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P. C. JACOBS, JR., ET AL
METHODS OF ASSEMBLING FUSES

2,740,187

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Fig. 1.

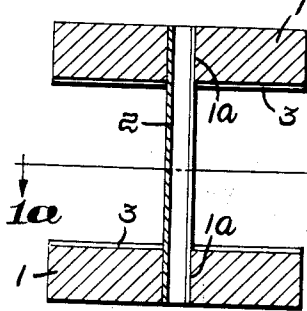


Fig. 2.

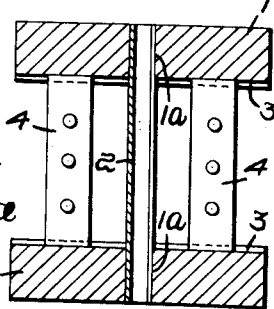


Fig. 3.

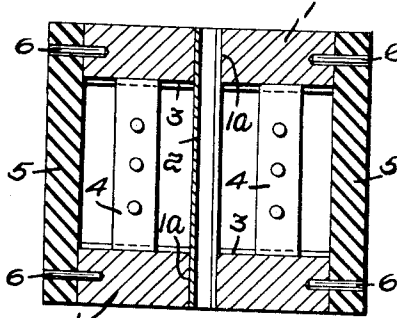


Fig. 1a.

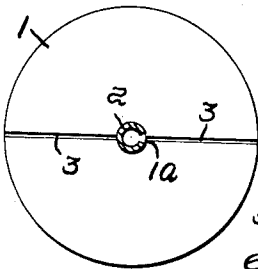


Fig. 4.

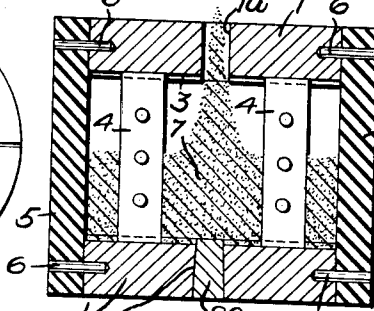


Fig. 5.

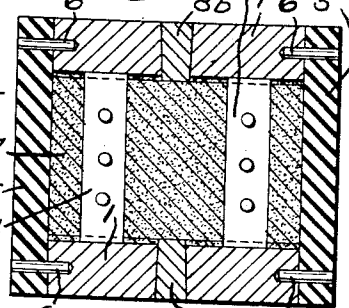


Fig. 6.

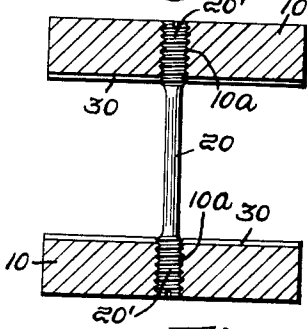


Fig. 7.

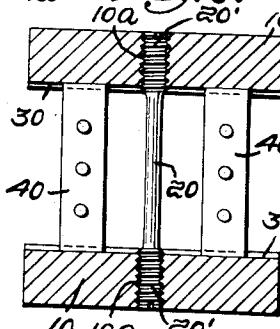


Fig. 8.

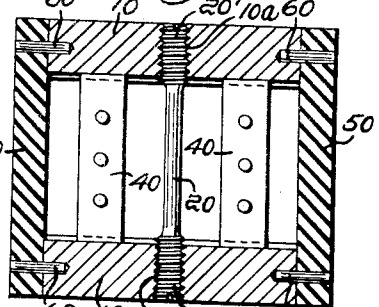


Fig. 9.

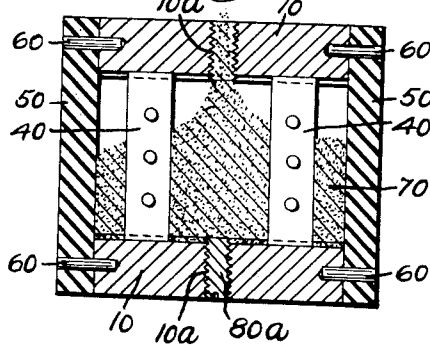
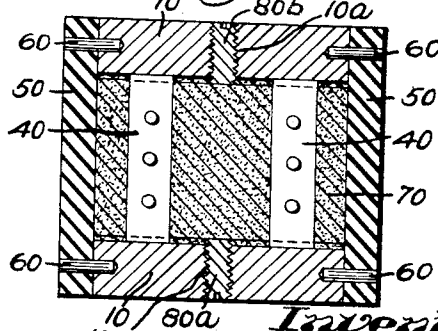


Fig. 10.



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2,740,187

METHODS OF ASSEMBLING FUSES

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Application March 7, 1955, Serial No. 492,438

6 Claims. (Cl. 29—155.5)

This invention relates to assembling of electric fuses, and more particularly to assembling of high interrupting capacity current-limiting fuses having a relatively high current carrying ability.

Fuses of this nature comprise generally a plurality of ribbon-type fusible elements, or fuse links, of which each is provided with one or more restricted cross-section portions or necks. The current-limiting action of these fuses increases as the cross-sectional area of the restricted cross-section portions or necks decreases. Decreasing the cross-sectional area of the reduced cross-section portions or necks of current-limiting fuses results in fragile metal ribbons which are relatively difficult to handle and are subject to damage during assembly of the fuse structure as well as thereafter, particularly during filling operations.

It is, therefore, one object of this invention to provide a method of assembling fuses making it relatively easy to incorporate fragile ribbon-type fuse links into them and resulting in fuse structures the fuse links of which are well protected against damage due to careless handling.

Some manufacturers of fuses resort to special jigs and fixtures for assembling the constituent parts of fuses. Such jigs and fixtures are, however, generally relatively complex and costly.

It is, therefore, another object of this invention to provide a method for assembling fuses which does not require complex and costly jigs and fixtures.

One problem encountered in assembling high interrupting capacity current-limiting fuses consists in maintaining the terminal elements thereof exactly in a predetermined spaced relation while conductively connecting, e. g. soldering, brazing, or spot welding, the fuse links to the terminal elements. To achieve this end, some of the prior art fuses are provided with spacers, generally in the form of center posts, extending from one of the terminal elements to the other. These spacers or center posts encumber the fuse casing, reduce the space available therein for accommodating fuse links and arc-quenching filler, and are likely to evolve gases under the heat of the arc tending to increase the pressure within the casing incident to blowing of the fuse.

It is, therefore, another object of this invention to provide a method for assembling fuses not subject to the limitations inherent in the aforementioned prior art structures involving center post spacers.

Unless the arc-energy is very low, current-limiting fuses must be filled with a suitable energy absorber, which is generally pulverulent as, for instance, quartz sand. The pulverulent filler is being poured into the casing of the assembled fuse structure through a hole or opening in one of the terminal elements of the fuse.

It is another object of this invention to provide a method for assembling fuses predicated upon the use of such filling holes, or openings, for spacing the terminal elements of the fuse during the assembly process thereof.

Another object of the invention is to provide a method for assembling fuses involving temporary spacing means for the terminal elements which means are removed from

the fuse structure before the assembly of the same is completed.

A still further object of the invention is to provide a novel and simple method of assembling fuses adapted for large scale production using labor of limited skill wherein the likelihood of error and the number of operations performed is reduced to a minimum with attendant increase in the speed and the quality of output.

Other objects and advantages of the invention will, in part, be obvious and in part appear hereinafter.

For a more complete understanding of the invention reference may be had to the following detailed description thereof taken in connection with the accompanying drawings, in which:

Fig. 1 shows in vertical section the terminal elements of a fuse spaced by a temporary spacer;

Fig. 1a is a transverse section of the structure shown in Fig. 1 along 1a—1a of Fig. 1;

Fig. 2 is a vertical section of the same structure as in Fig. 1 upon addition of a pair of fuse links;

Fig. 3 is a vertical section of the same structure as in Fig. 2 upon addition of a casing;

Fig. 4 is a vertical section of the same structure as in Fig. 3 upon removal of the temporary spacer and plugging of one of the holes in the terminal elements;

Fig. 5 is a vertical section of the same structure as in Fig. 4 upon filling of the casing with a pulverulent arc-quenching filler and plugging of the other hole in the terminal elements;

Fig. 6 shows in vertical section the terminal elements of a fuse spaced by a temporary spacer different from the temporary spacer shown in Fig. 1;

Fig. 7 is a vertical section of the same structure as in Fig. 6 upon addition of a pair of fuse links;

Fig. 8 is a vertical section of the same structure as in Fig. 7 upon addition of a casing;

Fig. 9 is a vertical section of the same structure as in Fig. 8 upon removal of the temporary spacer and plugging of one of the holes in the terminal elements; and

Fig. 10 is a vertical section of the same structure as in Fig. 9 upon filling of the casing with a pulverulent arc-quenching filler and plugging of the other hole in the terminal elements.

The fuse is made up of a pair of terminal elements to which reference numeral 1 has been applied. Terminal elements 1 are in the shape of relatively massive cylindrical blocks or discs of copper. Each of these copper blocks or discs may be provided on one of the faces thereof with a link-receiving groove 3 extending through the center of the respective face. Before starting assembling the constituent parts of the fuse, each of the pair of terminal elements 1 is being provided with a transverse bore 1a. Bores or holes 1a are preferably, though not necessarily, arranged in the center of terminal blocks or discs 1. In the structure of Fig. 1 both blocks or discs 1 are shown as being spaced by a temporary spacer. This spacer consists of a tubular element 2 slotted in a direction longitudinally thereof to increase its transverse resiliency. Spacer 2 is pushed under considerable pressure into holes or bores 1a, while blocks or discs 1 are arranged in a predetermined spaced relation with holes or bores 1a in registry. When spacer 2 is pushed into holes or bores 1a, the former is compressed and then firmly adheres by friction to blocks or discs 1. The subassembly unit shown in Fig. 1 is ready to be fitted with ribbon-type fuse links of the most sensitive kind. To this end two or more fuse links 4 are fitted into the aforementioned link-receiving grooves 3. Preferably some soft solder (not shown) is allowed to flow into grooves 3 at the points thereof where the ends of fuse links 4 are located. The structure is then ready for addition of the casing.

The casing consists of a short length of an insulating material having the properties required for this type of

3 service such as heat-shock resistance, high-dielectric and bursting strength, freedom from tracking, etc. In Figs. 3 to 5, inclusive, reference numeral 5 has been applied to indicate the casing of the fuse. Casing 5 is mounted on terminal elements or discs 1 by a relative movement of the unit shown in Fig. 2 and of casing 5 in a direction longitudinally thereof. This movement is effected under considerable pressure, preferably by means of a hydraulic press. Preparatory to mounting of casing 5 upon terminal elements or discs 1, said parts are suitably arranged in coaxial relation. Upon mounting of casing 5 upon terminal elements or discs 1, the former is attached to the latter by transverse steel pins 6, or like fasteners. At this time temporary spacer 2 may safely be removed from the structure, i. e. pushed out of holes 1a and taken out of the space bounded by casing 5 and terminal elements or discs 1, casing 5 having then taken over the function of securely spacing the terminal elements or discs 1. Removal of spacer 2 may be effected by placing the semi-assembled fuse upon a table having an aperture in registry with holes 1a and applying pressure upon the top of spacer 2 by means of a suitable press-operated mandrel. Upon removal of spacer 2, one of the holes 1a in one of the terminal elements 1 is being closed, as by a suitable plug 8a shown in Fig. 4. Thereupon quartz sand or another suitable pulverulent arc-quenching filler is poured through the still open hole 1a into the casing of the fuse. When the fuse structure is in part filled with arc-quenching filler, it is placed on a vibrating table and vibrated, which causes the filler to settle. The filling operation may then be completed. It may be desirable to alternate several vibrating and refilling operations. When all the pulverulent arc-quenching filler, that is desired to be added, has been added, the upper or filling hole 1a is closed, as by a suitable plug 8b shown in Fig. 5. The fuse is now completed, except for the addition of suitable connectors such as, for instance, blade contacts, for inserting the fuse into a fuse holder, or equivalent device. The addition of blade contacts or other connectors has not been illustrated in Figs. 1 to 5, inclusive, the many ways in which this can be achieved being well known in the art. It is also possible, if desired, to start the process of assembling the fuse illustrated in Figs. 1 to 5, inclusive, with terminal elements or discs 1 to which a blade contact or other suitable connector has already been attached.

According to Figs. 6 to 10, illustrating a modification of the process shown in Figs. 1 to 5, terminal elements or discs 10 are provided with link-receiving grooves 30 on juxtaposed faces thereof. Terminal elements or discs 10 are also provided with transverse screw-threaded holes or bores 10a. A temporary spacer 20 having screw-threaded axially outer ends is inserted into the screw-threaded holes or bores 10a. The distance between terminal elements 10 can be adjusted by rotation of terminal elements 10 relative to screw-threaded spacer stud 20. The friction between the male screw-threads on spacer stud or spacer post 20 and female screw-threads in bores 10a is sufficiently high to preclude accidental rotation of terminal elements 10 with regard to post or stud 20. Upon proper spacing of terminal elements 10 the fuse links 40 are inserted into the link-receiving grooves 30, as shown in Fig. 7. After establishing low resistance current carrying joints between the ends of links 40 and terminal elements 10, casing 50 is mounted under pressure upon the latter, as shown in Fig. 8. Thereafter the transverse steel pins 60 are being driven through casing 50 into terminal elements 10, which enables the subsequent removal of temporary screw-threaded spacer 20. Fig. 9 shows the structure upon removal of screw-threaded spacer 20 and closing of the lower screw-threaded opening 10a by means of a plug 80a in the process of being filled with a pulverulent arc-quenching filler 70. The fuse structure is then subjected to vibrations and gradually filled to full capacity, whereupon it is closed by inserting the upper screw-threaded plug 80b into the upper screw-

threaded hole 10a. Any kind of connectors may then be added to the fuse such as, for instance, blade contacts or stud contacts (not shown).

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

It is claimed:

1. A method of assembling electric fuses comprising the steps of providing each of a pair of terminal elements with a transverse hole, of arranging said pair of elements in spaced relation with said hole in each of said pair of elements in registry, of inserting a spacer into said hole in each of said pair of elements to maintain said pair of elements in spaced relation, of conductively interconnecting said pair of elements by fuse link means, of mounting a casing upon said pair of elements, and of attaching said casing to said pair of elements, and of removing said spacer from said hole in each of said pair of elements and from the space bounded by said pair of elements and said casing.

2. A method of assembling electric fuses comprising the steps of providing a pair of terminal elements with transverse holes, of arranging said pair of terminal elements in spaced relation with said holes thereof in alignment, of inserting spacing means into said holes to maintain said pair of terminal elements in spaced relation, of conductively interconnecting said pair of terminal elements by fuse link means, of mounting a casing upon said pair of terminal elements, of attaching said casing to said pair of terminal elements, of removing said spacing means from said holes and from the space bounded by said pair of terminal elements and said casing, and of closing said holes.

3. A method of assembling electric fuses comprising the steps of providing each of a pair of terminal elements with a transverse hole, of arranging said pair of elements in spaced relation with said hole in each in alignment, of inserting a spacer into said hole in each of said pair of elements to maintain said pair of elements in spaced relation, of conductively interconnecting said pair of elements by fuse link means, of pressure-mounting a casing upon said pair of elements, of attaching said casing to said pair of elements, of removing said spacer from said hole in each of said pair of elements and from the space bounded by said pair of elements and said casing, of filling a pulverulent arc-quenching filler into said casing through said hole in one of said pair of elements, and of plugging said hole in said one of said pair of elements.

4. A method of assembling electric fuses comprising the steps of providing a pair of terminal elements with transverse holes, of arranging said pair of terminal elements in spaced relation with said holes thereof in alignment, of inserting spacer means into said holes to maintain said pair of terminal elements in spaced relation, of conductively interconnecting said pair of terminal elements by fuse link means, of pressure-mounting a casing upon said pair of terminal elements, of pinning said casing to said pair of terminal elements, of removing said spacer means from said holes and from the space bounded by said pair of terminal elements and said casing, of filling a pulverulent arc-quenching filler through one of said holes into said casing, and of sealing said one of said holes.

5. A method of assembling electric fuses comprising the steps of providing each of a pair of terminal elements with a central transverse bore, of arranging said pair of terminal elements in spaced relation with said bore in each of said pair of terminal elements in registry, of press-fitting a center post into said bore in each of said pair of terminal elements to frictionally maintain said pair of terminal elements in spaced relation, of conductively interconnecting said pair of terminal elements by fuse

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link means, of pressure-mounting a casing upon said pair of terminal elements, of attaching said casing to said pair of terminal elements, and of removing said center post through said bore in one of said pair of terminal elements from said pair of terminal elements and from the space bounded by said pair of terminal elements and by said casing.

6. A method of assembling electric fuses comprising the steps of providing each of a pair of terminal elements with a central transverse screw-threaded bore, of arranging said pair of terminal elements in spaced relation with said bore in each of said pair of terminal elements

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in registry, of screwing a screw-threaded spacer into said bore in each of said pair of terminal elements, of conductively interconnecting said pair of terminal elements by fuse link means, of pressure-mounting a casing upon said pair of terminal elements, of attaching said casing to said pair of terminal elements, of unscrewing said spacer from said bore in each of said pair of elements, and of removing said spacer through said bore in one of said pair of terminal elements from the space bounded by said pair of terminal elements and by said casing.

No references cited.