June 1, 1943. J. M. WALLACE 2,320,494

CIRCUIT INTERRUPTER

Filed Oct. 20, 1939 2 Sheets-Sheet 1

Fig. 1.

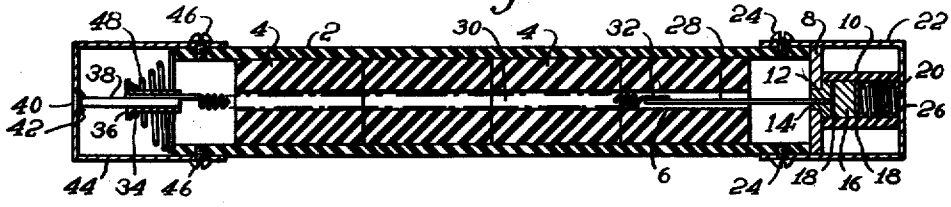


Fig. 2.

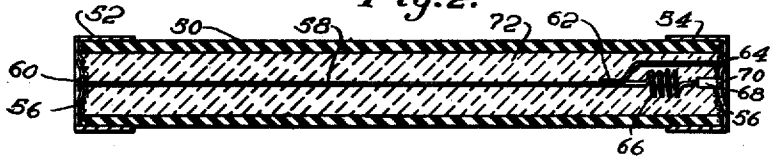


Fig. 3.

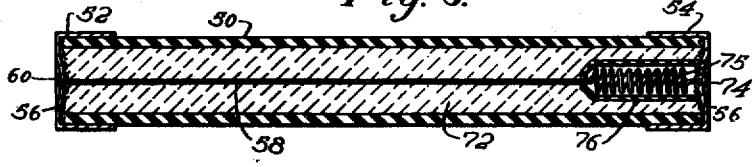


Fig. 4

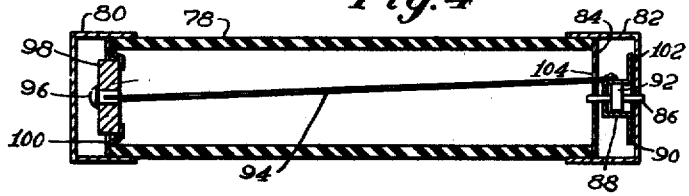


Fig. 5.

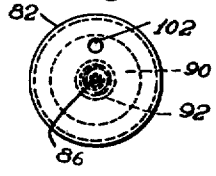


Fig. 6.

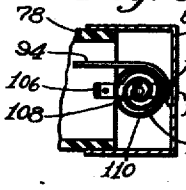


Fig. 7.

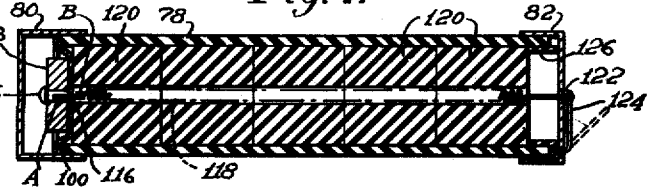


Fig. 8.

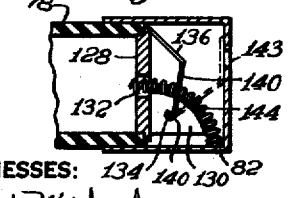


Fig. 9.

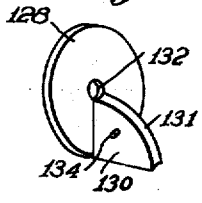
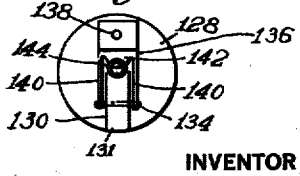


Fig. 10.



WITNESSES:

Edward Michaels

Arthur J. Stratton

INVENTOR

James M. Wallace.

BY

Ralph W. Swingle

ATTORNEY

June 1, 1943. J. M. WALLACE 2,320,494

CIRCUIT INTERRUPTER

Filed Oct. 20, 1939 2 Sheets-Sheet 2

Fig. 11.

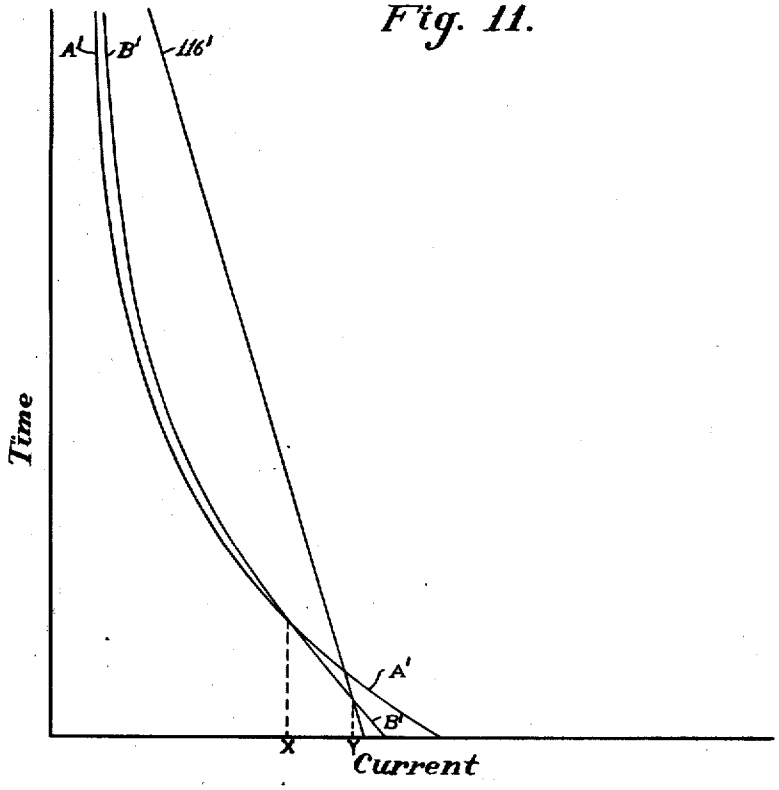


Fig. 12.

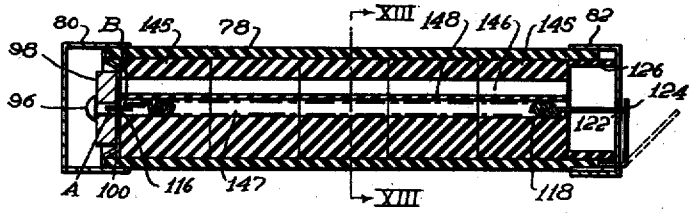
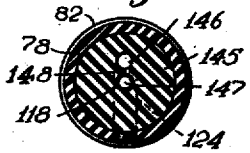


Fig. 13.



WITNESSES:

Edward Michaels

Arthur T. Stratton

INVENTOR

James M. Wallace.

BY

Ralph Z. Swingle

ATTORNEY

Patented June 1, 1943 2,320,494

UNITED STATES PATENT OFFICE

2,320,494

CIRCUIT INTERRUPTER

James M. Wallace, Braddock, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application October 20, 1939, Serial No. 300,365

26 Claims. (Cl. 200—117)

My invention relates, generally, to electric circuit interrupting devices, and more particularly to fusible interrupting devices adapted to automatically interrupt a circuit upon the passage therethrough of currents of a predetermined magnitude.

A primary object of my invention is to provide a novel interrupting device adapted to automatically interrupt a circuit substantially instantaneously in response to heavy overload and short circuit currents, and which will also operate with a time lag to interrupt relatively lighter but continuing overloads.

Fuses which provide for dual protection of this nature are known in the art. However, it is an object of my invention to provide a fuse of this type of simpler construction which is more reliable and efficient in operation than those known heretofore.

Interrupters designed to automatically protect an electric circuit or apparatus served thereby, are often mounted in relatively inaccessible locations, thus fuses for the protection of potential transformers are usually supported adjacent the transformer to be protected, on a pole or other elevated supporting means. It is, therefore, highly desirable that some indicating means be provided for the interrupter to provide a readily visible indication, from a remote point, of the condition of the interrupter, that is, whether or not it has operated to interrupt its associated circuit. Otherwise, when an outage occurs in a circuit which includes a plurality of protective devices, it is necessary to closely inspect each device to determine which one has operated.

Another object of my invention, therefore, is to provide in a device for automatically interrupting a circuit in response to currents of a predetermined magnitude, signalling means of relatively simple yet efficient form to readily indicate the condition of the device.

Another object of my invention is to provide signalling means in connection with a high voltage fuse, which in addition to providing a readily visible indication of the condition of the fuse, will operate to aid in extinguishing the arc formed when the fuse operates to interrupt a circuit.

It is old in the art to provide a fuse or other circuit interrupting devices with a chamber in which an arc is established when the device operates to open a circuit, and to provide the walls of such a chamber of a material which is capable of evolving an arc-extinguishing gas when in proximity to an electric arc, to extinguish the arc formed. Considerable difficulty has been encountered, however, in effectively extinguishing arcs formed in the interruption of currents of different magnitudes. To interrupt currents of relatively low magnitudes, it has been found that relatively small chambers are necessary to obtain maximum contact of the chamber walls and the arc. However, it has been found that to effectively extinguish arcs formed during the interruption of short-circuit currents, a much larger chamber is essential to effectively reduce and withstand the internal gas pressures developed by the arc.

Various relatively complex solutions to this problem have been proposed with varying degrees of success, and it is an object of my invention to provide an arc-extinguishing structure of extremely simplified form which will operate efficiently to extinguish arcs formed by the interruption of currents of any magnitude.

It is a further object of my invention to provide a fuse including a fusible element located in a relatively small chamber, the walls of which are formed of a material capable of evolving an arc-extinguishing gas when in proximity to an electric arc for extinguishing small current arcs, and an auxiliary chamber similar to the first chamber and automatically operable to assist in extinguishing large current arcs.

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

Figure 1 is a longitudinal sectional view of a fuse illustrating one form of my invention;

Fig. 2 is a similar view of a modified form of fuse;

Fig. 3 is a view similar to Fig. 1 of a still further modified form of fuse;

Fig. 4 is a longitudinal sectional view of another form of fuse embodying my invention;

Fig. 5 is an end view looking at the right hand end of the fuse shown in Fig. 4;

Fig. 6 is a partial longitudinal sectional view of a fuse showing a modified form of signalling device;

Fig. 7 is a longitudinal sectional view of a fuse similar to that shown in Fig. 4 but illustrating arc-extinguishing means in position in the fuse casing and a modified form of signaling means and fuse link;

Fig. 8 is a partial longitudinal sectional view of a fuse illustrating a still further modified form of signalling device;

Fig. 9 is a perspective view of the plug or signal supporting structure shown in Fig. 8;

Fig. 10 is a plan view of the signalling device and support therefor of Figs. 8 and 9, and shown in assembled relation and illustrating the manner in which the signalling device is engaged by the fuse spring;

Fig. 11 is a view showing the characteristic curves of the fuse shown in Fig. 7;

Fig. 12 is a longitudinal sectional view of a fuse similar to that shown in Fig. 7 but showing a modified form of arc-extinguishing structure; and

Fig. 13 is a transverse sectional view taken along the lines XIII—XIII of Fig. 12.

My invention as embodied in Figure 1 is shown in the form of a fuse which includes an insulating fuse tube 2 which may be of any desired insulating material, such for example as fiber, porcelain, glass or the like. Mounted within the tube 2 are a plurality of blocks of material 4 which are capable of evolving an arc-extinguishing gas when in proximity to an electric arc, such for example, as compressed boric acid. As shown on the drawings, there are four of these blocks, each having a central bore 6 for the reception of the fuse link structure. At the right hand end of the fuse tube as viewed in Fig. 1, there is provided a washer 8 seated on the end of the fuse tube, and between the washer 8 and a terminal cap 22, which is secured to the fuse tube by any desired means, such for example, as the screws 24, is mounted an insulating sleeve 10. The washer 8 and sleeve 10 may be made of any desired insulating material, preferably some molded or pressed insulating material. The washer 8 is provided with a central aperture 12 for receiving the reduced portion of a plug 14 made of any suitable conducting material, such for example, as brass or copper. The shoulders of the plug 14 seat on the outer side of the washer 8, and the outer side of the plug 14 is in engagement with a resistor block 16, being maintained in such engagement by a coiled compression spring 20. Spring 20 is compressed between the terminal cap 22 and resistor block 16, and maintains the resistor and plug 14 in both electrical and heat-conducting relation. The terminal cap 22 has a central aperture 26, the inwardly bent edges of which serve to position the spring 20 on assembly of the device. The resistor block 16 preferably has its opposite faces coated with a conducting material 18, such for example as a thin layer of copper or the like which may be sprayed on the faces of the block or applied thereto in the form of a thin sheet.

The conducting plug 14 is provided with a central aperture for the reception of a fusible wire 28 made of any desired resistance material, such for example as a copper-nickel alloy. The fuse wire 28 has one end thereof secured in the aperture in the conducting plug 14 by means of a low melting alloy solder, such for example as a bismuth-lead alloy. The other end of the fusible wire 28 is secured in any desired manner, such for example, as by soldering to one end of a coil-tension spring 30 as at 32. The other end of the coil-tension spring 30 extends through a conducting sleeve 34, of copper or other conducting material, which has an outer flange 36, and the spring 30 has its end bent over the flange 36 of the conducting sleeve 34 to aid in securing these parts together. Also received in the sleeve 34 is an indicating plunger 38 which, together with the end of the spring 30 passing through the conducting sleeve 36, is soldered or otherwise suitably secured in the sleeve. The indicating plunger 38 has its other end slidably mounted through an aperture in the terminal cap 44. The indicating plunger 38 is preferably formed of conducting material, such for example as copper or the like, and has at its outer end an enlarged head portion 40, which engages the inwardly bent edges 42 of the terminal cap aperture to limit inward movement of the indicating plunger 38. The terminal cap 44 is secured to the fuse tube in any desired manner, such for example as by the screws 46. A spirally coiled compression spring 48 has its inner end seated on and bearing against the adjacent end of the fuse tube 2, and has its outer end engaged with the flange 36 of the conducting sleeve 34 to continuously exert a bias on the indicating plunger 38 in a direction to project the plunger outwardly of the terminal cap 44.

The method of operation of this form of my invention is as follows. Magnetizing surges which will be encountered in service will not affect the fuse. Overloads of sufficient magnitude to damage the potential transformer or other apparatus in circuit with the fuse will cause enough heat to be generated by resistor 16 that the temperature of the conducting plug 14 will be raised until the soldered joint between fuse wire 28 and plug 14 is melted. Upon melting of the solder, spring 30 collapses and draws an arc through the boric acid 4 causing a gas blast which extinguishes the arc. Upon releasing the tension spring 30 the spiral spring 48 pushes the indicator rod 38 out of the terminal cap 44, thus providing a readily visible indication of a blown fuse. It should be noted that the spiral spring 48 also acts to positively lengthen the arc formed when the fuse blows, inasmuch as the spring 30 is anchored to the movable end of spring 48. On intermediate currents, fuse wire 28 blows to protect spring 30, and on high currents even the spring 30 may be vaporized. In each case the indicator rod 38 works as before.

The conducting sleeve 34 serves not only the purpose of anchoring springs 30 and 48 but also prevents the indicator 38 from being blown out of the terminal cap 44 on interruption of high currents. By using suitable values of resistors 16, fusing currents as low as .25 ampere are obtained, provided, of course, these currents are prolonged a sufficient period of time. In spite of the low current rating, however, this construction is rugged enough to withstand the most severe mishandling, which is a distinct improvement over the prior art, and this construction has the further advantage that it is easy to assemble in that no delicate adjustments are necessary and no extremely small parts are used. It is obvious that either spring 48 or 30 could be eliminated if desired and an operative device would still be had. However, it is preferable to employ both springs since the action is then more positive and efficient. Obviously, the terminal caps 22 and 44 may be perforated in addition to the central apertures shown, if desired, to permit escape of the gases formed by vaporization of the fusible parts and the gas evolved from the arc-extinguishing material 4.

In Fig. 2, I have shown a fuse which includes an insulating fuse tube 50 having end terminal caps 52, 54 mounted on the ends of the fuse tube, with the packing strips 56 between the caps and the end of the fuse. The packing 56 may be of any desired packing material but is preferably of

a textile material. A fuse wire 58 has its ends secured to the terminal caps as at 60 and 64. The fuse wire 58 may be of any desired fusible resistance material. An intermediate portion of the fuse wire is secured, as by solder 62 or the like, to one end of a coiled tension spring 66. The spring 66 has its other end secured to an indicating plunger member 68 by any suitable means, such for example as by soldering. The spring 66 maintains the fuse wire taut and maintains an outer enlarged head 70 on the indicating member 68 in engagement with the outer surface of the terminal cap 64. The indicator 68 is, of course, slidably mounted in an aperture in the end cap 64. The fuse tube in this embodiment of my invention is filled with an inert filling material 72. This material is preferably a refractory material, such for example as marble dust, which acts to fill the gap formed with such inert material when the fuse blows and to rapidly cool the arc gases formed and thus extinguish the arc.

In the operation of this form of my invention, it is obvious that upon the occurrence of predetermined values of current through the fuse that the fuse wire 58 will melt and permit spring 66 to increase the gap between the fused portions of the wire, and at the same time release the tension on indicator 68, thus permitting the indicator to move outwardly of the fuse.

Obviously, the fuse wire 58 may terminate at the connection 62 with spring 66, and a shunt of conducting material may be used around the spring 66 in place of the extended portion of the fuse wire. It should be noted in connection with this embodiment of my invention that the spring 66 performs three functions, that is, it provides a gap in the circuit when the fuse blows, it normally prevents the fuse from sagging into engagement with the walls of the fuse tube, and also holds indicator 68 in a non-indicating portion.

The fuse shown in Fig. 3 is very similar to that shown in Fig. 2. Hence, like reference numerals have been used to designate like parts. The fuse illustrated in this figure, however, is provided with an insulating cover sleeve 76 for the spring 75 which replaces the spring 66 shown in the embodiment of Fig. 2. The spring 75 is soldered as at 74 to the end cap 54. This construction permits the use of a spring having a greater travel than in the construction of Fig. 2, inasmuch as the insulating cover 76 prevents the filling material 72 from entering between the coils of the spring, thus permitting greater separation and travel of the spring 75. The cover 76 is made of any desired light insulating material, such for example, as a cellulose material such as paper or the like.

The operation of this form of my invention is similar to the operation of the form shown in Fig. 2 with the exception that the larger spring 75 is capable of introducing a larger air gap in the circuit when the fuse blows. Otherwise the operations of the two embodiments are identical and will not be repeated here.

In Figs. 4 and 5 of the drawings, I have shown a fuse which includes an insulating fuse tube 78 of fiber or other insulating material, having the terminal caps 80 and 82 suitably secured on opposite ends thereof. Fixed in the terminal cap 82, and the washer 84 provided over the adjacent end of the fuse tube 78, is a shaft member 86 on which is rotatably mounted a generally cup-shaped indicating member 88. The indicating member 88 is provided with an outwardly projecting flange 90 at its periphery, and encloses a spiral spring 92, one end of which is secured to the indicator 88 and the other end of which is secured to the shaft 86. This spring is normally maintained in stressed condition by the fuse link 94 extending through an aperture 104 in the washer 84 to be secured to the indicator 88 in any suitable manner as by soldering, and to an anchoring plug 96 by a low melting alloy solder connection. The anchoring plug 96 has an enlarged head and is mounted in a resistor block 98 made of suitable resistance material, such for example as carbon or the like. The resistor block 98 is seated in a depressed portion of a conducting washer 100, which contacts the terminal cap 80, and the washer is seated on the open end of the fuse tube 78. The terminal cap 82 is provided with an aperture 102 through which the flange 90 of the indicator 88 is readily visible. On assembly of the parts, a dot of paint or some other distinctive marking is applied to that part of the indicator which is visible through the aperture 102.

The method of operation of this form of my invention is as follows. A relatively light but continuing overload in the circuit causes the resistor 98 to rise in temperature to a point where the solder connection between anchoring plug 96 and fuse wire 94 melts. This releases the fuse wire which is wound up on the indicator 88 by the action of spring 92, thus drawing out the arc formed through any desired arc-extinguishing material which may be positioned in the fuse tube. This particular construction is very rugged because it has no tiny fusible element. It has a suitable time current curve. There is an appreciable time lag at intermediate currents (5 to 10 times rated current) because of the high capacity of the resistor. This will prevent operation of the fuse on magnetizing surges but will permit it to operate on very low prolonged currents, thus protecting not only the system with which the fuse is associated, but also the transformer or other apparatus served thereby. On high currents the fuse link 94 will vaporize with no time lag. Obviously any desired type of arc-extinguishing material may be inserted in the fuse tube to surround the fuse wire 94. When the fuse blows and the indicator 88 is rotated by spring 92, the dot of paint or other distinctive marking which normally was visible through the aperture 102 in the terminal cap 82 will be moved away from the aperture so as to give a clearly visible indication of the operation of the fuse.

In Fig. 6 I have shown another type of indicating means which could be readily used in connection with the fuse shown in Fig. 4, or any of the other fuses disclosed herein. This fuse includes a U-shaped indicator supporting strap 106 having the leg portions thereof secured at opposite points to the fuse tube, and having fixed in the outer ends of the leg portions thereof an indicator supporting shaft 108. The indicator is in the form of an annular band or drum 110 and is supported from the shaft 108 by the spiral spring 112 which has its ends secured to the shaft 108 and drum 110, respectively. The fuse wire 94 normally maintains the spring 112 in a stressed condition by its engagement with the indicator drum 110, as by being soldered thereto at 114. The lump of solder 114 which may be colored, if desired, is visible through an aperture 103 in the fuse terminal cap 82.

The operation of this form of my invention is very similar to that described in connection with Fig. 4 and will not be gone into in detail here. It is obvious, however, that when the fuse blows and the fuse link 94 is released, the spring 112

will then be free to move the lump of solder 114 away from the aperture 102 to give an indication that the fuse has blown.

In the embodiment of my invention shown in Fig. 7, I have illustrated a fuse which is quite similar to that shown in Fig. 4 and, therefore, like numerals are used to designate like parts. The fuse in this embodiment of my invention differs from that shown in Fig. 4 only by the provision of a different indicating means and fuse link, and a particular type of arc-extinguishing material is shown in position in the fuse. The fusible wire in this embodiment of my invention is secured at A in an anchoring plug 96 associated with resistor 98 in the same manner as is the fuse wire 94 in the embodiment disclosed in Fig. 4. However, the fusible wire 116 is relatively short and has its other end secured to one end of a coiled tension spring 118 at B, by a low melting point alloy solder. The coil spring 118 extends through central bores provided in blocks 120 of material which is capable of evolving an arc-extinguishing gas when in proximity to an electric arc, such for example as boric acid or the like. These blocks are much the same as the blocks illustrated in connection with the embodiment of my invention shown in Fig. 1. The other end of spring 118 extends through an aperture 122 in the terminal cap 82 and is secured to the free end of a leaf spring indicator 124. The opposite end of the indicator 124 is secured between the flange of the indicator cap and the outer side of the fuse tube 78. A spacing ring 126 is provided between the terminal cap 82 and the adjacent boric acid block 120 to maintain the blocks in a fixed position within the fuse tube 78.

The operation of this embodiment is as follows. On slight overloads which are prolonged a sufficient length of time, the heater 98 causes the solder joint A in the restraining plug 96 to melt and the spring 118 collapses to the other end of the tube. The arc comes into contact with the boric acid and produces a gas blast which causes its extinction. At currents about five times the normal blowing point of the fuse, the time lag is great enough so that the spring will heat to a temperature dangerously near its tempering point, before the fuse blows. To safe-guard against this, the solder joint B will melt before the spring is damaged. At higher currents and on short circuits the time lag of solder joints A and B is too great and the fuse wire 116 vaporizes. Irrespective of where the circuit is interrupted when interruption occurs, under any condition release of spring 118 permits the resilient indicator 124 to move to the dotted line position shown in Fig. 7 to give a clear indication of the indication of the fuse.

The characteristic curves of the solder joints A and B and the fuse link 116 are shown in Fig. 11 at A', B' and 116', respectively. As is clear from Fig. 11, all currents up to value X, if prolonged a sufficient length of time, will cause the solder joint A to melt and interrupt the circuit. At the point of current value X, the curves of solder joints A and B cross each other and from that point to the point of current value Y the solder joint B will operate to interrupt the circuit. Of course, upon the occurrence of currents of the value Y or greater, the fuse wire 116 vaporizes to interrupt the circuit as is obvious from Fig. 11.

In Figs. 8 to 10, I have shown another form of indicating device which may be used in conjunction with any of the fuses previously described, particularly that shown in Figs. 4 to 7, and like numerals are used here to designate like parts. In this form of indicating device an indicator supporting plug 128 has a peripheral shoulder seated on the end of the fuse tube 78 and includes a central aperture through which extends a coiled tension spring 144 to be anchored to terminal cap 82. The indicator supporting plug 128 includes an integral spring support 130 having an arcuate grooved spring supporting edge portion 131, and oppositely extending integral side pintles 134. The signalling device is in the form of a substantially L-shaped member 136 having on one leg thereof a distinctive dot 138 which may be colored if desired, and the free end of the other leg thereof is pivotally mounted on the pintles 134, said other leg of the indicator 136 is bifurcated to provide the spaced legs 140, which are, respectively, mounted on the pintles 134. There is provided between the bifurcations 140, a spring-engaging tab 142.

It is believed obvious that when the fuse link spring 144 is tensioned in its normal position, that the indicator 136 will be moved to the full line position shown in Fig. 8. When the fuse blows, the spring 144 is released and is then free to move the indicator 136 to the dotted line position shown in Fig. 8, and present the distinctive dot 138 behind the aperture 143 in the terminal cap 82, to thus provide a readily visible indication of the condition of the fuse.

In the embodiment of my invention shown in Figs. 12 and 13, I have shown a fuse which is identical with that shown in Fig. 7 with the exception of the structure of the arc-extinguishing material 145. Hence here too, like reference characters will be used to designate like parts. The arc-extinguishing material 145 which may be of the same type of material as the blocks 120 previously described in the connections with the embodiment illustrated in Fig. 7, is provided with two spaced parallel bores 146 and 147. The spring 118 is mounted in the central bore 147 as is the case in the embodiment illustrated in Fig. 7, while the bore 146 is normally inactive. A relatively thin walled portion 148 separates the two bores.

In the operation of this embodiment of my invention, low currents are interrupted in the relatively small main central bore 147. However, on high current interruption the wall 148 between the two bores is broken by the pressure produced by the vaporization of the fuse link and evolution of gas from the arc-extinguishing material, thus automatically increasing the bore to enable the fuse to effectively extinguish the higher current arcs. The thickness of wall 148 is determined by the mechanical strength of the fuse holder and arc-extinguishing material, and can be adjusted for maximum efficiency when different types of material are employed.

From the foregoing, it is believed obvious that I have provided a novel type of fuse of relatively simple but efficient structure which includes material which extinguishes the arcs formed by the failure of the fusible portions of the fuse. It should also be obvious that I have provided a novel form of fuse embodying a time lag characteristic for giving protection against relatively light prolonged overloads, as well as giving substantially instantaneous protection against heavy overload or short circuits. I have further disclosed as an important feature of my invention a novel construction of fuse which embodies a signalling means in intimate association there-

with, which signalling means may be of a plurality of different types. Another important feature of my invention which I have disclosed is the double-bore construction for arc-extinguising material, which enables the efficient interruption of both large and small currents and extinction of the resulting arcs.

Having described preferred embodiments of my invention in accordance with the patent statutes, I desire it to be understood that I do not wish to be limited to the particular construction described above in detail, inasmuch as it will be obvious, particularly to persons skilled in the art that many changes, modifications and substitutions may be made in these particular structures without departing from the broad spirit and scope of my invention. Therefore, I desire it to be understood that my invention be given as broad an interpretation as possible and be limited only by what is expressly stated in the appended claims.

1. In a circuit interrupting device, interrupter supporting means including a terminal seat, a resistance element adapted to be positioned wholly on said seat but unsecured thereto, conducting means having a fusible connection with said resistance element, and including means tensioning said conducting means to maintain said resistance element in engagement with said seat, and to draw out the arc formed upon failure of said fusible connection.

2. In a circuit interrupting device, interrupter supporting means including an apertured terminal seat, an apertured terminal block member seated on said seat, a fuse link extending through said apertures and connected to said terminal member and including means tensioning said link to maintain said terminal member in engagement with said seat, and to draw out the arc formed upon failure of said fuse link.

3. In a circuit interrupting device, interrupter supporting means including an apertured terminal seat, an apertured terminal block member seated on said seat, conducting means extending into said apertures and having a fusible connection with said terminal member and including resilient means tensioning said conducting means to maintain said terminal member in engagement with said seat and to draw out the arc formed upon failure of said fusible connection.

4. In a circuit interrupting device, a fuse tube, housing means at an open end of the tube and having an opening communicating with said tube, a conducting plug in said opening, conducting means in said tube having a fusible connection to said conducting plug, a resistance element and resilient means in said housing, said resistance element positioned on said plug and said resilient means reacting between said resistance element and a wall of said housing to maintain said plug and resistance element in engagement.

5. In a circuit interrupting device, a fuse tube, housing means at an open end of the tube and having an opening communicating with said tube and an outer opening, conducting means extending through said first opening and having a fusible connection to a conducting plug, a resistance element and resilient means in said housing, said housing means including a terminal cap for said one end of said tube, said resilient means acting between said resistance element and cap to maintain said resistance element and plug in engagement, and to electrically connect said resistance element and cap.

6. In a fuse, a fuse tube having a pair of terminals, means in said tube connected between said terminals including fusible means and resilient means, said resilient means adapted to tension said fusible means, a finely comminuted arc-extinguishing material filling said tube, and an inner casing for said resilient means.

7. In a circuit interrupting device, means for automatically interrupting a circuit upon the passage therethrough of currents of a predetermined magnitude, an enclosure therefor, signalling means movably mounted with respect to said enclosure, first resilient means connected between a terminal of said interrupting means and said signalling means for normally maintaining said signalling means in non-signalling position, second resilient means in said enclosure biasing said signalling means for movement outwardly with respect to said enclosure, said two resilient means having different resilient characteristics, whereby upon an interrupting operation by said interrupting means, the resulting arc is drawn out with a snap action, and said signalling means is moved to a projecting indicating position.

8. In a fuse, a fuse tube, a fuse link therein and including resilient means for tensioning the fusible portion of said link, an apertured cap for one end of said tube, an indicator slidably mounted in said aperture and connected to said resilient means, a second resilient means in said tube having different resilient characteristics than said first resilient means, and biasing said indicator for movement outwardly of said tube, whereby when the fuse blows, the resulting arc is drawn out with a snap action, and the indicator is projected from the tube.

9. In a circuit interrupting device, means for automatically interrupting a circuit upon the passage therethrough of currents of a predetermined magnitude, an enclosure therefor, indicating means including a resilient indicating device on said enclosure and biased for movement outwardly relative to said enclosure, resilient means connecting a terminal of said interrupting means and said indicating means whereby said indicating means is maintained in a resiliently stressed condition so that upon an interrupting operation of said interrupting means, the resulting arc is drawn out, and the indicating means released for outward movement to indicate the operation.

10. In a fuse, a fuse enclosure having a terminal, a fuse link therein, signalling means movably mounted in the enclosure and located entirely within said enclosure, resilient means connected to said signalling means, said fuse link connected between said terminal and signalling means to normally maintain said resilient means under stress, and an open aperture in said enclosure by means of which the position of the signalling means may be readily visibly determined.

11. In a fuse, a resistance element, a fusible element, a flexible, relatively infusible conductor, and means including a low melting point alloy connecting said elements and conductor in series relation.

12. In a fuse, a resistance element, a fusible element, a conducting spring, means including a low melting point alloy connecting said elements and spring in series relation.

13. In a circuit interrupter, means having a pair of adjacent arc passages therethrough, inner wall portions of said passages being of a material capable of evolving arc-extinguishing gas when in proximity to an electric arc, one of

said passages being of a size to interrupt currents of relatively small magnitudes, means solely in said one passage for drawing an arc, and the wall separating said passages being frangible to increase the size of the arc passage in response to interruption of heavy currents in said one passage.

14. In a circuit interrupter, a block of material having twin bores therethrough, at least the inner walls of said bores being of a material capable of evolving an arc-extinguishing gas when in proximity to an electric arc, means solely in one of said bores for drawing an arc, and the wall between said bores being destructible in response to the interruption of currents in said one bore greater than a predetermined magnitude.

15. In a circuit interrupting device, means of insulating material having a pair of adjacent spaced passages therethrough, means in one only, of said passages for drawing an arc, and the wall separating said passages being frangible in response to the drawing of an arc in said one passage above a predetermined current magnitude.

16. In a circuit interrupting device, means for automatically interrupting a circuit upon the passage therethrough of currents of a predetermined magnitude, an enclosure therefor, indicating means movably associated with said enclosure, resilient means in said enclosure for stressing a terminal of said interrupting means and maintaining said indicating means in a non-indicating position, said signalling means biased to an indicating position, means in said enclosure connecting said resilient means between said signalling means and said one terminal of said interrupting means, whereby said resilient means is responsive to an interrupting operation of said interrupting means to draw out the arc formed and release said signalling means for movement to said indicating position.

17. In a circuit interrupting device, interrupter supporting means including a terminal seat, a resistance element, conducting means having a fusible connection with said resistance element and including means tensioning said conducting means to maintain said resistance element in engagement with said seat, and to draw out the arc formed upon failure of said fusible connection, means of a material capable of evolving an arc extinguishing gas when in proximity to an electric arc and forming a pair of passages, said conducting means positioned in only one of said passages so that said arc is initially drawn in said one passage, a frangible wall separating said passages, and said terminal seat and parts supported thereby closing one end of said passages.

18. In a circuit interrupting device, interrupter supporting means including an apertured terminal seat, an apertured non-metallic resistance block adapted to be supported on said seat but being unsecured thereto, a fuse link, means securing said link in the aperture of said block, said link extending freely through said seat aperture, and means tensioning said link to maintain said block in firm engagement with said seat and to draw out the resulting arc upon fusion of the fusible portion of said fuse link.

19. In a circuit interrupting device, interrupter supporting means including an apertured terminal seat, an apertured non-metallic resistance block adapted to be supported on said seat but being unsecured thereto, flexible conducting means extending freely through said seat aperture, means securing said conducting means in said block aperture including a fusible mass of low melting point alloy material, and means tensioning said conducting means to maintain said block in firm engagement with said seat and to draw out the resulting arc upon fusion of said fusible mass.

20. In a circuit interrupting device, interrupter supporting means including an apertured terminal seat, an apertured non-metallic resistance block adapted to be supported on said seat but being unsecured thereto, a length of fusible material extending freely through said seat aperture, means securing said fusible material in said block aperture including a fusible mass of low melting point alloy material, and means tensioning said length of fusible material to maintain said block in firm engagement with said seat and to draw out the resulting arc upon fusion of said fusible mass or length of fusible material.

21. In a fuse, an insulating fuse tube having terminals adjacent opposite ends thereof, respectively, annular means of conducting material seated on one end of said tube and conductively associated with the adjacent tube terminal, annular heating means seated on the outer surface of said annular conducting means, a fuse link, means securing said link in the aperture of said annular heating means, said link extending freely through the opening of said annular conducting means and through said tube to be connected with the other of said terminals, said link including means tensioning said link to normally maintain said annular means in firm engagement and to draw out the arc resulting from fusion of the fusible portion of said means.

22. In a fuse, an insulating fuse tube having terminals adjacent opposite ends thereof, respectively, annular means of conducting material seated on one end of said tube and conductively associated with the adjacent tube terminal, annular heating means seated on the outer surface of said annular conducting means, the other of said terminals including an apertured cap, a resilient indicator strip mounted on the outside of said cap and normally biased to a readily visible indicating position, a fuse link, means securing said link in the aperture of said annular heating means, said link extending freely through the opening of said annular conducting means and through said tube and cap aperture to be connected with said indicator strip to maintain the latter in a non-indicating position, and said link including tensioning means to normally maintain said annular means in engagement and to draw out the arc resulting from fusion of said link and release said indicating strip for movement to its indicating position.

23. In a fuse, a resistance element, a fusible element, a flexible, relatively infusible conductor, connections each including a low melting point alloy connecting said elements and conductor in series, one of said connections being in heat conducting relation with said resistance element, and the other of said connections being spaced therefrom whereby the fusing characteristics of said connections differ.

24. In a circuit interrupting device, means forming a pair of adjacent spaced substantially identical arc passages and a frangible wall therebetween, and means in one only, of said passages for drawing an arc.

25. In a circuit interrupter, means having a plurality of adjacent arc passages therethrough,

inner wall portions of said passages being of a material capable of evolving arc-extinguishing gas when in proximity to an electric arc, means solely in one of said passages for striking an arc, and the wall separating said passages being frangible to increase the size of the arc passage in response to interruption of heavy currents in said one passage.

26. In a circuit interrupter, means having a plurality of adjacent arc passages therethrough, inner wall portions of said passages being of a material capable of evolving arc-extinguishing gas when in proximity to an electric arc, means solely in one of said passages and movable longitudinally thereof to strike an arc and draw the arc out along said passage, and the wall separating said passages being frangible to increase the size of the arc passage in response to interruption of heavy currents in said one passage.

JAMES M. WALLACE.