

Feb. 22, 1938.

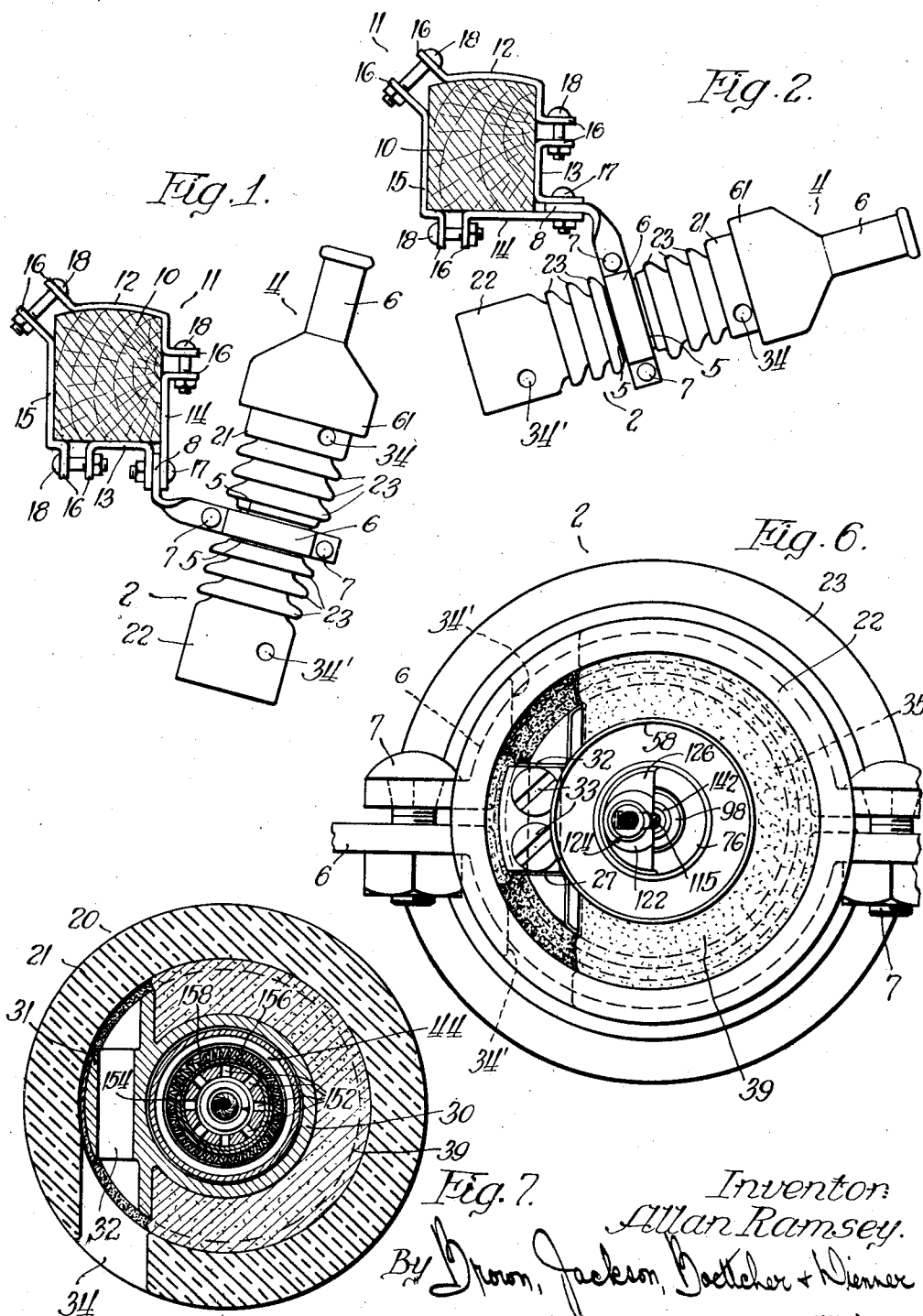
A. RAMSEY

2,108,993

CUT-OUT

Filed June 9, 1934

4 Sheets-Sheet 1



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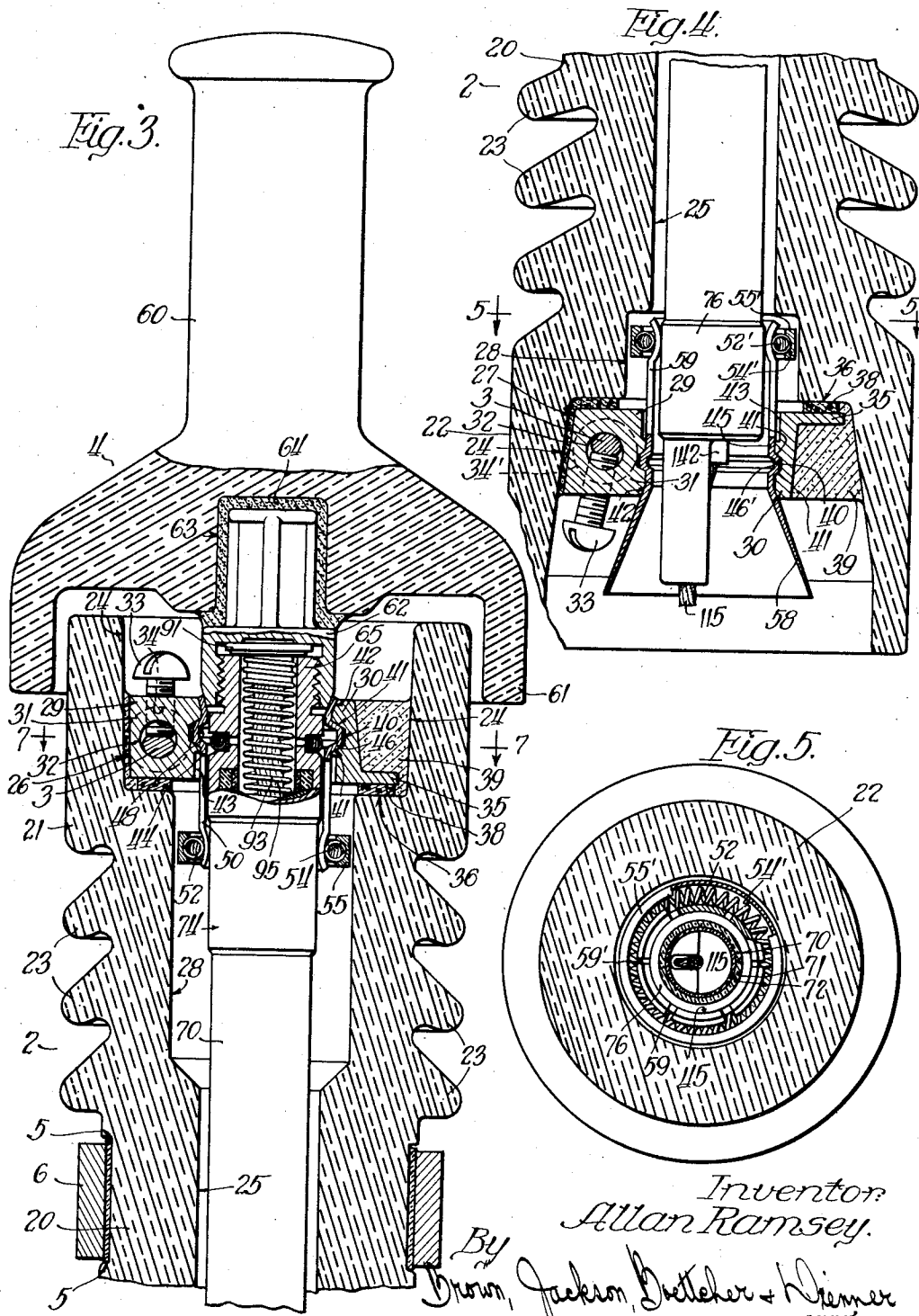
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4 Sheets-Sheet 2



Feb. 22, 1938.

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CUT-OUT

Filed June 9, 1934

4 Sheets-Sheet 3

Fig. 9.

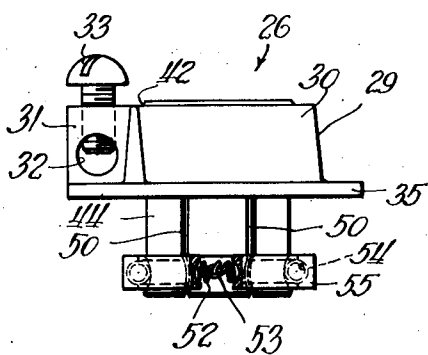


Fig. 8.

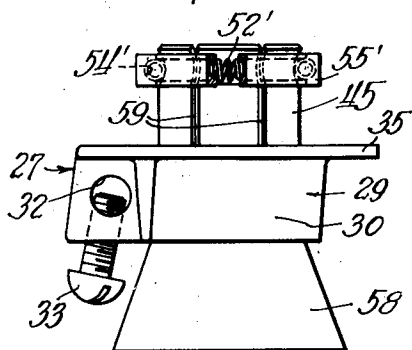
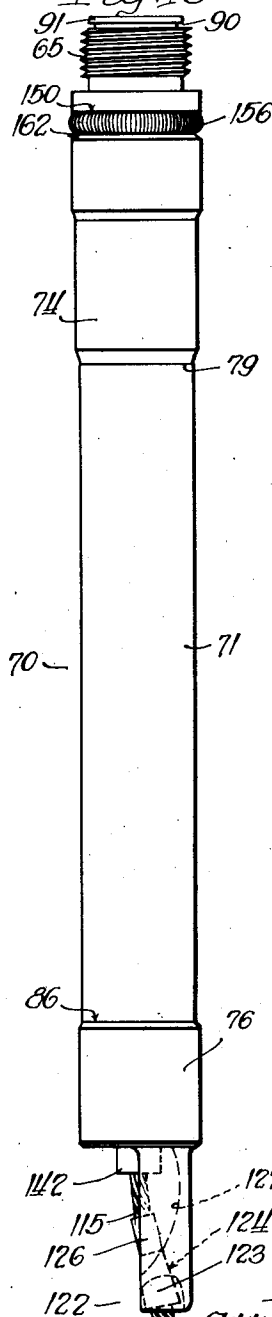


Fig. 10.



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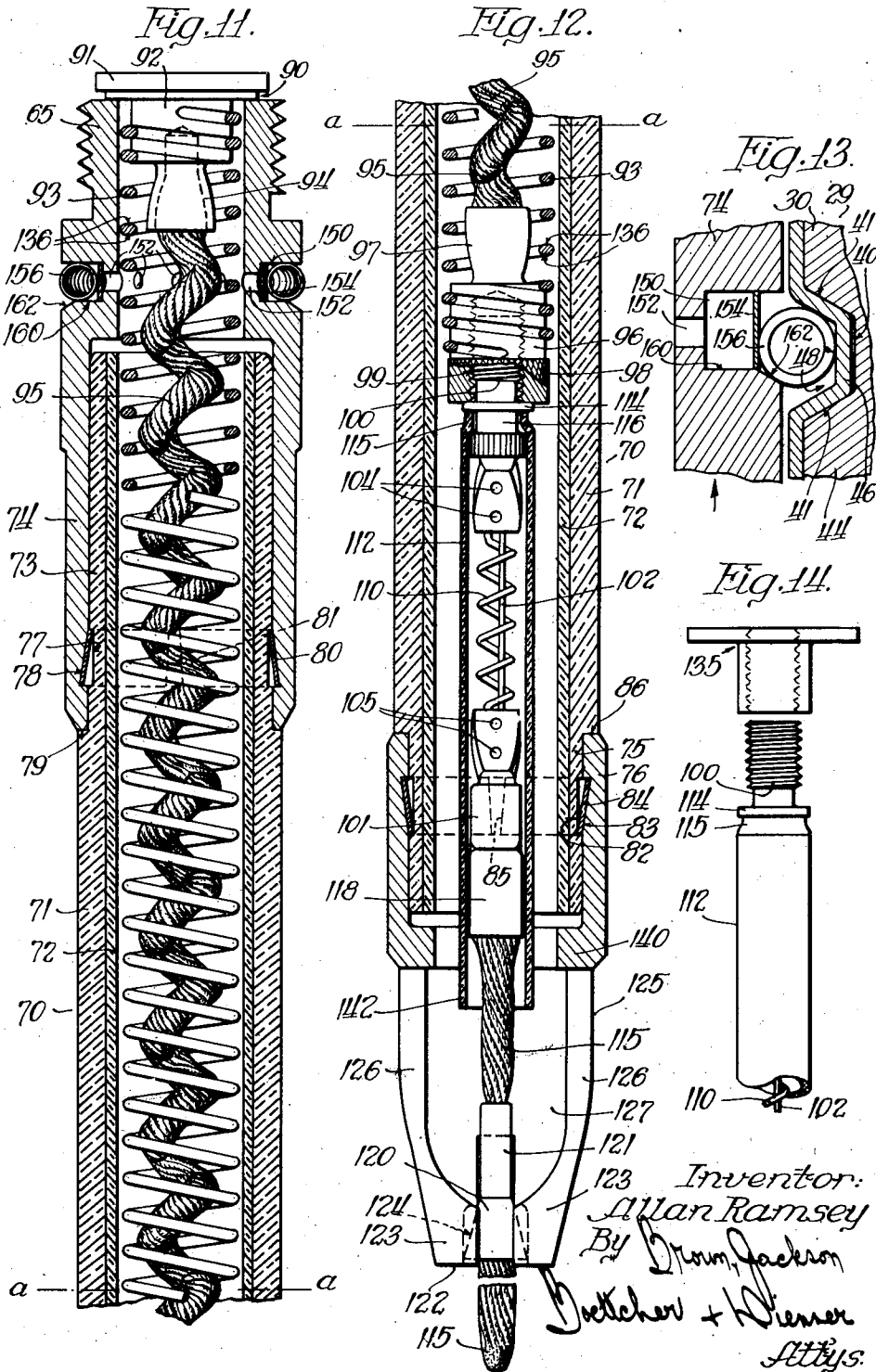
A. RAMSEY

2,108,993

CUT-OUT

Filed June 9, 1934

4 Sheets-Sheet 4



UNITED STATES PATENT OFFICE

2,108,993

CUT-OUT

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Application June 9, 1934, Serial No. 730,075

49 Claims. (Cl. 200—114)

My invention relates to cutouts for electrical circuits.

More particularly, my invention relates to an improved cutout for the primary circuits of an electrical distribution system. Primary circuits usually extend from electrical substations, or transformer stations on a high potential line, out over the immediate vicinity, and supply current to the service transformers for light and power distribution. Such circuits commonly carry potentials in the neighborhood of 7,500 volts, the voltage being sometimes less than this and sometimes slightly higher.

It is common practice to install primary cutouts in the primary leads of the distribution transformer. The function of the cutout is automatically to disconnect from and isolate from the feeder circuit a transformer which breaks down or is otherwise either partially or completely short-circuited. By thus isolating a defective transformer or a defective section of the circuit, outage of the entire feeder with its many transformer stations is prevented. That is, if the cutout were not there to disconnect the faulty transformer, the oil circuit breaker at the substation end of the feeder would be tripped out, thereby disconnecting service from a large number of customers.

A form of automatic disconnecting or circuit interrupting means used extensively in these circuits is the ordinary type of plug and socket cutout, wherein the plug carries a fusible link adapted to have connection with terminals in the socket, which terminals are connected in the line.

As ordinarily constructed, the plug of this type of cutout is held in the socket by frictional contact of the contact terminals on the plug with the contact terminals in the socket. The contact terminals in the socket are commonly slotted at numerous points to afford a greater resiliency of contact with the contact terminals or ferrules on the plug member of the device. The holding of the plug in the socket by frictional contact in this manner does not afford the desired security against blowing out or loosening of the plug by the reaction to the explosive force upon blowing of the fuse by short-circuit or overload and, as a result, the plug may be blown out of the socket or loosened to the extent that it may be jarred or otherwise displaced from its position in the socket.

Where frictional contact is relied upon to hold the plug in place and the contacts in proper engagement, there has been a definite obstacle to firm and positive locking of the plug in the sock-

et and the contact terminals on the plug in proper contact with the contact terminals in the socket, namely, the frictional resistance to blowing out or loosening of the plug upon overload or blowing of the fuse could not be sufficient to prevent the man reloading the fuse from pulling the plug freely out of the socket. With this limitation, the matter of holding the plug in place under the explosive force which accompanies blowing of the fuse has presented a difficult practical problem.

Bayonet locks which require turning of the plug after it is inserted or pushed into the socket complicate manipulation and present parts which are subject to corrosion and possible freezing in a manner which might make it difficult to remove the plug. And they present a lock which is in operative relation under normal conditions when there is no short circuit, overload or blowing of the fuse. Operativeness of the lock at this time is not required.

My invention aims to provide an improved form of locking device for locking the fuse plug in position within the socket without added resistance to free removal and insertion of the plug, and without requiring turning of the plug to lock it in place or presenting locking parts which are operative under normal conditions when there is no blowing of the fuse, or subject to corrosion or possible freezing.

According to my invention, I provide a locking device which is normally in released position with the plug in place in the socket, and is operable only at the instant required. This is attained in the illustrated embodiment of the invention by making the locking device operable by the pressure generated or the explosive force which occurs upon blowing of the fuse. And provision is made for releasing the lock when the explosive force is relieved. Other manners of rendering the locking device operative at the instant required are however, contemplated within the scope of the broader aspects of the present invention. The rendering operative of the locking device only at the instant required with the plug normally released enables free and quick withdrawal and insertion of the plug at all times.

Another object is to provide an improved arc chute arrangement for directing the gases and metal vapors out through the open bottom of the socket and away from the porcelain or other insulating body of the socket to protect the same from damage by the arc upon blowing of the fuse.

Another object is to provide an improved con-

tact clip construction and assembly, and an improved manner of securing the clip to the base or terminal block of the contact clip assembly. The particular clip assembly herein illustrated includes a contact clip slotted at numerous points to afford a greater resiliency of contact with the ferrules on the fuse tube and embraced by a tensioning spring which urges the contact fingers toward each other.

Another object is to provide an improved retaining ring arrangement for preventing deforming the contact fingers of the clip beyond their elastic limit.

Another object is to provide improved means for attaching or securing the ferrules or contact terminals to the fuse tube of the plug, which will provide strong joints at low cost and in small space, and will permit an ease of assembly and attachment of the ferrules to the fuse tube not heretofore provided.

Another object is to provide an improved flattened-side fuse spring for withstanding high pressures without distortion.

Another object is to provide a spring and cable assembly in which a stranded conductor is wound into a helix in a direction counter to the lay of the strands of the conductor, and placed within a spring wound into a helix in the direction of the lay of the strands of the conductor. This combination prevents the strands of the cable or the turns of the cable helix from paralleling the turns of the spring, thereby greatly reducing the tendency for the cable to be pinched between the turns of the spring, which spring collapses to establish the desired gap upon blowing of the fuse.

The fuse link assembly which I employ is of the type described and claimed in my copending application Serial No. 671,660, filed May 18, 1933, with certain improvements to make it universal or adapt it for use with the fuse device constituting a part of the plug of the cutout of the present invention, and with the dropout type ejector cutout box of my copending application Serial No. 734,262, filed July 9, 1934.

This fuse link assembly also embodies an improved visual indicator feature and other improvements which will hereinafter appear.

Another object is to provide an improved combination of an insulating outer sleeve having metallic ferrules constituting outer terminals, a pair of inner terminals within and adjacent one end of the outer sleeve and connected electrically with the outer terminals, one of the inner terminals being movable toward the other end of the sleeve, with a fusible element between the inner terminals and an inner sleeve of insulating material closely surrounding the inner terminals and closed by and attached to the movable inner terminal to move therewith toward the other end of the outer sleeve when the fusible element fuses.

Another object is to provide a silver fusible element in the present combination with the outer insulating sleeve and the inner insulating sleeve closely surrounding the inner fuse terminals and closed by and attached to the movable inner terminal to move therewith toward the other end of the outer sleeve when the fusible element fuses, whereby the silver fusible element is excluded from too free access to atmosphere.

My invention further provides an improved mounting bracket which permits mounting the cutout at the side of or under the cross-arm, and provides a tight clamping of the swivel joint by

placing the tongue of the cutout clamp between the split ends of the cross-arm bracket.

Further features and advantages and a concrete understanding of the present invention will be more apparent from the following detailed description taken in connection with the accompanying drawings, in which:

Figure 1 is a view illustrating my improved form of cutout mounted upon a cross-arm;

Figure 2 is a view similar to Figure 1, showing the cutout mounted in another position by means of the bracket constituting a part of the present invention;

Figure 3 is a fragmentary sectional view showing the upper end of the socket member and the plug member in operative association with the handle of the plug member and a portion of the fuse device in elevation;

Figure 4 is a fragmentary sectional view showing the lower end of the socket member with the lower end of the fuse carried by the plug member in operative association therewith;

Figure 5 is a transverse sectional view taken on the line 5-5 of Figure 4;

Figure 6 is an end view looking into the lower end of the socket member of the cutout, and showing the lower end of the fuse member of the plug part in operative association therein;

Figure 7 is a transverse sectional view taken on the line 7-7 of Figure 3;

Figure 8 is a side elevational view of the lower contact clip and terminal base assembly, partially broken away and in section;

Figure 9 is an elevational view of the upper contact clip and terminal base assembly, partially broken away and in section;

Figure 10 is a side elevational view of the fuse member of the cutout;

Figures 11 and 12 are parts of a longitudinal sectional view through the fuse member; (Figure 12 is to be laid below Figure 11 with the dot and dash line a-a of Figure 12 on the dot and dash line a-a of Figure 11).

Figure 13 is a fragmentary detail section on an enlarged scale and showing the locking device for locking the plug member of the cutout within the socket member; and

Figure 14 is a fragmentary elevational view of the upper end of the fuse link assembly showing the same removed from the retraction spring and cable assembly and another form of terminal button applied directly to the upper fuse terminal thereof.

The cutout of my present invention comprises an outer socket member 2, which carries the main contact terminals included in the line 3-3, and the removable plug member 4, which bears the fuse device for interrupting the circuit in case of overload or short circuit. It will be noted that the plug member 4 is adapted for insertion in the top of the socket member 2, this arrangement bearing particular relation to the type of fuse employed, as will hereinafter appear.

The socket member 2 principally consists of a tubular member of wet process porcelain, or other suitable insulation, finished with a chocolate glaze inside and out, and formed externally and intermediate its ends with two longitudinal spaced annular shoulders 5-5, between which engage a split clamp 6. The clamp 6 is gripped tightly about the body of the socket 2 by a pair of bolts 7 extending through the sides of the clamp and engaged in suitable nuts. One end of one side of the clamp 6 is extended and bent laterally to form a mounting tongue 8 which

is secured, for example, to the cross-arm 10 of a transformer pole or other point of disconnection by a bracket 11. The holes through the clamp part having the extending tongue 8 for the bolts 7 are preferably of square or polygonal form, and the bolts 7 preferably have corresponding square or polygonal portions engaging therein to prevent turning of the bolts in drawing up the nuts.

The bracket 11 comprises four bracket parts 12, 13, 14 and 15. The part 12 fits the top of the cross-arm 10 and has one end turned down along one side of the cross-arm. The part 15 fits against the opposite side of the cross-arm and has its lower portion offset or turned in beneath the bottom of the cross-arm. These parts 12 and 15 have outwardly directed flanges 16 at their opposite ends. The parts 13 and 14 are interchangeable. In Figure 2, the part 14, which is of L-shaped form, is fitted against the bottom of the cross-arm with its flange 16 in spaced relation to the flange on the adjacent end of the part 15 and its free end extending out from the opposite side of the cross-arm, and the part 13 is applied with its base against the side of the cross-arm between the flange 16 on the part 12 and the extending end of the clamp part 14, and with one of its flanges 16 in spaced relation to the flange 16 on the adjacent end of the clamp part 12 and its other flange 16 adjacent the extending end of the part 14. The tongue 8 of the clamp 6 is swiveled between the extending end of the clamp part 14 and the flange on the adjacent end of the clamp part 13 upon a carriage bolt 17 which may be loosened to permit the cutout to be adjusted or swung to any angular position about the axis of the bolt 17, and tightened to clamp the cutout firmly in the position in which it is arranged. Carriage bolts 18 pass through the other pairs of spaced flanges 16 for gripping the bracket tightly in place about the cross-arm 10. The arrangement of Figure 2 affords a generally horizontal mounting of the cutout under the cross-arm 10.

Where it is desired to mount the device on the side of the cross-arm, as shown in Figure 1, the clamp parts 13 and 14 are interchanged. This directs the extending end of the part 14 downwardly from the bottom of the cross-arm instead of outwardly from one side, as before, and disposes the axis of the bolt 17, forming the swivel connection between the tongue 8 and the bracket 11, horizontally instead of vertically, as before, and the cutout on one side of the cross-arm. By reversing the application of the bracket 11, the cutout may, of course, be disposed at the opposite side of the cross-arm in either case, the swivel connection at 17, in each case, permitting adjustment for mounting or arrangement of the cutout at any desired angle.

Referring to the detailed construction of the socket member 2 as shown in Figures 3 and 4, it will be noted that this member is in the form of a hollow sleeve 20, headed at its upper and lower ends at 21 and 22 respectively, and is formed externally with petticoats 23 between the upper headed end 21 and the upper shoulder 5 and between the lower shoulder 5 and the lower headed end 22. This socket member 2 is preferably constructed of wet process porcelain, as already explained, although other suitable insulating materials may be employed within the scope of my present invention. Contact terminal assemblies 26 and 27 are provided in the enlarged bores 24 at the upper and lower ends of the central bore

25, and the upper and lower ends of the central bore 25 are enlarged at 28 for a purpose which will hereinafter appear.

The upper and lower contact terminal assemblies 26 and 27 each comprises a clip base, preferably constructed of cast hard bronze or other suitable conducting material. The clip bases 29 at the upper and lower ends are substantially alike. Each has a hub or sleeve portion 30 provided integrally at one side with a thickened lug 31 having a transverse aperture 32 for receiving the bared end of the line wire 3 from either side, and each clip base has a pair of screws 33 for binding the inserted ends of the line wires 3 securely in place. The side wall of the headed upper end 21 of the sleeve 20 has an opening 34 for leading the upper line conductor 3 into one side of the upper clip base, and the side wall of the headed lower end 22 of the sleeve 20 has openings 34' at opposite sides for leading the lower line conductor 3 into either side of the lower clip base 29. The lower end of the upper clip base and the upper end of the lower clip base are provided integrally with base flanges 35 extending annularly between the opposite ends of the lugs 31. The bases 29 seat upon the radial shoulders 36 between the bores 24 and 28 at the upper and lower ends of the socket, and gaskets 38, preferably of relatively soft composition cork or other suitable material are interposed between the shoulders 36 and the clip bases 29. These bases 29 are secured in place by a cement or alloy binder or filler 39 filled in around the bases 29 which are centered in the bores 24 and over the flanges 35 in the illustrated embodiment up to the upper and lower ends of the hub or sleeve portions 30 and adhering to the inner surfaces of the bores 24 and to the bases 29 to secure the same firmly in place.

The bore or hollow interior through each clip base 29 has an annular groove 40, the sides of which, preferably, are tapered as shown at 41, and the upper end of the bore through the upper base and the lower end of the bore through the lower base preferably are tapered outwardly slightly at 42. The lower end of the upper base and the upper end of the lower base are counter-bored slightly at 43 to permit the desired resiliency of the upper and lower contact clips 44 and 45.

The upper contact clip 44 is preferably constructed of relatively soft copper tubing or other suitable material. In assembling the upper clip and base, the tubular clip 44 is inserted into the bore through the clip base 29 into the position shown, and the clip 44 is then rolled or spun at 46 out into the annular groove 40 to secure the clip in place in the base 29. This rolling or spinning is preferably accomplished without changing the outside diameter of the clip, and the opposite sides of the external bead thus formed are tapered in conformity with the taper of the sides of the groove 40 and fit snugly thereagainst. The upper end of the clip 44 is preferably rolled or spun out against the tapered end of the bore through the upper clip base 29. The rolling or spinning of the clip 44 at 46, in addition to forming an external bead and securing the clip in place in the base 29, forms an internal groove 48 for cooperation with the locking device for the plug, as will hereinafter appear.

The clip 44 is slotted upwardly from its lower end at numerous points, as indicated at 50, to form spring contact fingers and afford a greater resilience of contact with the ferrules on the

fuse member of the plug 4. The lower ends of the spring contact fingers are deformed inwardly slightly, leaving an annular depression externally about the contact fingers, and these fingers are embraced by a garter spring 52 lying in the annular depression thus formed. The spring 52 is coiled left-hand, in the illustrated embodiment of the invention, with maximum initial tension, and may be heat-treated after forming the hooks 53 at the opposite ends of the same (Figure 9). When the spring 52 is applied and the hooks 53 engaged as shown, the spring urges the contact fingers of the clip toward each other. The spring 52 is preferably light and soft acting so as not to produce too much friction on the ferrule. The spring 52 lies in the groove 54 in a reinforcing ring 55 which may be formed of brass rod or other suitable material, and which prevents deforming the contact fingers of the clip beyond their elastic limit. This is important because if the contact fingers are deformed beyond their elastic limit, a permanent set is produced which cannot be overcome by the garter spring 52. The enlargement 28, at the upper end of the bore 25, provides adequate accommodation for the garter spring and reinforcing ring assembly around the contact fingers of the clip 44.

The lower contact clip 45 is likewise preferably constructed of relatively soft copper tubing or other suitable material. This clip and its base 29 are assembled in the manner of assembling the upper clip and base, namely, the tubular clip 45 is inserted into the bore through the lower clip base 29 into the position shown, and the clip is then rolled or spun at 46' out into the annular groove 40 to secure the clip 45 in place in the base 29. As with the upper clip, this rolling or spinning is preferably accomplished without changing the outside diameter of the clip 45, and the opposite sides of the external bead thus formed are tapered in conformity with the taper of the sides of the groove 40 and fit snugly thereagainst. The lower end of the clip 45 extends downwardly from the bottom of the base 29 and is spun or rolled outwardly to trumpet or flaring shape as illustrated at 58. This trumpet or flaring end 58 of the clip 45 forms an arc chute arrangement for directing the gases and metal vapors out through the open bottom of the socket and away from the porcelain or other insulating body of the socket to protect the same from damage by the arc upon blowing of the fuse.

The clip 45 is slotted downwardly from its upper end at numerous points as indicated at 59 in the manner of the slotting of the lower end of the clip 44 to form spring contact fingers and afford a greater resiliency of contact with the ferrule on the lower end of the fuse member of the plug 4. The upper ends of the spring contact fingers thus formed are deformed inwardly, leaving an annular depression similar to the annular depression at the lower ends of the contact fingers of the clip 44, and the garter spring 52', similar to the spring 52, embraces the fingers of the clip 45 to urge these fingers toward each other. The spring 52' lies in the annular depression at the upper ends of the clip fingers and in a groove 54' in a reinforcing ring 55' similar to the ring 55 for the upper clip. This ring 55' prevents deforming the contact fingers of the clip beyond their elastic limit in the manner described in connection with the corresponding spring and ring for the upper clip. The enlargement at 28 of the lower end of the

bore 25 accommodates the lower clip fingers and the surrounding spring and reinforcing ring.

Referring now to the detailed construction of the plug member 4, the handle 60, which is preferably constructed of wet process porcelain, chocolate glazed, or other suitable insulating material, is formed with a depending hood 61 which is adapted to fit down over the upper end of the socket 2, thereby excluding moisture and shielding the operator's hand from any possible injury in pulling or inserting the plug. An insert 62, preferably formed of cast hard bronze or other suitable material, has at its upper end a ribbed post cemented firmly in place in an opening 63 in the handle by a suitable cement or alloy binder indicated at 64. The lower end of the insert 62 is enlarged slightly and internally threaded or tapped for receiving the externally threaded upper end 65 of the upper ferrule 74 for the fuse tube 70.

The fuse which I employ in my improved cut-out is of the type described and claimed in my copending application Serial No. 671,660, filed May 18, 1933, and embodies a number of improvements in this type of fuse, as will hereinafter appear. This fuse clears minor or low current faults as positively as it clears more severe faults, as during a short circuit or heavy overload; its operation does not require explosive action, but in all cases the instantaneous collapse of the coil spring establishes a definite and sufficient gap regardless of the amount of fault current. At the same time short circuit and heavy overload faults are cleared without attendant danger that excessive pressure may cause destruction of the equipment. Heavy pressures occur within a small cylinder or chamber which is a part of the fuse link, and the tube proper is freely vented. Pre-heating or corrosion does not deteriorate and result in "causeless" operation of the fuse element, because this element is made of a pure metal which has proved to be vastly superior from the standpoint of its resistance to corrosion and its ability to operate at a higher percentage of its melting point without deterioration. It is not necessary to replace unblown fuse links after an over-current has blown other fuses in the same circuit, and a permanent and exceptional accuracy of fuse ratings is obtained. The time delay characteristic and short arcing time make the fuse exceptionally suitable for selective operation.

Referring particularly to Figures 10, 11, 12 and 13, the fuse is enclosed in a tube designated 70 in its entirety which is preferably formed of grade "X" rolled "Bakelite" or phenol condensation product tubing 71 rolled on a fiber liner 72, or other suitable insulating material. At its upper end the outer diameter of the tube 71 is reduced at 73 to receive the upper ferrule 74 which is preferably formed of brass rod or other suitable material. At its lower end, the outer diameter of the tube 71 is reduced at 75 to receive the lower ferrule 76 which is preferably formed of cast hard bronze or other suitable material. The extreme ends of the tube 71 are preferably chamfered slightly, as illustrated. The upper reduced end of the tube 71 is provided with an external groove 77, and the inner surface of the ferrule 74 is provided with a downwardly flaring or generally conical groove 78 which, when the ferrule is in place upon the reduced upper end of the tube with its lower end in engagement with the shoulder 79, registers with the groove 77. A conical spring snap ring 80, formed of

seamless brass tubing (half hard) and split at 81, engages the shoulder at the upper end of the groove 77 and the shoulder at the lower end of the groove 78, and anchors or secures the ferrule 74 firmly to the tube without screws or the like and at low cost, and in a small space. At the same time, an exceptionally strong joint is provided between the tube and ferrule. In assembling these parts, the snap ring 80 may be applied to the groove 77 before placing the ferrule upon the tube. Then as the ferrule is passed down over the upper end of the tube, the larger lower end of the snap ring may be pressed into the groove 77 to permit passage of the ferrule into place, whereupon the ring 80 will spring out into the conical groove 78 and, by its engagement with the shoulder at the lower end of this groove, will anchor the ferrule firmly in place upon the tube.

The lower reduced end 75 of the tube 71 is provided with a groove 82 similar to the groove 77, and the inner surface of the ferrule 76 is provided with an upwardly flaring or generally conical groove 83 corresponding with the groove 78. A spring snap ring 84 slit at 85, similar to the ring 80, and engaging in the grooves 82 and 83 in a similar manner, locks or secures the lower ferrule 76 firmly in place upon the lower reduced end of the tube 71. This ring 84 and the ferrule 76 may be applied in the manner described in connection with the ring 80 and the ferrule 74, and the upper end of the ferrule 76 engages the annular shoulder 86 at the upper end of the lower reduced portion 75.

The upper cable terminal and spring fastener 90, which is preferably formed of brass rod or other suitable material, is flanged or headed to form a button 91 which seats upon the upper end of the ferrule 74. The reduced portion 92, depending integrally from the button 91, has a helical groove into which the upper few turns of the coiled fuse spring 93 are threaded, and an integral depending socket 94 receives the upper end of the stranded cable 95 and is pressed securely thereon. The stranded cable 95, which is preferably of stranded copper, or other suitable material, is connected to the lower cable terminal and spring fastener 96 by rigidly securing it in the socketed part 97 thereof, as by inserting it in the socket and pressing or flattening the socket firmly thereon and into secure engagement therewith. The terminal and fastener 96 has a helical groove for threaded engagement with the lower few turns of the spring 93. The terminal 96 is knurled externally at 98 and is tapped or threaded internally at 99 for receiving the threaded upper end of the upper fuse terminal 100 which is formed of copper or other suitable or preferred material.

The lower fuse terminal 101 is formed of similar material, and this terminal and the terminal 100 are connected by a strain wire or tensile element 102 arranged to bear the mechanical stress. The upper end of the wire 102 is inserted in a socket or opening in the lower end of the terminal 100, and is secured rigidly in place as by punching at 104 the stock of the terminal 100 into firm binding engagement with the wire, or by flattening the socket firmly upon the wire. The lower end of the wire 102 is inserted in a socket or opening in the terminal 101, and is secured rigidly in place as by punching at 105 the stock of this terminal into firm binding engagement with the wire, or, as before, by flattening the socket upon the wire.

The fuse wire 110 preferably is of silver, and the strain wire 102 preferably is of nickel chromium wire. The upper end of the fuse wire 110 is inserted in an opening in the terminal 100 and is secured firmly in place therein as by punching the adjacent side of the terminal into firm engagement therewith, or flattening the same thereon. The lower end of the wire 110 is inserted in an opening in the terminal 101 and may be secured firmly in place therein as by punching the adjacent sides of the terminal 101 into firm engagement therewith, or flattening the same thereon. Intermediate its ends, the fuse wire 110 is coiled about the strain wire 102.

It has been found that silver, as used in devices of this sort, has unusual characteristics. First there is not an appreciable absorption of oxygen until temperatures close to the melting point are reached, and this oxygen is released again upon a slight drop in temperature. Even if there is some oxidation, the oxide has conducting properties similar to those of silver. Also, it has been found that under certain circumstances, silver will form undesirable compounds with other elements on blowing. In some of the experiments and tests made on fuses under various conditions, the blowing of the fuse appeared to be more violent than the power current would seem to account for.

This applicant, by a combination of the silver fusible element with the outer insulating sleeve and the inner insulating sleeve closely surrounding the inner fuse terminals and closed by and attached to the movable inner terminal to move therewith toward the other end of the outer sleeve when the fusible element fuses, all as will hereinafter appear, excludes the silver fusible element from too free access to atmosphere, and maintains this exclusion upon blowing of the fuse and movement of the movable fuse terminal. The highly advantageous character of the silver, namely, that it appears to produce less metallic vapor for a given rating; that it will retain its form up to a very high temperature; that it will not oxidize and change its rating for the oxide appears to be conductive, and that the time-current characteristic, which is an all-important factor under certain circumstances, can readily be maintained over long periods, is utilized.

The fuse wire 110 of silver or other fusible conducting material, preferably whose oxide is a conductor, and the comparatively high resistance strain wire 102, both are completely enclosed and shielded from atmosphere, gases and moisture, by a tube 112 formed of fiber or other insulating material. The upper end of the tube 112 closely surrounds the upper fuse terminal 100 beneath the integral flange 114 thereon, and is shrunk or crimped at 115 into the annular groove 116 to close the upper end of the tube 112 against access of atmosphere to the silver fusible element and to secure the tube 112 to the upper fuse terminal 100 so that it will move therewith toward the other end of the outer sleeve when the fusible element fuses. The lower end of the tube 112 passes freely over and closely surrounds the lower fuse terminal 101 and extends down to a position beneath this terminal and from the lower end of the fuse tube, as illustrated in Figure 12. The tube 112 offers no impairment to free separation of the terminals 100 and 101 upon blowing of the fuse, yet, at the same time, it is rigid throughout its length and by its engagement at the upper end with the terminal 100 and its cooperation with the terminal 101 holds the ter-

minals 100 and 101 rigidly against relative lateral movement, such as otherwise might result in movement or even crimping or twisting of the fuse wire 110 and/or strain wire 102.

5 For the purpose of setting the fuse and holding the same set, the lower end of the terminal 101 is provided with an extension 115 formed of stranded conducting cable or other suitable material. Several strands of copper cable, preferably tinned, or "depth" cable are employed in the
10 illustrated embodiment, although this may, of course, vary widely. The upper end of this cable is inserted in a socket 118 on the lower end of the terminal 101, and this socket is flattened into
15 firm engagement with the cable to secure the same therein. Within its length, the stranded cable 115 is provided with a conical bushing 120 securely anchored in position upon the cable 115 as by flattening the upper end of the bushing
20 into firm engagement with the cable at 121. The lower conical part of the bushing 120 is engageable with a clip 122 to hold the fuse in set position. The clip 122 is formed by the outstanding and slightly hooked sides 123 of a conical socket
25 124 in the lower end of a tongue 125 formed integral with the lower ferrule 76 and depending therefrom, the integral sides 123 rounding or being hooked outwardly from the base of the tongue 125 at the lower extremities of the sides 126 which
30 round outwardly from the depressed portion 127.

The extension or stranded cable 115 constitutes a tail extension which, when the spring 93 is retracted, extends down below the lower end of the fuse casing 70 and ferrule 76 so that it may be gripped conveniently for setting the fuse and
35 placing the spring 93 under tension. With the spring 93 retracted, the setting of the fuse is accomplished by grasping the downwardly extending tail extension 115 and pulling the same
40 downwardly against the tension of the spring 93 until the conical bushing 120 is positioned below or clear of the bottom of the clip 122. The cable 115 above the bushing 120 is then passed through the open side of the clip 122. Then, upon releasing the tail extension 115, the spring 93 draws
45 the bushing up firmly against the conical socket 124 in the clip 122, and this cooperation of the bushing 120 with the hooked sides of the clip holds the spring 93 extended and the fuse in
50 set position. A circuit is thus established from the ferrule 74, upper cable terminal and spring fastener 90, stranded conductor 95, lower cable terminal and spring fastener 96, upper fuse terminal 100, fuse link and strain wire assembly 110
55 and 102, lower fuse terminal 101, stranded conductor 115, bushing 120 and clip 122 to the lower ferrule 76 through the tongue 125. The tail extension 115 below the conical bushing 120 may be cut off or otherwise removed after the fuse is set, as above described, but it is to be understood
60 that this removal of a part or all of the tail extension for setting the fuse or anchoring the lowering end of the fuse element assembly to the lower ferrule on the fuse casing is not necessary
65 within the scope of the present invention.

The fuse shown and described is a spring type expulsion fuse. A surrounding sectionalized cork (not shown) and an outer enclosing tube of water-proof paper, gummed paper or the like,
70 may be placed around the insulating tube 112 as in my copending application above identified, and this tube and the fuse element assembly per se may be modified in accordance with my said copending application. In the case of an ordinary air-type expulsion fuse as disclosed in my
75

said copending application, or in the case of the drop out type ejector cutout box of my copending application Serial No. 734,262, filed July 9, 1934, the spring and cable assembly 93, 95 and the associated terminals 90 and 96 may be removed by unscrewing the upper fuse terminal 100 from the tapped or threaded socket in the lower end of the terminal 96. Then, by merely
5 threading the upper end of the upper fuse terminal into a button 135 of suitable conducting material and flanged radially as shown in Figure 14, the same fuse link assembly is adapted for use with the ordinary air type expulsion fuse or with the drop out type ejector cutout box of my copending application above identified. This makes
10 the fuse link assembly universal in that it is adapted for different types of devices.

It will be noted from an inspection of Figures 11 and 12 that the upper and lower sides of the convolutions of the spring 93 are flattened at 136. This flattening increases the areas of contact of the convolutions of the spring with each other when the spring is retracted. A spring thus constructed in a device of this character will withstand high pressures without deformation or
25 spring distortion. Lateral distortion and the tendency of the convolutions to roll upon one another, when in contact particularly, are avoided.

It is to be further noted that the stranded conductor 95 is wound into a helix in a direction counter to the lay of the strands of the conductor and placed within a spring 93 wound into a helix in the direction of the lay of the strands of the conductor, or counter to the winding of the conductor. In the illustrated embodiment of the invention, a stranded conductor 95 with a left-hand lay is wound into a right-hand helix and placed within a spring 93 wound into a left-hand helix. This combination, particularly in a device of this sort, prevents the strands of the cable or the turns of the cable helix from paralleling the turns of the spring, and this greatly reduces the tendency for the cable to be pinched between the turns of the spring, which spring collapses to establish the desired gap upon blowing of the fuse.

The cylinder or tube 112, which encloses the fuse element 110 and strain wire 102, in addition to confining the arc in a very small space and preventing charring and metal spattering on the tube liner 72, and with its closed end attached to the movable terminal to prevent too free access of atmosphere to the fusible link and maintain the closure upon fusing of the link and movement of the movable fuse terminal, serves, by its downward extension below the ferrule 76 to perform the additional function of giving a visual indication when the fuse has been blown. The upper end of the tube or cylinder 112 being secured to the upper fuse terminal 100 by crimping or shrinking into the groove 116, it will be apparent that this tube 112 will move upwardly with the upper fuse terminal 100 and lower cable terminal and spring fastener 96 upon retraction of the spring 93. Consequently, the absence of the projection of the lower end of the tube 112 down from the bottom 140 of the ferrule 76 gives a visual indication that the fuse has blown and the spring 93 retracted. However, the presence of the lower end of the tube 112 beneath the bottom 140 of the ferrule 76 indicates visually that the fuse has not blown and that the device is in operative relation. The lower end of the tube 112, the absence or presence of which gives this indication, is indicated at 142 in Figure 12.

The cutout of my invention is set in operative relation by assembling the fuse parts as shown in Figures 11 and 12, and then screwing the upper threaded end 65 of the upper ferrule 74 into the insert 62 in the handle 60 of the plug member, the flange 91 at the top of the upper cable terminal and spring fastener being clamped between the inner end of the tapped opening in the insert 62 and the upper end of the ferrule 74. The plug 4 is then inserted into the socket 2 to the position in which the lower ferrule 76 is in engagement with the spring fingers of the lower contact clip 45, and the upper ferrule 74 is in engagement with the spring fingers of the upper contact clip 44 as illustrated in Figures 3 and 4.

For the purpose of locking the fuse plug in position within the socket, the upper ferrule 74 is provided with an annular groove 150, Figures 3, 11 and 13, and a plurality of circumferentially spaced vent openings 152 open radially through the wall of the ferrule 74 from the interior of the ferrule into the annular groove 150. A tube lock pressure band 154, which is preferably formed of spring tempered sheet phosphor bronze or other suitable material, is disposed in the groove 150 and wrapped about the portion of the ferrule 74, through which the openings 152 extend, normally to close these openings. The band 154 is of a length so that its free ends overlap appreciable distance in the normal position of the band, as shown in Figure 7. A coiled lock springs 156, preferably of spring wire or other suitable material, constitutes a garter spring, provided at its opposite ends with hooks 158. When these hooked ends 158 are engaged as shown in Figure 7, the spring 156 embraces the pressure band 154 and normally lies entirely within the groove 150. The bottom shoulder 160 of the groove 150 is preferably chamfered or inclined at its outer edge at 162 parallel, or substantially parallel, with the inclination of the upper inclined wall 41 of the channel 48 formed by spinning or rolling the external annular bead in the upper contact clip 44. The garter spring 156 is of a strength normally to hold the pressure band 154 in contracted position over the outer ends of the openings 152 and the spring in place in the groove 150, as shown in Figures 3 and 11.

The locking device is thus normally in released position with the plug 4 in place in the socket 2, and therefore adds no resistance to free removal and insertion of the plug. It also avoids any necessity for turning of the plug to lock it in place, and it presents no locking parts which are operative under normal conditions when there is no blowing of the fuse, or which are subject to corrosion or possible freezing. The locking device is, however, operable at the instant required. Upon blowing of the fuse, the pressure generated in the tube 71 causes an outward flow of air and gases from the interior of the fuse tube through the openings 152. This outward flow of air and gases expands the pressure band 154 outwardly and, with it, the garter spring 156 outwardly into the annular groove 48 in the contact clip 44, as illustrated in Figure 13. This engagement of the spring 156 in the groove 48 and with the upper inclined wall 41 of the contact clip 44 locks the plug 4 against blowing out or loosening by the reaction to the explosive force upon blowing of the fuse, and it does it at the instant required, namely, at the instant of blowing of the fuse. The plug is thus locked securely and positively in place. The paralleling of the shoulder 162 with the wall 41 of the contact clip 44 causes

any tendency toward outward movement of the plug member to act in compression upon the turns of the coiled spring 156 and not in shear, such as might result if the walls 41 were normal to the axis of the fuse. At the same time the inclination of the walls 41 enables free entry of the spring into the locking groove upon expansion into engagement therewith.

After the fuse is blown and the outward flow of air and gases through the openings 152 is spent, the thin metal expansion band and spring 156 are returned to their normal position within the groove 150, as shown in Figure 11, by the retractive effort of the spring. In this manner, the locking device not only operates at the instant required, but is released instantly the outward flow of air and gases is spent so that there is no added resistance to free removal of the plug from the socket.

The arrangement shown in the drawings is so simple, compact and inexpensive, and it releases the locking device instantly the flow of air and gases or the explosive force is spent.

To renew the fuse link or reload the device, the plug 4 is first withdrawn from the socket 2. The fuse tube is then removed from the handle 60 by unscrewing the threaded upper end of the ferrule 65 from the insert 62. The blown fuse link assembly is then removed by unscrewing the upper fuse terminal 100 from the cable terminal and spring fastener 96, whereupon a new fuse link assembly is applied by screwing the upper terminal thereof into the tapped opening in the terminal 96, and the fuse link, spring and cable assembly is inserted into the fuse tube through the upper end of the upper ferrule 74. The tail extension 115 is then grasped and drawn downwardly against the tension of the spring 93 and the conical bushing 120 engaged in the clip 122, whereupon the excess tail extension below the bushing 120 may be cut off with a pair of pliers.

While I have shown and described my invention with reference to the particular details of construction of one embodiment, it is to be understood that the invention may appear in different forms and with numerous modifications and variations such as will suggest themselves to one skilled in the art, and it is to be further understood that I consider all such modifications and variations to be included within the scope of my invention.

I claim:

1. In combination, a pair of contacts, a device connecting said contacts, and current interruption responsive means for locking said device to at least one of said contacts during current interruption.

2. In combination, a pair of contacts, a fuse device connecting said contacts, and means responsive to the blowing of the fuse for locking said fuse to at least one of said contacts.

3. In combination, a pair of contacts, a fuse device connecting said contacts, means responsive to the blowing of the fuse for locking said fuse to at least one of said contacts, and means for releasing said locking means when the fuse has blown.

4. In combination, a pair of contacts, a fuse device connecting said contacts, and means operable by the pressure evolved upon blowing of the fuse for locking said fuse to at least one of said contacts.

5. A device of the class described comprising plug and socket members provided with cooperating contacts, the plug member provided with a

fuse connected with said contacts, and a locking device for said plug member, said locking device being normally in released position with said plug in place in said socket and operable only at the instant required.

6. A device of the class described comprising plug and socket members provided with cooperating contacts, the plug member provided with a fuse connected with said contacts, a locking device for said plug member, said locking device being normally in released position, and rendered operative upon blowing of the fuse.

7. A device of the class described comprising plug and socket members provided with cooperating contacts, the plug member provided with a fuse connected with said contacts, and a locking device for said plug member, said locking device being normally in released position with said plug in place in said socket and operable by the pressure evolved upon blowing of the fuse.

8. A device of the class described comprising plug and socket members provided with cooperating contacts, the plug member provided with a fuse connected with said contacts, and a locking device for said plug member, said locking device being rendered operative upon blowing of the fuse and means for releasing said locking device when the fuse has blown.

9. A device of the class described comprising plug and socket members provided with cooperating contacts, the plug member provided with a fuse connected with said contacts, and a locking device normally in released position with said plug in place in said socket and operable by the pressure evolved upon blowing of the fuse to lock the plug in the socket, said locking device comprising means for releasing said locking device when the explosive force is relieved.

10. A device of the class described comprising plug and socket members provided with cooperating contacts, the plug provided with a fuse connected with said contacts, said fuse having an enclosure, port means opening from said enclosure, and a locking device disposed adjacent said port means and expandible into locking engagement with the socket member by the explosive force through said port means upon blowing of the fuse.

11. A device of the class described comprising plug and socket members provided with cooperating contacts, the plug provided with a fuse connected with said contacts, said fuse having an enclosure, port means opening from said enclosure, and a locking device disposed adjacent said port means and expandible into locking engagement with the socket member by the outward flow of air and gases through said port means upon blowing of the fuse, said locking device comprising spring means normally holding said locking device in released position and releasing said locking device when the fuse has blown.

12. A device of the class described comprising plug and socket members provided with cooperating contacts, the plug member provided with a fuse connected with said contacts, said fuse having an enclosure, port means opening from said enclosure, a pressure band surrounding the ported portion of said enclosure, and a coiled garter spring surrounding said pressure band, said spring being normally retracted to released position and expandible into locking engagement with the socket member by the expansion of the pressure band by the pressure evolved upon blowing of the fuse.

13. A device of the class described comprising plug and socket members provided with cooperating contacts, the plug member provided with a fuse connected with said contacts, a groove in the socket member, a groove in the plug member, and locking means normally disposed in the groove in one of said members to permit free insertion and removal of the plug member and engageable in the groove in the other member upon blowing of the fuse to lock the plug member in place in the socket member.

14. A device of the class described comprising plug and socket members provided with cooperating contacts, the plug member provided with a fuse connected with said contacts, a groove in the socket member, a groove in the plug member, and locking means normally disposed in the groove in one of said members to permit free insertion and removal of the plug member and engageable in the groove in the other member by the explosive force upon blowing of the fuse to lock the plug member in place in the socket member, said locking means comprising a pressure band and an annular spring of coiled form normally retracted to released position and expandible to locking position.

15. A device of the class described comprising plug and socket members, a contact in the socket member, said contact having an annular groove, the plug member provided with a fuse having an enclosing tube, a contact ferrule on the fuse tube adapted to engage the contact in the socket member, said contact ferrule having a groove therein, port means opening from the interior of the fuse tube into said last groove, a pressure band disposed in the groove in the contact ferrule, and a spring surrounding said pressure band and normally disposed in the groove in said contact ferrule, said band and spring being expanded by the pressure evolved upon blowing of the fuse to force said spring into engagement with the groove in the socket contact to lock the plug in place in said socket member.

16. A device of the class described comprising plug and socket members, a contact in the socket member, said contact having an annular groove, the plug member provided with a fuse having an enclosing tube, a contact ferrule on the fuse tube adapted to engage the contact in the socket member, said contact ferrule having a groove therein, port means opening from the interior of the fuse tube into said last groove, a pressure band disposed in the groove in the contact ferrule, and a spring surrounding said pressure band and normally disposed in the groove in said contact ferrule, said band and spring being expanded by the pressure evolved upon blowing of the fuse to force said spring into engagement with the groove in the socket contact to lock the plug in place in said socket member, said spring being of coiled form arranged annularly and having hooked ends in engagement.

17. A device of the class described comprising plug and socket members, a contact in the socket member, said contact having an annular groove, the plug member provided with a fuse having an enclosing tube, a contact ferrule on the fuse tube adapted to engage the contact in the socket member, said contact ferrule having a groove therein, port means opening from the interior of the fuse tube into said last groove, a pressure band disposed in the groove in said contact ferrule, and a spring embracing said pressure band and normally disposed in the groove in the contact ferrule, said band and spring being expandible by the pressure evolved upon blowing

of the fuse to force said spring into engagement with the groove in the socket contact to lock the plug in place in said socket, the grooves in the contact in the socket member and in the contact ferrule on the fuse tube having inclined surfaces disposed substantially parallel so that the turns of the spring act in compression in locking the plug member in the socket member.

18. In combination, a socket member, a plug member adapted to be inserted into and removed from said socket member, a groove in the socket member, a groove in the plug member, and a spring normally confined in the groove in one of said members and expandible into the groove in the other member for locking the plug member in the socket member, and the grooves in the socket and plug members having inclined surfaces disposed substantially parallel so that the turns of the spring act in compression in locking the plug member in the socket member.

19. In a fuse, a fuse sleeve, a ferrule on said sleeve, a groove in said ferrule, port means opening from the interior of the sleeve into said groove, and a locking device disposed in said groove and expandible by the flow of air and gases through said port means upon blowing of the fuse.

20. In a fuse, a fuse sleeve, a ferrule on said sleeve, a groove in said ferrule, port means opening from the interior of the sleeve into said groove, a locking device disposed in said groove and expandible by the explosive force through said port means upon blowing of the fuse, said locking device comprising a pressure band disposed in said groove and surrounding the ported portion of said ferrule, and a spring surrounding said band and normally disposed in said groove.

21. A contact assembly comprising the combination of a metal ring having a bore, a groove in the bore, and a wrought metal contact member having a tubular body fitting within the bore and having a hollow rib fitting tightly in the groove and having integral contact fingers extending from one edge of said body.

22. The combination of claim 21 wherein the outer ends of said fingers have portions offset toward the axis of the said tubular body, and a garter spring embracing said offset portions.

23. The combination of claim 21 with spring means for pressing the ends of the fingers toward the axis of the said tubular body, and a band encircling the fingers for limiting the travel of said fingers radially away from said axis.

24. The combination of claim 21 wherein the tubular body portion has an integral flared portion at the end opposite the fingers.

25. As an article of manufacture, a tubular wrought metal body portion having an integral flared portion forming an arc chute at one end and integral fingers separated by slots and extending from the other end, said body portion and said fingers being of substantially uniform thickness.

26. A contact clip of tubular form slotted at spaced points to form resilient contact fingers, a reinforcing spring surrounding said fingers and a reinforcing ring floating on said spring to limit its outward expansion, said contact clip being open and unobstructed at each end.

27. A contact clip of tubular form having intermediate its ends, an external rib and a flare at one end forming an arc chute of generally trumpet form, the opposite end of said clip having slots defining resilient contact fingers, said contact clip being open and unobstructed at each end.

28. A contact clip of tubular form having with-

in its length an internal groove and an external rib and a flare at one end forming an arc chute of generally trumpet form, the opposite end of said clip having slots defining resilient contact fingers, a reinforcing spring surrounding said fingers, and a reinforcing ring floating on said spring to limit its outward expansion, said contact clip being open and unobstructed at each end.

29. A contact assembly comprising a contact base having a bore provided with a groove within its length, a contact clip of tubular form secured in the bore in said base by a projecting part of its wall conforming to the shape of the groove in the bore of the base, said contact clip being open and unobstructed at each end.

30. A contact assembly comprising a base having a bore provided with a groove within its length, a contact clip of tubular form secured in the bore in said base by a projecting part of its wall conforming to the shape of the groove in the bore of the base, said clip projecting from said base and being slotted at spaced points to form resilient contact fingers, a reinforcing spring surrounding said fingers, and a reinforcing ring floating on said spring to limit its outward expansion, said contact clip being open and unobstructed at each end.

31. A contact assembly comprising a contact base having a bore provided with a groove within its length, a contact clip of tubular form secured in the bore in said base by a projecting part of its wall conforming to the shape of the groove in the bore of the base, said clip projecting from said base and being slotted at spaced points to form resilient contact fingers, a reinforcing spring surrounding said fingers and a reinforcing ring floating on said spring to limit its outward expansion, and the other projecting end of said clip being flared out to form an arc chute of generally trumpet form, said contact clip being open and unobstructed at each end.

32. In combination with a fuse tube having an open end, a ferrule on said end of the tube, a fuse link in the tube connected to said ferrule, blowing of said link causing the expulsion of gases from said open end, and a cooperating contact and arc chute member comprising a tubular body portion having at one end integral fingers engaging the ferrule and having at the other end an integral flared arc chute extending beyond said open end.

33. The combination with claim 32 of a tubular housing member provided with a bore for receiving the fuse tube and a counterbore at one end, a terminal ring seated in said counterbore and embracing and holding said body portion in alignment with the bore of the housing.

34. A tubular wrought metal terminal member having spring fingers extending from one end, and a flared metallic arc chute forming an extension at the other end.

35. In combination a fuse tube, a ferrule embracing the fuse tube, the tube having a groove of rectangular cross section on its outer surface, the ferrule having a groove of triangular cross section matching with the groove of the tube, a split locking ring in the form of a thin strip of substantially uniform thickness and of a width substantially equal to the width of said rectangular slot, said rectangular slot being of a depth substantially equal to the thickness of said strip, said band being biased to expand into the form of a hollow cone whereby the larger diameter portion expands into said triangular groove to

limit the movement of the tube relative to the slot in one direction, and shoulder means on the tube and on the ferrule for limiting the movement of the tube relative to the slot in the other direction.

36. In a fuse, a cylindrical body of insulating material having an external groove between its ends providing an axially facing shoulder, a metal ferrule embracing the cylindrical surface of the body, and having an internal groove between its ends providing an axially facing shoulder opposed to said first shoulder and a thin conical split spring ring having its larger end expanded into and lying wholly within the groove in the ferrule and having its smaller end lying wholly within the groove in the cylindrical body whereby said ring forms an annular diagonal strut between said oppositely facing shoulders.

37. In combination, a metal ferrule having a cylindrical bore, a member of insulation having a portion provided with an external cylindrical surface, said member and said ferrule being telescopically fitted together, and a thin split spring ring of substantially uniform thickness which when permitted to expand radially assumes the form of a frustum of a hollow cone having a radial projection substantially in excess of its actual thickness, said cylindrical portion having an external groove wide enough to receive said ring and of a depth substantially equal to the thickness of said ring and providing an axially facing shoulder to be engaged by the small diameter end of said ring when it assumes its conical form, said ferrule having an internal groove deep enough to receive the large diameter end of the ring when it assumes its conical form, said internal groove providing an axially facing shoulder which is adapted to engage the end face of the large diameter end of the ring when it is in conical form, said ring being disposed in expanded conical form in said grooves and forming an annular diagonal strut between the said shoulder on the ferrule and the said shoulder on the said portion of the member.

38. In a device of the class described, the combination of a tubular casing, a movable system within said casing including a movable terminal member and a coil spring normally under tension and connected to said terminal member, said spring having the sides of its convolutions flattened to withstand high pressure of the convolutions against each other without displacement edgewise relative to each other.

39. In a cutout, a plug member and a cooperating socket member, said socket member comprising a sleeve of insulation having contacts therein, said plug member comprising an expulsion fuse having a fuse sleeve provided with terminal contacts adapted to engage with the contacts in the socket member, a movable system within said fuse sleeve including a terminal member and a flattened spring wire coiled helically and connected to said terminal member.

40. In a device of the class described, a movable system including a movable terminal member, a stranded cable connected to said terminal member and wound into a helix counter to the lay of the strands of the cable, and a coiled spring normally under tension and connected to said terminal member, said coiled spring being wound into a helix counter to the winding of the helix in said strand whereby the strands of the cable and the turns of the cable helix are prevented from paralleling the turns of the spring to re-

duce the tendency for the cable to be pinched between the turns of the spring.

41. In a device of the class described, a movable system including a movable terminal member, a stranded cable connected to said terminal member and wound into a helix, and a coiled spring normally under tension and connected to said terminal member, said coiled spring being wound into a helix counter to the winding of the helix in said strand whereby the turns of the cable are prevented from paralleling the turns of the spring to reduce the tendency for the cable to be pinched between the turns of the spring.

42. In combination, a tubular casing, a ferrule thereon, a plunger, a fusible element between the plunger and said ferrule, and a spring attached to said plunger and having its convolutions flattened to withstand high pressure of the convolutions against each other without displacement edgewise relative to each other.

43. In combination in a fuse device, an expulsion fuse having a ferrule through which arc gases are adapted to be expelled, a stationary terminal member providing a ring having an internal groove, a contact clip of tubular stock having slotted fingers engaging said ferrule, and having a cylindrical portion provided with a hollow annular flange fitting into the groove in said ring, and having a flared integral portion extending beyond the opening in the ferrule to form an arc chute.

44. In combination in a fuse device, an expulsion fuse having a ferrule through which arc gases are adapted to be expelled, a cooperating contact clip of tubular stock having slotted fingers engaging said ferrule, and having a flared integral arc chute portion extending beyond the opening in the ferrule.

45. In combination in a fuse device, a stationary tubular mounting, an expulsion fuse having a ferrule at one end, a stationary terminal member mounted at one end of the mounting, said terminal member being provided with a ringlike portion having an internal peripheral groove, a contact clip of tubular stock having slotted fingers engaging said ferrule, and having a central integral portion provided with a hollow annular flange fitting into said groove and having an outwardly flared integral portion at the end opposite the slotted fingers.

46. In combination with a fuse device, a tubular housing having a bore, an expulsion fuse adapted to be mounted in the bore of the tubular housing, a counterbore being formed at one end of the bore to provide a terminal receiving recess, a terminal having a ringlike portion mounted in said recess, said ringlike portion being substantially coaxial with the bore of the housing, said ringlike portion having a groove on its inner periphery, a contact clip of tubular stock provided with a hollow annular flange fitting into said groove to form an electrical and mechanical connection with the terminal, said clip having integral fingers extending inwardly of the bore of the housing, a constricting spring embracing the fingers and a non-expandable ring disposed in the housing and backing up said spring.

47. In combination, a pair of supporting contacts, an expulsion type fuse removably mounted in said contacts, and pneumatic means actuated by blowing of the fuse for locking the fuse to one of the supporting contacts during blowing of the fuse only to prevent the fuse from shifting in the contacts on blowing of the fuse.

48. In combination a mounting for a fuse, a

5 fuse supported in said mounting and being normally free to be inserted into or withdrawn from the mounting, said fuse when blown by excess current tending to shift in said mounting, and pneumatically operated locking means actuated by blowing of the fuse to lock the fuse to the mounting during blowing of the fuse.

49. In a circuit interrupter, the combination of a socket, a plug for insertion in the socket, and means for locking the plug in said socket during circuit interruption but leaving said plug free to be withdrawn from the socket at all other times. 5

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