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K. W. SWAIN ET AL
PLUG-IN TYPE POWER FUSES

2,834,852

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2 Sheets-Sheet 2

Fig. 4.

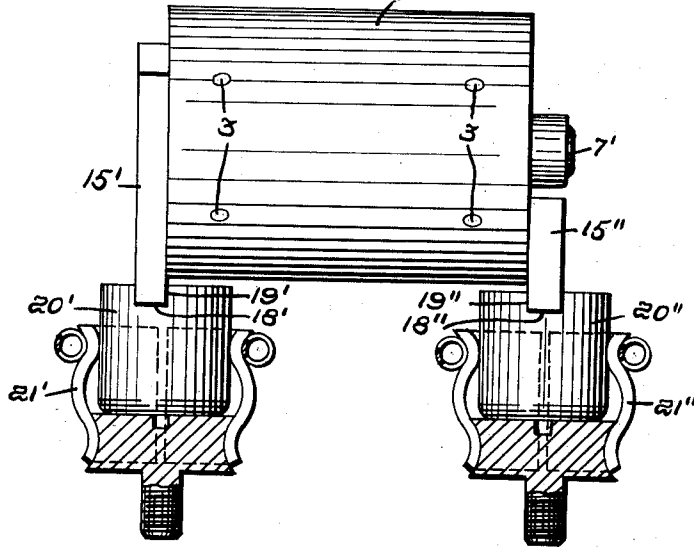
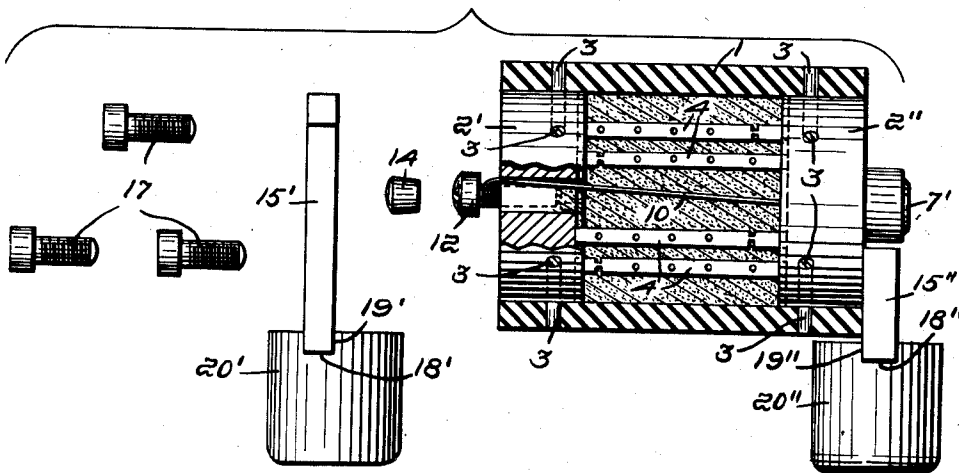


Fig. 5.



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2,834,852

PLUG-IN TYPE POWER FUSES

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7 Claims. (Cl. 200—117)

This invention relates to low-voltage power fuses, and more particularly to fuses of the current-limiting type.

In some instances, particularly with prevailing space limitations, it is desirable to provide power fuses with plug-in contacts rather than with the more conventional blade-type contacts.

It is, therefore, one object of this invention to provide plug-in-type power fuse structure capable of carrying relatively high currents, i. e. currents in the order of many hundred amperes, which are reliable in operation and inexpensive to manufacture.

Another object of the invention is to provide plug-in combinations of power fuses and fuse holders, i. e. combinations wherein contact is being established by cooperative engagement of plug-type contacts and tulip-type contacts, which combinations are reliable in operation, easy to assemble and capable of carrying currents in the order of at least several hundred amperes.

A further object of the invention is to provide plug-in-type fuses adapted to be provided with striker pins, i. e. the constituent plug-in parts of which lend themselves well to the provision of striker pins on the fuses.

Still another object of the invention is to provide fuses having a relatively high current-carrying capacity—at least in the order of several hundred amperes—with adequate contact means which can readily be secured to the fuses and whose bulk is considerably less than the bulk of the contact means of comparable prior art fuses.

Other objects and advantages of the invention will become apparent as this specification proceeds, and the features of novelty will be pointed out with particularity in the appended claims forming part of this specification.

For a better understanding of the invention reference may be had to the accompanying drawing in which:

Fig. 1 is substantially a longitudinal section of a striker pin fuse embodying the present invention;

Fig. 2 is an end view of the structure shown in Fig. 1 seen in the direction of the arrow R₂;

Fig. 3 is an end view of the structure shown in Fig. 1 seen in the direction of the arrow R₃;

Fig. 4 is a side elevation of the same structure as shown in Fig. 1 with the plug-type contacts thereof cooperatively engaging a pair of tulip-type contacts; and

Fig. 5 is an exploded side view of the constituent parts of the structure shown in Figs. 1 to 4, inclusive.

Referring now to the drawing, and more particularly to Figs. 1 to 3 thereof, reference numeral 1 has been applied to indicate a tubular casing 1 of insulating material closed on both ends by substantially cylindrical copper plugs 2' and 2''. Casing 1 is secured to plugs 2', 2'' by means of a plurality of angularly displaced steel pins 3. Multiperforated ribbon-type fuse links 4 submersed in a pulverulent arc-quenching filler 5 interconnect conductively the two copper plugs 2' and 2''. The particular geometry of fuse links 4 shown in Fig. 1 is more fully disclosed in United States Patents 2,653,203 to Frederick J. Kozacka, September 22, 1953, Current-Limiting Fuse, and 2,658,974 to Frederick J. Kozacka, November 10,

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1953, High Current Carrying Capacity Current-Limiting Fuse, and for a more complete understanding of this particular geometry reference may be had to the two aforementioned patents. Each plug 2', 2'' is provided with an axially extending passage 6' and 6'', respectively. Striker pin 7 is arranged in the wide axially outer end of passage 6'' and biased axially outwardly by a helical spring 8 resting against collar 7' of striker pin 7. If desired, striker pin 7 may be enclosed in a shell of sheet metal shown at 9. Normally striker pin 7 is held in position against the action of spring 8 by a restraining wire 10 of which one end is attached to striker pin 7 and the other end of securely held at copper plug 2'. The right end of restraining wire 10 is threaded through a disc 11 of silicone rubber sandwiched between two metal discs and compressed by the action of helical spring 8. Disc 11 forms a heat resistant seal precluding the escape of products of arcing from the inside of casing 1 to the outside thereof. The left end of restraining wire 10—as seen in Fig. 1—is threaded through passage 6' in copper plug 2' and clamped by means of clamping screw 12 and washer 13 against the external surface of plug 2'. Passage 6' is closed by a tapered plug 14 wedging wire 10 against passage 6', thus safely precluding taut wire 10 from becoming loose. Plug 14 also establishes a good electric contact between wire 10 and plug 2'. Wire 10 forms a current path between plugs 2' and 2'' which includes striker pin 7, helical spring 8 and shell 9. This current path has a relatively high resistance and does not carry any appreciable current normally since it is shunted by fuse links 4 whose resistance is insignificant compared to that of the current path of wire 10. Wire 10 must have a relatively high tensile strength to resist the action of spring 8, and may be an appropriate steel wire, e. g. a piano wire. Reference numerals 15' and 15'' have been applied to indicate a pair of metal plates, preferably copper plates, each abutting with one of the wide sides thereof against an external surface 16', 16'' of one of plugs 2', 2''. Plate 15' is adapted to permit axial outward travel of striker pin 7. To this end plate 15' is considerably shorter than plate 15''. Plate 15' covers the tapered plug or wedge body 14 to preclude ready access thereto, thus precluding tampering with the striker pin mechanism of the fuse. To the same end plate 15' covers also clamping screw 12 and washer 13. The axially inner surface of plate 15' may be provided with a recess to accommodate the head of clamping screw 12 and washer 13. Plate 15' is removably secured to plug 2', preferably by means of a group of three screws 17, whereas plate 15'' is permanently secured to plug 2'', preferably brazed to it. Each plate 15', 15'' projects with an edge 18', 18'' thereof into a groove 19', 19'' of a pair of plug-type contacts 20', 20'', thus tending to establish firm bonds between plates 15', 15'' and contacts 20', 20''. Where parts 15', 15'' engage parts 20', 20'' both are joined together, preferably by silver solder. It will be noticed that plug-type contacts 20', 20'' are arranged at right angles to the axis of casing 1, and that the grooves 19', 19'' are arranged on the side of contacts 20', 20'' juxtaposed to casing 1.

Each plug-type contact 20', 20'' forming an integral part of the fuse structure is plugged into one of a pair of spaced tulip-type contacts 21', 21'' arranged coaxially with respect to plug-type contacts 20' and 20'' and having the same spacing as that of plug-type contacts 20' and 20''.

Fig. 5 indicates how simply and efficiently this novel type of fuses may be assembled. As shown in Fig. 5, two sub-assemblies are being formed of which one comprises plate 15' and contact 20' and the other comprises all the other parts of the fuse, including casing 1, plugs 2' and 2'', plate 15'' and contact 20''. No metal forming

operation, or brazing operation, is needed subsequent to insertion of the fuse links 4 into the fuse structure, and thus the danger of damaging the relatively fragile fuse links, or the relatively fragile casing, by metal forming or brazing operations taking place during assembly is completely eliminated. Plug 2'' with plate 15'' and contact 20'' form a pre-fabricated sub-assembly element that can as readily be handled in assembly as a single plug terminal. Since the spacing of plugs 2' and 2'' can rigorously be maintained during assembly—as, for instance, by the means described in United States Patent 2,740,187 to Philip C. Jacobs, Jr. et al., April 3, 1956, Methods of Assembling Fuses—and since the positions of all other parts of the fuse are directly determined and maintained by that of plugs 2', 2'', the entire fuse structure lends itself to precision production and enables to readily achieve high standards of dimensional stability.

The operation of the fuse under fault current conditions is substantially the same as that of other fuses having the same type of fuse links. Fusing of links 4 is initiated before the fault current reaches its available peak value. The multibreak feature of the fuse links resulting from the multiple perforation thereof causes the arc voltage to increase at a rapid rate. Upon interruption of the current paths through links 4 by more or less complete vaporization thereof a voltage drop prevails across plugs 2' and 2'' sufficiently high to cause a current to flow through restraining wire 10 which results in its immediate fusion. This permits spring 8 to eject striker pin 7 with a sufficiently large force to cause tripping of an automatic switching device which may be arranged in series with the fuse.

In the embodiment of the invention illustrated a fuse structure has been shown wherein the spacing between the axes of plug-type contacts 20', 20'' is substantially equal to the length of casing 1, and the distance between the external surfaces 16', 16'' of plugs 2', 2''. The invention is by no means limited to this particular relation, or to this particular spacing of plug-type contacts 20', 20''. If it is desired to obtain a fuse structure whose plug-type contacts have a smaller spacing, a bent of 90 degrees may be provided in either of plates 15' or 15'', thus bringing either of contacts 20' or 20'' closer to the median plane of casing 1. Presence of such a bent does not affect the assembly process of the fuse since it may be performed before the assembly of the fuse is started.

It will be understood that although but one embodiment of the invention has been illustrated and described in detail, the invention is not limited thereto. It will also be understood that the structure illustrated may be modified without departing from the spirit and scope of the invention as set forth in the accompanying claims.

We claim as our invention:

1. In combination, a pair of spaced tulip-type contacts, a pair of spaced plug-type contacts plugged into said pair of tulip-type contacts, said pair of plug-type contacts forming an integral part of an electric power fuse comprising a tubular insulating casing, a pair of metal plugs plugged into the ends of said casing and fuse link means conductively interconnecting said pair of plugs, and one of said pair of plug-type contacts being permanently secured to one of said pair of plugs and the other of said pair of plug-type contacts being removably secured to the other of said pair of plugs.

2. In combination, a pair of spaced tulip-type contacts, a pair of spaced plug-type contacts plugged into said pair of tulip-type contacts, said pair of plug-type contacts forming an integral part of an electric power fuse comprising a tubular insulating casing, a pair of metal plugs plugging both ends of said casing, fuse link means conductively interconnecting said pair of plugs, and a pair of metal plates conductively connecting said pair of plugs to said pair of plug-type contacts, one of said pair of plates being permanently secured to one of said pair of plugs and the other of said pair of plates being removably secured to the

other of said pair of plugs, and each of said pair of plates abutting with one of the wide sides thereof against one of said pair of plugs and each of said pair of plates engaging with an edge portion thereof a groove in one of said pair of plug-type contacts.

3. In combination, a pair of spaced tulip-type contacts, a pair of spaced plug-type contacts plugged into said pair of tulip-type contacts, each of said pair of plug-type contacts having a groove in the top surface thereof, said pair of plug-type contacts forming an integral part of an electric power fuse comprising a tubular insulating casing, a pair of metal plugs plugging both ends of said casing, fuse link means conductively interconnecting said pair of plugs, a first metal plate brazed with one of the wide sides thereof to one of said pair of plugs, and a second metal plate screwed with one of the wide sides thereof against the other of said pair of plugs, and said first plate and said second plate each engaging with an edge portion thereof said groove in one of said pair of plug-type contacts.

4. In an electric power fuse the combination of a tubular insulating casing; a pair of metal plugs plugging both ends of said casing; fuse links conductively interconnecting said pair of plugs; a pair of plates each abutting with one of the wide sides thereof against an external surface of one of said pair of plugs; one of said plates being permanently secured to one of said pair of plugs and the other of said pair of plates being removably secured to the other of said pair of plugs; and a pair of spaced plug-type contacts arranged at right angles to the axis of said casing, each of said pair of contacts having a groove at the side thereof juxtaposed to said casing engaged by the edge of one of said pair of plates to secure said pair of contacts to said pair of plugs.

5. In an electric power fuse the combination of a tubular insulating casing; a pair of metal plugs plugging both ends of said casing; fuse link means conductively interconnecting said pair of plugs; a pair of plates each abutting with one of the wide sides thereof against an external surface of one of said pair of plugs, one of said pair of plates being brazed to one of said pair of plugs and the other of said pair of plates being screwed to the other of said pair of plugs; and a pair of spaced plug-type contacts arranged at right angles to the axis of said casing, each of said pair of contacts having a groove at the side thereof juxtaposed to said casing engaged by the edge of one of said pair of plates to firmly secure said pair of contacts to said pair of plugs.

6. In an electric power fuse the combination of a tubular insulating casing; a pair of metal plugs plugging both ends of said casing; fuse link means conductively interconnecting said pair of plugs; a pair of axially extending passages one in each of said pair of plugs; a spring-biased striker pin normally restrained by a wire accommodated in one of said pair of passages; a wedge body for securing one end of said restraining wire arranged in the other of said pair of passages; a pair of metal plates each abutting with one of the wide sides thereof against an external surface of one of said pair of plugs, one of said pair of plates being adapted to permit axial outward travel of said striker pin and the other of said pair of plates covering said wedge body to preclude ready access thereto, one of said pair of plates being permanently secured to one of said pair of plugs and the other of said pair of plates being removably secured to the other of said pair of plugs; and a pair of spaced plug-type contacts arranged at right angles to the axis of said casing, each of said pair of contacts having a groove at the side thereof juxtaposed to said casing engaged by the edge of one of said pair of plates to firmly secure said pair of contacts to said pair of plugs.

7. In an electric power fuse the combination of a tubular insulating casing; a pair of metal plugs plugging both ends of said casing; fuse link means conductively interconnecting said pair of plugs; a pair of axially extending passages one in each of said pair of plugs; a spring-biased striker pin normally restrained by a wire accommodated

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in one of said pair of passages; a wedge body for holding one end of said restraining wire arranged in the other of said pair of passages; a pair of metal plates each abutting with one of the wide sides thereof against an external surface of one of said pair of plugs, one of said pair of plates being adapted to permit axial outward travel of said striker pin and the other of said pair of plates covering said wedge body to preclude ready access thereto; one of said pair of plates being brazed to one of said pair of plugs and the other of said pair of plates being screwed against the other of said pair of plugs; and a pair of spaced plug-type contacts arranged at right angles to the axis of said casing, each of said pair of contacts having a groove at the side thereof juxtaposed to said casing en-

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gaged by the edge of one of said pair of plates to firmly secure said pair of contacts to said pair of plugs.

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U. S. DEPARTMENT OF COMMERCE
PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,834,852 Kenneth W. Swain et al.

May 13, 1958

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 25, for "said plates" read -- said pair of plates --.

Signed and sealed this 8th day of July 1958.

(SEAL)

Attest:

KARL H. AXLINE

Attesting Officer

ROBERT C. WATSON
Commissioner of Patents

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