March 9, 1937. N. J. CONRAD 2,072,854

FUSE BOX AND FUSE

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Fig. 1.

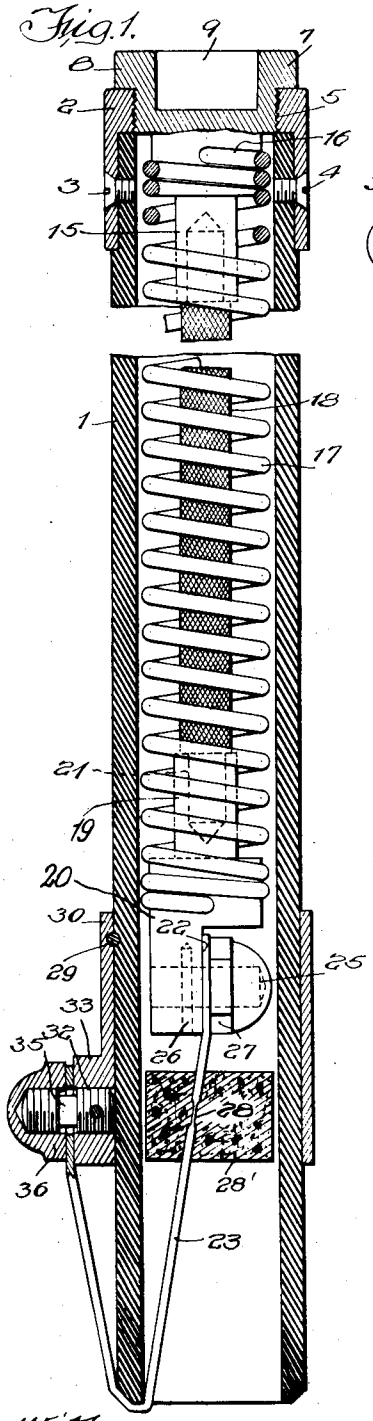


Fig. 2.

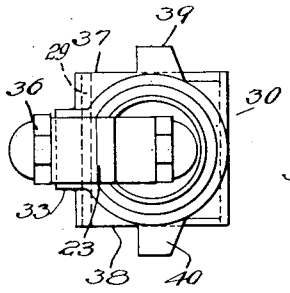


Fig. 3.

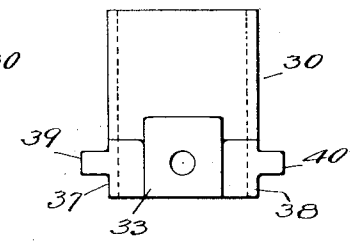


Fig. 13.

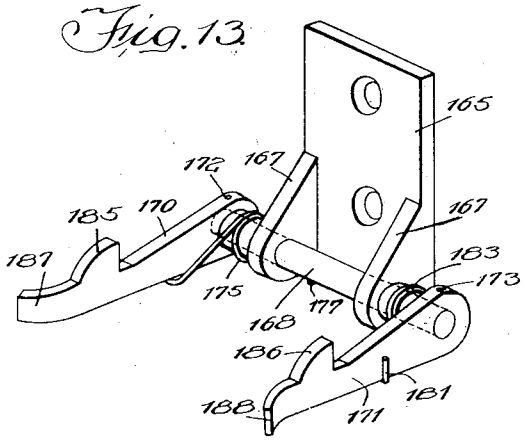
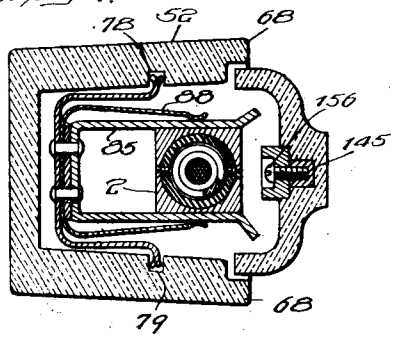


Fig. 9.



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William L. Kilroy

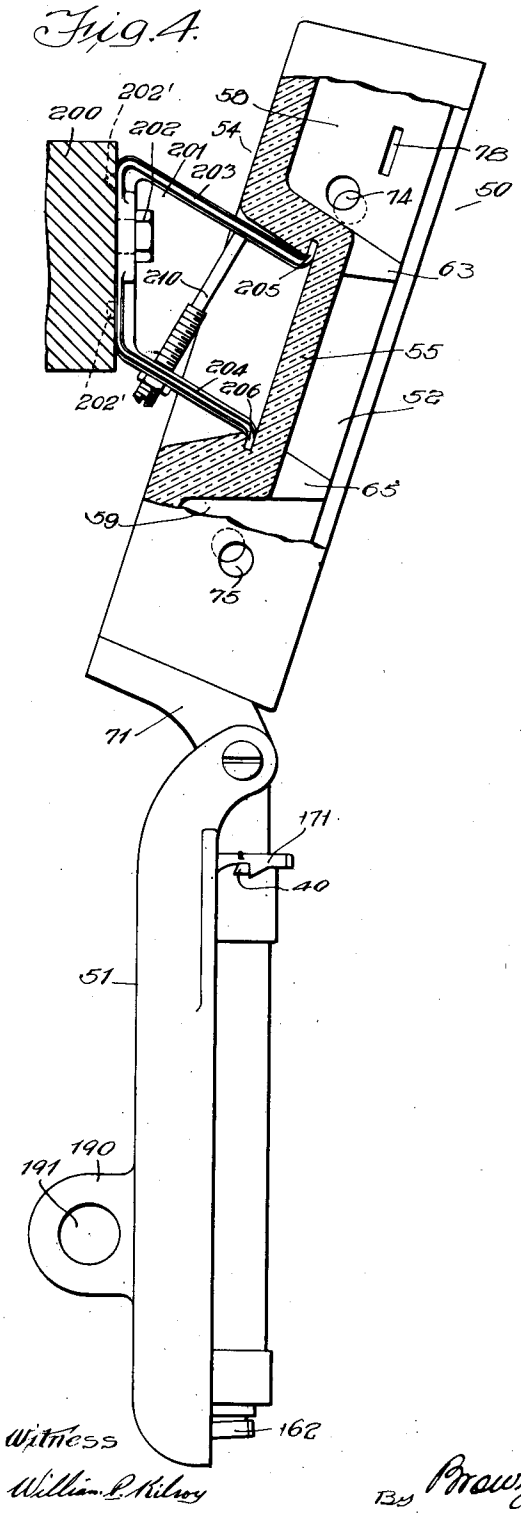
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By Brown Jackson Boettcher & Dunn
Attys

March 9, 1937. N. J. CONRAD 2,072,854

FUSE BOX AND FUSE

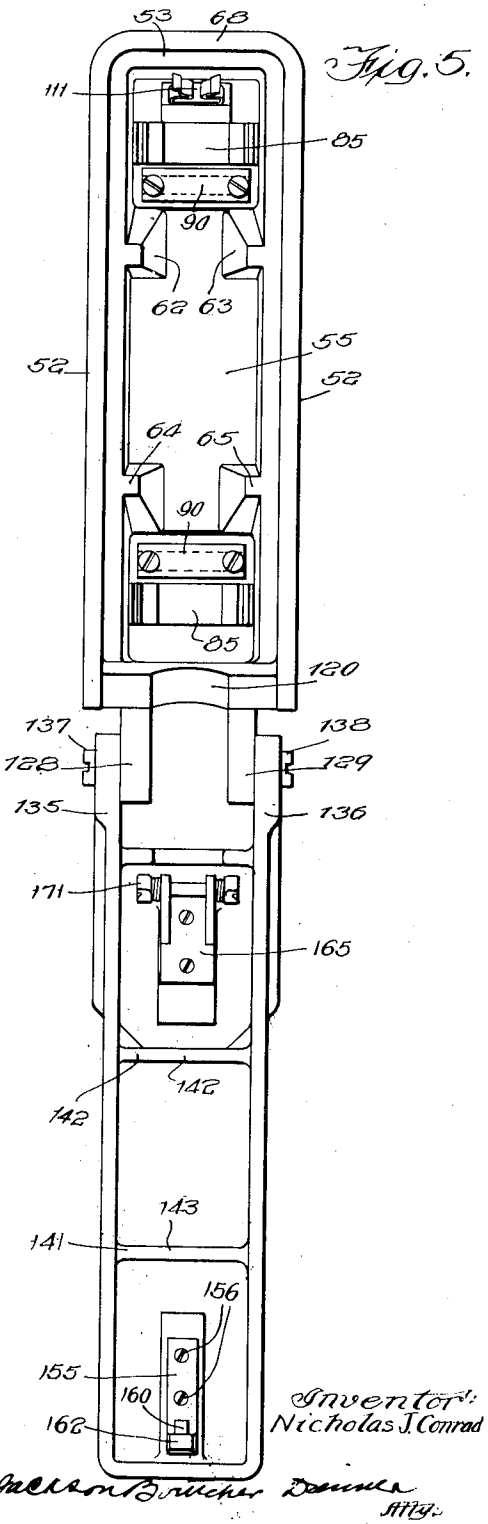
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Fig. 4.



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Fig. 5.



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FUSE BOX AND FUSE

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Fig. 7.

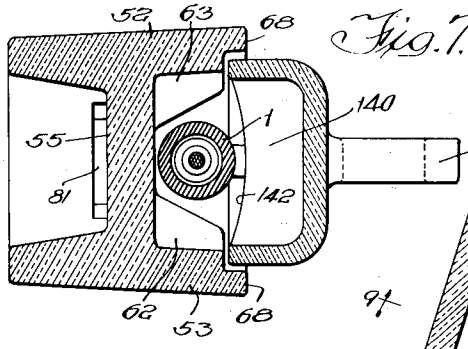


Fig. 6.

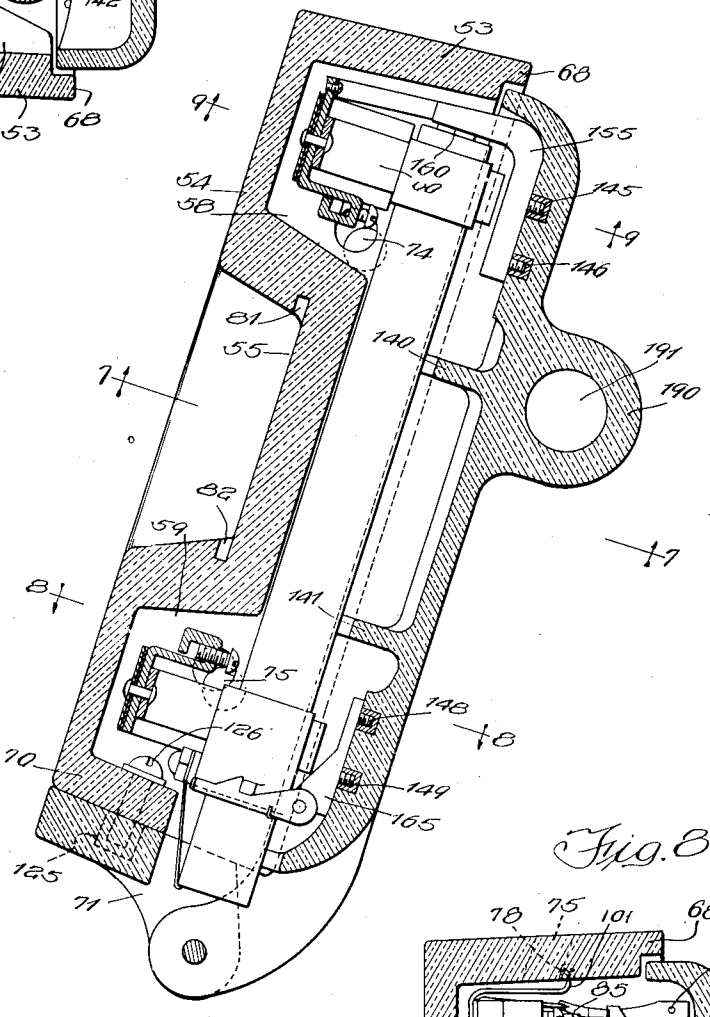
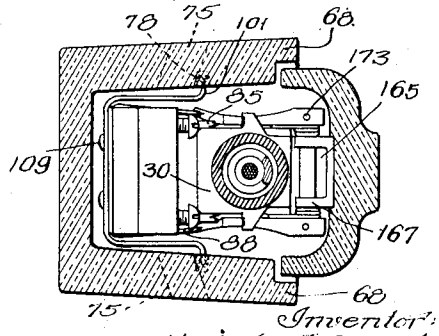


Fig. 8.



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FUSE BOX AND FUSE

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Fig. 10.

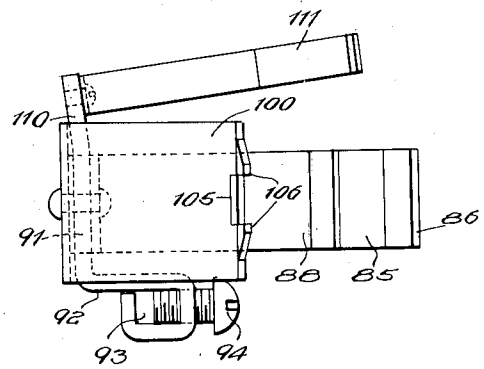


Fig. 11.

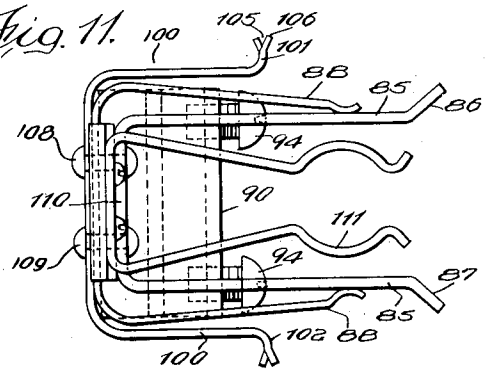
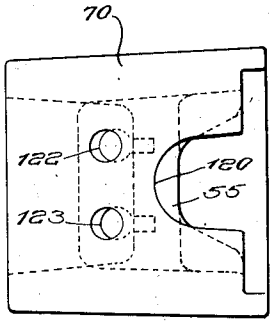


Fig. 12.



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Patented Mar. 9, 1937 2,072,854

UNITED STATES PATENT OFFICE

2,072,854

FUSE BOX AND FUSE

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Application November 11, 1929, Serial No. 406,313

19 Claims. (Cl. 200—117)

This invention relates to boxes for housing electrical parts in general, and more particular to fuse boxes and it is one of the objects of the present invention to provide an improved box of the type adapted for outdoor use, although it is not limited to such use. It is a further object of the present invention to provide an improved fuse for use in connection with my improved fuse box.

Fuse boxes generally comprise a long, narrow box of suitable insulation, said box being provided with a pair of spaced contact clips for receiving a fuse between them. The box is generally provided with a hinged cover which has means for receiving and holding a fuse. Upon closure of the cover the fuse is inserted between the terminal clips and upon opening of the cover the fuse is drawn outward from the terminal clips. When mounted outdoors the box is supported in an inclined position to provide suitable drainage and prevent the entrance of moisture into the box. Fuse boxes are generally made of porcelain. As is known to those skilled in the art, dry process porcelain is not satisfactory for fuse boxes, especially on high voltage systems. The dielectric strength of dry process porcelain is relatively low and also the porcelain is quite porous and the walls of the box must be made comparatively thick. Liberal spacing of the side walls from the contacts is also necessary. As a result dry porcelain boxes are bulky and cumbersome. After such a box has been in service any length of time the current will leak through the dry process walls to the crossarms or other supporting means for the box. Leakage and burning of the crossarms results and a great, insidious danger is presented. Where such boxes are employed the linemen or other workmen in the region of the box are at all times subjected to a great danger. Dry process porcelain boxes have, therefore, been of little use on high voltage systems, and their use has been confined to lower voltages.

Wet process porcelain, however, affords much greater protection, particularly under high voltages. Its dielectric strength is much higher. It is less porous and is suitable for use with safety under much higher voltages. Due to its greater moisture content before firing and greater density, which greater density materially retards the escape of moisture during firing, it has been found that wet process porcelain is subject to much higher internal stresses in firing than is dry process porcelain, and that it will tend to warp or distort. As a result greater difficulty has been encountered in the construction of an irregular shaped article of wet process porcelain, particularly a fuse box having an opening at one end.

To prevent convergence of the side walls during the firing process, where wet process porcelain was used, it has been customary to insert between the side walls of the box, prior to firing of the box, a spacer of frangible material to prevent convergence of the side walls. After firing of the box this spacer is first broken and then removed. This adds appreciably to the cost of manufacture of a wet process porcelain box and in addition there is always the great danger of breaking the box during the operation of removing the spacer insert. It is one of the objects of the present invention to provide a fuse box of wet process porcelain and of such a shape that convergence of the side walls during the process of manufacture is prevented. This is accomplished, in the embodiment of my invention herein illustrated, by providing the back wall of the box with a projection, of a generally arch shape, which extends toward the front of the box and about the center of the box and acts as the spacer for preventing convergence of the side walls. On the rear side of the arched projection the box is provided with a pair of slots for mounting the same.

A bracket made of resilient material is sprung into the slots and is held in place therein, said bracket constituting the mounting means for the box. Heretofore it has been customary to mount the wet process fuse boxes by means of bolts embedded in the porcelain. This greatly increases the cost of manufacture of the box and by providing the arch shaped projection in the back of the box with slots I provide a better means for mounting the box, this being one of the purposes for the provision of the arched projection entirely independent of its function as a spacer of preventing convergence of the side walls.

As previously stated, contact clips are generally mounted in the box for receiving a fuse between them. Heretofore it has been customary to cement the contact clip in a cavity provided within the box for this purpose. In general, the contacts were rigidly fixed and irreplaceable. It is one of the objects of the present invention to provide a novel contact clip and a novel means for mounting the same within a fuse box.

The side walls of the fuse box are provided with a pair of slots on the opposite sides and the contact clip is mounted on a resilient support having a pair of spring arms that are sprung

into the slots and held therein by their own resiliency. The contacts are thus resiliently mounted and have a full floating action to permit them to adjust themselves to any small misalignment of the fuse as the same is brought into contact with the terminal clips.

It is a further object of the present invention to provide a novel cover construction for the fuse box, said cover being provided with means for holding the fuse when the cover is open and being provided with a means for resiliently supporting the fuse when the cover is closed and the fuse is between the terminal clips.

As previously stated, it is one of the objects of the present invention to provide an improved fuse for use in connection with my improved fuse box. The fuse comprises a tube of insulation closed at one end by a ferrule and open at the other end. A ferrule is likewise provided adjacent the other end, said ferrules constituting the means for establishing a circuit through the fuse.

A movable terminal is suspended within the tube by means of a coiled spring that is supported by a stationary terminal integral with the ferrule that closes one end of the tube. A flexible conductor extends from that floating terminal to the other terminal. A fuse link is connected to the movable terminal, which fuse link has a portion thereof extending through the open end of the tube and connected to the ferrule adjacent to the open end. The fuse maintains the spring under tension. When the fuse blows the tension on the spring is released with the result that it rapidly draws the floating terminal out of the region of the arc to quickly interrupt the circuit. The fuse is mounted with its open end downward and opposite the opening at the bottom of the fuse box thereby permitting the fused metal to drop out of the fuse box when the fuse blows.

The attainment of the above and further objects of the present invention will be apparent from the following specification taken in conjunction with the accompanying drawings forming a part thereof.

In the drawings;

Fig. 1 is a longitudinal sectional view of my improved fuse;

Fig. 2 is a bottom view of the fuse;

Fig. 3 is a front view of the lower ferrule;

Fig. 4 is a side view, partly in section, of my improved fuse box and showing the manner of mounting the same;

Fig. 5 is a front view of the fuse box, the cover being in its open position;

Fig. 6 is a longitudinal section of the fuse box, the cover being shown in its closed position;

Fig. 7 is a sectional view taken along the line 7—7 of Fig. 6;

Fig. 8 is a sectional view taken along the line 8—8 of Fig. 6 and looking in the direction of the arrows;

Fig. 9 is a sectional view taken along the line 9—9 of Fig. 6 and looking in the direction of the arrows;

Fig. 10 is a side view of the upper fuse clip;

Fig. 11 is a top view of the upper fuse clip;

Fig. 12 is an end view of the fuse box with the cover supporting bracket removed; and

Fig. 13 is a perspective view of the fuse supporting means mounted on the cover of the fuse box.

Reference may now be had more particularly to Figs. 1, 2 and 3 showing the construction of the fuse.

The fuse comprises a tube 1 of suitable insulating material such as fiber impregnated with a synthetic resin, fiber, or the like. In practice this tube preferably is constructed as disclosed in my copending Patent No. 1,818,382, of August 11, 1931. That is, the inner portion of fiber stock paper is wound on a mandrel to a required thickness, then paper impregnated or coated with raw "Bakelite" or similar material is wound upon the first layers to a required thickness. The "Bakelite" or other material is then treated as by baking or hot moulding under pressure, the outer layers becoming a substantially homogeneous impregnated mass or layer, and the inner layers remaining in their original condition as what is known commercially as fiber. The inner layer of fiber enables it to better withstand the arc, as it does not so readily carbonize. The outer impregnated layers render the tube weather and moisture proof, and prevent warping and swelling. A ferrule 2 fits over the top end of the fuse and is rigidly secured thereto by means of a pair of screws 3 and 4 that thread into the tube. The outer sides of the ferrule are squared to adapt the sides to make good electrical contact with a pair of contact clips to be fully described as the description proceeds. The ferrule is made of bronze or other suitable material of high conductivity. The ferrule 2 is internally threaded, as indicated at 5, to receive an upper terminal 7 therein. The terminal 7 has a hexagonal head 8 to facilitate the turning thereof into the ferrule 2. The top of the terminal has a bore 9 formed therein to receive a stud on a bracket in the fuse box, to be presently described, to hold the fuse in position. The terminal closes the top of the tube and has a hollow rod 15 formed integrally therewith and extending into the tube. Between the tube 15 and the bottom threaded portion of the terminal there is provided a portion 16 having formed thereon a helical groove for receiving a spring 17. A flexible braided conductor 18 has one end thereof passed into the hollow portion of the member 15 and is rigidly secured thereto in any preferred manner.

The braided conductor 18 is made of copper or the like and extends the circuit to the ferrule by way of the terminal 7, which terminal is preferably made of brass or other suitable material of high conductivity. The opposite end of the flexible braided conductor 18 is secured to the adjacent upper end of the terminal 20 in any desired manner. As illustrated this is accomplished by passing the end of the conductor into a bore 21 in the shank 19 of the terminal and compressing the hollow walls of the shank of the terminal upon the conductor. The lower terminal is likewise provided with a cylindrical portion having a helical groove formed therein and the spring is secured to the lower terminal by being threaded into the groove. The lower terminal 20 is thus suspended by the spring 17. The lower terminal has a part of the cylindrical body cut away to provide a flat clamping surface 22 which is adapted to receive the end of a fuse link 23. The lower part of terminal 20 is threaded transversely to receive a stud 25 which is then locked in place by means of a pin 26. The fuse link extends around the stud 25 and is bolted to the flat face 22 of terminal 20 by means of a cap or acorn nut 27 that threads onto the stud 25. The terminal 20 below the anchorage of the spring 17 thereto is of a cross section which substantially fills the bore of the tube 1.

A lower ferrule 30, of cast hard bronze or other

material of high conductivity, is secured to the tube 1 adjacent the lower end thereof by means of a key 29 which passes through ferrule and engages tube 1; preventing movement of ferrule on tube and keeping lower ferrule in alignment with upper ferrule. A stud 32 is threaded into place in the ferrule 30, as shown.

The stud 32 is threaded throughout its length and is undercut at approximately its center as indicated at 35. One end of the fuse link 23 is secured to the terminal 20 within the fuse by means of the stud 25 and the nut 27 as previously stated. The terminal 20 is then drawn downwardly by means of the fuse link 23 thus placing the spring 17 under tension, and the opposite end of the fuse link 23 is secured to the stud 32 by means of a cap or acorn nut 36 that is threaded onto the extending end of the stud. A circuit is thus established from the fuse to the lower ferrule 30. As may be seen in Figure 2 the sides of the ferrule 30 are square and the flat sides 37 and 38 are machine finished and are adapted to be received between a pair of spring jaws upon a contact clip to establish a circuit through the fuse. The fuse link 23 is made of suitable fusible material and it has a portion 28 of reduced cross-sectional area at a point along its length within the tube 1, said reduced portion being surrounded by a cork 28'. Should the fuse blow it will blow at the point 28 and the tension on the spring 17 being thereby released the spring 17 will quickly snap the terminal 20 upwards and away from the point of blowing of the fuse to quickly draw out and extinguish any arc that may form during the blowing of the fuse.

In alternating current circuits, the arc is momentarily extinguished at the current zero. If the space through which the arc must reestablish itself is of sufficient dielectric or breakdown value to resist the rise of voltage upon the occurrence of the succeeding half cycle, the arc will not be reestablished, and will remain out.

On low overloads, the action of extinguishing the arc is as follows: As the current rises to a value greater than the carrying capacity of the reduced section 28, the fuse parts due to spring tension and an arc is formed inside the cork 28'. If the overload is so low that it takes substantially the peak of the current half cycle to melt the fusible portion 28, the arc may be established without appreciable melting of the main body of the fusible member 23.

The arc being formed within the cork 28' causes the evolution of gas therefrom. At the same time, the movable terminal 20 is carried rapidly upward by the spring 17. These actions cause a rapid lengthening of the arc and a deionization of the arc sufficient to cause it to be promptly extinguished.

Upon short circuit conditions, the rise of the current wave is so rapid that the entire free length of the fusible member 23 is melted back to the terminal 20 before the arc is extinguished and before the terminal 20 has completed its upward travel. The arc immediately ruptures and expels the cork 28'. The bore of the tube 1 is filled with the arc and arc gases to such an extent as to cause rapid evolution of gases from the fiber walls and a great increase in internal pressure in the bore of the tube. The terminal 20 travels upward exposing further area of the inner walls of fiber to the arc. When such an arc is formed within the fiber tube 1, the extinguishing blast which is developed depends upon, first, the facility with which gas is given off by the walls of the bore containing the arc; second, the size of the arc relative to the size of the bore of the tube; and, third, the length of the bore acted upon by the arc relative to the diameter of the bore.

The present fuse is so constructed that upon the occurrence of a low impedance fault with consequent heavy current flow, a violent evolution of gas from the walls of the tube 1 occurs and provides the desired extinguishing effect upon the arc, by virtue of which, when the arc passes through zero current value, the resistance to breakdown of the gaseous medium in the space is so great as to prevent reestablishment of the arc. The melting of the whole or substantially the whole of the fusible link 23 results in the drawing of the arc from the lower end of the terminal 20. This terminal 20 substantially fills the bore of the tube 1, and the heavy arc causes a violent evolution of gas from the fiber forming the inner walls of the tube 1. By the upward travel of the terminal 20 the arc is brought into contact with more of the inner walls of the tube, thereby heightening the effect of the outflowing gas by the increase in area exposed, and also by the fact that the longer the area of the walls exposed to the arc, the greater is the choking effect of the bore of the tube. The result is a powerful blast of gases out of the open end of the tube, these gases serving to sweep the ionized particles and metal vapor out of the arc space and tending to increase the dielectric strength of the space.

The cross-sectional area of the fusible link 23 has no relation to the size of the arc which may be produced. The fusible link is graduated to the normal current which it is desired to supply through the circuit. Thus, for example, on potential transformer service, normal current flow may be merely a fraction of an ampere, but in the event of a low impedance fault, the current may rise to thousands of amperes.

Whatever pressure is developed in the tube 1 reacts upon the plungerlike terminal 20 to drive it in the same direction as it is urged by the spring 17, thus tending to accelerate its motion in extending the length of the arc. Due to the relatively close fit of the plunger terminal 20, such pressure does not disturb its concentric position, nor does the plunger terminal tend to cock or bind in the bore.

The lower fuse ferrule 30 is provided with a pair of projecting ears 39 and 40. These ears are adapted to rest upon and be supported by the two arms of a spring supporting member such as shown in Fig. 13 in a manner to be described as the description proceeds.

A description will now be given of the construction of the fuse box and of the terminal clips therein for receiving the fuse shown in Fig. 1. The fuse box comprises a main box body portion 50 having a cover 51 hinged thereto. The box 50 is made of wet process porcelain and constitutes one integral member. The box has side walls 52, and end wall 53, and a back or rear wall 54 all formed as an integral object. The back 54 has an arch shaped projection 55 extending towards the front of the box at a point approximately midway of the length of the box. The arched back portion 55 extends between the side walls 52 and is integral with the side walls thereby acting as a spacer to prevent convergence of the walls during the firing process. A pair of pockets or depressions 58 and 59 are thus formed between the arched projection 55 and the ends of the fuse box. The terminal clips are mounted

within these pockets. A pair of ribs 62 and 63 are formed at the top of the arch member 55 and at the end thereof, said ribs extending from the side walls 52 towards one another into box and being tapered from a maximum thickness at the arched portion to a minimum thickness at the open or front end of the box.

A similar set of ribs 64 and 65 are formed at the lower end of the arch member 55 and likewise extend inward from the side walls of the box. These ribs act to strengthen the box. The side walls 52 and the top end wall 53 are provided with a continuous projecting rim 68 which overlies the cover member when the same is in its closed position, thereby acting as a water shed to prevent the entrance of moisture into the fuse box. The lower end 70 of the fuse box has a substantial opening therein indicated at 120 through which the end of the fuse extends and it also provides a support for a hinge bracket 71 which is secured to the box and provides a hinge support for the cover member. A pair of perforations 74 and 75 are formed in one of the walls 52 for extending conductors into the fuse box to the respective fuse clips mounted therein. Similar perforations are provided in the opposite wall 52, these perforations being provided in both of the side walls in order to permit the extension of a conductor into a fuse box from either side thereof. The holes are formed in the side walls at an angle extending upwardly, as viewed from the outside of the box, thereby preventing moisture from entering the box through these holes or perforations.

Adjacent the depression or pocket 58 the side walls 52 are formed with a pair of slots 78 and 79 opposite to one another for receiving the terminal clip. A similar pair of slots is provided in the side walls adjacent the lower pocket 59. The terminal clips are mounted in these slots and are held therein by their own resiliency as will be pointed out as this description proceeds. A pair of slots 81 and 82 are formed in the arch projection 55 at the outer rear side of the box. These slots are provided for receiving a spring bracket member for mounting the box in place. It is to be noted that the box, when formed, has no inserts embedded therein and that the terminal clips are adapted to be removably secured to the box without resorting to the use of studs or the like formed integrally with the body of the box. The same applies to the mounting means.

The upper contact clip comprises a U shaped contact finger 85 formed preferably of bus copper or other suitable metal of high conductivity, said contact finger having its ends flared outwardly as indicated at 86 and 87 to serve as guides for the ferrule of the fuse as the same is inserted in place. A U shaped spring member 88 is provided for forcing the contacting arms of the contact finger 85 together into firm contacting engagement with the ferrule when the same is inserted between the sides of the contact finger.

The spring 88 is preferably made of phosphor bronze although the invention is not limited to the use of such material. A connector which is preferably, although again not necessarily, made of cast copper is provided for establishing a connection to the contact clip. This connector is indicated at 90 and comprises a base portion 91 and upstanding portion 92 which is formed back upon itself to provide a rectangular opening 93 for receiving an incoming line conductor. A set of screws of brass or the like is provided for securing the ends of the incoming conductor in firm electrical contact with the connector. The terminal clip is provided with a support 100 which is preferably made of phosphor bronze sheet spring material and formed into a U shape. The ends of the arms of the U shaped support are bent parallel to the base of the U as indicated at 101 and 102. Each of the bent back portions 101 and 102 is slit twice intermediate its length and the central portion 105 is bent downward and the two end portions 106 are bent upward a slight amount. The contact finger 85, the spring 88, the connector 90, and the support 100 are secured together by means of two rivets 108 and 109 that extend through aligned holes in the respective members.

The connector 90 has an extension 110 formed integrally with the portion 91 thereof and a catch 111 is secured thereto by a set of screws extending through aligned holes in the catch 111 and in the projection 110. This catch is made of spring material and preferably comprises a strip of phosphor bronze. The catch is provided to receive a member at the end of the cover and on the inside thereof for holding the cover closed. The lower terminal clip that is mounted in the pocket 59 of the fuse box is substantially the same as the upper terminal clip differing therefrom only in that on this clip the catch member 111 is omitted and that therefore the projection 110 on the portion 91 of the connector is likewise omitted. The connector is movably mounted in place by flexing the arms of the support 100 together until the projecting portions 101 and 102 can pass between the side walls of the fuse box. The connector is then inserted into the pocket 58 of the fuse box until the portions 101 and 102 of the support come opposite the slots 78 and 79 in the side walls 52 of the fuse box.

The arms of the connector 100 are then released thereby permitting the projecting portions 101 and 102 of the support 100 to enter the slots 78 and 79 in the fuse box and be held therein by their own resiliency. The bent portions 105 and 106 are provided in order to cause the parts 101 and 102 to fill the slots 78 and 79 and prevent side play of the terminal clip. It is to be noted that when the terminal clip is inserted in place the bottom of the terminal clip clears the back wall of the fuse box. As a result a floating support for the contact finger 85 is provided since the spring support 100 is permitted to deflect small amounts should the ferrule that is being inserted between the contact fingers be slightly out of alignment with the contact fingers. It is to be noted that the projecting portions 106 are tapered as may be seen in Fig. 10. The portions 106 have minimum width at their outer end and their maximum width at the point where they merge with the arms 101 and 102, respectively.

Due to this taper a small amount of play of the contact clips is permitted in the slots 78 and 79, this end play being both angular and longitudinal of the fuse box. End play can take place by the flexing inwardly of the sides of the clip supports 100, which must take place against the natural resiliency of the clips. As a result the clips normally remain centered in the slot, extending fully into the slot so that the widest portion of the projecting arms 106 fill the slot.

The lower end of the box has an opening 120 through which the lower end of the fuse is adapted to extend. The end of the box is likewise provided with two perforations 122 and 123 by means

of which a hinge bracket is secured to the box for mounting the cover. The bracket is indicated at 71 and is made of suitable molded insulation. The bracket member 71 has a pair of hexagonal thimble members 125 embedded therein and in alignment with the perforations 122 and 123 in the fuse box.

The thimbles 125 are internally threaded and closed at the bottom. Screws 126 are passed through the perforations 122 and 123 and are threaded into the thimble members 125 to rigidly secure the bracket member 71 to the end 70 of the fuse box. The bracket 71 is provided with a pair of arms 128 and 129 which are adapted to extend between a pair of similar arms 135 and 136 in the cover member 51. The openings in the arms 128 and 129 are provided with internally threaded bushings embedded therein whereas the openings in the arms 135 and 136 are not threaded nor are they provided with a bushing member although if desired this may be provided. A hinge pin 137 is passed through the opening in the arm 135 and is threaded into the sleeve in the member 128 thus rigidly securing it to the arm 128, said pin passing freely through the opening in the arm 135. A similar pin 138 is passed through the arm 136 and is threaded into the bushing in the arm 129 to rigidly secure it to said arm. Here again the pin passes freely through the perforation in the arm 136. As a result of this arrangement the arms 135 and 136 are free to turn about the hinge pins 137 and 138 which pins are in alignment.

The cover 51 is made as an integral unit of suitable molded insulation, such as synthetic resin or the like, and includes a back wall with well rounded edges merging into side walls. A number of ribs 140 and 141 are formed integrally with the back wall and extend across the same, merging into and being united as an integral part of the side walls. These ribs have hollow depressions 142 and 143 for permitting a fuse to rest in the cover member, extending outward therefrom somewhat. A pair of internally threaded bushings 145 and 146 are embedded in the molded insulating material of the cover member adjacent one end thereof and a similar pair of internally threaded bushings 148 and 149 are likewise embedded in the molded insulating material of the cover at the other end thereof. An upper fuse bracket 155 is secured to the cover member by means of a pair of screws 156 that pass through openings in the bracket member 155 and are threaded into the bushings 145 and 146. This bracket member is in general L shaped and is provided at one end with a cylindrical projecting portion 160 which is adapted to fit into the socket 9 in the upper terminal 7 of the fuse shown in Fig. 1.

The base of the L shaped bracket is cylindrical as indicated at 162, and is adapted to be received between the ends of the spring arms of the catch 111 that is mounted upon the upper fuse clip secured within the fuse housing.

A spring latch is provided for holding the fuse in the cover member when the fuse box is open and for supporting the fuse in the fuse box when the cover is closed. This latch comprises a latch base 165 that is secured to the cover member 51 by means of a pair of screws that extend through a pair of holes in the latch base in alignment with the polygonal and internally threaded bushings 148 and 149. The latch base is provided with a pair of projecting arms 167 having aligned openings therein through which a hinge pin 168 is passed. The hinge pin is freely rotatable in the openings in the arms 167 and extends outside of the arms. A pair of latch dogs 170 and 171 are mounted on the projecting ends of the hinge pins and are locked thereto by means of pins 172 and 173 that extend through the latch dogs into the hinge pin 168.

A coil spring 175 is mounted on the hinge pin 168, one end of the spring passing around the arm 170 tending to force the same upward as seen in Fig. 13. The opposite end of the spring is passed around one arm 167 being bent back and held in place by said arm. At the other end of the hinge pin there is provided a similar coiled spring 183 similarly bent around the latch dog 171 as indicated at 181 to resiliently support the same against downward movement. The opposite end of the spring 183 is passed around the back of the opposite arm 167 and is likewise held in place by said arm. The arms 167 act as bearing points for the ends of the springs whereby the springs resist downward motion of the latch dogs as seen in Fig. 13. The hinge pin has a tapped hole therein into which a fillister stop screw 177 is threaded, the head extending out of the pin. A similar hole for receiving a similar screw is formed in the pin, spaced from the first mentioned hole and disposed at about 120° thereto. The heads of these screws are adapted to abut against a shoulder on the base 165 to limit the extent of rotative movement of the pin in either direction. The latch dogs are provided with latches 185 and 186 for receiving and holding the supporting ears 39 and 40 on the lower fuse ferrule as shown in Fig. 2. The latch dogs 170 and 171 are likewise provided with outwardly flaring surfaces 187 and 188 to guide the lower fuse ferrule between the latch dogs when the same is being inserted into place.

As previously stated the latch is secured to the cover member 51 on the inside thereof by means of the latch base 165.

The cover member 51 is provided with an eye member 190 having a central perforation 191. The eye 190 is formed integrally with the cover member and is provided for receiving the end of a hook stick whereby the cover may be manipulated to the closed or the open position.

The entire fuse box is shown as being mounted upon a support 200 by means of a bracket 201 that is bolted to the support by means of a single bolt 202. A number of pointed dogs 202' on the bracket embed themselves in the support and hold the box against turning. The bracket is made of malleable iron and has a pair of arms 203 and 204 having bent back portions 205 and 206 respectively. In the normal condition of the bracket the distance between the ends of the bent back portions 205 and 206 is slightly greater than the distance between the inner edges of the slots 81 and 82 in the fuse box. The arms 203 and 204 are somewhat resilient and they are slightly compressed towards one another to permit the entrance of the ends 205 and 206 into slots 81 and 82 respectively.

A stud 210 is then passed through a tapped opening in the arm 204 and is threaded therein until the opposite end of the stud comes into engagement with the arm 203. The arm 203 has no opening opposite the opening in the arm 204 through which the stud 210 passes. Hence after the stud 210 comes into contact with the arm 203 further turning thereof in its opening in the arm 204 causes it to force the arms 203 and 204 apart, thus further forcing the ends

205 and 206 into the slots 81 and 82 of the fuse box. This provides an excellent support for the fuse box which may be readily removed by merely loosening the stud 210 and then forcing the arms 203 and 204 somewhat together to cause the projecting portions 205 and 206 to clear the slots in the fuse box.

To insert the fuse shown in Figure 1 into the fuse box the fuse is turned with its bottom side up and, the cover of the fuse box being open, the ferrule 30 is inserted between the dogs 170 and 171 of the latch, the flared ends 187 and 188 guiding the ferrule between the dogs.

The ears 39 and 40 are brought under the latching portions 185 and 186 respectively as may be seen in Fig. 4 and the fuse is then elevated thus turning the latching dogs 170 and 171 against their springs 175 and 183 respectively. When the fuse has been elevated sufficiently to permit its now lower end to clear the extending portion 160 of the upper fuse bracket 155 it is moved inwardly and lowered so that the extending portion 160 enters the socket 9 in the normally upper terminal 7 which is now in the lower position. A fuse is now rigidly held in the cover member by means of the fuse bracket 155 and the latch assembly at the opposite end of the cover. A hook stick is provided for manipulating the cover of the fuse box, said stick comprising a long member of wood suitably treated to have a high insulating value and provided with a hook at the end thereof. The hook at the end of the stick is then inserted through the opening 191 in the eye 190 and by means of the stick the cover is swung about its hinge into its closed position.

As the cover approaches its closed position the upper and lower ferrules of the fuse enter between the contact fingers of the corresponding contact clips mounted in the fuse box. The ferrules are guided into the contact clips by the guiding portions 86 and 87 on the contacts and, since the contacts are of the floating type, as was previously pointed, the contacts are enabled to align themselves to slight misadjustment in the position of the fuse. As the cover comes into the full closed position the cylindrical portion 162 at the end of the upper fuse bracket 155 enters between the spring jaws of the catch 111 that is mounted on the upper fuse clip, and said catch serves to maintain the cover in the full closed position. It is to be noted that the sides and the end of the fuse box overlie the cover member thus effectively preventing the entrance of moisture into the fuse box. The lower open end of the fuse tube extends through the opening 120 in the bottom end of the fuse box thereby permitting the ready expulsion of the contents of the fuse upon blowing thereof.

When the fuse is in the full closed position, the spring latch mounted on the cover member serves to help hold the fuse.

To remove the fuse the cover is opened by inserting the hook stick into the eye 190 and the cover is pulled into the open position. The catch 111 is made of spring material and upon pulling of the cover it permits the withdrawal of the cylindrical portion of the bracket 155 from between its jaws. The operation of the fuse is as follows: Upon the occurrence of overload, the fusible link melts at the restricted part 28 within the cork 28'. If the overload is relatively light, the fusing of other parts of the link may not occur during arcing. As soon as the mechanical strength of the link is destroyed, the spring 17 draws the terminal 20, which substantially fills the bore of the tube 1, upwardly. At the same time, the metal vapors of the fuse and the gases evolved from the cork and from the walls of the tube by the heat of the arc, expel the cork and the lower portion of the link 23 out the open end of the tube 1. The tube 1, being of fiber, or lined with fiber, evolves by the heat of the arc, as is well known in the art, gases which are driven out the open end of the tube 1. This expels the metal vapors and supplants them with a relatively large volume of gases which are not ionized and thereby provides extinguishing action. If the overload is heavy, that is, approaches maximum current flow, as due to a short circuit, the action is much more violent, the cork being substantially destroyed, and immediately expelled with violence, carrying such part of the link 23 as may not be fused. The terminal 20, which as above pointed out substantially fills the bore of the tube 1, begins to move upwardly along said bore. In this case, the volume of the arc is such that it contacts the bore of the tube 1 and causes the evolution of large volumes of gas which drive the metal vapors and ionized gases of the arc out through the open end. The chief function of the cork 28 is in connection with low current values of the arc which would not derive large volumes of gas from the tube 1. The occurrence of an arc of a volume such as to cause a rapid evolution of large volumes of gas from the fiber walls of the bore of the tube as the terminal 20 is drawn upwardly, the arc thus being extended further along the bore, and thereby continuing to evolve such gases to produce the desired blast and extinguishing effect. Thus, as the terminal 20 is drawn upwardly, the continued evolution of gases from the fiber walls of the tube 1 causes a flow in the opposite direction out of the open end of the tube.

In compliance with the requirements of the patent statutes I have herein shown and described a preferred embodiment of my invention. The invention is however not limited to the precise construction herein shown, which is merely illustrative of the invention, but is capable of various modifications within the spirit and scope of the appended claims.

What I consider new and desire to secure by Letters Patent is:

1. In a device of the class described, the combination of a tubular casing open at one end, a terminal closing the opposite end of said casing, a coiled spring disposed within the casing and secured at one end to said terminal, a movable terminal secured upon the opposite end of the spring, a conductor extending through the spring and connected at its opposite ends to said terminals, a lug on said movable terminal offset with respect to the axis of the casing and having a flat face substantially on the axis of said casing, a stud anchored in said lug and extending laterally from said face, a terminal on the outside of the casing adjacent the open end of the casing, a lateral stud anchored in said last terminal, and a fuse link connected to said first stud at substantially the axis of the casing and extending diagonally to the end of the side wall of the casing at the open end thereof, said fuse link extending around and tensioned on the end of the side wall of the casing and connected to the stud on the outside terminal.

2. In a device of the class described, the combination of a tubular casing open at one end, a terminal closing the opposite end of said casing,

a coiled spring disposed within the casing and secured at one end to said terminal, a movable terminal secured upon the opposite end of the spring, a conductor extending through the spring and connected at its opposite ends to said terminals, a lug on said movable terminal offset with respect to the axis of the casing and having a flat face substantially on the axis of said casing, a stud anchored in said lug and extending laterally from said face, a terminal on the outside of the casing adjacent the open end of the casing, a lateral stud anchored in said last terminal, a fuse link connected to said first stud at substantially the axis of the casing and extending diagonally to the end of the side wall of the casing at the open end thereof, said fuse link extending around and tensioned on the end of the side wall of the casing and connected to the stud on the outside terminal, said fuse link having a portion of reduced cross-sectional area between the movable terminal and the open end of the casing, and a member encasing the reduced cross-sectional area of the fuse element and substantially filling the inner cross section of the casing.

3. An air filled fuse, comprising a sleeve of fibrous insulation open at one end, means closing the other end of the sleeve, a fuse link stretched over the lip of the open end and anchored outside the sleeve at a point spaced from said open end, said link having a connection within the sleeve extending to the closed end, said link having a fusible portion of graduated current carrying capacity disposed in the bore of the sleeve, and a tension spring within the sleeve for separating the ends of the fusible portion upon fusing of the same.

4. An air filled fuse, comprising a sleeve of fibrous insulation open at one end, a fuse link stretched over the lip of the open end and anchored outside the sleeve at a point spaced from said open end, and a tension spring in the sleeve connected to the link, said link having a fusible portion of graduated current carrying capacity disposed in the bore of the sleeve adjacent said open end.

5. An air filled fuse, comprising a sleeve of fibrous insulation open at one end, a fuse link stretched over the lip of the open end and anchored outside the sleeve at a point spaced from said open end, a tension spring connected to the inner end of the link, said link having a fusible portion of limited current carrying capacity disposed in the bore of the sleeve adjacent said open end, and an enclosing body of heat insulating material for insulating said fusible portion from the walls of the sleeve.

6. In a fuse device, a housing comprising a box and a lid hinged on the box, a fuse comprising a tube having a pair of spaced terminal contacts, the box having a pair of spaced spring circuit contacts for receiving said fuse terminal contacts, the lid having a pair of spaced quick detachable anchorages for mechanically holding the fuse to register the fuse terminal contacts with the box contacts when the lid is closed, one of said anchorages comprising a recoil block to sustain the recoil of the fuse upon blowing of the same, and the other comprising spring means for holding the fuse and the recoil block in contact.

7. In a fuse device, a housing comprising a box and a lid hinged on the box, a fuse comprising a tube having a pair of spaced terminal contacts, the box having a pair of spaced spring circuit contacts for receiving said fuse terminal contacts, said lid having a pair of spaced quick detachable anchorages for mechanically holding the fuse to register the fuse contacts with the box contacts when the lid is closed, one of said anchorages being releasable only by movement of the fuse longitudinally with respect to the lid, said one anchorage comprising a recoil block and the other anchorage including yieldable means for holding the fuse and recoil block in engagement.

8. In a fuse device, a housing comprising a box and a lid hinged on the box, a fuse comprising a tube having a pair of spaced terminal contacts, the box having a pair of spaced spring circuit contacts for receiving said fuse terminal contacts, said lid having a pair of spaced quick detachable anchorages for mechanically holding the fuse to register the fuse contacts with the box contacts, said anchorages lying endwise beyond the corresponding fuse contacts, one of said anchorages comprising a recoil block, and the other of said anchorages comprising means for pressing the fuse and the recoil block endwise into engagement.

9. In a fuse device, a housing comprising a box and a lid hinged on the box, a fuse comprising a tube having a pair of spaced terminal contacts, the box having a pair of spaced spring circuit contacts for receiving said fuse terminal contacts, the lid having a pair of spaced quick detachable anchorages for mechanically holding the fuse to register the fuse terminal contacts with the box contacts when the lid is closed, said anchorages comprising a projection and a socket registering by movement of the fuse longitudinally relative to its axis, and a hook and shoulder registering by lateral movement of the fuse relative to its axis.

10. In a fuse device, a housing comprising a box and a lid hinged on the box, a fuse comprising a sleeve of fibrous insulation open at one end, a fuse link stretched over the lip of the open end, said sleeve having a pair of spaced terminal contacts, one providing a closure for the upper end of the sleeve, the other being disposed at a point relatively remote from the open end, the outer end of the fuse link being anchored to said second terminal contact, a tension spring in the sleeve connected to the link, said link having a fusible portion of graduated current carrying capacity disposed in the bore of the tube adjacent the open end, an anchorage for the upper terminal contact of the fuse upon the lid, comprising a projection and a socket registering by movement of the fuse longitudinally relative to its axis, said second terminal contact having an anchorage to the lid, comprising a hook and shoulder registering by lateral movement of the fuse relative to its axis and involving a spring tending to hold the projection and socket in engagement.

11. In a device of the class described, a sleeve of insulation open at one end, means closing the other end of the sleeve, a fuse link adapted to stand under spring tension, said link having a readily fusible portion lying within the bore of the sleeve, spring means placing said readily fusible portion under tension to separate the terminals of the fusible portion when the fusible portion melts under overload, an external terminal at a point remote from the open end of the sleeve, said terminal being connected to one end of the fuse link and lying out of the path of the blast of gases formed upon blowing of the fusible portion.

12. In a device of the class described, a sleeve of insulation open at one end, means closing the other end of the sleeve, said other end of the

sleeve having a terminal for external connection to a circuit and for internal connection to a fuse link adapted to stand under spring tension, a permanent external terminal remote from the open end of the sleeve and lying out of the path of arc gases issuing from said open end upon blowing of the fusible portion, a fuse link having a fusible portion, one end of the link being connected to said external terminal and a portion of the link forming a movable terminal for one end of the fusible portion, the opposite end of the fusible portion having connection with said first terminal, and a spring for separating the terminals of the fusible portion upon the occurrence of overload, said first movable terminal for the fusible portion being expelled out of the open end of the sleeve upon melting of the fusible portion.

13. In a device of the class described, a sleeve of insulation open at one end, means closing the other end of the sleeve, said means including an external terminal for connecting the device to an external circuit, and an internal terminal for connection with a fuse link, an external terminal remote from the open end of the sleeve, and lying out of the path of the arc gases issuing from said open end upon blowing of the fusible portion, a fuse link including a fusible portion and a lead portion extending from the fusible portion to said second external terminal, said part of the lead portion which lies within the sleeve being expelled from the open end of the sleeve upon blowing of the fusible portion, said fusible portion being adapted to stand under tension and means for tensioning the fusible portion to cause separation of the terminals thereof upon melting of the fusible portion by the occurrence of overload whereby the arc is rapidly lengthened within the sleeve and its extinguishment is insured for all values of current flow.

14. In a fuse device, the combination of a tube of insulation adapted to be closed at one end, a terminal member at said end, the other end of the tube permitting the escape of gases when the fusible portion blows, a conductor extending through the tube, one end of the conductor being joined to the terminal member, said conductor having a readily fusible portion disposed within the tube and adapted to be melted upon excessive current flow through the conductor, said fusible portion being adapted to stand normally under spring tension, and a spring connected to the conductor at one side of the fusible portion for extending the gap made by fusing of the fusible portion, the reaction of the spring being supported upon the said terminal and upon the second mentioned end of the tube, said conductor having a flexible portion extending outside the tube for connection with a second terminal remote from the second end.

15. In a fuse device, the combination of a tube of insulation, a stationary terminal member closing one end of the tube, the other end of the tube premitting the escape of gases when the fuse portion blows, a conductor extending through the tube, one end of the conductor being joined to the terminal member, said conductor having a readily fusible portion disposed within the tube and adapted to be melted upon excessive current flow through the conductor, said fusible portion being adapted to stand normally under spring tension, and a spring connected to the conductor at one side of the fusible portion extending the gap made by fusing of the fusible portion, the reaction of the spring being supported upon said terminal and upon the second mentioned end of the tube, said conductor having a flexible portion extending outside of the tube for connection with the second terminal remote from the second end, and out of the blast of gases produced by blowing of the fusible portion.

16. In a fuse device, the combination of a tube of insulation adapted to be closed at one end, a terminal member at said end, the other end of the tube permitting the escape of gases when the fusible portion blows, a conductor extending through the tube, one end of the conductor being joined to the terminal member, said conductor having a readily fusible portion disposed within the tube and adapted to be melted upon excessive current flow through the conductor, said fusible portion being adapted to stand normally under spring tension, and a spring connected to the conductor at one side of the fusible portion for extending the gap made by fusing of the fusible portion, the fusible portion being closely embraced by a sleeve of insulating material within which the arc is lengthened by spring tension when the fuse melts, said conductor having a flexible portion leading from the end of the embracing sleeve to a terminal remote from the open end of the first tube.

17. In a fuse device, the combination of a tube of insulation adapted to be closed at one end, a terminal member at said end, the other end of the tube permitting the escape of gases when the fusible portion blows, a conductor extending through the tube, one end of the conductor being joined to the terminal member, said conductor having a readily fusible portion disposed within the tube and adapted to be melted upon excessive current flow through the conductor, said fusible portion being adapted to stand normally under spring tension, and a spring connected to the conductor at one side of the fusible portion for extending the gap made by fusing of the fusible portion, a sleeve of insulating material closely embracing the fusible portion, within which an arc of small current value is lengthened by the spring tension when the fuse blows, but which is adapted to be ruptured and blown out of the end of the tube by arcs of larger current value, said conductor having a flexible portion leading from the insulating sleeve out of the open end of the tube and to a terminal remote from the open end so that the embracing insulating material and flexible lead can clear the tube on arcs of high current value.

18. In a circuit interrupter, an arc extinguishing structure having walls defining a chamber, said walls being fixedly mounted during the extinguishing of the arc and being of a material which, when acted upon by the arc, gives off gas to extinguish the arc, and arc drawing means movable within said chamber, the cross-sectional area of said arc drawing means being substantially the same as the cross-sectional area of said chamber, said walls of the chamber extending along the path of the arc for substantially the whole length thereof, and said chamber being open during the extinguishing of the arc at the end away from which said arc drawing member moves to cause the gas to flow through said chamber and out the end thereof, and an annular terminal disposed to be out of the direct line of the gas blast from the open end of the chamber.

19. In a fuse, an arc extinguishing structure having a tubular passage therethrough, the inner walls of said passage being fixedly mounted dur-

ing the extinguishing of the arc and being of material which evolves a large volume of gas when acted upon by the arc, a fusible element, separable terminals for the fusible element, one of which is fixed adjacent one end of the tubular passage, the other of which is movable through said passage to draw the arc therein when the fusible element melts, said inner walls extending along substantially the whole path of movement of the movable terminal, and said passage being of small cross section to restrict the cross section of the arc, and said passage being open at its end adjacent the fixed terminal to permit free flow of gas out of said open end, the fixed terminal being disposed out of the direct line of the gas flow from the open end of the chamber.

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