

July 2, 1946.

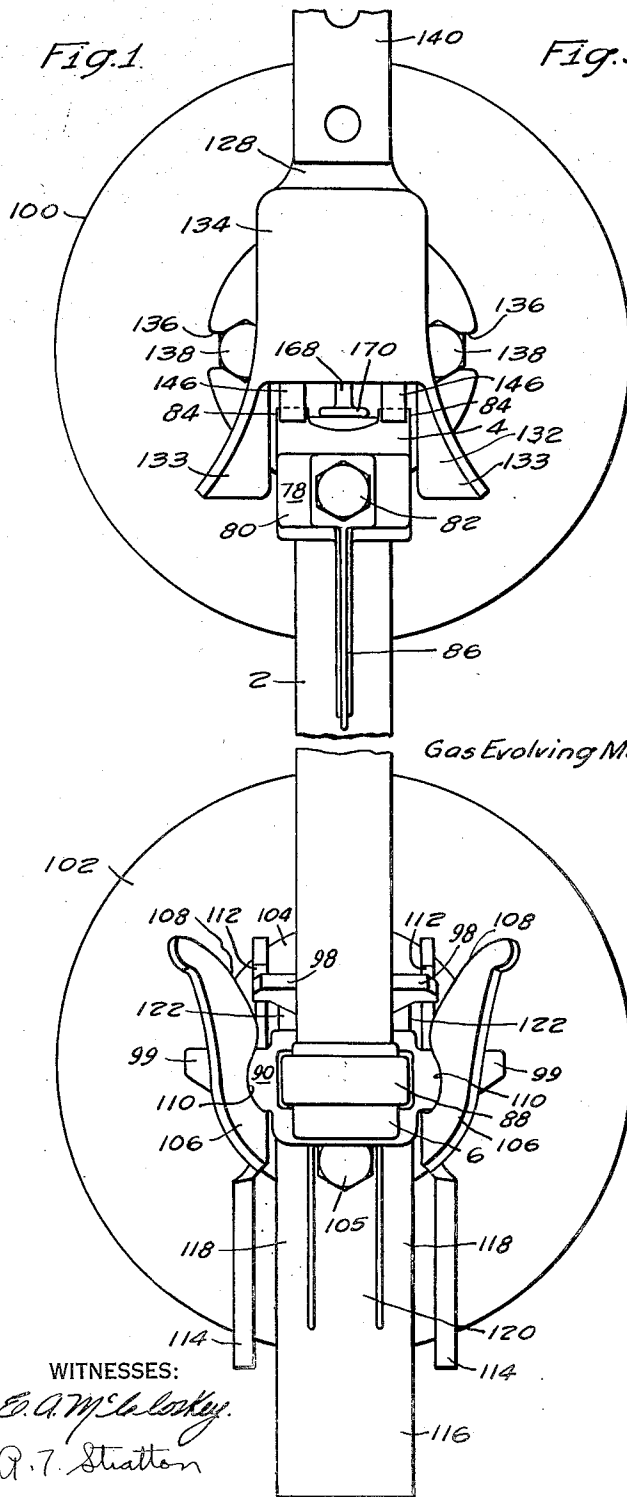
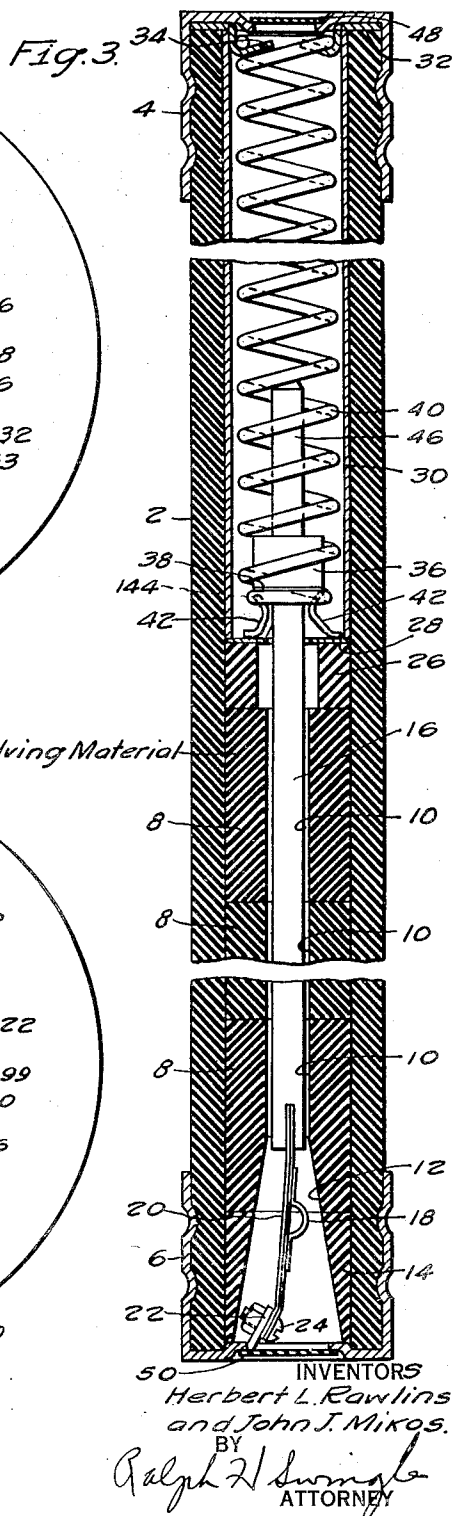
H. L. RAWLINS ET AL

2,403,121

CIRCUIT INTERRUPTER

Filed Jan. 29, 1942

4 Sheets-Sheet 1



July 2, 1946.

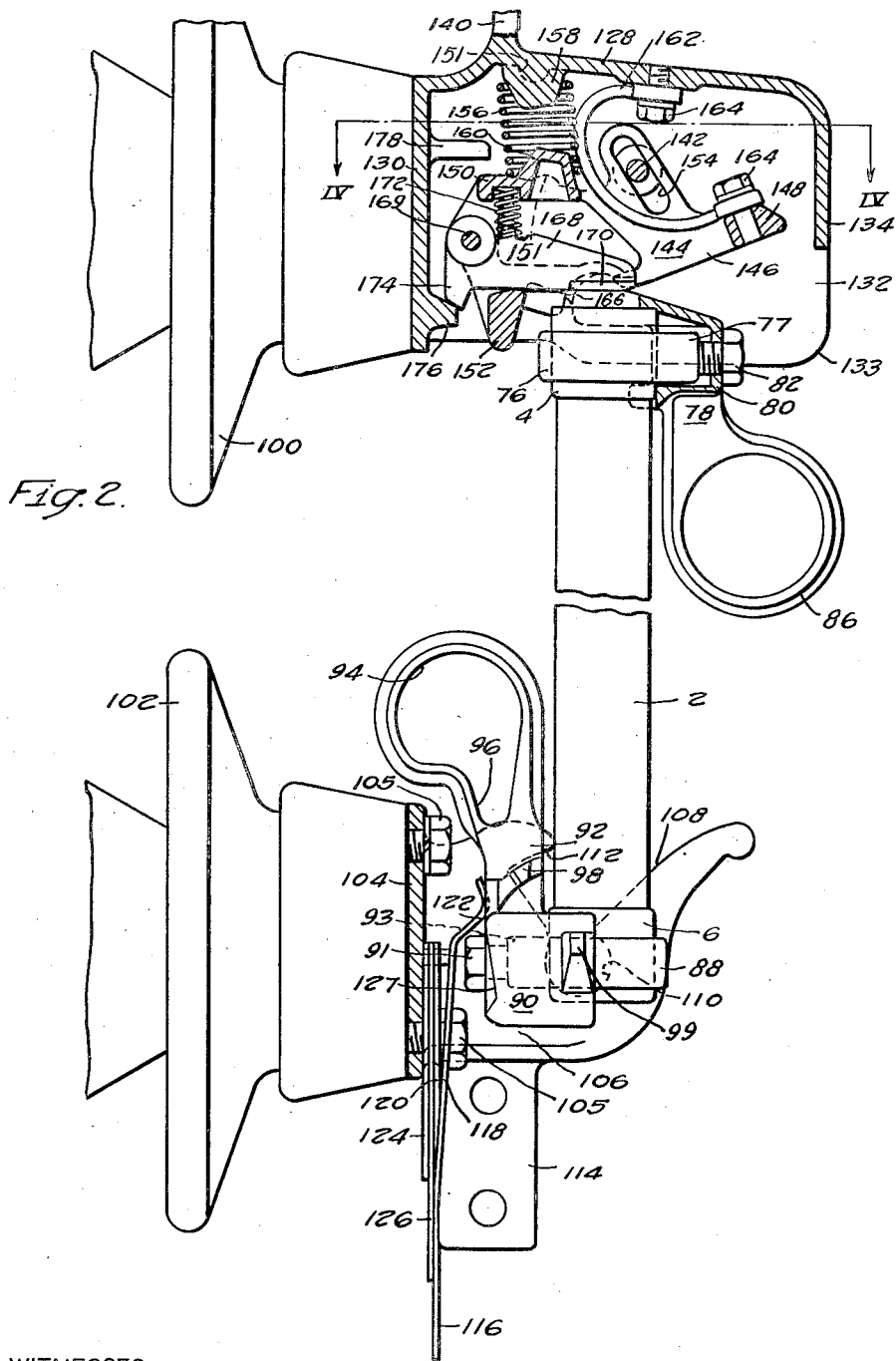
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CIRCUIT INTERRUPTER

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4 Sheets-Sheet 2



WITNESSES:

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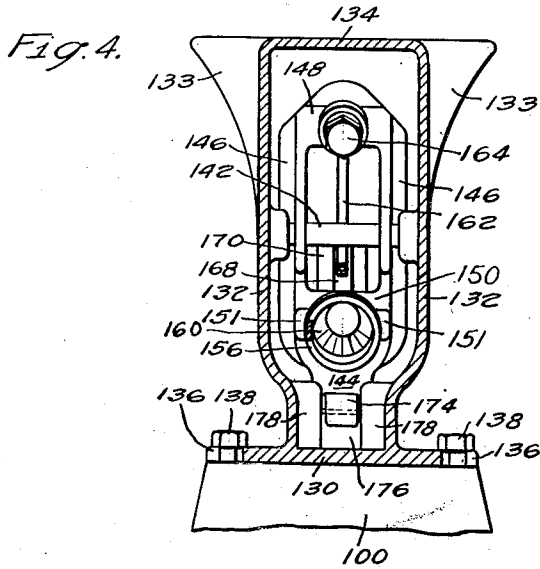
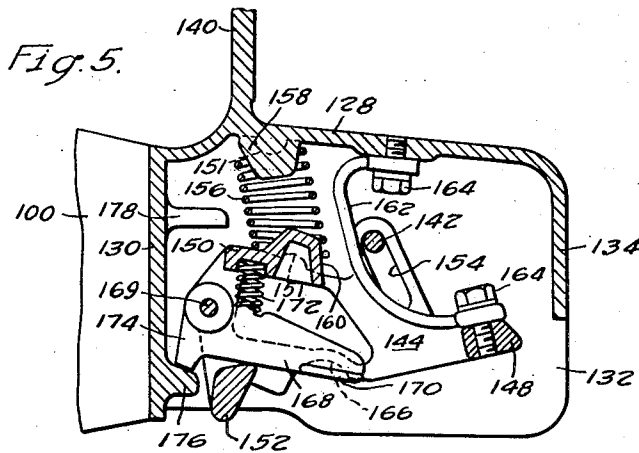
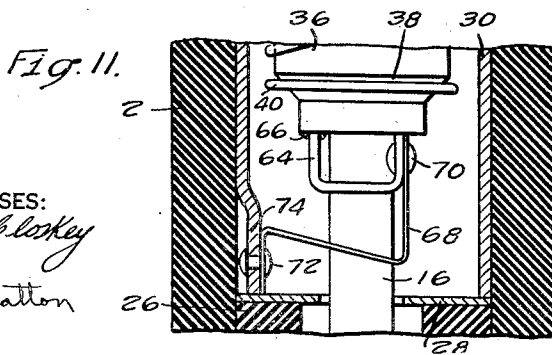
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CIRCUIT INTERRUPTER

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4 Sheets-Sheet 3



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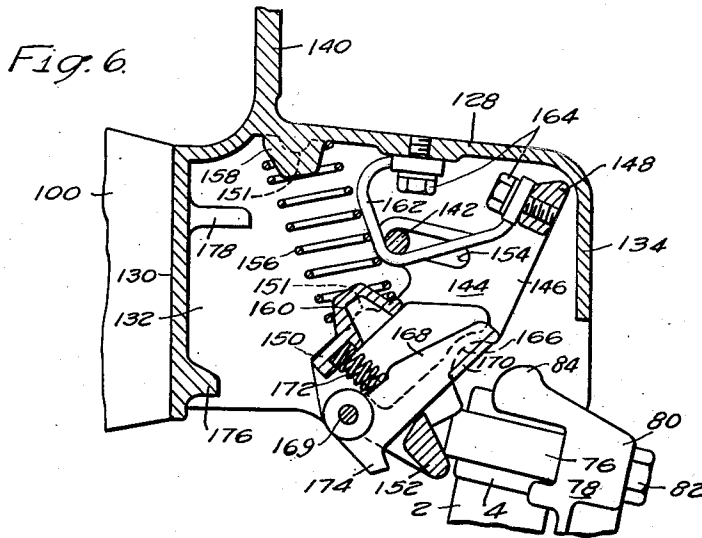
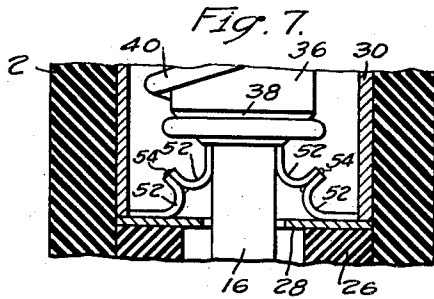
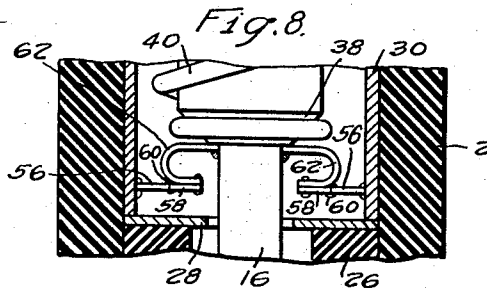
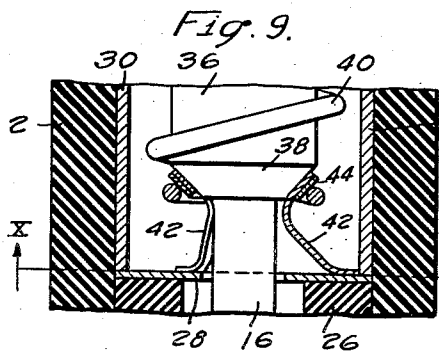
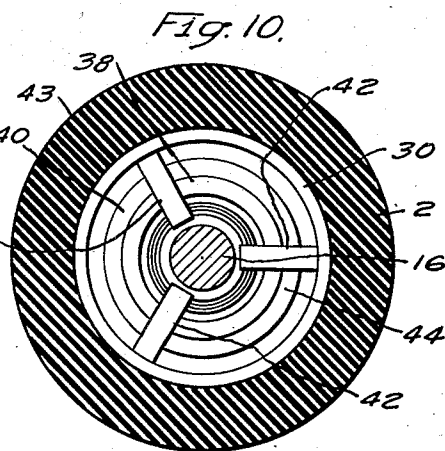
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CIRCUIT INTERRUPTER

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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,403,121

CIRCUIT INTERRUPTER

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Application January 29, 1942, Serial No. 428,710

60 Claims. (Cl. 200—117)

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This invention relates generally to circuit interrupters, and more specifically to high voltage fuses.

One object of this invention is to provide a novel type of high voltage fuse which is relatively simple in construction and economical of manufacture, while being capable of efficiently interrupting relatively large currents.

Power fuses have been used wherein a fusible element is connected between terminals with one of the terminals spring-biased to draw out the arc formed when the fuse blows. One way by which current has been conducted to the movable terminal is by the use of a flexible shunt. Such a shunt takes up considerable space, and must be moved by the spring during circuit interruption.

Another object of this invention therefore is to provide a novel fuse construction for conducting current to a movable fuse terminal without the use of flexible shunts or the like.

Another object of this invention is to provide a normally enclosed fuse of novel construction having an operating member which is projected through the fuse enclosure when the fuse blows.

Another object of this invention is to provide for cooperation with a novel fuse construction of the type described, novel releasable means for holding the fuse in circuit and adapted to be released by an operating member actuated upon blowing of the fuse.

Another object of this invention is to provide novel latching means for a fuse of the type described for normally releasably maintaining the fuse in circuit but operable in response to blowing of the fuse to release the fuse for movement out of the circuit, while at the same time permitting manual manipulation of the fuse into and out of the circuit.

Another object of this invention is to provide novel releasable latch means for a fuse, which latch means upon release thereof is operable to move the fuse associated therewith out of the circuit.

Another object of this invention is to provide a novel drop-out fuse mounting having a novel movable mounting element capable of releasably holding the fuse in an intermediate open position, and of cushioning the opening movement thereof.

These and other objects of this invention will become more apparent upon consideration of the following detailed description of preferred embodiments thereof when taken in connection with the attached drawings, in which:

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Figure 1 is a front elevational view of a fuse constructed in accordance with this invention;

Fig. 2 is a side elevational view of the fuse shown in Fig. 1, with the upper and lower contacts shown in section;

Fig. 3 is a longitudinal sectional view through the fuse cartridge shown in Figs. 1 and 2;

Fig. 4 is a section view of the upper contact construction taken substantially on the line IV—IV of Fig. 2;

Fig. 5 is a section view of the upper fuse contact construction similar to the section of this contact shown in Fig. 2, but with the fuse removed;

Fig. 6 is a view similar to Fig. 5, but with the parts shown in a different position, and with the upper end of the fuse shown in elevation;

Fig. 7 is an enlarged, partial, central sectional view of a fuse showing a modified form of fuse construction;

Fig. 8 is a view similar to Fig. 7 showing another modified construction;

Fig. 9 is a view like Figs. 7 and 8 but showing still another modification;

Fig. 10 is a transverse section view taken substantially on the line X—X of Fig. 9; and

Fig. 11 is a view like Figs. 7, 8 and 9, but illustrating still another modified form of fuse construction.

Referring first to the construction of the fuse per se as illustrated in Figs. 3, 9, and 10 of the drawings, it will be observed that there is provided a fuse tube 2 of insulating material, such as fiber, synthetic resin or the like, and opposite ends of the fuse tube are adapted to be closed by end terminal caps 4, 6, respectively.

The lower portion of fuse tube 2, as viewed in Fig. 3, is provided with a plurality of blocks 8, of an insulating material which is capable of evolving an arc extinguishing gas when in proximity to an electric arc, supported within the tube. The insulating material 8 is preferably boric acid, but any other insulating material having the property set forth above may be employed, such, for example, as fiber or a synthetic resin.

The insulating blocks 8 are each provided with a central bore 10, so that the bores, when the blocks are mounted in the tube, form an elongated arc passage of restricted cross-section. The lower end of the arc passage formed by bores 10 is flared outwardly as shown at 12, and the lower block 14 which acts to support the blocks 8 on end cap 6, is preferably of fiber, a synthetic resin or other gas-evolving material which has a greater strength

than boric acid. An arcing contact rod 16 is

than boric acid. An arcing contact rod 16 is

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adapted to be normally positioned within the arc passage formed by bores 10, and the lower end of this rod is electrically connected to terminal cap 6 by a fusible strip 18, paralleled by a strain member 20, secured in any desired manner to the rod 16 and terminal cap 6. As shown, fusible strip 18 and strain member 20 have one end inserted in a slot in the lower end of arcing contact rod 16 to be secured therein in any desired manner, such as by soldering or riveting, and the other end of the fuse strip and strain means is bolted or otherwise secured as at 24 to an inwardly bent tongue 22 formed integral with end terminal cap 6. Fusible strip 18 may be of any desired fusible material, such, for example, as silver, zinc, tin, or alloys thereof. The strain member 20 paralleling the fusible strip is preferably of a higher resistance material which has a greater tensile strength than the material comprising fusible strip 18.

An insulating spacer block 26, having a central aperture, is preferably mounted within fuse tube 2 immediately above insulating blocks 8 for supporting a conducting washer 28. A tube 30 of good electrical conducting material such, for example, as copper or the like, extends between conducting washer 28 and a washer 32 also of a good electrical conducting material which is clamped between end terminal cap 4 and the upper end of fuse tube 2. As shown in Fig. 3, the end terminal caps 4 and 6 may be secured in position in any desired manner but are preferably secured on the ends of fuse tube 2 by a pressing operation forming indentations in the end cap flanges entering into the material of tube 2. Washer 32 is provided with a central aperture and with integral inwardly extending supporting and locking tongues 34, for a purpose to be hereinafter referred to. Just above insulating spacer 26, arcing contact rod 16 is provided with an enlarged portion 36 having a tapered lower surface 38, on which is seated an end coil of a coiled tension spring 40, the opposite end coil of which is supported by tongues 34, so that the rod 16 is biased upwardly towards end terminal cap 4, and strain member 20 is normally maintained under tension. Spring 40 also maintains washer 32 in pressure engagement with conducting tube 30, and this in turn forces the tube against washer 28 to provide good electrical contact at these points.

In order to provide a good electrical connection from arcing contact rod 16 to terminal cap 4, flexible strips 42 of a conducting material such as copper, are preferably secured to conducting washer 28 at the lower end of conducting tube 30, and the free ends of the strips are inserted between the tapering contact surface 38 on the arcing contact rod and the lower coil of spring 40. Thus, spring 40 also acts to maintain contact strips 42 in engagement with tapered surface 38 on the contact rod under pressure. Flexible contact strips 42 are preferably secured to or formed integral with a contact ring 44, to facilitate assembly of the parts. It will be noted that arcing contact rod 16 is provided with an integral extension 46 above enlarged portion 36, and that the end terminal caps 4 and 6 are each provided with a central aperture normally closed by displaceable closure disks 48 and 50, respectively, which may be releasably maintained in position, such, for example, as by cementing or the like.

The electric circuit through the fuse described above extends from one end terminal cap 4

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through conducting washer 32, conducting tube 30, contact strips 42, contact arcing rod 16, fusible strip 18 to the other end terminal cap 6. When an overload appears on the circuit in which the fuse is connected, fusible strip 18 will melt and strain member 20 will be vaporized shortly thereafter, to thereby release arcing contact rod 16 and permit spring 40 to move it upwardly towards terminal cap 4. As soon as fusible strip 18 and strain member 20 are melted, the pressure created in the flared passage 12, augmented by gas evolved from the material of bores 10, as arcing rod 16 moves upwardly, will be sufficient to displace closure disk 50 to thereby permit the gases to be expelled to the atmosphere. Spring 40 will be effective to move contact arcing rod 16 upwardly and extension 46 of the rod will engage closure disk 48 and displace the disk so that the extension will be projected from terminal cap 4 an amount limited only by engagement of enlarged portion 36 of the rod with tongues 34 on washer 32. It will be noted that the space between tongues 34 is slightly less than the diameter of rod extension 46, so that in passing upwardly between the tongues the extension will bend them upwardly, and the tongues will therefore lock extension 46 in its projecting position and prevent any subsequent tendency of the rod or extension 46 to move into the fuse tube. During interruption, when an arc is drawn between the lower end of arcing contact rod 16 and arcing tongue 22 on end cap 6, contact strips 42 will move out from between the lower turn of spring 40 and the tapered surface 38 on the contact rod, so that as the rod moves upwardly, the current will be carried by spring 40. Inasmuch as the arcing time is very short, it has been found that the spring will be undamaged by the passage of current therethrough for such short periods of time. Accordingly, in this fuse construction no flexible shunt is necessary to carry current from end terminal cap 4 to the moving arcing contact rod 16, because current is normally carried to the rod by conducting tube 30 and separable contact strips 42, whereas during the short arcing period, coil spring 40 is permitted to carry the current. Coil spring 40 also performs the function of moving contact rod 16 an amount sufficient to project extension 46 thereof out through the aperture in terminal cap 4 where it is locked against movement by locking tongues 34.

A modified type of separable connection between arcing contact rod 16 and the inner end of tubular conductor 30 is illustrated in Fig. 7, wherein a plurality of connections may be provided between these elements in the normal position thereof, and wherein each connection comprises a strip 52 of flexible conducting material connected to conducting washer 28 or the lower end of tube 30 or to both, and a second strip 52 connected to arcing contact rod 16 in any desired manner, such, for example, as by soldering or the like. The adjacent ends of the two conducting strips 52 of each connection are then brought together in face to face relation, as shown in Fig. 7, and secured at 54 by rupturable means, for example, as by soldering or the like.

In the operation of this embodiment of the invention, when a circuit interrupting operation occurs, arcing contact rod 16 is moved upwardly by spring 40, and the conducting strips 52 of each connection between the contact rod and tube 30 are straightened out and pulled apart at the soldered connection 54. The strips 52 are readily pulled apart by the spring, because the

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act of straightening out the strips will bend the securing means 54 substantially 90°. This bending action will at least weaken securing means to such an extent that but a small force is needed to pull the strips apart.

In the embodiment of the invention shown in Fig. 8, a plurality of connections each of which may comprise a pair of rigid conducting members 56 and 58 and a flexible conducting member 62 are provided between arcing contact rod 16 and conducting tube 30. As shown in Fig. 8, one of the rigid conducting strips 56 preferably is secured at one end to tube 30, for example, as by soldering or the like, whereas the other rigid conducting strip 58 is secured to one end of flexible strip 62 in any desired manner, such as by riveting or the like, and the other end of strip 62 is secured to contact rod 16 in any desired manner, such, for example, as by soldering, riveting or the like. The other ends of rigid conducting strips 56 and 58 are then secured together in abutting relation by soldering or the like 60. This places the solder connection 60 between two cantilever members 56 and 58 so that when the fusible and strain elements of the fuse melt and contact rod 16 is moved upwardly by spring 40, flexible conducting strips 62 will be straightened out and pull the end of strip 58 to which they are secured upwardly, and cause strips 58 to pivot about solder connection 60 to thereby readily break this soldered connection, and thereby interrupt the circuit from conducting tube 30 to arcing contact rod 16, so that the current during arcing will be carried by spring 40.

Still another type of separable connection between conducting tube 30 and arcing contact rod 16 is illustrated in Fig. 11, wherein a substantially U-shaped member 64 of a rigid conducting material has the free end of one leg thereof secured to the under surface of enlarged portion 36 of the contact rod, as by solder 66, and the other leg thereof is secured to one end of a substantially Z-shaped strip 68 of flexible conducting material, for example, as by a rivet 70. The other end of flexible conducting strip 68 is connected to an integral tongue 74 formed on conducting tube 30, for example, as by a rivet 72.

When circuit interruption occurs, it will be observed that since only one leg of rigid U-shaped member 64, shown in Fig. 11, is secured to enlargement 36 of the contact rod, that as soon as the contact rod is moved upwardly as by spring 40, flexible strip 68 will be straightened out and cause rotation of U-shaped member 64 about its soldered connection 66 to thereby readily break this connection and interrupt the circuit from tube 30 to the moving contact rod. An advantage of the solder type of connections shown in Fig. 11, as well as in Figs. 7 and 8, is that they normally form a solid path of good electrical conducting material for current flowing through the fuse, while at the same time they are capable of being readily separated or broken to permit interruption of the circuit within the arcing passage formed by bores 10.

Referring now to Fig. 2, it will be observed that for the purpose of mounting on circuit contacts, the fuse described above is adapted to have handling and mounting fixtures applied to the terminal caps thereof. Thus, terminal cap 4 is provided with a clamping ring 76 generally circular in form but provided on one side with a non-circular extension 77, and over this extension is provided a hook eye and latch fixture 78 having a supporting portion substantially channel-

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shaped in section to fit over the extension 77 of the clamping ring. A screw 82 passes through an aperture in the base of fixture 78 and is adapted to be threadedly engaged with the clamping ring to cause engagement of the U-shaped channel section 80 of the fixture with end terminal cap 4. Extending outwardly beyond end terminal cap 4, fixture 78 is provided with integral latch engaging extensions 84 on each side of terminal cap 4, for a purpose to be referred to. A hook eye portion 86 is also formed integral with the fixture and depends from channel section 80 thereof to be located in front of the fuse as shown in Fig. 2, to permit manipulation of the fuse about its lower pivotal mounting.

Lower end terminal cap 6 of the fuse is also provided with a clamping ring 88 similar to clamping ring 77 for the upper end of the fuse, and a hook eye contact fixture 90 of semi-circular shape and of channel form in cross-section is adapted to be mounted over extension 93 of the clamping ring and be secured in firm engagement with terminal cap 6 by a screw 91 passing through the web of fixture 90, to be threadedly engaged with extension 93 of the clamping ring. The fixture 90 is provided with an integral upwardly extending projection 92, having a hook eye 94 formed therein generally circular in form except at the side adjacent fixture 90, wherein a flaring slot portion 96 is located. Extension 92 on contact fixture 90 is also provided intermediate hook eye 94 and the channel section thereof with laterally extending guide arms 98 at opposite sides thereof for a purpose hereinafter referred to. Adjacent each end of U-shaped fixture 90, there is provided an outwardly laterally extending trunnion 99 for pivotally supporting the fuse.

The fuse is adapted to be supported upon a pair of vertically spaced insulating supports, such, for example, as the insulators 100 and 102. The lower insulator 102 is provided with a generally U-shaped contact secured thereto as, for example, by machine screws 105 extending through the base portion 104 of the contact. The legs 106 of the pivot contact are formed adjacent their outer ends with upwardly flaring notches 108 terminating at the inner lower ends thereof in a keyhole notch portion 110, with a laterally extending guide edge 112 provided at one end of one side of the notch 108 in each leg. Each leg is also provided with an integral, downwardly extending terminal leg portion 114 for connection of a line conductor thereto. Intermediate legs 106 of the pivot contact, a leaf spring member 116 of a resilient conducting material, together with backing leaf spring members 124 and 126 are preferably secured to the base 104 of the contact, for example, as by one of the contact mounting screws 105. The leaf spring 116, as shown in Fig. 1, is provided in the upper portion thereof with a pair of spaced longitudinally extending slits to form independently movable outer leg portions 118, and a central leg portion 120. Preferably the central leg portion 120 of spring 116 is secured by screw 105, and the outer leg portions 118 are preferably preset laterally outwardly of the plane of leaf spring 116 and central leg 120 thereof, and have the upper ends thereof extended beyond inner leg 120 and bent to form detent portions 122.

Referring to Fig. 2, it will be observed that when the fuse is mounted so that trunnions 99 are received in the keyhole portions 110 of slots 108 in the legs of the contact, withdrawal of trunnions 99 is prevented by engagement of guide arms 98 beneath guide edges 112 of notches 108.

It will also be observed that in this position of the parts detent portions 122 of conducting spring 116 are in engagement with the upper inner edge of contact fixture 90, and preferably in this position of the parts, the outer legs 118 of spring contact strip 116 have been stressed so that a good contact pressure is insured between the detent portions 122 thereof and the adjacent edge of contact fixture 90 on the fuse tube. Upon pivotal movement of the fuse in a clockwise direction about trunnions 99, it will be observed that guide arms 98 will first be moved clear of guide edges 112 on the pivot contact arms 106, but at this time trunnions 99 will have their widest dimension presented to the opening in keyhole slot 110, so that in order to remove the fuse from the pivot contact it is necessary to further rotate the fuse in a clockwise position to a depending position, substantially 180° from that shown in Fig. 2. It will be observed that at a position 45° from that shown in Fig. 2, detent portions 122 at the upper ends of arms 118 of leaf contact spring 116, will enter detent notches 127 on contact fixture 90, so that if desired the fuse may be retained in this position. However, this detent action does not offer very great resistance to continued clockwise movement of the fuse, so that the fuse may be moved manually past this position to a depending position, wherein hook eye 94 will then be presented in front of the fuse and the fuse may then readily be removed from the supporting hinge contact by lifting upwardly on hook eye 94. It should also be noted that the lower end of contact spring 116 forms a resilient bumper for the fuse when it reaches a position substantially 180° from that shown in Fig. 2, so that in automatic drop-out operation, or in any case where the fuse moves to its depending position under the influence of gravity, it will impinge upon the lower end of contact spring 116 and thereby prevent damage to insulator 102, or the fuse, or parts thereof.

The upper supporting insulator 100 has secured thereto a generally rectangular shaped contact supporting and enclosing hood which includes a top wall 128, a rear end wall 130, opposite side walls 132 flared outwardly adjacent the free corners thereof as at 133, and a partial front end wall 134 joined to top wall 128. Rear end wall 130 is substantially circular in form, as shown in Fig. 1, and has opposed notches 136 formed in portions thereof beyond side walls 132 for receiving mounting screws 138, for securing rear wall 130 of the hood to supporting insulator 100. The top wall 128 of the contact hood is provided with an integral upwardly extending terminal lug 140 for the connection of a line conductor thereto. Interiorly of the contact housing there is provided a supporting pin 142, extending transversely of and mounted in side walls 132, for supporting a floating contact and latch member 144 for movement within the housing. The floating contact and latch member 144 may be in the form of a casting, and, as shown, is substantially rectangular in form, including opposite side members 146 secured together by an integral front connecting member 148, a rear top connecting member 150, and a rear bottom connecting member 152. The side legs 146 of the floating contact are provided with integral extensions having elongated slots 154 therein for receiving supporting pin 142, so that the contact may move in a plurality of different directions within the housing. A coil compression spring 156 engages between a supporting lug

158 on the top wall 128 of the housing and a similar supporting lug 160 formed integral with transverse connecting member 150 of the floating contact to bias the floating contact 144 in a counterclockwise direction relative to pin 142. A rounded projection 151 is provided at the base of lugs 158 and 160 at each side thereof to permit angular movement of spring 156 without distortion thereof. The floating contact 144 is electrically connected with top wall 128 of the housing by a flexible shunt 162, secured to the top wall of the housing and to cross member 148 of the contact, for example, as by machine screws 164. The lower edges of side legs 146 of the floating contact, are provided intermediate their ends with notches 166 adapted to receive latch engaging projections 84 on the fuse. A releasable supporting lever 168 is pivotally mounted between side legs 146 of the floating contact by means of a pivot pin 169, and this lever is biased for movement in a clockwise direction relative to floating contact 144 into engagement with cross member 152 of the contact, by a coil compression spring 172 engaging between lever 168 and cross member 150 of the contact. The forward end of lever 168 is provided with a flattened portion 170 positioned, when a fuse is engaged in notches 166, so as to be directly over the top of the fuse. A supporting lug 174 is also formed integral with lever 168 for cooperation with an integral supporting lug 176 formed on the rear wall of the contact housing. Stop lugs 178 are also formed integral with rear wall 130 of the contact housing, for engagement with cross member 150 of the floating contact to limit movement thereof towards the top wall 128 of the housing.

The operation of the contact and latching structure described above will be best understood by referring first to Fig. 5 of the drawings, which illustrates the position of the parts with the fuse removed. Under such conditions it will be noted that supporting lug 174 of lever 168 is in engagement with supporting lug 176 on the rear wall of the contact hood, so that spring 156 has caused the floating contact to move in a generally clockwise direction about lugs 174 and 176, until supporting pin 142 has reached the upper end of slot 154. In this position it will be observed that the lower edges of the side legs 146 of the floating contact have their outer ends inclined upwardly, so that when a fuse is moved pivotally in a counterclockwise direction into engagement with the floating contact, it may cause counterclockwise pivoting of the contact about lugs 174, 176, by engagement of latching lugs 84 on the fuse with the lower edges of legs 146 of the floating contact while stressing coil spring 156, until the latch lugs are received in notches 166 formed in legs 146 of the floating contact. At this time the parts will have assumed the positions shown in Fig. 2, and it will be noted that spring 156 has been stressed to the extent that supporting pin 142 is now intermediate the ends of slot 154 on the floating contact. This will provide a good contact pressure between the lugs 146 of the floating contact and fixture 78 associated with upper fuse terminal 4.

Now, with the fuse in the closed circuit position shown in Fig. 2, in the event an overload appears on the circuit causing the melting of fusible strip 18 and strain member 20 of the fuse, so that the arcing contact rod 16 is moved upwardly as previously described, when extension

46 on rod 16 is projected through the top of the fuse, it will engage the outer end of releasable supporting lever 168, and cause movement of this member in a counterclockwise direction about its pivot 169 to thereby move lug 174 off fixed supporting lug 176 so that the inner end of the floating contact is no longer supported, thereby permitting spring 156 to move the contact in a counterclockwise direction about supporting pin 142. Counterclockwise movement of floating contact 144 about supporting pin 142 will cause movement of the upper end of the fuse outwardly, relative to insulator 100, and in a clockwise direction about trunnions 99, to the position shown in Fig. 6 of the drawings. When the parts have attained this position, and even before, it will be obvious that the fuse will have reached an unstable position so that the action of gravity will cause the fuse to drop downwardly to a depending position into engagement with bumper 116 as previously described. In this drop-out movement of fuse tube 2, it will not be halted by detent 122 engaging notch 127 of the fuse, because this notch is purposely made shallow and of such shape that the spring arm detent 122 will be unable to stop the downward movement of the fuse, so that the fuse will move down into engagement with the bumper formed by contact spring 116. The fuse may then be removed from the supporting hinge contact in the manner previously described and replaced by a new fuse, and this fuse may be then rotated in a counterclockwise direction about its trunnions 99 towards closed circuit position. The floating contact 144 will be in the position shown in Fig. 6 of the drawings, so that, upon continued counterclockwise rotation of the fuse, it will engage cross member 152 of the floating contact to move the floating contact inwardly and in a generally clockwise direction about its supporting pin 142, until lug 174 of lever 168 engages lug 176 on the housing, and passes over the lug by compression of biasing spring 172, to become seated on top of the lug in the position shown in Fig. 2 of the drawings, whereby latch projections 84 on the fuse may enter notches 166 in the lower edges of sides 146 of the floating contact when the parts will be in the position shown in Fig. 2.

From the foregoing, it is apparent that the invention disclosed herein provides a novel form of drop-out fuse wherein a normally solid or otherwise good electrical conducting circuit through the fuse is interrupted upon blowing of the fuse by separation of a portion of this circuit, and the arc extinguished by elongating the same within a restricted arc passage having walls of a gas evolving material, with the arc drawing contact having a portion which is projected outwardly of the fuse only when the arcing terminal is substantially at the end of its path of movement. This is an important feature because by delaying projection of extension 46 of arcing contact rod 16 from the tube until the arc has been drawn out substantially the entire length of the restricted arc passage, it is thereby insured that the arc has been subjected to substantially the entire arc extinguishing capacities of the fuse prior to release of the fuse from its line contacts, to thereby ensure that the circuit will always be interrupted within the fuse and no arc drawn at the line contacts. The spring which acts to draw out and extinguish the arc within the tube also acts to project the extension 46 through the end of the tube to release a combined floating contact and latch member engaging the upper end of the

fuse, and permit the fuse to be moved out of engagement with at least one line contact.

Furthermore, the extension 46 of the arcing rod is not only projected through the central opening in terminal cap 4 by spring 40, but it is positively held in such latch releasing position by engagement of locking tongues 34 therewith, to positively ensure that the latch releasing means is held in a released position, and thereby make certain that the fuse is released from at least one line contact.

The particular contact and latch construction for the upper end of the fuse is especially designed for cooperation with a fuse of the type wherein an extension on the arc drawing rod is projected through the fuse to positively engage and actuate a means for positively moving the fuse in a direction out of engagement with one of its line contacts. The floating contact 144 employed is especially efficient and reliable in operation, while being relatively simple in construction in that but a single spring 156 is utilized for both furnishing adequate contact pressure with the upper fuse terminal, and also initially moving the fuse in a direction away from the contact upon blowing of the fuse. The floating contact and latch are entirely foolproof in construction in that they may be reset solely by moving a fuse into engagement therewith, so that all that is necessary to insert a new fuse in a circuit is merely to rotate it into engagement with the floating contact.

There has also been disclosed herein novel pivot supporting contact structure wherein a single spring is provided for (1) forming a good electrical contact with the lower fuse terminal, (2) forming a detent to maintain the fuse at an intermediate open position when adjusted manually to such position, but ineffective to hold the fuse at such intermediate position upon automatic drop-out operation thereof, and (3) forming a bumper for the fuse when it falls to open circuit position under the influence of gravity.

Having described preferred embodiments of this invention in accordance with the patent statutes, it should be understood that the invention is not to be limited to the particular embodiments disclosed herein, inasmuch as it will be obvious, particularly to persons skilled in the art, that many changes and modifications may be made in these particular structures without departing from the broad spirit and scope of the invention. Accordingly, this invention should be interpreted as broadly as possible and limited only as required by the prior art.

We claim as our invention:

1. In a circuit interrupter having a pair of terminals, arcing contacts at least one of which is movable away from the other to draw an arc, said contacts connected with said terminals, respectively, biasing means for moving said movable contact away from the other of said contacts, electroresponsive means for maintaining said contacts against separation but operative to release said contacts in response to predetermined electrical conditions, and the connection of said movable contact and its corresponding terminal including a solid connection which is capable of being ruptured by said biasing means when said contacts are released.

2. In a circuit interrupter having a pair of terminals, arcing contacts at least one of which is movable away from the other to draw an arc, said contacts connected with said terminals, respectively, biasing means for moving said movable

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contact away from the other of said contacts, electroresponsive means for maintaining said contacts against separation but operative to release said contacts in response to predetermined electrical conditions, and the connection of said movable contact and its corresponding terminal including a solid connection having a soldered portion which is capable of being ruptured by said biasing means when said contacts are released.

3. In a circuit interrupter having a pair of terminals, arcing contacts at least one of which is movable away from the other to draw an arc, said contacts connected with said terminals, respectively, biasing means for moving said movable contact away from the other of said contacts, electroresponsive means for maintaining said contacts against separation but operative to release said contacts in response to predetermined electrical conditions, and the connection of said movable contact and its corresponding terminal including a solid connection having a relatively weak portion positioned so as to be subjected to bending stress and to be broken by said biasing means when said contacts are released.

4. In a circuit interrupter having a pair of terminals, arcing contacts at least one of which is movable away from the other to draw an arc, said contacts connected with said terminals, respectively, biasing means for moving said movable contact away from the other of said contacts, electroresponsive means for maintaining said contacts against separation but operative to release said contacts in response to predetermined electrical conditions, and the connection of said movable contact and its corresponding terminal including a solid connection having a relatively weak portion, and a cantilever member connected thereto so that said portion will be subjected to bending stress and broken by said biasing means when said contacts are released.

5. In a circuit interrupter having a pair of terminals, arcing contacts at least one of which is movable away from the other to draw an arc, said contacts connected with said terminals, respectively, biasing means for moving said movable contact away from the other of said contacts, electroresponsive means for maintaining said contacts against separation but operative to release said contacts in response to predetermined electrical conditions, and the connection of said movable contact and its corresponding terminal including a solid connection having a relatively rigid part connected at points thereof spaced laterally of the direction of movement of said movable contact, to said movable contact and its corresponding terminal, respectively, and one of said connections comprising a solder connection, whereby said part will be rotated about said solder connection upon separating movement of said movable contact, to rupture the same.

6. In a circuit interrupter, a tubular enclosure of insulating material having terminals adjacent opposite ends thereof, conducting means in said tube connecting said terminals including means capable of automatically interrupting the circuit in response to predetermined electrical conditions, a movable arcing contact normally held against movement by said interrupting means, means of material capable of evolving an arc extinguishing gas when in proximity to an electric arc forming a restricted arc passage in which said contact is movable, biasing means for moving said contact through said passage in response to fusion of said fusible means, and said contact having a part movable therewith which is pro-

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jected from one end of said casing only upon movement of said contact by said biasing means to a position adjacent the end of said passage.

7. In a circuit interrupter, a tubular enclosure of insulating material having terminals adjacent opposite ends thereof, conducting means in said enclosure connecting said terminals including arcing terminals at least one of which is movable in said tube, means capable of automatically interrupting the circuit in response to predetermined electrical conditions for normally preventing movement of said movable arcing terminal, biasing means for moving said movable arcing terminal to a position wherein an end portion thereof projects from one end of said tube upon a circuit interrupting operation by said interrupting means, and the connection between said movable arcing terminal and its respective tube terminal being separable upon movement of said movable arcing terminal from its normal position.

8. In a fuse, a fuse tube of insulating material having terminals adjacent opposite ends thereof, arcing terminals at least one of which is movably mounted in said tube, fusible means connecting said arcing terminals and normally preventing movement of said movable arcing terminal, means biasing said movable arcing terminal for movement upon fusion of said fusible means to a position wherein a portion thereof projects from one end of said tube a predetermined amount, connections between said arcing terminals and said tube terminals, respectively, and the connection between said movable arcing terminal and its respective tube terminal being separable upon movement of said movable arcing terminal from its normal position.

9. In a fuse, a fuse tube of insulating material having terminals adjacent opposite ends thereof, arcing terminals at least one of which is rod-like in character and is movably mounted in said tube, fusible means connecting said arcing terminals and normally preventing movement of said movable arcing terminal, means biasing said movable arcing terminal for movement upon fusion of said fusible means to a position wherein one end portion thereof projects from one end of said tube a predetermined amount, connections between said arcing terminals and said tube terminals, respectively, shoulder means at said one end of said tube, and cooperating shoulder means on said rod-like terminal to limit outward movement thereof to a position wherein said one end portion thereof projects from said tube said predetermined amount.

10. In a fuse, a fuse tube of insulating material having terminals adjacent opposite ends thereof, arcing terminals at least one of which is rod-like in character and is movably mounted in said tube, fusible means connecting said arcing terminals and normally preventing movement of said movable arcing terminal, means biasing said movable arcing terminal for movement upon fusion of said fusible means to a position wherein one end portion thereof projects from one end of said tube a predetermined amount, connections between said arcing terminals and said tube terminals, respectively, shoulder means at said one end of said tube, cooperating shoulder means on said rod-like terminal to limit outward movement thereof to a position wherein said one end portion thereof projects from said tube said predetermined amount, and means also at said one end of said tube for automatically holding said rod-like terminal in the position wherein said end portion thereof projects from said tube.

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11. In a fuse, a fuse tube of insulating material having terminals adjacent opposite ends thereof, arcing terminals at least one of which is rod-like in character and is movably mounted in said tube, fusible means connecting said arcing terminals and normally preventing movement of said movable arcing terminal, means biasing said movable arcing terminal for movement upon fusion of said fusible means to a position wherein one end portion thereof projects from one end of said tube a predetermined amount, connections between said arcing terminals and said tube terminals, respectively, shoulder means at said one end of said tube, an enlargement on said rod-like terminal positioned to engage said shoulder means to limit outward movement of said terminal to a position wherein said one end portion thereof projects from said tube said predetermined amount, and the connection between said rod-like arcing terminal and its respective tube terminal including a separable connection with said enlargement.

12. In a fuse, a replaceable fuse unit which is adapted to be replaced each time the fuse blows comprising, in combination, a fuse tube of insulating material having terminals adjacent opposite ends thereof, arcing terminals at least one of which is movably mounted in said tube, fusible means connecting said arcing terminals and normally preventing movement of said movable arcing terminal, the other of said arcing terminals being adjacent and electrically connected to one of said tube terminals, said movable arcing terminal being normally spaced from the other of said tube terminals, spring means tensioned between said movable arcing terminal and said other tube terminal, conducting means extending from said other tube terminal and having a connection with said movable arcing terminal which is separable upon movement of said terminal by said spring means, said spring means and separable connection constituting the sole conducting paths between said other tube terminal and movable arcing contact, whereby said spring means carries the current to said movable arcing contact during arcing.

13. In a fuse, a fuse tube of insulating material having terminals adjacent opposite ends thereof, a line contact, means mounting said tube for movement of one of its terminals into and out of engagement with said line contact, latch means for releasably maintaining said tube terminal in engagement with said line contact, conducting means in said tube connecting said terminals including fusible means and a movable arcing contact, and biasing means for moving said arcing contact to a position wherein a portion thereof projects from one end of said tube upon fusion of said fusible means, to release said latch means and permit movement of said tube to disengage said tube terminal from said line contact.

14. In a fuse, a fuse tube of insulating material having terminals adjacent opposite ends thereof, conducting means in said tube connecting said terminals including fusible means and a movable arcing contact, biasing means for moving said arcing contact to a position wherein a portion thereof projects from one end of said tube upon fusion of said fusible means, a line contact, means pivotally mounting said tube for movement of one terminal thereof into and out of engagement with said line contact, releasable latch means for latching said tube terminal in engagement with said line contact, and said

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latch means having a latch releasing part positioned in the path of movement of said portion of said movable arcing contact to release said tube terminal for movement out of engagement with said line contact upon movement of said movable contact portion to said projecting position.

15. In a fuse, a fuse tube of insulating material having terminals adjacent opposite ends thereof, conducting means in said tube connecting said terminals including fusible means and a movable arcing contact, means of a material capable of evolving an arc extinguishing gas when in proximity to an electric arc forming a restricted arc passage in which said contact is movable, biasing means for moving said contact through said passage in response to fusion of said fusible means, said contact having a part movable therewith which is projected from one end of said casing upon movement of said contact by said biasing means to a position adjacent the end of said passage, a line contact, means pivotally mounting said tube for movement of one terminal thereof into and out of engagement with said line contact, releasable latch means for latching said tube terminal in engagement with said line contact, and said latch means having a latch releasing part positioned in the path of movement of said portion of said movable arcing contacts to release said tube terminal for movement out of engagement with said line contact upon movement of said movable contact portion to said projecting position and after the arc has been drawn out substantially the entire length of said arc passage.

16. In a fuse, a fuse tube of insulating material having terminals adjacent opposite ends thereof, conducting means in said tube connecting said terminals including fusible means and a movable arcing contact, biasing means for moving said arcing contact to a position wherein a portion thereof projects from one end of said tube upon fusion of said fusible means, a line contact, means pivotally mounting said tube for movement of one terminal thereof into and out of engagement with said line contact, said line contact being mounted for movement in a direction towards said one tube terminal and also in a direction to cause movement of said one tube terminal away from said line contact, means resiliently biasing said line contact for movement in said two directions, releasable latch means normally restraining movement of said line contact in said second direction and including a part positioned in the path of movement of said portion of said movable arcing contact to release said line contact for movement in said second direction to move said one tube terminal out of engagement with said line contact upon movement of said movable arcing contact portion to said projecting position.

17. In a fuse, a fuse tube of insulating material having terminals adjacent opposite ends thereof, conducting means in said tube connecting said terminals including fusible means and a movable arcing contact, biasing means for moving said arcing contact to a position wherein a portion thereof projects from one end of said tube upon fusion of said fusible means, a line contact, means pivotally mounting said tube for movement of one terminal thereof into and out of engagement with said line contact, releasable latch means for latching said tube terminal in engagement with said line contact, said latch means having a latch releasing part positioned in the

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path of movement of said portion of said movable arcing contact to release said tube terminal for movement out of engagement with said line contact upon movement of said movable contact portion to said projecting position, and means for holding said contact portion at said projecting position to positively maintain said latch means in a released condition.

18. In a fuse, a fuse tube of insulating material having terminals adjacent opposite ends thereof, conducting means in said tube connecting said terminals including fusible means and a movable arcing contact, biasing means for moving said arcing contact to a position wherein a portion thereof projects from one end of said tube upon fusion of said fusible means, a line contact, means pivotally mounting said tube for movement from a substantially upright position wherein one terminal thereof is in engagement with said line contact to a depending position wherein said one terminal thereof is out of engagement with said line contact, releasable latch means for latching said tube terminal in engagement with said line contact, said latch means having a latch releasing part positioned in the path of movement of said portion of said movable arcing contacts to release said tube terminal for movement out of engagement with said line contact upon movement of said movable contact portion to said projecting position, and means for releasably maintaining said tube in a position intermediate said upright and depending positions.

19. In a fuse, a fuse tube of insulating material having terminals adjacent opposite ends thereof, conducting means in said tube connecting said terminals including fusible means and a movable arcing contact, biasing means for moving said arcing contact to a position wherein a portion thereof projects from one end of said tube upon fusion of said fusible means, a line contact, means pivotally mounting said tube for movement from a substantially upright position wherein one terminal thereof is in engagement with said line contact to a depending position wherein said one terminal thereof is out of engagement with said line contact, releasable latch means for latching said tube terminal in engagement with said line contact, said latch means having a latch releasing part positioned in the path of movement of said portion of said movable arcing contact to release said tube terminal for movement out of engagement with said line contact upon movement of said movable contact portion to said projecting position, means for releasably maintaining said tube in a position intermediate said upright and depending positions, and resilient stop means for limiting movement of said tube at said depending position.

20. In a fuse, a fuse tube of insulating material having terminals adjacent opposite ends thereof, conducting means in said tube connecting said terminals including fusible means and a movable arcing contact, biasing means for moving said arcing contact to a position wherein a portion thereof projects from one end of said tube upon fusion of said fusible means, a line contact, means pivotally mounting said tube for movement of one terminal thereof into and out of engagement with said line contact, said line contact being slidably mounted for movement in a direction towards said one tube terminal and pivotally mounted for movement in a direction to cause movement of said one tube terminal

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away from said line contact, means resiliently biasing said line contact for movement in said two directions, releasable latch means normally restraining movement of said line contact in said second direction and including a part positioned in the path of movement of said portion of said movable arcing contact to release said line contact for movement in said second direction to move said one tube terminal out of engagement with said line contact upon movement of said movable arcing contact portion to said projecting position.

21. In a fuse, a fuse tube of insulating material having terminals adjacent opposite ends thereof, conducting means in said tube connecting said terminals including fusible means and a movable arcing contact, biasing means for moving said arcing contact to a position wherein a portion thereof projects from one end of said tube upon fusion of said fusible means, a line contact, means pivotally mounting said tube for movement of one terminal thereof into and out of engagement with said line contact, said line contact being slidably mounted for movement in a direction towards said one tube terminal and pivotally mounted for movement in a direction to cause movement of said one tube terminal away from said line contact, means resiliently biasing said line contact for movement in said two directions, releasable latch means normally restraining movement of said line contact in said second direction and including a part positioned in the path of movement of said portion of said movable arcing contact to release said line contact for movement in said second direction and move said one tube terminal out of engagement with said line contact upon movement of said movable arcing contact portion to said projecting position, and said line contact having a part engageable by said fuse upon manual movement thereof towards said line contact to pivotally move said line contact in an opposite direction to reset said latch means.

22. In a drop-out fuse, an elongated fuse holder having fusible means therein connected between spaced terminals on said holder, an electric circuit in which said fuse is adapted to be connected, means pivotally mounting said holder so that said holder is movable into and out of said circuit, means for releasably maintaining said fuse in closed circuit position including a latch member engageable with said holder and mounted for limited movement in a first direction toward a latch engaging part of said holder, and in a second direction to move said holder to open circuit position, means resiliently biasing said latch member in said two directions, latch means normally preventing movement of said latch member in said second direction, and means responsive to fusion of said fusible means for releasing said latch means to permit said biasing means to move said latch member in said second direction and said holder to open circuit position.

23. In a drop-out fuse, an elongated fuse holder having fusible means therein connected between spaced terminals on said holder, an electric circuit in which said fuse is adapted to be connected, means pivotally mounting said holder so that said holder is movable into and out of said circuit, means for releasably maintaining said fuse in closed circuit position including a floating latch member engageable with said holder, means biasing said member at a point offset from its point of engagement with said holder in a direction to cause engagement with said

holder and movement of said holder to an open circuit position, releasable means for supporting said latch member at a third spaced point to normally prevent movement thereof in a direction to move said holder to an open circuit position, and means responsive to fusion of said fusible means for releasing said releasable supporting means.

24. In a drop-out fuse, an elongated fuse holder having fusible means therein connected between spaced terminals on said holder, an electric circuit in which said fuse is adapted to be connected, means pivotally mounting said holder so that said holder is movable into and out of said circuit, means for releasably maintaining said fuse in closed circuit position including a floating latch member engageable with said holder, means biasing said member at a point offset from its point of engagement with said holder in a direction to cause engagement with said holder and movement of said holder to an open circuit position, releasable means for supporting said latch member at a third spaced point to normally prevent movement thereof in a direction to move said holder to an open circuit position, means responsive to fusion of said fusible means for releasing said releasable supporting means, and means slidably and pivotally supporting said member to limit the aforesaid movements thereof and retain said member in a position to be engaged by said holder on movement thereof to closed circuit position.

25. In a drop-out fuse, an elongated fuse holder having fusible means therein connected between spaced terminals on said holder, an electric circuit in which said fuse is adapted to be connected, means pivotally mounting said holder so that said holder is movable into and out of said circuit, means for releasably maintaining said fuse in closed circuit position including a circuit contact and latch member engageable with one terminal of said holder and mounted for limited movement in a first direction toward said one terminal and in a second direction to move said holder to open circuit position, means resiliently biasing said latch member for movement in said two directions, latch means normally preventing movement of said latch member in said second direction, and means responsive to fusion of said fusible means for releasing said latch means to permit said biasing means to move said latch member in said second direction and said holder to open circuit position.

26. In a drop-out fuse, an elongated fuse holder having fusible means therein connected between spaced terminals on said holder, an electric circuit in which said fuse is adapted to be connected, means pivotally mounting said holder so that said holder is movable into and out of said circuit, means for releasably maintaining said fuse in closed circuit position including a floating latch member engageable with said holder, means biasing said member at a point offset from its point of engagement with said holder in a direction to cause engagement with said holder and movement of said holder to an open circuit position, releasable means for supporting said latch member at a third spaced point to normally prevent movement thereof in a direction to move said holder to an open circuit position, means responsive to fusion of said fusible means for releasing said releasable supporting means, and means supporting said member for limited movement in the aforesaid directions and adapted to retain said member in a position to be engaged

by said holder on movement thereof to closed circuit position.

27. In a drop-out fuse, an elongated fuse holder having fusible means therein connected between spaced terminals on said holder, a line terminal, means pivotally mounting said holder for movement of one terminal thereof toward and away from said line terminal, a floating contact member on said line terminal, means electrically connecting said contact and line terminal, means biasing said contact with a force having a component in a direction to move said contact member into engagement with said one holder terminal, and a second component to move said contact member in another direction to cause movement of said holder away from said line terminal, releasable abutment means normally opposing movement of said contact member under the influence of said second force component, and means operative in response to fusion of said fusible means for releasing said abutment means.

28. In a drop-out fuse, an elongated fuse holder having fusible means therein connected between spaced terminals on said holder, a line terminal, means pivotally mounting said holder for movement of one terminal thereof toward and away from said line terminal, a floating contact member on said line terminal, means electrically connecting said contact and line terminal, means biasing said contact with a force having a component in a direction to move said contact into engagement with said one holder terminal, and a second component to move said contact member in another direction to cause movement of said holder away from said line terminal, cooperating abutments on said contact and line terminal one of which is releasable for normally opposing movement of said contact member under the influence of said second force component, and means operative in response to fusion of said fusible means for releasing said releasable abutment.

29. In a drop-out fuse, an elongated fuse holder having fusible means therein connected between spaced terminals on said holder, a line terminal, means pivotally mounting said holder for movement of one terminal thereof toward and away from said line terminal, a floating contact member on said line terminal, means electrically connecting said contact and line terminal, means biasing said contact with a force having a component in a direction to move said contact member into engagement with said one holder terminal, and a second component to move said contact member in another direction to cause movement of said holder away from said line terminal, releasable abutment means normally opposing movement of said contact member under the influence of said second force component, means operative in response to fusion of said fusible means for releasing said abutment, means movably supporting said contact on said line terminal when said abutment is released in a position to be engaged by said one holder terminal upon movement thereof toward said line terminal, and means responsive to movement of said contact by said holder for resetting said releasable abutment.

30. In a drop-out fuse, an elongated fuse holder having fusible means therein connected between spaced terminals on said holder, a line terminal, means pivotally mounting said holder for movement of one terminal thereof toward and away from said line terminal, a floating contact member on said line terminal, means electrically con-

necting said contact and line terminal, means biasing said contact with a force having a component in a direction to move said contact member into engagement with said one holder terminal, and a second component to move said contact member in another direction to cause movement of said holder away from said line terminal, releasable abutment means normally opposing movement of said contact member under the influence of said second force component, means operative in response to fusion of said fusible means for releasing said abutment, and means for limiting movement of said contact under the influence of said first force component to maintain said contact in a position to be engaged by said holder terminal upon movement thereof toward said line terminal.

31. In a drop-out fuse, an elongated fuse holder having fusible means therein connected between spaced terminals on said holder, a line terminal, means pivotally mounting said holder for movement of one terminal thereof toward and away from said line terminal, a floating contact member on said line terminal, means electrically connecting said contact and line terminal, means biasing said contact with a force having a component in a direction to move said contact member into engagement with said one holder terminal, and a second component to move said contact member in another direction to cause movement of said holder away from said line terminal, releasable abutment means normally opposing movement of said contact member under the influence of said second force component, means operative in response to fusion of said fusible means for releasing said abutment, means for limiting movement of said contact under the influence of said first force component to maintain said contact in a position to be engaged by said holder terminal upon movement thereof toward said line terminal, means movably supporting said contact on said line terminal when said abutment is released in a position to be engaged by said one holder terminal upon movement thereof toward said line terminal, and means responsive to movement of said contact by said holder for resetting said releasable abutment.

32. In a drop-out fuse having a fuse holder with terminals adjacent opposite ends thereof and fusible means therein connected between said terminals, vertically spaced line contacts, means pivotally mounting said holder adjacent one end thereof near the lower of said line contacts for movement of at least the terminal at the other end thereof into and out of engagement with the upper one of said line contacts, latch means for releasably maintaining said holder in closed circuit position, means responsive to fusion of said fusible means for releasing said latch means to cause said holder to rotate to a depending open circuit position, a leaf spring member supported intermediate its ends on said pivotal supporting means and including a detent portion at one end thereof engageable with cooperating detent means on said holder to releasably maintain said holder at an intermediate position, and the other end of said spring member positioned to be resiliently engaged by said holder adjacent said depending position.

33. In a circuit interrupter, a tubular enclosure of insulating material having terminals adjacent opposite ends thereof, a line contact, means mounting said enclosure for movement of one of its terminals into and out of engagement with said line contact, latch means for releasably main-

taining said enclosure terminal in engagement with said line contact, conducting means in said enclosure connecting said terminals including circuit interrupting means having a movable rod-like member normally restrained against movement but released for movement upon a circuit interrupting operation, and biasing means for moving said rod-like member to a position wherein a portion thereof projects from one end of said enclosure upon a circuit interrupting operation of said circuit interrupting means, to release said latch and permit movement of said enclosure to disengage said one terminal thereof from said line contact.

34. In a circuit interrupter, an elongated tubular enclosure having circuit interrupting means therein connected between spaced terminals on said enclosure, an electric circuit in which said interrupter is adapted to be connected, means pivotally mounting said enclosure so that the interrupter is movable into and out of said circuit, means for releasably maintaining said interrupter in closed circuit position including a latch member engageable with said enclosure and mounted for limited movement in a first direction toward a latch engaging part of said enclosure, and in a second direction to move said enclosure to open circuit position, means resiliently biasing said latch member in said two directions, latch means normally preventing movement of said latch member in said second direction, and means responsive to a circuit interrupting operation of said interrupting means for releasing said latch means to permit said biasing means to move said latch member in said second direction and said enclosure to open circuit position.

35. In a line contact construction, a line terminal, a floating contact member on said line terminal, means electrically connecting said contact member and line terminal, means biasing said contact member relative to said terminal with a force having a component in one direction to cause engagement of said contact member with a cooperable contact means, and a second component in a direction to cause movement of said floating contact member in another direction away from said terminal, cooperating abutments on said floating contact member and line terminal, respectively, for normally opposing said second force component, and one of said abutments being releasable to permit movement of said floating contact member away from said line terminal.

36. In a line contact construction, a line terminal, a floating contact member on said line terminal, means electrically connecting said contact member and terminal, means biasing said contact member with a force having a component in a direction to cause engagement of said floating contact member with a cooperating contact means, and a second component in another direction to cause movement of said floating contact member away from said line terminal, releasable abutment means normally opposing said second force component, whereby upon release of said abutment means said biasing means is operable to move said floating contact member away from said line terminal, and means for limiting movement of said floating contact member under the influence of said first force component to maintain said contact in a position to be engaged by said cooperable contact means.

37. In a line contact construction, a line terminal, a floating contact member on said line terminal, means electrically connecting said con-

tact member and terminal, means biasing said contact member with a force having a component in a direction to cause engagement of said floating contact member with a cooperating contact means, and a second component in another direction to cause movement of said floating contact member away from said line terminal, releasable abutment means normally opposing said second force component, whereby upon release of said abutment means said biasing means is operable to move said floating contact member away from said line terminal, and means movably supporting said floating contact member on said line terminal when said abutment means is released, to retain said floating contact member in operative position for engagement by said cooperating contact means.

38. In a contact construction, a contact member mounted at least for pivotal movement on a contact support, a coil compression spring biasing said contact member for movement in one direction relative to said support, and means on said contact and support for engaging and positioning said spring including integral lugs over which the ends of said spring are adapted to be seated, and rounded projections at opposite sides of each lug for engaging the end coils of said spring, whereby said contact is movable relative to said support without distorting said spring.

39. In a circuit interrupter having a pair of terminals, arcing contacts at least one of which is movable away from the other to draw an arc, said contacts connected with said terminals, respectively, biasing means for moving said movable contact away from the other of said contacts, electroresponsive means for maintaining said contacts against separation but operative to release said contacts in response to predetermined electrical conditions, the connection of said movable contact and its corresponding terminal including a contact member electrically connected with said terminal, said contact member normally frictionally engaging between said movable arcing contact and the part of said biasing means which is movable with said movable arcing contact, whereby said biasing means is normally effective to maintain pressure engagement of said contact member and movable arcing contact, and disengagement thereof is effected when said contacts separate.

40. In a circuit interrupter having a pair of terminals, arcing contacts at least one of which is movable away from the other to draw an arc, said contacts connected with said terminals, respectively, biasing means for moving said movable contact away from the other of said contacts, electroresponsive means for maintaining said contacts against separation but operative to release said contacts in response to predetermined electrical conditions, the connection of said movable contact and its corresponding terminal including a contact member electrically connected with said terminal, and a cooperating contact surface on said movable arcing contact disposed at an acute angle to the direction of movement of said movable arcing contact, said contact member normally frictionally engaging between said contact surface and the part of said biasing means which is movable with said movable arcing contact, whereby said biasing means is normally effective to maintain pressure engagement of said contact member and contact surface, and disengagement thereof is effected when said contacts separate.

41. In a fuse, a replaceable fuse unit which is

adapted to be replaced each time the fuse blows comprising, in combination, a fuse tube of insulating material having terminals adjacent opposite ends thereof, arcing terminals at least one of which is movably mounted in said tube, fusible means connecting said arcing terminals and normally preventing movement of said movable arcing terminal, the other of said arcing terminals being electrically connected to one of said tube terminals, spring means in said tube tensioned between said movable arcing terminal and said other tube terminal, conducting means in said tube extending from said other tube terminal and having a connection with said movable arcing terminal which is separable upon movement of said terminal by said spring means, said spring means and separable connection constituting the sole conducting paths between said other tube terminal and movable arcing contact, whereby said spring means carries the current to said movable arcing contact during arcing.

42. In a fuse, a fuse tube of insulating material having terminals adjacent opposite ends thereof, a line contact, means mounting said tube for movement of one of its terminals into and out of engagement with said line contact, latch means for releasably maintaining said tube terminal in engagement with said line contact, conducting means in said tube connecting said terminals including fusible means and a movable rod-like arcing contact, said rod-like arcing contact normally spaced a predetermined distance from at least one end of said tube, and biasing means for moving said arcing contact to a position wherein an end portion thereof projects from said one end of said tube upon fusion of said fusible means, to release said latch means and permit movement of said tube to disengage said tube terminal from said line contact only after said arcing contact has moved at least said predetermined distance.

43. In a fuse, a fuse tube of insulating material having terminals adjacent opposite ends thereof, conducting means in said tube connecting said terminals including fusible means, a line contact, means pivotally mounting said tube for movement from a substantially upright position wherein one terminal thereof is in engagement with said line contact to a depending position wherein said one terminal thereof is out of engagement with said line contact, releasable latch means for latching said tube terminal in engagement with said line contact, means responsive to fusion of said fusible means to release said tube terminal for movement out of engagement with said line contact, means for releasably maintaining said tube in a position intermediate said upright and depending positions, and resilient stop means for limiting movement of said tube at said depending position.

44. In a line contact construction, a line terminal, a floating contact member on said line terminal, means electrically connecting said contact member and line terminal, spaced means mechanically supporting said contact member on said terminal, means biasing said contact member in one direction, at least one of said spaced supporting means permitting limited motion of said contact member by said biasing to exert contact pressure, and the other of said supporting means being releasable to permit said biasing means to move said contact member in a different direction.

45. In a line contact construction, a line terminal, a floating contact member on said line

terminal, means electrically connecting said contact member and line terminal, spaced means mechanically supporting said contact member on said terminal, means biasing said contact member in one direction, at least one of said spaced supporting means permitting limited motion of said contact member by said biasing to exert contact pressure, the other of said supporting means being releasable to permit said biasing means to move said contact member in a different direction, and said releasable supporting means automatically resetting in response to predetermined movement of said contact member in the opposite direction.

46. In apparatus of the type described, relatively angularly movable members, a coil compression spring biasing said members for relative movement, means on each of said members for engaging and positioning said spring to prevent lateral spring movement and spring distortion upon relative movement of said members including rounded projections engaging end coils of said spring.

47. In apparatus of the type described, relatively angularly movable members, a coil compression spring biasing said members for relative movement, means on each of said members for engaging and positioning said spring to prevent lateral spring movement and spring distortion upon relative movement of said members including limited area projections engaging end coils of said spring, said projections formed to present substantially line spring-engaging surfaces extending substantially transversely of the plane of relative movement of said members.

48. In a circuit interrupter which is adapted to be replaced in its entirety after a circuit interrupting operation, comprising, in combination, a tube of insulating material, a filler for one end of said tube occupying a substantial part of the length of said tube and comprising a solid insulating material which is capable of evolving an arc-extinguishing gas when in proximity with an electric arc, a restricted bore through said filler, terminal caps secured on each end of said tube, a rod of conducting material in said bore, means connecting one end of said rod to the terminal cap at said one end of said tube, said connecting means being automatically responsive to currents above a predetermined magnitude to release said rod, a relatively thin member of conducting material in said tube connected to the other terminal cap and extending in engagement with the inner wall of said tube along the remaining length of said tube into proximity with the other end of said rod, a separable electrical connection between said rod and the inner end of said conducting member, a tensioned spring also connecting said rod and other terminal cap, and said spring and conducting member constituting the sole electrical connections between said rod and other cap, whereby upon an automatic circuit interrupting operation said spring separates said separable connection and draws the rod through said bore while all the arcing current is carried by said spring.

49. In a circuit interrupter which is adapted to be replaced in its entirety after a circuit interrupting operation, comprising, in combination, a tube of insulating material, a filler for one end of said tube occupying a substantial part of the length of said tube and comprising a solid insulating material which is capable of evolving an arc-extinguishing gas when in proximity with an electric arc, a restricted bore through

said filler, terminal caps secured on each end of said tube, a rod of conducting material in said bore, means connecting one end of said rod to the terminal cap at said one end of said tube,

5 said connecting means being automatically responsive to currents above a predetermined magnitude to release said rod, a relatively thin member of conducting material in said tube connected to the other terminal cap and extending in engagement with the inner wall of said tube along the remaining length of said tube into proximity with the other end of said rod with said gas-evolving material held against longitudinal movement between said one terminal cap and the inner end of said conducting member, a separable electrical connection between said rod and the inner end of said conducting member, a tensioned spring also connecting said rod and other terminal cap, whereby upon an automatic circuit interrupting operation said spring separates said separable connection and draws the rod through said bore to extinguish the arc.

50. In a circuit interrupter which is adapted to be replaced in its entirety after a circuit interrupting operation, comprising, in combination, a tube of insulating material, a filler for one end of said tube occupying a substantial part of the length of said tube and comprising a solid insulating material which is capable of evolving an arc-extinguishing gas when in proximity with an electric arc, a restricted bore through said filler, terminal caps secured on each end of said tube, a rod of conducting material in said bore, means connecting one end of said rod to the terminal cap at said one end of said tube, said connecting means being automatically responsive to currents above a predetermined magnitude to release said rod, a relatively thin tubular member of conducting material in said tube connected to the other terminal cap and extending in engagement with the inner wall of said tube along the remaining length of said tube into proximity with the other end of said rod, a separable electrical connection between said rod and the inner end of said conducting member, and a coil tensioned spring occupying the space within said tubular member and connected between said other terminal cap and rod to separate said separable connection and draw the rod through said bore upon release of said rod by said current responsive means.

51. In a circuit interrupter which is adapted to be replaced in its entirety after a circuit interrupting operation, comprising, in combination, a tube of insulating material, a filler for one end of said tube occupying a substantial part of the length of said tube and comprising a solid insulating material which is capable of evolving an arc-extinguishing gas when in proximity with an electric arc, a restricted bore through said filler, terminal caps secured on each end of said tube, a rod of conducting material in said bore, means connecting one end of said rod to the terminal cap at said one end of said tube, said connecting means being automatically responsive to currents above a predetermined magnitude to release said rod, a relatively thin tubular member of conducting material in said tube connected to the other terminal cap and extending in engagement with the inner wall of said tube along the remaining length of said tube into proximity with the other end of said rod, a separable electrical connection between said rod and the inner end of said conducting member, a coil tensioned spring occupying the space within said tubular

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member and connected between said other terminal cap and rod to separate said separable connection and draw the rod through said bore upon release of said rod by said current responsive means, and permanent mounting terminal fixtures releasably secured to said terminal caps, respectively, for supporting said interrupter and electrically connecting said terminal caps to circuit contacts.

52. In a circuit interrupter which is adapted to be replaced in its entirety after a circuit interrupting operation, comprising, in combination, a tube of insulating material, a filler for one end of said tube occupying a substantial part of the length of said tube and comprising a solid insulating material which is capable of evolving an arc-extinguishing gas when in proximity with an electric arc, a restricted bore through said filler, terminal caps secured on each end of said tube, a rod of conducting material in said bore, means connecting one end of said rod to the terminal cap at said one end of said tube, said connecting means being automatically responsive to currents above a predetermined magnitude to release said rod, a relatively thin member of conducting material in said tube connected to the other terminal cap and extending in engagement with the inner wall of said tube along the remaining length of said tube into proximity with the other end of said rod, a separable electrical connection between said rod and the inner end of said conducting member, a coil tensioned spring occupying the space within said tubular member and connected between said other terminal cap and rod to separate said separable connection and draw the rod through said bore upon release of said rod by said current responsive means, each of said terminal caps having a central opening, a displaceable closure for each of said openings, and means responsive to a circuit interrupting operation for displacing said closures.

53. In a circuit interrupter which is adapted to be replaced in its entirety after a circuit interrupting operation, comprising, in combination, a tube of insulating material, a filler for one end of said tube occupying a substantial part of the length of said tube and comprising a solid insulating material which is capable of evolving an arc-extinguishing gas when in proximity with an electric arc, a restricted bore through said filler, terminal caps secured on each end of said tube, a rod of conducting material in said bore, means connecting one end of said rod to the terminal cap at said one end of said tube, said connecting means being automatically responsive to currents above a predetermined magnitude to release said rod, a relatively thin member of conducting material in said tube connected to the other terminal cap and extending in engagement with the inner wall of said tube along the remaining length of said tube into proximity with the other end of said rod, a separable electrical connection between said rod and the inner end of said conducting member, a coil tensioned spring occupying the space within said tubular member and connected between said other terminal cap and rod to separate said separable connection and draw the rod through said bore upon release of said rod by said current responsive means, said one terminal cap having an opening through which one end of said rod is projected only after said rod has moved through substantially the entire length of said bore.

54. In a circuit interrupter, spaced line con-

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tacts, a renewable interrupter adapted to be connected to said contacts and to automatically move out of engagement with at least one of said contacts in response to a circuit interrupting operation, said interrupter comprising a tubular enclosure of insulating material having terminals mounted thereon at opposite ends with said terminals connected by interrupting means within said enclosure, said interrupting means being automatically responsive to currents above a predetermined value to interrupt the circuit, permanent mounting terminal fixtures releasably secured to said terminals, respectively, one of said fixtures having means for supporting said interrupter for movement of at least one of said terminals into and out of engagement with one of said contacts, one of said fixtures and contacts having cooperating means for latching said interrupter in closed circuit position wherein said terminals are held in engagement with said contacts, and means responsive to an automatic circuit interrupting operation of said interrupter to release said latch means and permit said interrupter to drop out of the circuit.

55. In a circuit interrupter, spaced line contacts, a renewable interrupter adapted to be connected to said contacts and to automatically move out of engagement with at least one of said contacts in response to a circuit interrupting operation, said interrupter comprising a tubular enclosure of insulating material having terminals mounted thereon at opposite ends with said terminals connected by interrupting means within said enclosure, said interrupting means being automatically responsive to currents above a predetermined value to interrupt the circuit, permanent mounting terminal fixtures releasably secured to said terminals, respectively, one of said fixtures having means for pivotally supporting said interrupter on one of said contacts for movement of the other terminal into and out of engagement with the other contact, the other of said fixtures and contacts having cooperating means for latching said interrupter in closed circuit position wherein said terminals are held in engagement with said contacts, and means responsive to an automatic circuit interrupting operation of said interrupter to release said latch means and permit said interrupter to drop out of the circuit.

56. In a circuit interrupter, interrupting means having a terminal, a terminal fixture adapted to be secured to said terminal, said fixture including a part having an opening of a size to freely receive said terminal, a cooperating part adapted to engage one side of said terminal, and screw means for moving said parts relative to each other into clamping engagement with opposite sides of said terminal, respectively, to provide a rigid mechanical and good electrical connection of the fixture and terminal.

57. In a circuit interrupter, interrupting means having a terminal, a terminal fixture adapted to be secured to said terminal, said fixture including a part having an opening of a size to freely receive said terminal, a cooperating part of channel shape for receiving one side of said first part with the flanges of said channel-shaped part extending toward said terminal and adapted to engage one side of said terminal, and screw means for moving said parts relative to each other into clamping engagement with opposite sides of said terminal, respectively, to provide a rigid mechanical and good electrical connection of the fixture and terminal.

58. In a circuit interrupter having a pair of terminals, arcing contacts at least one of which is movable away from the other to draw an arc, said contacts connected with said terminals, respectively, biasing means for moving said movable contact away from the other of said contacts, electroresponsive means for maintaining said contacts against separation but operative to release said contacts in response to predetermined electrical conditions, the connection of said movable contact and its corresponding terminal comprising a solid connection having a relatively weak portion joining a relatively rigid element to one member, and a flexible connection from the other member to said element at a point offset from said weak portion in a direction laterally of the direction of motion of said movable contact, so that said weak portion will be subjected to bending and tensile stress so as to be readily broken by said biasing means in response to a circuit interrupting operation.

59. In a circuit interrupter, a holder tube enclosure of insulating material having terminals adjacent opposite ends thereof, conducting means in said tube connecting said terminals including means automatically responsive to predetermined electrical conditions for interrupting the circuit, a line contact, means pivotally mounting said tube for movement from a substantially upright position wherein one terminal thereof is in engagement with said line contact to a depending position

wherein said one terminal thereof is out of engagement with said line contact, releasable latch means for latching said tube terminal in engagement with said line contact, means responsive to a circuit interrupting operation of said interrupting means to release said tube terminal for movement out of engagement with said line contact, means for releasably maintaining said tube in a position intermediate said upright and depending positions but ineffective to stop movement of said tube on automatic dropout movement thereof.

60. In a line contact construction, a line terminal, a floating contact member on said line terminal, means electrically connecting said contact member and line terminal, a single spring biasing said contact member relative to said terminal with a force having a component in one direction to cause engagement of said contact member with a cooperable contact means, and a second component in a direction to cause movement of said floating contact member in another direction away from said terminal, cooperating abutments on said floating contact member and line terminal, respectively, for normally opposing said second force component, and one of said abutments being releasable to permit movement of said floating contact member away from said line terminal.

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