July 27, 1965 E. LANGE ETAL 3,197,593

ELECTRICAL CURRENT-LIMITING FUSE

Filed April 20, 1961



FIG. 2.



FIG. 1.

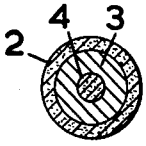


FIG. 4.

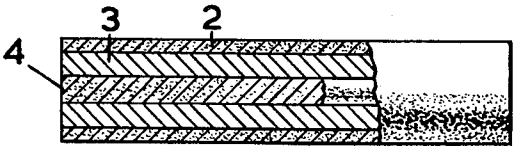


FIG. 3.

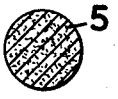


FIG. 6.

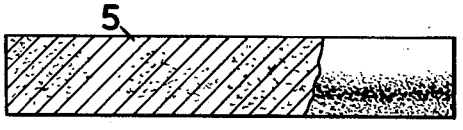


FIG. 5.



FIG. 8.

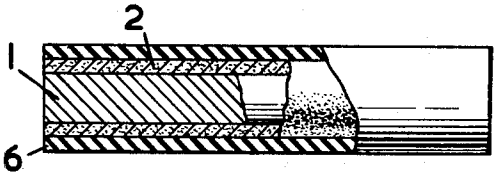


FIG. 7.

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ELECTRICAL CURRENT-LIMITING FUSE

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This invention relates to electric safety fuse components of the kind comprising fusible metallic conductors and non-metallic material.

There are known fuse components of the kind referred to which each comprise a fuse wire arranged in an insulating tube which is filled with sand. The volume of the sand is very large in proportion to that of the fuse wire, and because of this the construction of the fuse component is unduly large and expensive.

The necessity of a large volume of sand in such hitherto known fuse arrangements is due to the need for a safe manner of operation in interrupting an electric current. The sand loosely surrounds the fuse wire, and because of this the process of interrupting the current is often inefficient so that the fuse arrangement is damaged by explosion.

The invention is intended to provide an improved fuse component of the kind referred to in which the fuse wire is not loosely embedded in sand or other non-metallic material and the latter is not present in unduly large quantities.

According to the invention there is provided an electric safety fuse component comprising a fusible metallic conductor and non-metallic material, characterised in that the metallic conductor is directly in fixed connection with a pre-determined volume of the non-metallic material. The non-metallic material may consist of or comprise sand. In one advantageous construction the metallic conductor is in the form of a wire or strip on the surface of which the non-metallic material is carried in the form of a layer or covering of a pre-determined quantity or thickness. In a modified construction the metallic conductor is tubular and non-metallic material is provided both inside and outside the metallic conductor. Sand or other non-metallic material may be distributed throughout the metal of the metallic conductor, and the fuse component may comprise or be surrounded by a thin-walled tube of insulating material. When sand is used it may be fine-milled.

The invention is illustrated by way of example in the accompanying drawing, in which

FIGURES 1, 3, 5 and 7 show four fuse components according to the invention in longitudinal section, and

FIGURES 2, 4, 6 and 8 are cross-sectional views corresponding respectively to FIGURES 1, 3, 5 and 7.

FIGURES 1 and 2 show a fuse component comprising a metallic conductor in the form of a wire **1** on the surface of which non-metallic material is carried in the form of a layer **2** of sand of a pre-determined quantity or thickness directly in fixed connection with the wire **1**. The thickness of the layer **2** of sand may be between 0.1 and 4 millimetres and is determined in accordance with the desired current breaking capacity of the fuse component. In particular instances this thickness and thus the volume of the sand may be still greater.

In order to apply the sand directly in fixed connection on the metallic conductor, the sand may, for example, be mixed with a suitable liquid or binder and applied in

the form of a paste or mixture which hardens upon the conductor, so that the latter is then enclosed or surrounded by a fixed layer of sand. It is also possible to apply the sand to the metallic conductor whilst the latter is heated so that it glows; when using such a process the sand layer fixedly surrounds the conductor and some sand particles penetrate the conductor.

In order to protect the layer of sand from external influences a very thin-walled tube of insulating material may be drawn over the layer of sand. This arrangement has the advantage that it is possible to use a tube of insulating material which generates gas to assist the breaking of the current.

The device operates as follows:

Upon the occurrence of an excessive current or short-circuit current the fuse wire which is surrounded with sand melts through and the sand immediately in its vicinity is likewise fused so that the current breaking process proceeds until the flow of current is terminated. After this process the melted layer of sand remains behind.

The construction of fuse arrangements can be greatly simplified by the use of fuse wires with fixed sand coverings. The manner of operation of such a fuse arrangement is in no way influenced disadvantageously and its capacity lies within the same limits as with the known fuse arrangements. Because of the prior determination of the thickness of the sand covering it is easy to determine in advance the capacity of the device.

In order to achieve a still better effect from the melting sand, the metallic conductor **3** may be tubular with non-metallic material **4** inside and non-metallic material **2** outside as shown in FIGURES 3 and 4. The sand provided both internally and externally operates very favourably during the fusing process.

FIGURES 5 and 6 illustrate how a still more intimate connection may be achieved between the metal of the conductor **5** and the sand by distributing the non-metallic material throughout the metal by casting them together. Such a mixture permits a very favourable fusing process between the metal and the sand.

FIGURES 7 and 8 illustrate how a fuse wire **1** with a sand covering **2** can be surrounded by a thin-walled tube **6** of insulating material. This arrangement has the advantages that the layer of sand is well protected and that during the fusing process gases released from the material of the tube can co-operate favourably in the quenching process.

The fuse wire with a fixed sand covering can be used with substantial advantages in many fuse arrangements.

An example of a suitable use of fuse components in accordance with the invention is in fuse arrangements of the kind in which quenching of the arcs is effected by means of a stream of quenching material under pressure generated by the arcs themselves. In such fuse arrangements with conventional fuse wires, especially for very high voltages, with a view to the interruption of small currents the length of the construction must be made very large and consequently it is necessary to quench a long arc. In the interruption of large currents however this long burning arc produces in the quenching chamber a pressure which is unnecessarily high but makes a very heavy construction of the quenching chamber necessary.

By the use of a fuse wire with a sand covering of quite small thickness it is easily possible to interrupt the small currents because of the action of the sand. Thus

the fuse arrangement can be reduced to small dimensions so that the interruption of large currents is effected without the production of excessive increases in pressure in the quenching chamber through the streams of quenching medium flowing under pressure produced by the arcs themselves.

The sand may be fine-milled to the form of powder and then mixed with a liquid to form a paste to be applied to the fuse wire. The mixture hardens and surrounds and encloses the fuse wire completely so that the materials necessary for the current breaking process are employed very advantageously.

We claim:

In an electric current-limiting fuse consisting of a fusible metallic conductor and sand, with some of said sand forming a fixed uniform hard coating enclosing said conductor, the fuse structure with some of said sand penetrating the surface of said conductor resulting from heating said conductor and said sand together.

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