The spring-biased indicator pin of a blown fuse indicator is normally restrained by a fusible element arranged with the preponderant portion of its length in a plane at right angles to the axis of said pin, projecting through a bore in said pin and subjected to a shear action by the spring-bias of said pin.

5 Claims, 6 Drawing Figures
This invention relates to blown fuse indicators for electric fuses, and its principal aims are to simplify the construction and assembly of blown fuse indicators. A more specific object of this invention is to improve blown fuse indicators for polyphase fuses having stab contacts, i.e., fuses wherein several fuse units, each for controlling excess currents in one phase of a polyphase circuit, are integrated to form a structural unit that can be inserted by means of stab contacts into a polyphase circuit to be protected against excess currents. Such polyphase fuses are well known in the art and one embodiment thereof is disclosed in U.S. Pat. No. 3,319,027 to P. C. Hitchcock, issued May 9, 1967 for ENCAPSULATED FUSE STRUCTURE FOR POLYPHASE CIRCUITS. This patent shows a type of blown fuse indicator which, and variations of which, have been widely adopted in connection with polyphase fuses as, for instance, the polyphase fuses not featuring stab contacts disclosed in U.S. Pat. No. 3,671,910 to F. J. Kozacka, issued June 20, 1972 for COMPACT POLYPHASE FUSE. Reference may be had to the two aforementioned patents as representative of the state of the art in regard to blown fuse indicators, and more specifically to blown fuse indicators for polyphase fuses.

Polyphase fuses include often spaced metal strips conductively interconnected by current-carrying fusible elements having a relatively low resistance and fusible restraining elements for the blown fuse indicator having a relatively high resistance and connected in parallel to the former. The fusible restraining elements for the blown fuse indicator are generally oriented and arranged in a way entirely different from the way the current carrying fusible elements are oriented and arranged. This results in difficulties which are eliminated by the present invention.

SUMMARY OF THE INVENTION

Fuses embodying this invention include an indicator pin of electric insulating material having an indicating front end, a rear end defining a transverse passageway, and a spring-supporting collar or flange of increased diameter arranged between said front end and said rear end of said pin. A plate of electric insulating material is arranged at right angles to the axis of said pin and has an aperture arranged in registry with said pin. The rear end of said pin projects into said aperture to such an extent that said pin extends beyond the plane of said plate remote from said front end of said pin. Fuses embodying this invention further include fusible current-carrying element means having a relatively low resistance and fusible restraining element means having a relatively high resistance connected in parallel to said fusible current-carrying element means. The preponderant portion of the length of said fusible restraining element means is arranged in said plane of said plate remote from said front end of said pin and said fusible restraining element means is threaded through said transverse passageway in said rear end of said pin. A helical spring surrounds said rear end of said pin, rests with said one end thereof against said spring-supporting collar or flange of said pin and subjects the portion of said fusible restraining element means threaded through said passageway in said rear end to said pin to a shear-action.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation of a polyphase fuse having stab contacts for insertion of the fuse into an electric polyphase circuit, one portion of the housing and of the cover of the fuse being broken away to expose to view the internal structure of the fuse;

FIG. 2 is a section along 2--2 of FIG. 1;

FIG. 3 is a section along 3--3 of FIG. 2;

FIG. 4 shows a modification of the structure of FIG. 1 in the same fashion as FIG. 1;

FIG. 5 is a section along 5--5 of FIG. 4; and

FIG. 6 is an isometric view of the blown fuse indicator of FIGS. 4 and 5 and of the parts which are associated with it.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to FIGS. 1-3 of the drawings, numeral 1 has been applied to indicate a prismatic housing for three fuse units, each for one phase of a polyphase three phase circuit. Each of the three fuse units can be inserted by means of stab contacts 2 into contacts of a polyphase or three phase fuse holder (not shown). Housing 1 defines three substantially prismatic chambers closed at the sides and the bottom thereof and having an open end. FIG. 1 shows one of these three chambers and reference numeral 3 has been applied to it. Chamber 3 is also shown in FIG. 2. Reference numeral 4 has been applied to indicate the open side of chamber 3 which is normally closed by a cover 5. Housing 1 and cover 5 are of an electric insulating material, preferably a molded synthetic resin. Chamber 3 houses a pair of metal strips 6 arranged adjacent and parallel to two sides or side walls thereof. Metal strips 6 are conductively interconnected by fusible current-carrying element means preferably formed by perforated ribbons 7 of silver. Metal strips 6 have external ends projecting transversely through the bottom 25 of chamber 3 to the outside thereof. The ends of strips or plates 6 outside housing 1 and outside chamber 3 form the aforementioned stab contacts 2. Cover 5 may be affixed to housing 1 by any desired fastener means, e.g., screws (not shown) projecting through the four corners of cover 5 into housing 1. Cover 5 has a recess 8 housing an indicator pin 9 of electric insulating material. Indicator pin 9 has a front end and a rear end and the latter defines a transverse passageway 10. Indicator pin 9 has a spring flange or collar 11 of increased diameter arranged between the front end and the rear end of pin 9. The plate 12 of electric insulating material is arranged at right angles to the axis of pin 9 and has an aperture 13 arranged in registry with pin 9. The rear end of pin 9 projects into aperture 13 to such an extent that the rear end of pin 12 extends beyond the plane of plate 12 remote from the front end of pin 9. In addition to the fusible current-carrying element means 7 having a relatively low resistance each fuse unit is provided with a fusible restraining element 14 having a relatively high resistance. Elements 7 and 14 are connected in parallel, i.e., both elements conductively interconnect the pair of metal plates or strips 6 of one fuse unit. The preponderant portion of the length of fusible restraining element 14 is arranged in the plane of plate 12 remote from the front end of pin 9. As shown in FIG. 3, element 14 is formed by a high resistance wire which is threaded...
through transverse passageway 10 in pin 9. The rear end of pin 9 is surrounded by a helical spring 15 which rests with the upper end thereof against flange or collar 11 of pin 9. The other end of spring 15 rests against plate 12 and thus subjects a shear action the portion of fusible restraining element 14 threaded through passageway 10 in pin 9. Plate 12 is arranged in a plane parallel to that of cover 5 and has shoulder-forming projections 16 engaging projection-receiving slots 17 in the ends of metal strips or plates 6 adjacent cover 5. By virtue of its shoulders plate 12 has edges clamping bent ends of fusible restraining element 14 against the ends of metal strips 6 adjacent cover 5.

A gasket 18 at the bottom of chamber 3 precludes the outflow of pulverulent arc-quenching filler 19 from the inside of housing 1 and chamber or chambers 3 through the apertures in bottom 25 provided therein for the passage of the stab-contact-forming ends of metal strips or plates 6. Fusible elements 7 carry the load current as long as it is not excessive. During this period of time wire 14 virtually does not carry any current since its resistance exceeds by far that of current-carrying fusible elements 7 by which it is shunted. When the latter melt and breaks take their place, wire 14 begins to carry current and is heated by $I^2R$ losses occurring therein. Heat dissipation from wire 14 is minimized at the point thereof where wire 14 projects through passageway 10 in pin 9. Therefore the temperature along wire 14 forms a steep peak at the region or point thereof where it is subjected by spring 15 to a shear action. As a result of this distribution of temperature and the aforementioned shear action the current path formed by wire 14 is rapidly broken when it is caused to carry current and pin 9 propelled axially outwardly under the action of spring 15, thus indicating that the fuse has blown.

In FIGS. 4, 5 and 6 the same reference characters as in FIGS. 1–3 with a prime added have been applied to indicate like parts. Therefore the structure shown in FIGS. 4, 5 and 6 calls for a detailed description only inasmuch as it differs from that of FIGS. 1–3 which has been described above in detail.

Speaking generally, in the structure of FIGS. 4–6 cover 5 performs the function of parts 5 and 12 of the structure of FIGS. 1–3. To be more specific, cover 5 performs the function of closing the open end of chamber 3 and of supporting a fusible restraining element 14' arranged on the inner surface of cover 5'.

In the structure of FIGS. 4–6 recess 8 in cover 5' houses a cap 20' of electric insulating material and helical indicator-pin-biasing spring 15' rests with one end thereof against cap 20' and with the other end thereof against flange or spring collar 11' of pin 9'. The high resistance fusible pin-restraining element 14' is formed by a narrow strip of sheet metal threaded through transverse passageway 10' in the rear end of pin 9' which, in turn, projects through the end surface of cap 20'. Element 14' has a short length of reduced cross-sectional area coextensive with passageway 10'. As a result, a steep temperature peak occurs at the portion of element 14' inside of passageway 10'. The ends of fusible restraining element 14' are affixed, e.g., by means of screws 21', to the inner surface of cover 5'. The ends of element 14' are in physical contact with and hence conducively connected to — a pair of contact leaf springs 22'. Cover 5', cap 20', pin 9', spring 15', fusible element 14' and contact leaf spring 22' form a self-contained structural unit that can be removed as a unit from housing 1' and affixed as a unit to housing 1'. When the aforementioned cover unit 5', 20', 9', 15', 14', 22' is caused to engage housing 1' (as shown in FIGS. 4–6) contact leaf springs 22' come to rest on the edges of strips or plates 6' adjacent to cover 5'. As a result, fusible element 14' is conductively connected across strips or plates 6' in parallel to fusible elements 7'. Fusible element 14' becomes current-carrying after fusion of fusible elements 7'. This allows spring 15' to form a break at the point of fusible element 14' where it is threaded through the rear end of indicator pin 9'. This, in turn, frees indicator pin 9' and thus allows helical spring 15' to propel pin 9' outwardly to the indicating position thereof.

Contact leaf springs 22' are effective means for conductively connecting the ends of fusible restraining element 14' to metal strips 6'. It is, however, apparent that other contact means might be substituted for contact leaf springs 22'.

I claim as my invention:

1. In an electric fuse having a blown fuse indicator the combination of
   a. an indicator pin of an electric insulating material including an indicating front end, a rear end defining a transverse passageway and a spring-supporting collar of increased diameter arranged between said front end and said rear end of said pin;
   b. a plate of electric insulating material arranged at right angles to the axis of said pin and having an aperture arranged in registry with said pin, said rear end of said pin projecting into said aperture to such an extent that said rear end of said pin extends beyond the plane of said plate remote from said front end of said pin;
   c. fusible current-carrying element means having a relatively low resistance and fusible restraining element means having a relatively high resistance connected in parallel to said fusible current-carrying element means, the preponderant portion of the length of said fusible restraining element means being arranged in said plate remote from said front end of said pin and said fusible restraining element means being threaded through said transverse passageway in said rear end of said pin; and
   d. a helical spring surrounding said rear end of said pin, resting with one end thereof against said spring-supporting collar of said pin and subjecting to shear action the portion of said fusible restraining element means threaded through said passageway in said rear end of said pin.

2. In an electric fuse as specified in claim 1 the combination of
   a. a housing defining a substantially prismatic chamfer closed at the sides and at the bottom thereof and having an open end;
   b. a pulverulent arc-quenching filler inside said chamber submersing said fusible current-carrying element means;
   c. a pair of spaced metal strips inside said chamber arranged adjacent and parallel to two sides thereof and conductively interconnected by said fusible current-carrying element means, said pair of metal strips having external ends projecting transversely
through said bottom of said chamber to the outside thereof and forming a pair of stab contacts;
d. a cover affixed to said housing and closing said open end of said chamber, said cover having a recess housing said indicator pin;
e. said plate of electric insulating material being arranged in a plane parallel to the plane of said cover and said fusible restraining element being arranged on the side thereof remote from said cover, said plate having shoulder-forming projections engaging projection-receiving slots in the ends of said pair of metal strips adjacent said cover and having edges clamping the ends of said fusible restraining element against said ends of said metal strips adjacent said cover.

3. An electric fuse as specified in claim 1 wherein
a. said fusible current-carrying element means are arranged in a housing defining a substantially prismatic chamber closed at the sides and at the bottom thereof and having an open end;
b. a pulverulent arc-quenching filler is arranged inside said chamber submerging said fusible current-carrying element means;
c. a pair of spaced metal strips inside said chamber is arranged adjacent to two sides thereof, said pair of metal strips being conductively interconnected by said fusible current-carrying element means and said pair of metal strips having external ends projecting transversely through said bottom of said chamber to the outside thereof and forming a pair of stab contacts;
d. said plate of electric insulating material being affixed to said housing in such a way as to form a cover for said open end of said chamber, said plate having a recess housing said indicator pin and supporting said fusible restraining element means on the side thereof adjacent said chamber; and
e. a pair of contacts supported by said plate of electric insulating material on said side thereof adjacent said chamber, said pair of contacts being conductively interconnected by said fusible restraining element means and each of said pair of contacts engaging one of said pair of metal strips at the ends thereof adjacent said plate of electric insulating material.

4. An electric low-voltage fuse including
a. a housing of synthetic resin defining a substantially prismatic chamber closed at the sides and at the bottom thereof and having an open end;
b. a pulverulent arc-quenching filler inside said chamber;
c. a pair of spaced metal strips inside said chamber arranged adjacent and parallel to two said sides thereof, said pair of metal strips having ends projecting transversely through said housing to the outside thereof and forming a pair of terminals for connecting said fuse into an electric circuit;
d. fusible element means inside said chamber immersed in said filler and conductively interconnecting said pair of metal strips;
e. a cover affixed to said housing and closing said open end of said chamber;
f. a blown fuse indicator on and supported by said cover, said blown fuse indicator including a spring-biased indicator pin; and
g. means normally restraining said indicator pin against the spring bias thereof, said restraining means including a fusible pin-restraining element projecting transversely through said pin and being arranged with the preponderant portion of the length thereof substantially parallel to said cover, said fusible pin-restraining element having ends juxtaposed to the ends of said pair of metal strips adjacent said cover and being clamped under pressure against said ends of said pair of metal strips adjacent said cover.

5. An electric fuse as specified in claim 4 including a plate of electric insulating material arranged parallel to said cover, said plate having an aperture arranged in registry with said indicator pin, said indicator pin having a projection extending into said aperture and said projection having a transverse bore, said fusible pin-restraining element being arranged on the side of said plate remote from said cover and extending from one of said pair of metal strips through said bore in said projection of said indicator pin to the other of said pair of metal strips.