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ELECTRIC FUSE HAVING COMBUSTIBLE ELEMENTS COMPRISING LEAD SALTS OF NITROPHENOLS

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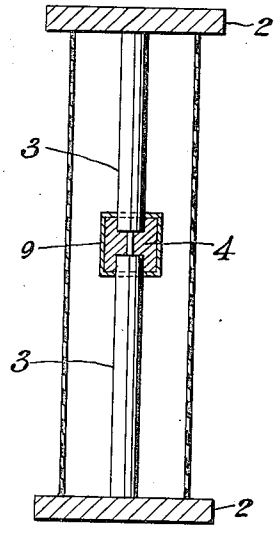

Fig. 1

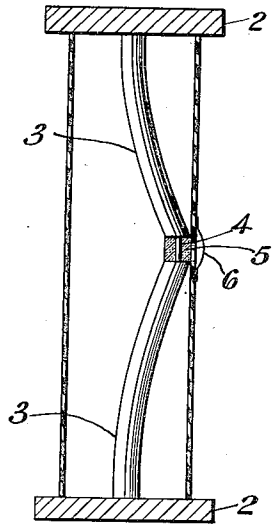

Fig. 2

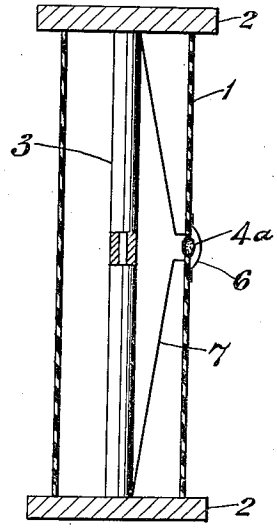

Fig. 3

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ELECTRIC FUSE HAVING COMBUSTIBLE ELEMENTS COMPRISING LEAD SALTS OF NITROPHENOLS

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9 Claims. (Cl. 200—121)

This invention pertains to a new and improved electric fuse of the type employed in electric power circuits and containing a combustible element; in particular it relates to such a fuse characterized by a new and improved combustible element.

As is well known, electric fuses are employed in electrical circuits in order that an overload of current will merely rupture the fuse rather than cause permanent damage to the circuit. A more recently developed type of fuse is equipped with a combustible element. This element is so disposed in the fuse that an overload, causing a predetermined temperature rise in the metal fuse bar, initiates the combustible element. This combustible element upon initiation may either sever the fuse bar or serve to scar a label on the outside of the fuse, thus indicating that the fuse has blown. In some types the combustible element is adapted to perform both of these breaking and indicating functions.

These electrical fuses of the type containing a combustible element have had certain disadvantages. Fuses of this type have had the defect that the combustible elements employed were characterized by low sensitiveness to ignition and poor heat stability.

The object of the present invention is a new and improved electric fuse for use in electric circuits and of the type containing a combustible element. Another object is a new and improved combustible element for use in such fuses. A further object is an improved combustible element adapted to indicate that the fuse has been ruptured. A still further object is an improved combustible element capable of rupturing the current conducting member of said fuse. Other objects will become apparent from the following detailed description of the invention.

We have found that the foregoing objects may be accomplished and disadvantages overcome by constructing an electric fuse wherein the combustible element comprises a lead salt of a nitrophenol containing not more than two nitro groups, for example the basic lead salt of dinitrophenol, lead mononitroresorcinol, the lead salt of dinitro-ortho cresol, lead nitrato-bis basic lead dinitro-ortho cresylate. Other compounds of this group are disclosed more fully in the copending application of Burrows and Filbert, Serial No. 171,512, filed October 28, 1937.

In order to describe our invention in greater detail, reference is made to the accompanying drawing. As far as possible, similar numerals will be employed to refer to corresponding parts throughout the several views therein. It should be understood that this represents merely preferred embodiments of our invention and is not to be construed as limiting the scope thereof.

Referring generally to the figures of the drawing, Figure 1 is a view in cross-section of an electric fuse containing the combustible element according to our invention of the type wherein the combustible element is adapted to rupture the fuse bar. Figures 2 and 3 represent similar views of fuses of the indicating type likewise charged with combustible element according to the present invention.

Referring to Figure 1 in greater detail, the outer surface of the fuse body is designated by the numeral 1, said fuse body being composed of paper, fiber or other materials conventionally employed for the construction of this portion of the fuse. The reenforced ends 2 impart desired mechanical strength to the assembly. These ends may be constructed of suitable metal in order to provide means for electric contact, thereby serving a dual purpose. When the fuse is in an electric circuit the circuit is completed by means of the current carrying metal fuse bar 3. Located at any convenient position and in heat transfer relationship with 3 is the combustible element 4, comprising a composition according to our invention and held in place adjacent to that portion of the fuse bar which is to be ruptured. The amount of charge employed, as well as the method fixing it in position, of course depends on the characteristics of the particular fuse for which the element is to be adapted. If a relatively large combustible element is required, it is desirable to enclose said composition in a container 9 which may be fitted about the metal fuse bar.

Figure 2 shows a fuse of the type wherein the combustible element serves both as a means for rupturing the fuse bar and as an indicating means. In this case the fuse bar 3 at its weakened portion 5 is bent toward the fuse case 1. The combustible element is fixed about the weakened portion 5 of the fuse bar. On the outside of the case, in a locus adjacent to the combustible element, is placed the label 6. Upon the passage through the fuse bar of a current exceeding a predetermined value the combustible element is initiated, rupturing the weakened segment 5 of the fuse bar and at the same time scarring the label 6, thus indicating that the fuse has been ruptured. This arrangement enables the construction of a fuse highly sensitive to electric charges exceeding a predetermined value, the thermal capacity of the reduced segment 5 being at a minimum.

Figure 3 discloses an indicating fuse wherein

an ancillary member 7 is joined in parallel with the main fuse bar 3. The member 7 is designed so that it does not attain a temperature sufficient to initiate the combustible element in conjunction therewith, except after the main link 3 has been ruptured. Usually said ancillary member has a resistance much higher than that of fuse bar 3 and an ampere rating much lower than that member. The rupture of the fuse bar 3 is followed by the passage of an electric current greatly exceeding the current carrying capacity of 7, with the result that the latter is heated quickly to the temperature of initiation of the combustible element 4—*a*, comprising a composition according to the present invention. The firing of this element causes physical alteration of the label 6. Although Figure 3 shows a combustible element adapted to rupture the member 3, it is of course understood that such an arrangement may be readily omitted.

In order to describe in detail the application of our combustible elements to particular fuses, the following examples are set forth as specific embodiments.

Example I

A number of electric fuses of the type illustrated in Figure 3 described in the foregoing, having a capacity of 660 volts and 30 amperes, were furnished with an 18% nickel-silver ancillary high resistance wire, in parallel with the main link of the fuse. Said ancillary wire was 4 inches in length and 0.003 inch in diameter. To the ancillary member of each was added a combustible element comprising a globule of a paste of lead-nitrato-bis basic lead dinitro-ortho cresylate and a 7% solution of nitrocotton. After the globule was dry, a paper label was pasted over the charge and the fuse assembly connected to an electric circuit having a variable power source. As long as the current was kept below the rated capacity of the fuse (660 volts, 30 amperes), there was no change in the appearance of the label, nor was there any tendency for the charge to initiate. However, upon overloading the circuit, the main link of the fuse melted, whereupon the ancillary high-resistance member was heated almost immediately, causing initiation of the globule, which burst the paper label glued over its surface. Although the high-resistance member was fused very soon after the rupture of the main conducting link, initiation of the globule attached thereto was effected in every instance.

Example II

Several fuses were prepared in a manner identical with that set forth in Example I, except that the plastic combustible element employed was a mixture of 80 parts by weight of lead-nitrato-bis basic lead dinitro-ortho cresylate and 20 parts of potassium chlorate, in a 7% solution of nitrocotton. The initiation of the charge was effected in all the tests, and, with the exception that the rupture of the label was more pronounced, the results of these tests were identical with those obtained in Example I.

The electric fuses containing the combustible elements comprising the lead salts of nitrophenols according to the present invention, possess definite advantages over the fuses of the art. In the first place the combustible elements according to our invention are heat stable; that is, they may be heated to temperatures below their initiation temperature for long intervals of time without affecting said initiation temperature. The discovery of such a readily initiated composition which may be heated at temperatures below its lower limit of initiation for long intervals of time without impairing the sensitiveness to initiation of said composition is very surprising in view of the fact that compositions known to the art are unstable when subjected to heat.

This composition also has the property that it ignites sufficiently rapidly that the fuse bar cannot be fused through before the composition has had time to ignite. Moreover the tendency of the combustible element to decompose and deteriorate in general is lessened in view of the fact that it cannot be heated even momentarily at temperatures as high as its initiation temperature without firing. The foregoing initiation properties of the combustible element are extremely important to the completed fuse assembly because they permit the construction of a fuse which will surely open the electric circuit upon the passage of an overload of current.

The following example demonstrates the heat stability of the lead salts of nitrophenols containing not more than two nitro groups.

Example III

A sample of lead nitrato-bis basic lead dinitro-ortho cresylate was divided into two equal portions. The first portion was heated at a constant temperature of 290° C. Initiation was effected after 0.5 second. The second portion was subjected to a constant temperature of 220° C. for a period of 10 minutes, this temperature being very close to the lower limit of its initiation range. Following this treatment, the sample was heated at 285° C. Again initiation was effected after 0.5 second, thus showing that the initiation temperature of lead nitrato-bis basic lead dinitro-ortho cresylate was substantially unaffected in spite of heating for 10 minutes at a temperature approaching the initiation temperature of the material. It will be understood that the foregoing example is given merely by way of illustration and is not intended as limiting our invention.

While our invention has been described in detail in the foregoing, it should be noted that many variations may be made in the arrangements, construction and composition of the various members of the fuses disclosed without departing from the spirit and scope of the invention. For instance it is understood that many oxidizing agents, fuels, carbonaceous materials, and in general, ingredients which have been accepted in the explosives art, may be employed in conjunction with the lead salts of nitrophenols containing not more than two nitro groups. Potassium chlorate is an example of such a desirable ingredient. We intend therefore to be limited only in accordance with the following patent claims.

We claim:

1. An electric fuse comprising a metal fuse bar and a combustible element in heat transfer relationship with said fuse bar comprising a lead salt of a nitrophenol containing not more than two nitro groups.

2. The electric fuse of claim 1 wherein the combustible element comprises lead mononitroresorcinol.

3. The electric fuse of claim 1 wherein the combustible element comprises lead nitrato-bis basic lead dinitro-ortho cresylate.

4. An electric fuse comprising a metal fuse bar and a combustible element in contact with said

fuse bar adapted to rupture said fuse bar upon passage of an overload of current through the latter, said combustible element comprising a lead salt of a nitrophenol containing not more than two nitro groups.

5. An electric fuse comprising a metal fuse bar, a combustible element in contact with said fuse bar, a fuse case enclosing said fuse bar and said combustible element, and an indicating label on said fuse case at a locus adjacent to said combustible element, said combustible element comprising a lead salt of a nitrophenol containing not more than two nitro groups.

6. An electric fuse of the indicating type comprising a metal fuse bar, an ancillary current conducting member connected in parallel with said fuse bar, and a combustible element comprising a lead salt of a nitrophenol containing not more than two nitro groups.

7. The electric fuse of claim 6 wherein the combustible element comprises lead mononitroresorcinol.

8. The electric fuse of claim 6 wherein the combustible element comprises lead dinitro-ortho cresylate.

9. The electric fuse of claim 6 wherein the combustible element comprises lead nitrato-bis basic lead dinitro-ortho cresylate.

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