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METHOD OF MAKING A FUSE WITH A SAND CORE

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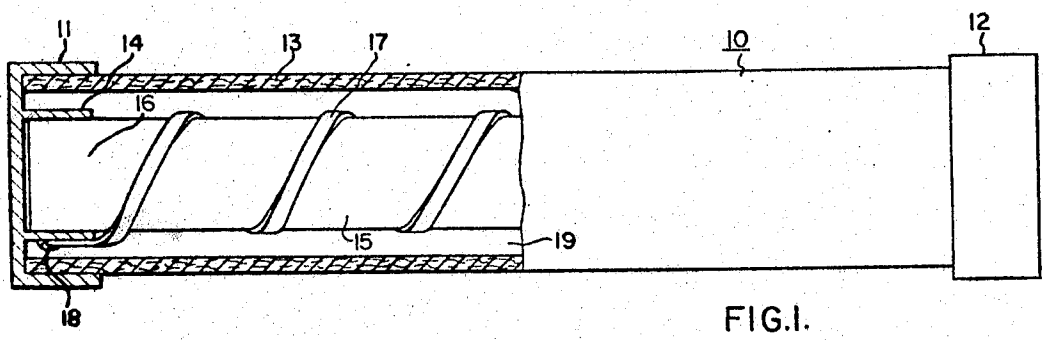


FIG.1.

FIG.2.

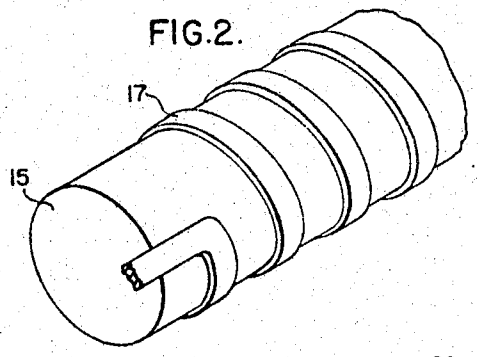


FIG.3.

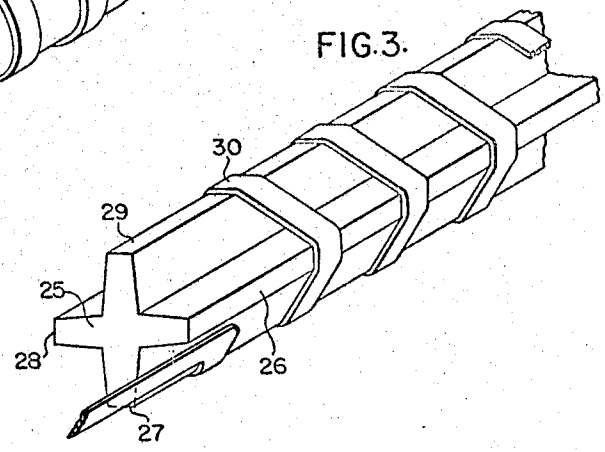
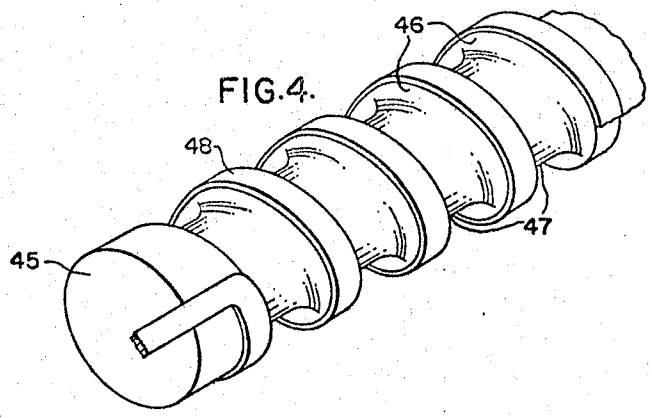


FIG.4.



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METHOD OF MAKING A FUSE WITH A SAND CORE

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Int. Cl. H01h 69/02

U.S. Cl. 29—623 8 Claims

ABSTRACT OF THE DISCLOSURE

Sand is placed in a mold of suitable dimensions in accordance with the dimensions of the fuse tube and ferrule structure to be used in the fuse. A fluid is added to the sand which is then frozen to form a rigid core. Water is one suitable fluid. The core may be cylindrical in shape, cruciform, or have a spiral ridge. While the core is frozen, a fuse element is wound thereon, the turns of which are carefully spaced. The core and wound fuse element are placed in a fuse tube before unfreezing, the remainder of the space in the fuse tube filled with sand or other arc-extinguishing material, and ferrules attached. Thereafter the sand of the core is unfrozen and if desired, the fuse heated for a period of time to drive out substantially all fluid or moisture.

This application is a continuation-in-part of application Ser. No. 435,423, filed Feb. 26, 1965.

FIELD OF THE INVENTION

This invention relates to improvements in methods of making fuses, and more particularly to a method of making a fuse which may be current limiting of the type in which sand is utilized for providing an arc quenching material, the sand being utilized both in the core and in the space within the fuse tube around the core for providing space for temporarily storing the gas produced by the arc when the fuse blows and assisting in extinguishing the arc.

DESCRIPTION OF THE PRIOR ART

It is old in the art to make a current limiting fuse by winding a series of turns of a silver fuse element on a center mandrel or core composed of ceramic or other suitable material, and placing the core and fuse element in a tube which is filled with a special sand. The sand provides an arc quenching action, and also provides some space for temporarily storing the gas produced by the arc.

I have discovered that improved performance can be obtained by also making the center core of sand, so that the core also contributes to the space available for gas storage.

SUMMARY OF THE INVENTION

According to one method of making the fuse, in practicing my invention I press the sand into a mold and fill it with a liquid, such as water, which is volatile at a high temperature but can be solidified at moderately low temperatures. The sand is locked in place by freezing. The core thus made remains strong as long as it is kept at a low temperature, and is wound in this frozen condition with the fusible element, the turns of which are carefully spaced, and subsequently assembled in the tube. Then, after final filling with sand, the whole assembly is warmed to melt the ice or other frozen fluid, and the assembly is then heated to dry out the moisture. The final

result is a fusible element with properly spaced turns in a body of sand all of a homogeneous kind, with no remaining binder.

An object is to provide a new and improved method of making a fuse having a sand core.

Another object is to provide a new and improved method of constructing a fuse having a sand core by freezing the sand to provide temporary rigidity for the core.

These and other objects will become more fully apparent after a study of the following specification, when read in connection with the accompanying drawings, in which:

FIGURE 1 is a view partially in cross-section of a fuse constructed according to the preferred core shape of my invention, while the core is still in rigid form;

FIG. 2 is a view of the core and fuse element of FIG. 1, showing the frozen sand core and fuse element in greater detail;

FIG. 3 is a view showing a core while rigid and fuse element according to a second method of my invention; and

FIG. 4 is a view showing a core while rigid and fuse element according to a third method of my invention.

Particular reference is made now to FIG. 1, in which the reference numeral **10** generally designates the fuse. The ferrules **11** and **12** composed of conductive material are mounted on and close the ends of a fuse tube **13** composed of insulating material. Each ferrule has an inwardly extending annular cap for enclosing the end of the core **15**, the cap of ferrule **11** being shown at **14**. The cap **14** may be formed integrally with the remainder of the ferrule **11** and is preferably coaxially disposed therein. The sand core **15** has one end **16** thereof disposed in the cap **14**, and has a spiral wound fuse element **17** disposed thereon, with the end of the fuse element **17** being soldered at **18** to the cap **14**. The generally cylindrical space **19** between the outer wall of the sand core **15** and the inner wall of the fuse tube **13** is filled with sand especially selected for its arc quenching action and for its porosity to provide some space for temporarily storing the gas produced by an arc when the fuse element **17** is melted in response to an overcurrent condition therein and the electrical circuit interrupted.

The manner of attaching the end of the rigid core **15** to the ferrule **11** may be done in one of several conventional ways. The core **15** while still in rigid form may be attached to the ferrule by utilizing the exterior surface of the core as shown in FIG. 1, which is the preferable method, or the core **15** could, if desired, be attached to the ferrule by drilling into the rigid core or forming the core with a central bore in the end thereof, and utilizing a pin or stud, mounted in the ferrule and extending into the end of the core.

Particular reference is made now to FIG. 2, which shows the core **15** and fusible element **17** in somewhat greater detail. The fusible element **17** is seen to be wound on the core with sufficient spacing between turns to provide electrical insulation, and also to provide mechanical strength if desired. The spacing between turns of the embodiment of FIG. 2 may vary; since the core **15** at the time of winding the fuse element is composed of frozen sand, the turns of the fusible element may be made close together to provide additional support for the core during the processing thereof. The turns are closely spaced in one method of my invention, to tend to restrain the sand of the core within the space defined by the spiral fuse element, even after the sand is unfrozen. When water is added to the core of sand and frozen, some expansion takes place. After the water is evaporated by heating, if the expansion is maintained, the space available for temporarily storing the gas produced by the arc when the

fuse blows is increased, and the efficacy of the fuse in extinguishing the arc is enhanced.

The frozen sand core and the spiral fuse element may be thought of as an assembly.

Particular reference is made now to FIG. 3, where a core **25** as seen in cross-section is generally cruciform, and as seen in perspective comprises four generally rectangular support portions disposed at spaced angular intervals of 90° around the longitudinal axis of the core with flat support surfaces extending generally parallel to the longitudinal axis of the core, supporting surfaces **26**, **27**, **28** and **29** having the turns of a fuse element **30** wound thereon.

Particular reference is made now to FIG. 4. The core **45** is seen to be generally spiral in shape, with alternate ridge portions **46** and alternate trough portions **47**, and a spiral fuse element **48**.

A method of making the fuse of my invention comprises the steps of pressing the sand into a mold and adding a liquid, such as water, until substantially all the minute spaces between particles of sand are filled. Water is volatile at a high temperature, and can be solidified at moderately low temperature. I lock the sand in place by freezing. The core thus made remains strong, because I maintain it at a low temperature below freezing and wind it with the fusible element while it is maintained at a low temperature, and subsequently assemble the sand core in the fuse tube **13** with one ferrule while maintaining the temperature below freezing. After the fuse tube **13** is filled with sand, the other ferrule is attached. The whole fuse tube assembly is allowed to warm, which melts the ice, and in effect the core is melted. The fuse tube, sand, and core are then allowed to dry out, as by heating to a temperature of, for example, 100° C. for a period of eight hours, or 125° C. for a period of four hours. When the heat treatment is completed, the fuse is ready for use.

It will be understood that the material chosen for the fuse elements **17**, **30**, and **48** does not melt at a temperature of 125° C.

It will be understood that the drawings and aforegoing written description are illustrative and exemplary only, and are not to be interpreted in a limiting sense.

I claim as my invention:

1. The method of constructing a fuse having a core composed of sand, which comprises the steps of pressing the sand into a mold and introducing into the mold a fluid which is volatile at a high temperature and which can be solidified by freezing at a moderately low temperature, the fluid substantially filling all the spaces between the minute particles of sand, freezing the sand and the fluid to form a rigid core, removing the rigid core from the mold, winding the core with a fuse element while maintaining the core at or below the freezing temperature of the fluid, assemblying the core and fuse element in a fuse tube, filling the space in the tube between the core and fuse element and the inner wall of the tube with sand, warming the tube and core to melt the fluid and thereafter heating the tube and core for a predetermined time period to a temperature less than the melting point of the fuse element to evaporate substantially all of the fluid.

2. A method according to claim **1**, in which the fluid employed is water.

3. A method according to claim **1** in which the mold produces a core which is substantially cylindrical in shape.

4. A method according to claim **1** in which the mold produces a core which is cruciform in shape.

5. A method according to claim **1** in which the mold produces a core which has a spiral ridge extending over at least a substantial portion of the length thereof.

6. The method of constructing a fuse which includes the steps of forming a sand core by means restraining the sand in a predetermined shape, adding to the sand a fluid which is volatile at a high temperature and which can be solidified by freezing at a moderately low temperature, freezing the sand and the fluid to form a rigid core, removing the rigid core from the restraining means while maintaining the core in frozen condition, winding the rigid frozen sand core with a fuse element, assemblying the rigid core and fuse element in a fuse tube, filling the space in the tube between the core and fuse element and the inner wall of the fuse tube with sand, and warming the assembly to melt the fluid and evaporate the fluid.

7. A method according to claim **6** in which the fuse element is spiral and is wound of a number of closely spaced turns which tend to maintain the sand of the fuse core within the space enclosed by the spiral element after the fluid has been melted and evaporated.

8. In a method of making a fuse having a spirally wound fuse element in a fuse tube, the space defined by the spirally wound fuse element being filled with sand and the space between the spirally wound fuse element and the wall of the fuse tube being filled with sand, the steps which comprise expanding a discrete portion of sand which is to be located within the spiral element by adding a fluid which expands upon freezing, freezing the sand and fluid, forming an assembly of the fuse element and the frozen sand, and thereafter heating the sand and fluid to remove the fluid, the space available for storage of gas formed by an arc when the fuse blows being increased by the expanded sand.

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