July 23, 1957 K. W. SWAIN ET AL 2,800,556

FUSE STRUCTURES

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Fig. 1

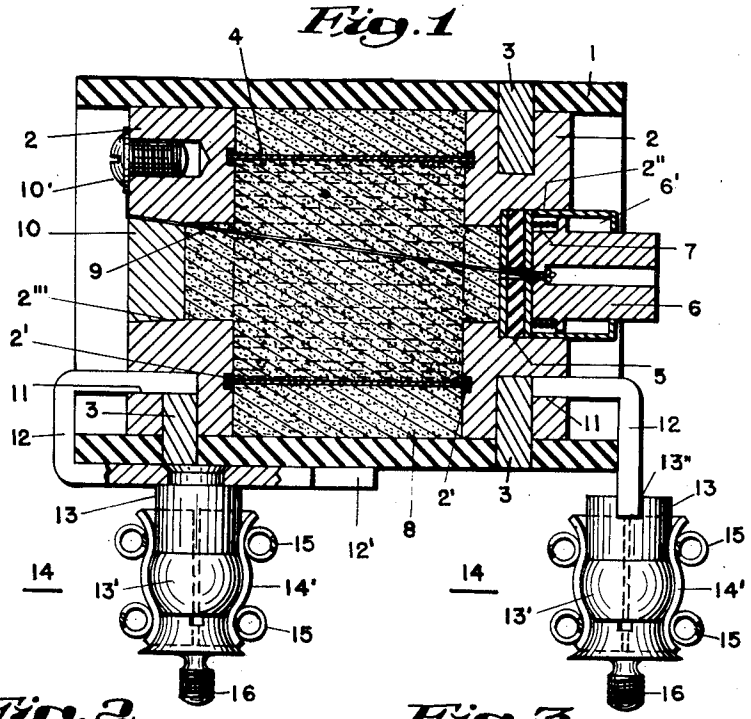


Fig. 2.

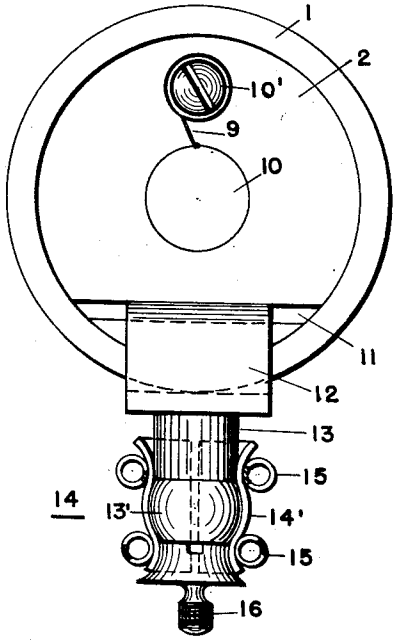
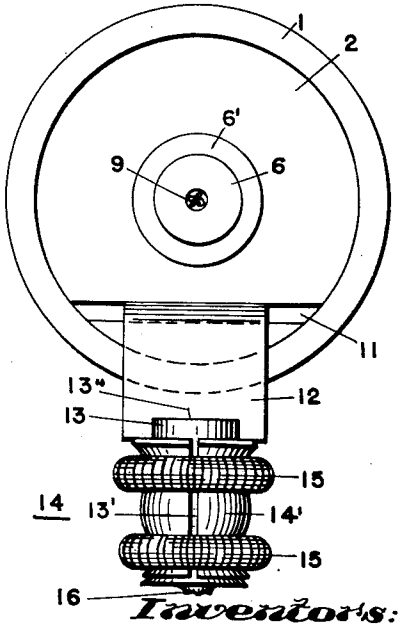


Fig. 3.



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FUSE STRUCTURES

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4 Claims. (Cl. 200—131)

This invention relates generally to electric fuses for the protection of electric distribution systems and the protection of electric apparatus and machinery connected into such systems, and more particularly to cartridge fuses with rod-type plug-in contacts.

Low-voltage power fuses for relatively high current ratings are generally provided with blade contacts adapting such fuses for insertion into a fuse holder having contacts designed to cooperate with blade contacts as, for instance, finger type contacts. Fuses having blade contacts are relatively bulky, i. e. they require relatively large amounts of space. Where space limitations prevail it is generally desirable to apply fuses having contact arrangements not as bulky as conventional blade contacts and contacts designed to cooperate with blade contacts.

Structures of drastically decreased bulk may be achieved by providing fuses with rod-type contacts whose axes intersect at right angles the longitudinal axis of the cartridge or casing of the fuse, which rod-type contacts cooperate with fixed tulip-type contacts provided in a socket, switch base or switch frame, or the like. The change-over from blade contacts to rod-type contacts involves serious difficulties which, to overcome, is one of the objects of this invention.

There are applications where it is more desirable to use the conventional arrangement of contacts comprising a pair of blade contacts forming an integral part of the fuse and cooperating with conventional fuse holder contacts, and there are other applications where it is more desirable to use the aforementioned arrangement of rod-type plug-in contacts and cooperating tulip-type contacts. This makes it generally necessary to manufacture and to stock two fundamentally different kinds of fuses, as will be more apparent from what follows.

The co-pending patent application Frederick J. Kozacka et al., Ser. No. 499,651, filed April 6, 1955, for Fuse Structures with Striker Pins is concerned with cartridge fuses having rod-type contacts intended to co-operate with tulip-type contacts.

Manufacturing fuses with contacts of this kind involves an extensive and expensive tooling program.

It is, therefore, another object of the invention to provide cartridge fuses of the plug-in type which can be manufactured without retooling.

If one of two fuses having identical fuse links and being substantially identical in all other respects is provided with conventional blade contacts and the other of the two fuses is provided with contacts of the kind disclosed in the aforementioned patent application, both fuses will prove to have different operating characteristics. The reason for this difference in performance lies in the difference in the heat dissipating properties of both contact structures. A manufacturer manufacturing fuses with blade contacts who desires to adopt the contact structure of patent application Ser. No. 499,651 must redesign—not only the fuse contacts of his fuses—but his entire line of fuse structures to make readjustments for the change of

heat dissipating property resulting from the change of contact structure.

It is, therefore, another object of the invention to provide compact fuse structures having terminal elements including rod-type plug-in contacts, which terminal elements have substantailly the same thermal characteristics as conventional terminal elements including blade contacts, thus making it possible to use for fuses with rod-type plug-in contacts the same basic assemblies of parts as previously used for fuses with blade contacts.

Another object of the invention is to provide fuses having rod-type plug-in contacts and comprising fuse links being as short as possible to achieve an optimum of current-carrying capacity and a minimum of $i^2 \cdot r$ losses.

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

For a better understanding of the invention reference may be had to the accompanying drawing illustrating the invention, wherein

Fig. 1 is substantially a longitudinal section of a fuse embodying the invention with some parts shown in front elevation;

Fig. 2 is substantially an end view of the structure shown in Fig. 1 seen from the left side of Fig. 1; and

Fig. 3 is substantially an end view of the structure shown in Fig. 1 seen from the right side of Fig. 1.

Referring now to the drawing, numeral **1** has been applied to indicate a casing of insulating material, preferably a synthetic-resin-glass-cloth laminate. Casing **1** is closed on both ends by a pair of copper plugs **2** press-fitted into casing **1** to provide gas-tight seals thereof. Each copper plug **2** is pinned to casing **1** by a plurality of angularly displaced steel pins **3**. Each plug **2** is provided with an internal circular concentric groove **2'** accommodating the ends of a system of ribbon-type fuse links **4** of silver conductively interconnecting copper plugs **2**. Fuse links **4** define a cylindrical surface arranged coaxially with respect to casing **1**. Each link-receiving groove **2'** is filled with soft solder to minimize the ohmic resistance between plugs **2** and fuse links **4**. The right plug **2**—as seen in Fig. 1— is provided on the outside thereof with a recess **2''** accommodating a barrier **5**, a striker pin **6** and a helical striker-pin-biasing spring **7**. Spring **7** rests aganist barrier **5** and striker pin **6** and biases the latter from left to right. Striker pin **6** and spring **7** are housed in cap **6'** of sheet metal. Barrier **5** consists of an inner layer, preferably of silicone rubber, sandwiched between a pair of outer layers, preferably of metal, e. g. copper. The space between copper plugs **2** is filled with a pulverulent arc-quenching filler **8** as, for instance, chemically pure quartz sand, wherein fuse links **4** are submersed. Barrier **5** precludes the loss of filler **8** through recess **2''** as well as the escape of hot products of arcing from the space inside casing **1** through recess **2''**. Normally striker pin **6** is held in the position shown by a restraining wire **9** of steel wedged between a plug **10** and a filler filling hole **2'''** provided in the left copper plug **2**. The left end of restraining wire **9** is clamped to left plug **2** by means of clamping screw **10'**.

The spacing between the axially outer surfaces of plug **2** is less than the length of casing **1**, and casing **1** projects with the circular edges thereof beyond the axially outer surfaces of plugs **2**. As a result, the arcing chamber of the fuse, i. e. the sand filled space within casing **1**, is considerably smaller than the internal volume of the casing. This arrangement of plugs **2**, i. e. their reduced spacing, results in a system of relatively short fuse links **4** tending to increase their current-carrying capacity and

to decrease $i^2 \cdot r$ losses, whereas the relatively small volume of the arcing chamber tends to increase the pressure generated therein incident to blowing of the fuse and hence to increase the arc voltage. The relatively high pressures inside of the arcing chamber tending to push the two copper plugs 2 axially outwardly call for particularly strong ties between casing 1 and plugs 2. This requirement for increased mechanical strength is met by the recessed arrangement of pins 3 axially inwardly relatively remote from the edges of casing 1, whereby the shearing strength of the structure is greatly increased. The specific arrangement of rod-type plug-in contacts described below is in part predicated on the particular geometry of the fuse structure shown in Fig. 1 which, in turn, is predicated on the concept of compressing the length of the arcing chamber to limit the length of the fuse links and of coping with the resulting increase in internal pressure by imparting increased mechanical strength to the fastening means for the plugs 2.

Each copper block or plug 2 is provided with a groove or recess 11 receiving one end of a contact-supporting metal strap 12. Each metal strap 12 supports on the end thereof remote from groove 11 a rod-type contact 13 comprising a spherical portion 13'. Each of the two rod-type contacts 13 is inserted into a tulip-type contact generally indicated by reference numeral 14. Each tulip-type contact is made up of a solid of revolution having a screw-threaded end 16, a plurality of contact elements 14' supported by the aforementioned solid of revolution and, a pair of garter springs 15 surrounding contact elements 14'.

The left side of Fig. 1 and Fig. 2 show one way and the right side of Fig. 1 and Fig. 3 show another way of securing a rod-type plug-in contact to a fuse structure. Both ways of securing a rod-type plug-in contact to a fuse structure may be embodied in one and the same fuse structure, as has been shown in Fig. 1. On the other hand, both rod-type contacts 13 may be secured to the fuse structure either as shown on the left of Fig. 1 and in Fig. 2, or as shown on the right of Fig. 1 and in Fig. 3. Where the longitudinal axis of rod-type contacts 13 is supposed to be situated between the ends of casing 1, the arrangement shown on the left side of Fig. 1 is indicated. The arrangement shown on the right side of Fig. 1 is applicable in instances where the longitudinal axis of a rod contact is supposed to be situated outside the ends of casing 1. Strap 12 shown on the left of Fig. 1 is substantially U-shaped and arranged to overlap casing 1 with one shank 12' thereof arranged parallel to the axis of casing 1. No clearance between the shank 12 overlapping casing 1 and casing 1 has been shown in Figs. 1 and 2, but it may be advisable to leave a small clearance between the two parts. The strap 12 shown on the right of Fig. 1 and in Fig. 3 is in the shape of an angle piece of which one side is parallel and the other side at right angles to the longitudinal axis of casing 1. Angle piece 12 engages with the end thereof remote from groove 11 a groove 13'' extending diametrically across rod contact 13.

It will be observed that the rod-type contacts 13 project radially outwardly from casing 1, i. e. that they extend in a direction transversely of casing 1, and that their geometrical axes coincide with the geometrical axes of tulip-type contacts 14.

The operation of the fuse structure shown involves a strong magnetic blast action due to the relatively narrow current loop of the current path formed by it. Fuse link means 4 and restraining wire 9 fuse in rapid sequence and striker pin 6 is projected to the right upon fusion of wire 9.

When assembling the fuse, subassemblies are made of the left plug 2 with its strap 12 and rod contact 13 and of the right plug 2 with its strap 12 and rod contact 13. Both straps 12 are brazed to plugs 2 before the latter are driven into casing 1 to preclude injury to casing

1 during the brazing operations. The strap 12 on the right of Fig. 1 may be made of soft copper and may be straight when brazed to plug 2 with which it is associated. This strap 12 is bent 90 degrees after insertion of the plug 2 by which it is supported into casing 1.

Having disclosed a preferred embodiment of our invention it is desired that the same be not limited to any particular structure disclosed. It will be obvious to any person skilled in the art that many modifications and changes may be made without departing from the broad spirit and scope of our invention. Therefore it is desired that the invention be interpreted as broadly as possible and that it be limited only as required by the prior state of the art.

We claim as our invention:

1. A fuse comprising a tubular casing of insulating material, a pair of metal plugs inserted into said casing on opposite ends thereof to seal said casing, the spacing between the outer surfaces of said pair of plugs being less than the length of said casing and said casing projecting with the circular edges thereof beyond said outer surfaces, a pair of straight grooves one in each of said outer surfaces of said pair of plugs arranged between the center and the periphery thereof, a plurality of metal pins projecting transversely across said casing into said pair of plugs to attach said pair of plugs to said casing, fuse link means housed in said casing conductively interconnecting said pair of plugs, a pair of rod-type contacts extending radially with regard to said casing for inserting said fuse into an electric circuit, and a pair of metal straps each inserted with one end thereof into one of said pair of grooves, each bent over one of said edges of said casing and each supporting one of said pair of rod-type contacts.

2. A fuse comprising a tubular casing of insulating material, a pair of metal plugs inserted into said casing on opposite sides thereof to seal said casing, the spacing between the outer surfaces of said pair of plugs being less than the length of said casing and said casing projecting with at least one circular edge thereof beyond one of said outer surfaces, a recess in at least one of said outer surfaces, ribbon-type fuse link means housed in said casing conductively interconnecting said pair of plugs, a pair of rod-type contacts arranged outside of said casing radially with respect thereto for plugging said fuse into a pair of cooperating fixed contacts, a pair of metal straps each supporting one of said pair of rod-type contacts and each being supported by one of said pair of plugs, and one of said pair of metal straps being inserted with the end thereof remote from one of said pair of rod-type contacts into said recess in at least one of said outer surfaces.

3. A fuse comprising a tubular casing of insulating material, a pair of metal plugs inserted into said casing on opposite sides thereof to seal said casing, the spacing between the outer surfaces of said pair of plugs being less than the length of said casing and said casing projecting with at least one circular edge thereof beyond one of said outer surfaces, a recess in at least one of said outer surfaces, ribbon-type fuse link means housed in said casing conductively interconnecting said pair of plugs, a pair of rod-type contacts arranged outside of said casing radially with respect thereto for plugging said fuse into a pair of cooperating fixed contacts, a pair of metal straps each supporting one of said pair of rod-type contacts and each being supported by one of said pair of plugs, one of said metal straps comprising a portion parallel to the axis of said casing supporting one of said pair of rod-type contacts, the other of said pair of metal straps comprising a portion parallel to one of said outer surfaces supporting the other of said pair of rod-type contacts, and one of said pair of metal straps being inserted with the end thereof remote from one of said pair of rod-type contacts into said recess in at least one of said outer surfaces.

4. A fuse comprising a tubular casing of insulating material, a pair of metal plugs inserted into said casing on

opposite sides thereof to seal said casing, ribbon-type fuse link means housed in said casing conductively interconnecting said pair of plugs, a pair of rod-type contacts arranged outside of said casing radially with respect thereto for plugging said fuse into a pair of cooperating contacts, one of said pair of rod-type contacts being provided with a transverse groove, a pair of metal straps each in immediate physical engagement at one end thereof with one of said pair of metal plugs, one of said pair of straps comprising a portion parallel to the outer surface of one of said pair of plugs, one end of said portion remote from said outer surface engaging said transverse groove in said one of said pair of rod-type contacts, and the other of said pair of straps comprising a portion parallel to the axis of said casing supporting the other of said pair of rod-type contacts.

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