIECK.