May 25, 1948. W. F. SKEATS 2,442,216

ELECTRIC FUSE AND INDICATOR

Filed June 9, 1944

Fig. 1.

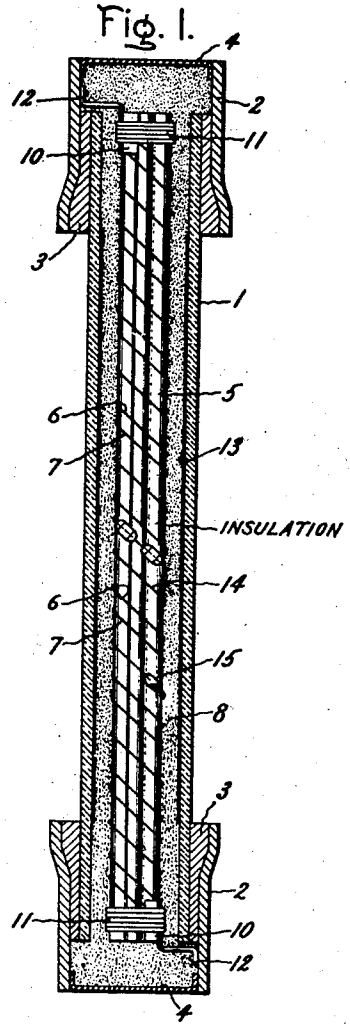


Fig. 2.

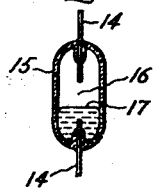


Fig. 3.



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ELECTRIC FUSE AND INDICATOR

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8 Claims. (Cl. 200—121)

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My invention relates to improvements in electric fuses, and more particularly to improvements in indicating means for electric fuses of the enclosed type.

In the development of power fuses for interruption of currents of large magnitude without noise, discharge of solid or liquid particles, or production of gases which must be either discharged to atmosphere or dissipated in a high pressure chamber, difficulties have been encountered in providing suitable enclosures and fuse operation indicating means which do not render the fuses subject to contamination or escape of gases.

It is an object of the present invention to provide improved housing and indicating means employable for overcoming the above mentioned difficulties in fuses of the character referred to and in other applications where problems of a similar nature are encountered.

One of the more specific objects of the invention is the provision of a substantially gas-tight casing for an enclosed fuse, which casing embodies means arranged to give indication of fuse operation without impairment of the casing seal.

It is another object of my invention to provide a new and improved indicating means comprising a small quantity of changeable color coating material visible from the outside of the fuse tube which is caused to change color in response to operation of the fuse.

Further objects and advantages of my invention will become apparent as the following description proceeds and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of my invention reference may be had to the accompanying drawing in which Fig. 1 is a sectional view of an exemplary form of high voltage fuse embodying the improved indicating means of my invention; Fig. 2 is an enlarged view of a portion of the fuse illustrated in Fig. 1, and Fig. 3 is an end view of the core employed in the fuse of Fig. 1.

Although it will be evident from the following description that the present invention may be practiced to advantage with different types and forms of electric fuses, the invention lends itself most advantageously to practice with the enclosed type of fuse such as is disclosed and claimed in United States Letters Patent 2,294,132, granted August 25, 1942, upon an application of C. L. Schuck, and assigned to the same assignee as the present application, wherein the fusible

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conductor is shown as being enclosed in a tubular casing and surrounded by and embedded in a granular, inert, arc quenching material.

Referring now to the drawing, it will be seen that the illustrated circuit interrupting device specifically shown as a high voltage fuse is provided with a tubular enclosing casing 1 upon the opposite ends of which are disposed metallic terminal ferrules 2. While the casing is indicated as being constructed of glass, it may equally well be constructed of other suitable transparent or at least partially transparent insulating material. The terminal ferrules 2 are secured on the casing 1 by any suitable form of glass-to-metal seal indicated at 3 and the outer ends of the ferrules are closed by sealed-in caps 4. As is common practice in devices of the type illustrated, an insulating and refractory core 5 extending longitudinally in casing 1 is provided for the purpose of supporting the long current interrupting link to be described hereinafter so that the latter may be accommodated in a casing of practical dimensions. The particular fusible element or interrupting link shown spirally wound on the core 5 of Fig. 1 includes two fusible elements 6 and 7 arranged in parallel relationship. The interior of the casing or housing 1 around the core 5 is filled with a granular, refractory, arc quenching material 8, such as sand or pulverized quartz, which has a high dielectric strength and is substantially inert or non-gas producing at temperatures likely to be encountered during circuit interruption. As will be evident from Figs. 1 and 3, core 5 has a plurality of longitudinally extending fins or ribs 9 which engage the conductors or fusible elements 6 and 7 of the interrupting link only at spaced points and serve to maintain the conductors or elements spaced outwardly from the central body portion of the core 5. Thus the maximum length of the conductors is embodied in and directly exposed to the arc quenching material.

The opposite ends of the elements 6 and 7 are secured to terminals 10 which are mounted respectively on opposite ends of core 5. Any suitable form of terminal may be employed for the purpose but the particular terminals employed in the illustrated construction are of the improved form disclosed and claimed in the above mentioned Schuck patent. As fully explained in said Schuck patent, the terminals engage the fins 9 of core 5 in a manner such as to prevent unwinding or slipping of the conductors 6 and 7 of the interrupting link. As additional precaution against displacement of the terminals 10, wires

11 are wrapped around the ends of the core in a manner securely to anchor the terminals 10 in place. Tabs 12 extend from the terminals 10 and are joined to the inner surface of the terminal ferrules 2 so as to provide electrical connections between the terminal ferrules and the opposite ends of the interrupting link comprising parallel arranged conductors 6 and 7.

Fuses of the type described above are available on the market today and are generally referred to as current limiting fuses or power fuses of the enclosed type. They have also been referred to as silver sand fuses since the fusible elements 6 and 7 are usually formed of silver and the granular material 8 is usually sand. Since fuses of the above mentioned type operate without noise, discharge of liquid or solid particles, or production of gases, a problem arises with regard to providing suitable indicating means to indicate operation thereof. Two satisfactory indicating means which have been used successfully are disclosed and claimed in United States Letters Patent 2,188,816 and 2,343,224, both assigned to the same assignee as the present application. My invention is specifically concerned with still another indicating means for fuses for circuit interrupting devices of the above mentioned type.

In accordance with my invention, I coat the inner surface of the glass tube or housing 1 of the circuit interrupting device described above with a thin film of a material which changes its color under certain conditions upon operation of the circuit interrupting device. Instead of using a thin coating one may also place a small amount of the changeable color material adjacent the inside surface of the housing so as to be visible from the outside of the housing. I have discovered that a film of a compound of selenium and sulphur, such as stable chemically active selenium sulphide represented by the formula SeS_2 disclosed and claimed in Nordlander Patent 1,860,154 and assigned to the same assignee as the present application, provides a sensitive film which is darkened when in the presence of very minute quantities of mercury vapor. In Fig. 1 this film or coating is represented by the numeral 13. In order to provide means responsive to the operation of the fuse device for causing the sensitive film 13 to change color and hence give an indication that the circuit interrupting device is operative, I have provided a specific arrangement comprising a target or indicator element 14 connected in parallel with the link comprising fusible conductors 6 and 7. This indicator wire is provided with a gap so that under normal conditions of the circuit interrupting device no current flows therethrough. This gap may be provided in any suitable manner such for example, as is disclosed in Figs. 1 and 2, by providing a closed rupturable or frangible container such, for example, as a glass capsule 15 into which the indicator wire 14 is fused with the gap in the wire within the capsule, this gap being specifically designated in Fig. 2 by the numeral 16. Also contained within the capsule 15 would be a small amount of substance 17, which would be vaporized in response to the arc formed across gap 16 to cause the rupture of capsule 15 and a change in the color of the sensitive film 13. This substance 17 may preferably comprise mercury which would vaporize and diffuse throughout the interior of the tube 1 coming in contact with the indicator 13, coating the inside surface of tube 1, and changing its color.

It will be obvious that with the arrangement

described above, the substance such as mercury contained within capsule 15, would be prevented from doing any harm under normal conditions and would be set free to act upon the indicator film 13 when the circuit interrupting device operates. Since the fuse device described above is sealed, no material can escape to atmosphere.

Instead of using selenium sulphide for the thin film of coating material dry cobaltous chloride may be used. In such a case the mercury in capsule 15 would be replaced by water. The cobaltous chloride which has a blue color when dry takes up the water vapor when released to form a hydrate which is red.

In view of the detailed description included above, the operation of my invention will be obvious. By virtue of the gap 16 in the indicator wire 14, no current will flow through the indicator wire 14 under normal conditions of the fuse device. Upon blowing or rupture of the fuse link comprising elements 6 and 7, a potential will appear across the gap 16 within the capsule 15 which will cause the gap to arc over with the consequent destruction of capsule 15 due to the heat of the arc produced. This heat also causes vaporization of the substance 17 which is preferably mercury, whereupon it is diffused throughout the interior of housing or casing 1, coming in contact with the sensitive film 13. The change in color of this sensitive film which occurs in a very short time will clearly indicate that the circuit interrupting device has operated.

While I have shown and described a particular embodiment of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from my invention in its broader aspects, and I therefore aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In combination with an electric fuse device of the enclosed type comprising a transparent housing, a pair of terminals respectively associated with the ends of said housing, a fusible element within said housing interconnecting said terminals, a small amount of selenium sulphide on the inside surface of said transparent housing, and means responsive to rupture of said fusible element for causing said selenium sulphide to change color whereby to indicate the blown condition of said fuse device comprising a closed frangible container in said housing, mercury in said container, and conductors respectively extending from each of said terminals into said container in parallel relation with said fusible element, the ends of the conductors within said container being spaced to form an air gap for vaporizing some of the mercury in the container upon breakdown of the air gap after rupture of said fusible element.

2. In combination with an electric fuse device of the enclosed type comprising a housing formed of at least partially transparent material, a pair of terminals respectively associated with the ends of said housing, a fusible element within said housing interconnecting said terminals, a small amount of changeable color material located on the inside surface of the transparent part of said housing, a closed rupturable container in said housing, conductors respectively extending from said terminals into said container, the ends of the conductors within the container being spaced to form an air gap, a vaporizable substance in

said container effective upon breakdown of said air gap after rupture of said fusible element to rupture said container, said substance being reactive with said material to change the color thereof whereby to indicate the blown condition of said fuse device.

3. In combination with an electric fuse device of the enclosed type comprising a housing formed of at least partially transparent material, a pair of terminals respectively associated with the ends of said housing, a fusible element within said housing interconnecting said terminals, a small amount of selenium sulphide located on the inside surface of the transparent part of said housing so as to be visible from the exterior of said housing, and means responsive to rupture of said fusible element for causing said selenium sulphide to change color whereby to indicate the blown condition of said fuse device comprising a closed rupturable container in said housing, mercury in said container, conductors respectively extending in parallel with said fusible element from said terminals into said container, the ends of the conductors within the container being spaced to form an air gap whereby upon breakdown thereof after rupture of said fusible element to vaporize the mercury in the container and cause rupture thereof thus to indicate the blown condition of said fuse device.

4. In combination with an electric fuse device of the enclosed type comprising a tubular housing formed of at least partially transparent material, a pair of terminals respectively associated with the ends of said housing, a fusible element within said housing interconnecting said terminals, a thin film of a selenium sulphide on the inside surface of said housing so as to be visible from the exterior thereof, and means responsive to rupture of said fusible element for releasing mercury vapor whereby to cause said selenium sulphide film to change color comprising a closed frangible container in said housing, mercury in said container, conductors respectively extending in parallel with said fusible element from said terminals into said container, the ends of the conductors within the container being spaced to form an air gap whereby upon breakdown thereof upon rupture of said fusible element to vaporize the mercury in the container and cause rupture thereof to effect escape of mercury vapor into said housing thus to indicate the blown condition of said fuse device.

5. In combination with an electric fuse device of the enclosed type comprising a housing formed of at least partially transparent material, a pair of terminals associated one with each end of said housing, a fusible element within said housing interconnecting said terminals, a small amount of cobaltous chloride located adjacent to the inside surface of said housing so as to be visible from the exterior of said housing, and a frangible capsule in said housing having water therein and provided with spark electrodes effective upon rupture of said fusible element for vaporizing said water to rupture said capsule and release water vapor to cause said cobaltous chloride to change color and consequently indicate the blown condition of said fuse device.

6. In combination with an electric fuse device

of the enclosed type comprising a tubular transparent housing, a pair of terminals respectively associated with the ends of said housing, a fusible element within said housing interconnecting said terminals, a thin film of a changeable color coating material on the inside surface of said transparent housing, a closed frangible container in said housing, conductors respectively extending in parallel relation with said fusible element from each of said terminals into said container, the ends of the conductors within the container being spaced to form an air gap, a vaporizable metallic substance in said container effective upon breakdown of said air gap after rupture of said fusible element to break said container, said substance being chemically reactive with the material of said film to change the color thereof whereby to indicate the blown condition of said fusible element.

7. An electric fuse device having a tubular transparent housing, a thin film of a changeable color coating material on the inside surface of said housing, a pair of terminals closing the ends of said housing, a fusible element within said housing interconnecting said terminals, refractory granular material embedding said element, a frangible capsule embedded in said material, a vaporizable liquid in said capsule chemically reactive with the material of said film to change the color thereof, and electrical means connected to be effectively energized upon fusion of said element for vaporizing said liquid to rupture said capsule and release said vaporized liquid whereby to cause said film to change color and thus indicate the fusion of said element.

8. An electric fuse device having a tubular transparent housing, a film of changeable color material on the inside surface of said housing, a pair of terminals sealing the ends of said housing, a fusible element within said housing interconnecting said terminals, refractory granular material embedding said fusible element, a frangible capsule embedded in said material, a vaporizable liquid enclosed in said capsule and reactive on the material of said film to change the color thereof, and means including spark gap terminals extending within said capsule for vaporizing said liquid in response to rupture of said fusible element and thereby release said vaporizable liquid to effect a change in the color of said film.

WILFRED F. SKEATS.

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The following references are of record in the file of this patent:

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