

- ## [54] LOW-VOLTAGE FUSE WITH BLOWN FUSE INDICATOR

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- [52] U.S. Cl..... 337/148, 337/158, 337/206,
337/244

- [51] Int. Cl. H01h 85/30

- [58] **Field of Search**..... 337/5, 148, 241,
337/244, 265, 267, 158, 206

- [56]
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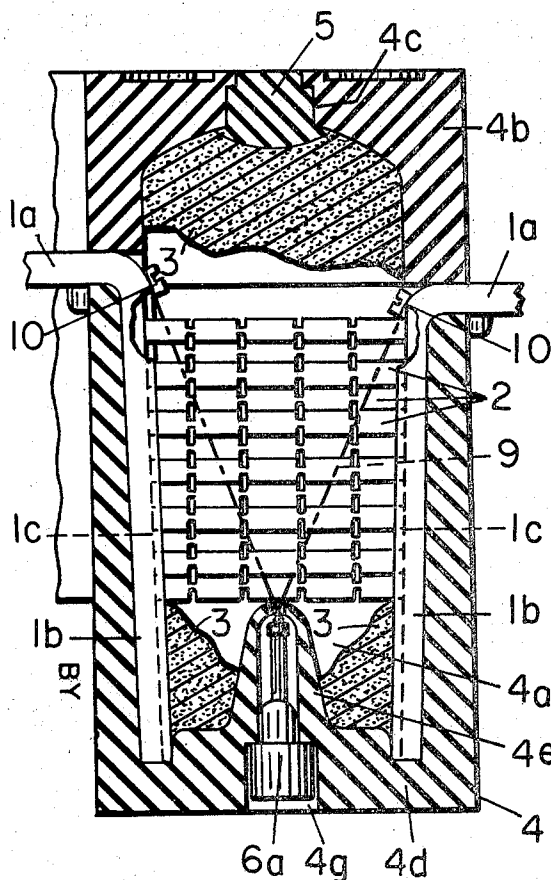
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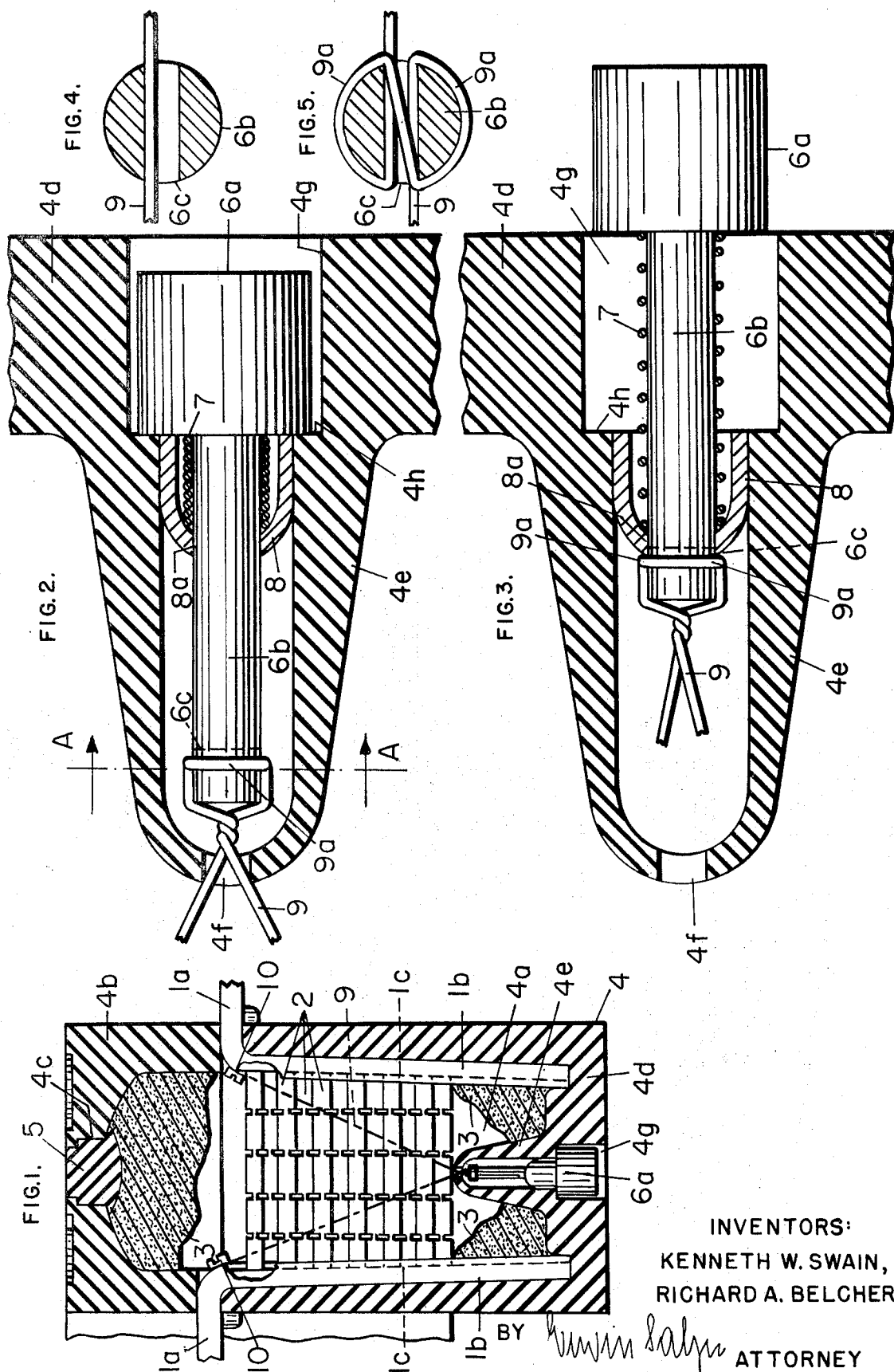
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[57] **ABSTRACT**

A low-voltage fuse has a molded insulating casing of a synthetic resin and a blown fuse indicator is installed in the casing's front wall. The spring biased plunger of the indicator is of electric insulating material and has an axially outer cylindrical portion of relatively large and an axially inner cylindrical portion of relatively small diameter. The former is arranged in an aperture having a relatively large inner diameter formed in the aforementioned front wall, and the latter is arranged in a hollow projection inside the housing coaxial with the indicating plunger having a relatively small inner diameter.

7 Claims, 5 Drawing Figures





LOW-VOLTAGE FUSE WITH BLOWN FUSE INDICATOR

BACKGROUND OF THE INVENTION

The general object of this invention is to improve the blown fuse indicators disclosed in the copending patent applications of Kenneth W. Swain et al., filed Oct. 28, 1971 for POLYPHASE FUSE WITH BLOWN FUSE INDICATOR and of Richard A. Belcher and Fedderick J. Kozacka, filed Aug. 24, 1971 Ser. No. 174,445; now U.S. Pat. No. 3,697,916; Oct. 10, 1972 for ELECTRIC LOW-VOLTAGE FUSE. One specific object of the invention is to reduce the number of constituent parts of the above blown fuse indicator structures and thus to decrease the cost of manufacture thereof. Another specific object of the invention is to maximize the distance between the front end of the indicating plunger which is accessible and may be manipulated and the part closest to it which is under a contact potential and where arcing may occur.

SUMMARY OF THE INVENTION

Structures embodying this invention include a housing of a molded insulating material accommodating fusible element means and a pulverulent arc-quenching filler. The aforementioned housing includes an integral insulating wall substantially in plate form having a recess therein. This wall further forms an integral substantially tubular member having a predetermined inner diameter, arranged in coaxial relation with said recess in said wall and projecting in cantilever fashion into the inside of said housing. The structure further includes a cylindrical plunger formed of an integral workpiece of insulating material. One cylindrical end portion of said plunger has a relatively large diameter and the other cylindrical end portion of said plunger has a relatively small diameter. The relatively large diameter end portion of the plunger is arranged in said recess of said wall and said relatively small diameter end portion of said plunger is arranged in said tubular member and has a substantially transverse bore and is surrounded by a helical biasing compression spring. One end of this spring rests directly against said relatively large diameter end portion of said plunger. The other end of said spring is supported by a spring support which, in turn, is supported by said tubular member. The plunger is normally restrained by a restraining wire threaded three times through said bore in the small diameter portion thereof in such a way that two substantially semi-circular loops are formed each engaging one lateral side of the small diameter end portion of the plunger. Said restraining wire has ends extending outwardly from opposite ends of said bore and out of said tubular member.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical section through a molded case fuse as disclosed in the above referred-to patent application of Richard A. Belcher and Frederick J. Kozacka and including a blown fuse indicator embodying the present invention.

FIG. 2 shows a blown fuse indicator embodying this invention partly in axial section and partly in side elevation in the non-indicating position thereof;

FIG. 3 shows the structure of FIG. 2 in the same way as FIG. 2 but in the indicating position thereof;

FIG. 4 is a cross-section of the indicating plunger taken along A—A of FIG. 2 in the process of being affixed the restraining wire thereof; and

FIG. 5 is a cross-section of the indicating plunger taken along A—A of FIG. 2 upon completion of the process of affixing the restraining wire thereof.

DESCRIPTION OF PREFERRED EMBODIMENT

The electric fuse shown in FIG. 1 includes a pair of substantially L-shaped terminal strips 1a, 1b. Each terminal strip includes a connector portion 1a for connecting the fuse into an electric circuit and a fusible-element-receiving portion 1b. Portions 1b are provided with grooves 1c receiving the ends of ribbon fuse link means 2 conductively interconnecting terminal strips 1a, 1b. Fuse link means 2 are conductively connected to terminal strips 1a, 1b by solder joints not shown. A pulverulent arc-quenching filler 3 shown only in part embeds fuse link means 2. Reference character 4 has been applied to indicate a molded casing of a synthetic resin, i.e., of an electric insulating material forming a chamber 4a housing the fusible-element-receiving portion 1b of terminal strips 1a, 1b fuse link means 2 and arc-quenching filler 3. Terminal strips 1a, 1b are affixed to housing 4 by any appropriate means, e.g., they may be cemented to housing 4. Cover 4b having an aperture 4c for filling arc-quenching filler 3 into chamber 4a forms a part of housing 4. When chamber 4a is filled with filler 3 aperture 4c is closed by a plug 5. The substantially planar front wall 4d of casing 4 forms an integral hollow or tubular cantilever-like projection 4e extending into chamber 4a. Projection 4e has a relatively small aperture 4f at the axially innermost end thereof. The wall 4d further has a relatively large aperture or recess 4g juxtaposed to and coaxially related to, aperture 4f. A shoulder 4h is formed between aperture or recess 4g and the inner surface of projection 4e. A blown fuse indicator is arranged in the space defined by recess 4g and extension or projection, 4e. This indicator includes a plunger of electric insulating material in the form of a solid of revolution arranged in coaxial relation to projection 4e and aperture or recess 4g. One end portion 6a of the aforementioned plunger 6a, 6b has a relatively large diameter and is arranged inside of aperture or recess 4g and the other end portion 6b of the aforementioned plunger 6a, 6b has a relatively small diameter and is arranged adjacent the relatively small diameter aperture 4f in projection 4d.

The end portion 6b of the insulating plunger 6a, 6b has a substantially transverse bore 6c and is surrounded by a substantially helical compression spring 7. As seen in FIGS. 2 and 3, the right end of compression spring 7 rests against the larger diameter portion 6a of plunger 6a, 6b. A substantially bell-shaped metal cap 8 projects from shoulder 4h in the direction of bore 6c. Cap 8 supports the end of compression spring 7 remote from large diameter end portion 6a of plunger 6a, 6b. Cap 8 has a central bore 8a for the passage of the small diameter end portion 6b of plunger 6a, 6b. A fusible restraining wire 9 for plunger 6a, 6b is threaded through aperture 4f and is threaded three times through bore 6c as shown in FIG. 5. Restraining wire 9 and cap 8 form cooperating abutments limiting movement of plunger 6a, 6b relative to casing 4 upon fusion of restraining wire 9. This is clearly shown in FIG. 3. Restraining wire 9 is substantially V-shaped and its spaced ends are clamped by screws 10 against terminal bars 1a, 1b.

FIGS. 4 and 5 show the way in which restraining wire 9 is firmly attached to the end portion 6b of plunger 6a,6b. Wire 9 is threaded three times through bore 6c and forms two substantially semi-circular loops 9a each engaging the lateral surface of end portion 6b of plunger 6a,6b. Restraining wire 9 extends from opposite sides of bore 6c away from bore 6c. The ends of restraining wire 9 extending away from opposite sides of bore 6c engage and are twisted about each other at a point juxtaposed to the end surface of end portion 6b of insulating plunger 6a, 6b. This is clearly shown in FIGS. 2 and 3.

The inner diameter of the portion of projection 4e housing end portion 6b of plunger 6a, 6b is smaller than the inner diameter of the cavity or recess 4g housing the portion 6a of plunger 6a,6b but the axial length of said cavity exceeds the axial length of the end portion 6a of plunger 6a,6b. The portion 6a of plunger 6a,6b is slidably arranged inside of aperture 4g and metal cap 8 is press-fitted into the portion of projection 4e whose inner diameter is less than the diameter of aperture 4g. Shoulder 4h forms an abutment precluding movement of plunger 6a,6b against the bias of spring 7. Since the axial length of portion 6a of plunger 6a, 6b is less than the length of the cavity 4a receiving it the front end of portion 6a of plunger 6a,6b is normally recessed as clearly shown in FIG.2.

Normally the difference in potential between screws 10 is virtually zero because terminal bars 1a,1b are normally conductively interconnected by fusible elements 2 whose ohmic resistance is small. Upon fusion of fusible elements 2 the voltage between screws 10 is equal to the voltage of the arcs taking the place of fusible elements 2. Hence a current flow is established through restraining wire 9 resulting in fusion thereof at a point outside of projection 4e. Consequently spring 7 then propels plunger 6a,6b from the position shown in FIG.2 to the position shown in FIG.3. Restraining wire 9 or, to be more specific, portions 9a of wire 9 increase the width of plunger portion 6b at one point thereof beyond the diameter of bore 8a in metal cap 8. Thus wire 9 forms an abutment cooperating with cap 8 and thereby limiting the travel of plunger 6a,6b from left to right as seen in FIGS. 2 and 3. In other words, part 9a of wire 9 is a dual function means normally restraining plunger 6a, 6b and limiting upon fusion of wire 9 the travel of plunger 6a,6b as well as its removal from housing 4. In the positions of plunger 6a, 6b shown in FIGS. 2 and 3 the plunger can safely be touched since it is entirely of insulating material and since any parts which have a contact potential and any points where arcing occurs are spaced relatively far apart from the front end 6a / of plunger 6a, 6b.

Referring now more particularly to FIG. 5, it will be apparent from that figure that the restraining wire 9 enters bore 6c on one end thereof (e.g., the right end), extends through bore 6c leaves said bore 6c at the other end thereof (e.g., the left end) and forms a first substantially semi-circular loop 9a extending in one direction along the lateral surface of the small diameter end portion 6b of plunger 6a,6b. Restraining wire 9 re-enters bore 6c at said one end thereof (e.g., the right end), extends a second time through bore 6c, leaves bore 6c at said other end thereof (e.g., the left end) and forms a second substantially semi-circular loop 9a extending in a direction opposite to said one direction along the lateral surface of end portion 6b of plunger

6a,6b. After initial entry of wire 9 into bore 6c the former re-enters twice into the latter (into the right side of bore 6c as seen in FIG. 5), extends three times through bore 6c, as clearly shown in FIG. 5, and leaves bore 6c at the opposite side it enters bore 6c. This way of attaching wire 9 to plunger 6a,6b is of considerable importance in view of the fact that the portion of the plunger to which restraining wire is attached consists of an electric insulating material rather than metal. It will also be apparent from FIG. 5 that the directions of both semi-circular loops 9a are opposite. To be more specific, if the upper semi-circular loop 9a of FIG. 5 is considered to be clockwise, then the lower semi-circular loop 9a is counter-clockwise. As shown in FIG. 1, the ends of restraining wire 9 are firmly affixed by screws 10 to parts 1a,1b. Since it is the middle section of restraining wire 9 which is attached to plunger 6a,6b rather than an end of wire 9, wire 9 and plunger 6a,6b cannot be separated from each other as may occur wherever a restraining wire is attached to a plunger at one end of the former which is twisted around itself.

We claim as our invention:

1. The combination of an electric fuse and of a blown fuse indicator including

- a. a housing of a molded electric insulating material accommodating fusible element means and a pulverulent arc-quenching filler, said housing including an integral insulating wall substantially in plate form having a recess therein, said wall further forming an integral substantially tubular member having a predetermined inner diameter, arranged in registry with said recess in said wall and projecting in cantilever fashion into the inside of said housing;
- b. a cylindrical plunger formed of an integral work-piece of insulating material, one cylindrical end portion of said plunger having a relatively large diameter and the other cylindrical end portion of said plunger having a relatively small diameter, said relatively large diameter end portion of said plunger being arranged inside said recess of said wall and said relatively small diameter end portion of said plunger being arranged in said tubular member, having a substantially transverse bore and being surrounded by a helical compression biasing spring resting with one end thereof directly against said relatively large diameter end portion of said plunger;
- c. a support for the other end of said biasing spring supported by said tubular member; and
- d. a restraining wire for said plunger threaded three times through said bore in said small diameter end portion thereof and forming two substantially semi-circular loops each engaging one lateral side of said small diameter end portion of said plunger, and said restraining wire having ends extending outwardly from opposite ends of said bore and out of said tubular member.

2. A structure as specified in claim 1 wherein said ends of said restraining wire extending from opposite ends of said bore engage and are twisted about each other at a point juxtaposed to the end surface of said relatively small diameter end portion of said plunger.

3. A structure as specified in claim 1 wherein

- a. said recess in said wall has a relatively large inner diameter in comparison to said predetermined inner diameter of said tubular member forming a shoulder between said recess and the inside of said

tubular member, said recess having a greater axial length than the axial length of said relatively large diameter end portion of said plunger and said relatively large diameter end portion of said plunger being slidably arranged in said recess, said shoulder forming an abutment limiting movement of said plunger against the bias of said biasing spring, and wherein

- b. said support for said other end of said biasing spring is formed by a substantially bell-shaped metal cap press-fitted into said tubular member and having a central bore for the passage of said relatively small diameter end portion of said plunger.
4. A blown fuse indicator structure comprising
 - a. a housing of electric insulating material including an integral flat insulating wall having a recess therein and a substantially tubular insulating member having a smaller inner diameter than the diameter of said recess being supported only on one end thereof and projecting in cantilever fashion from said wall into the inside of said housing;
 - b. a plunger of insulating material in the form of a solid of revolution, one end portion of said plunger having a relatively large diameter and the other end portion of said plunger having a relatively small diameter, said relatively large diameter end portion of said plunger being arranged inside said recess of said wall and said relatively small diameter end portion of said plunger being arranged inside said tubular member, having a substantially transverse bore at the end thereof remote from said relatively large diameter end portion of said plunger and being surrounded by a helical compression spring resting with one end thereof against said relatively large diameter end portion of said plunger;
 - c. a metal cap supporting the other end of said spring and being press-fitted into said tubular member; and
 - d. a restraining wire for said plunger having one end entering into said bore of said small diameter end portion of said plunger forming several turns in opposite directions around said small diameter end portion of said plunger and leaving said bore of said small diameter end portion of said plunger at the end of said bore opposite to said one end thereof so that an uninterrupted center portion of said restraining wire engages said plunger normally retaining said plunger in position against the action of said spring, both ends of said restraining wire extending from the inside of said tubular member to the outside thereof.
5. A blown fuse indicator including
 - a. a substantially flat plate member of electric insulating material having a recess therein and supporting one end of an integral substantially tubular projection coaxial with said recess, said projection being unsupported at the end thereof remote from said plate member, said recess having a relatively large inner diameter and said tubular projection having a relatively small inner diameter;
 - b. an indicating plunger of electric insulating material having a cylindrical section of relatively large diameter slidably arranged in said recess in said plate member and said plunger further including a cylindrical section of relatively small diameter slidably arranged in said tubular projection, said section of

relatively small diameter of said plunger having a substantially transverse bore adjacent the end thereof remote from said section of relatively large diameter of said plunger;

- c. a substantially bell-shaped metal cap press-fitted into said tubular projection;
- d. a helical compression spring inside said metal cap having one end resting against said metal cap and another end resting against said relatively large diameter section of said plunger;
- e. a fusible restraining wire normally restraining said plunger against the action of said spring, said restraining wire projecting through said bore in said section of relatively small diameter of said plunger and forming a pair of inverse loops each encompassing substantially one half of the periphery of said section of relatively small diameter of said plunger for affixing said restraining wire to said plunger and for abutting against said metal cap upon fusion of said restraining wire and thereby limiting the stroke of said plunger.
6. An electric fuse comprising
 - a. a pair of terminal strips each including a connector portion and a fusible-element-receiving portion;
 - b. fuse link means conductively interconnecting said fusible-element-receiving portion of said pair of terminal strips;
 - c. a pulverulent arc-quenching filler embedding said fuse link means;
 - d. a casing of electric insulating material defining a chamber housing said fusible-element-receiving portion of said pair of terminal strips, said fuse link means and said arc-quenching filler, one wall of said casing forming an integral substantially tubular projection extending in cantilever fashion into said chamber and having a relatively small aperture at the innermost end thereof, said one wall of said casing further having a relatively large recess juxtaposed to said relatively small aperture, and said wall of said casing forming a shoulder between said recess and the end of said tubular projection adjacent said recess;
 - e. a blown fuse indicator arranged inside said recess and said tubular projection, said blown fuse indicator including a plunger of electric insulating material in the form of a solid of revolution, one end portion of said plunger having a relatively large diameter and being arranged inside of said recess of said one wall of said casing and the other end portion of said plunger having a relatively small diameter and being arranged inside said tubular projection, said other end portion of said plunger having a substantially transverse bore and being surrounded by a helical compression spring resting with one end thereof against said relatively large diameter portion of said plunger, a substantially bell-shaped cap projecting from said shoulder in the direction of said substantially transverse bore in said other end portion of said plunger and supporting the other end of said compression spring, said cap having a central bore for the passage of said other end portion of said plunger, and a fusible restraining wire for said plunger threaded through said relatively small aperture in said hollow projection and threaded through said substantially transverse bore of said other end portion of said plunger, said restraining wire and said cap forming

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cooperating abutments limiting movement of said
plunger relative to said casing upon fusion of said
restraining wire.

7. An electric fuse as specified in claim 8 wherein
- a. said restraining wire enters said bore on one end 5
thereof, extends through said bore, leaves said bore
at the other end thereof and forms a first substan-
tially semi-circular loop extending in one direction
along the lateral surface of said end portion of said
plunger having a relatively small diameter; wherein 10
b. said restraining wire re-enters said bore at said one
end thereof, extends a second time through said

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- bore, leaves said bore at said other end thereof and
forms a second substantially semi-circular loop ex-
tending in a direction opposite to said one direction
along said lateral surface of said end portion of said
plunger having a relatively small diameter; and
wherein
- c. said restraining wire twice re-enters said bore on
said one end thereof, extends three times through
said bore and leaves said bore at said opposite end
thereof.

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