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METHOD OF MAKING HEAT OR FLAME DETECTING ELEMENTS

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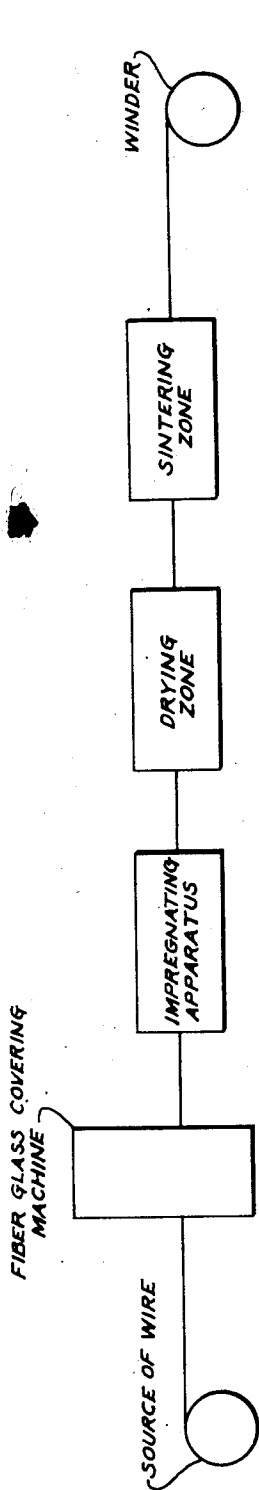


Fig. 1.



Fig. 2.



Fig. 3.

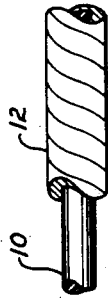


Fig. 4.



Fig. 5.



Fig. 6.



Fig. 7.

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METHOD OF MAKING HEAT OR FLAME
DETECTING ELEMENTS

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14 Claims. (Cl. 154—2.28)

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The present invention relates to a method of making heat or flame detecting elements, and, more particularly, relates to a method of making elements such as illustrated and described in my co-pending application for United States Letters Patent, Serial No. 115,594, filed September 14, 1949, now Patent No. 2,587,916.

The invention is primarily concerned with the making of the heat sensitive elements for heat or flame detecting cables of the type generally comprising an elongate tube or housing, one or more electrically conductive wires disposed in the tube, and a covering of fiber glass yarn on the wires which is practically non-conductive at normal temperatures but is rendered conductive at much higher temperatures, whereby the wires in effect are insulated from each other and/or the tube at normal temperatures and an electrical circuit is established between the wires and/or the tube at higher temperatures.

Accordingly, an object of the present invention is to provide a simple, practical and economical method of making such heat or flame detecting elements.

Another object is to provide a method of the foregoing character which facilitates adjusting the electrical properties of the covering and/or improving its high temperature withstanding qualities.

A further object is to provide a method of the foregoing character for producing covered wires which may be immediately inserted into tubes or may be conveniently stored for use in the future.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

In accordance with the invention, the foregoing objects are accomplished by applying a covering of fiber glass yarn to an electrical conductor, such as a wire, by braiding or winding the covering thereon, applying a material to the covering by impregnating or coating the same, which material modifies the electrical characteristics of the covering and/or enables the covering to withstand high temperatures, and drying and/or sintering the treated covering. The elements produced by the foregoing process may be inserted into tubes immediately or may be stored for use in the future by winding the same on spools or drums or the like.

In the drawing:

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Figure 1 is a diagrammatic flow chart illustrating a method of making the elements in accordance with the present invention.

Figure 2 is a fragmentary elevational view of a length of wire or the like.

Figure 3 is a fragmentary elevational view of the wire having a braided fiber glass yarn covering thereon.

Figure 4 is a fragmentary elevational view of the wire having a spirally wound fiber glass yarn covering thereon.

Figure 5 is a cross-sectional view illustrating the covering and wire shown in either Figure 3 or Figure 4.

Figure 6 is a cross-sectional view illustrating the covered wire shown in Figure 5 disposed in a tube.

Figure 7 is a view similar to Figure 6 with the diameter of the tube reduced.

Referring to the drawing, and more particularly to Figure 1 thereof, there is shown a diagrammatic flow sheet illustrating a method of making heat or flame detecting elements in accordance with the invention. An electrical conductor, such as wire 10 (Figure 2), is supplied from a source such as a spool or drum and is delivered to a machine for providing a fiber glass yarn covering thereon. Such a machine may be of the type which braids the yarn on the wire 10 to provide a braided covering 11 (Figure 3) or of the type which spirally winds the yarn or a strip or tape of yarn to provide a wound covering 12 (Figure 4). In either instance, a porous fiber glass fabric covering is applied to the wire.

The fiber glass yarn may be of any composition, although yarns made of boro-silicate or barium type glass fibers are preferred because of their relatively high softening point temperatures and thermal endurance without material variation in physical or chemical characteristics upon repeated changes in temperature over a wide range. Such glass compositions have negative temperature coefficients of resistivity which enable the fiber glass covering to act as an insulator at normal atmospheric temperatures and to act as a conductor of electricity upon being subjected to flame or heat produced by flame.

It has also been found suitable to utilize fiber glass yarn which has been treated in a 15% hydrochloric acid solution at about 150° F. Such treatment is believed to remove lead oxide from the glass and thereby raise the softening point temperature of the glass composition.

The covered wire is then delivered to apparatus for applying a material adapted to give the cov-

ering desired heat detecting characteristics, such as the ability to withstand temperatures approaching 2000° F. and higher, and/or a predetermined desired negative temperature coefficient.

The covering may be improved to resist high temperature by coating or impregnating the same with a slurry of refractory material or compositions of two or more refractory materials. Such materials may be complexes or compounds of aluminum oxide, aluminum silicate, calcium oxide, chromic oxide, chromite, magnesium oxide, magnesium silicate, silicon carbide, titanium oxide, zirconium oxide and zirconium carbide and the like.

These materials or compositions thereof may contain other compounds in small percentages without materially affecting the refractory properties thereof. For example, small amounts of carbonates are not objectionable, but, to the contrary, are desirable to provide a fluxing action in the event it is desired to sinter the refractory materials and the glass fibers.

Various commercially available prepared refractory type cements may be utilized to good advantage for improving the yarn to withstand high temperatures.

Graphite of the refractory type may be also utilized, but, due to its relatively high electrical conductivity, its use in small amounts or in mixtures comprising a major proportion of less conductive refractory materials is recommended.

Since refractory materials have negative temperature coefficients of resistivity, they may also be applied to the covering for the purpose of modifying the resistivity thereof whereby the covering becomes relatively conductive at predetermined temperatures.

The resistivity of the covering, either with or without application of the refractory material, may be modified or adjusted to a predetermined value by the application of materials having thermistor-like properties. Such materials may be oxides of barium, beryllium, cadmium, cerium, cobalt, copper, iron, lead, manganese, nickel, strontium, tin and tungsten and the like. These materials may be applied in slurry form or may be incorporated in the slurry of refractory materials. Alternatively, suitable salts of these metals in a solvent may be applied to the covering or may be incorporated with the refractory material, which thereafter are converted into the oxide of the metal.

The so treated covered wire is then delivered to a drying zone where the liquid or solvent of the slurry or solution is removed by the application of heat at a temperature well above the boiling point of water.

The wire (Figure 5) is finally delivered to a zone maintained at temperatures adapted to effect sintering of the refractory material and glass fibers and/or the conversion of metallic salts to oxides of the metals. Sintering apparently produces a glass-refractory composition which may be alternately and repeatedly subjected to temperatures varying between about -70° F. and about 2000° F. without any material variation in temperature coefficient of resistivity.

The element produced by the foregoing described method is now ready to be cut in lengths and inserted into a tube 14 having an inner diameter which is greater than the diameter of the element (Figure 6), and the tube may then be reduced in diameter, for example, by redrawing the same to snugly house the element (Figure 7).

Alternatively, the element may be wound on a drum or spool or the like, and stored for future use in a compact and convenient manner.

From the foregoing description, it will be seen that the present invention provides a simple, economical and practical process for producing heat or flame detecting elements wherein all of the steps may be performed in line sequence from the bare wire to the insertion of the treated covered wire into the tube or housing. The method of this invention has great utility because it can be carried out in a minimum amount of floor space and at all times leaves the wire in a flexible condition to facilitate handling and storage thereof.

As various changes may be made without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in any limiting sense.

I claim:

1. A method of making continuous flexible heat or flame detecting elements of the class described, which comprises applying a continuous flexible covering of fiber glass yarn to an electrically conductive flexible wire, and applying a material to the covering adapted to give the covering desired heat detecting characteristics said material being a substance selected from the group consisting of aluminum oxide, aluminum silicate, calcium oxide, chromic oxide, chromite, magnesium oxide, magnesium silicate, silicon carbide, titanium oxide, zirconium oxide and zirconium carbide.

2. A method of making continuous flexible heat or flame detecting elements of the class described, which comprises applying a continuous flexible covering of fiber glass yarn to an electrically conductive flexible wire, applying a material to the covering adapted to give the covering desired heat detecting characteristics, and drying the covering said material being a substance selected from the group consisting of aluminum oxide, aluminum silicate, calcium oxide, chromic oxide, chromite, magnesium oxide, magnesium silicate, silicon carbide, titanium oxide, zirconium oxide and zirconium carbide.

3. A method of making continuous flexible heat or flame detecting elements of the class described, which comprises applying a continuous flexible covering of fiber glass yarn to an electrically conductive flexible wire, applying a material to the covering adapted to give the covering desired heat detecting characteristics, and winding the covered wire said material being a substance selected from the group consisting of aluminum oxide, aluminum silicate, calcium oxide, chromic oxide, chromite, magnesium oxide, magnesium silicate, silicon carbide, titanium oxide, zirconium oxide and zirconium carbide.

4. A method of making continuous flexible heat or flame detecting elements of the class described, which comprises applying a continuous flexible covering of fiber glass yarn to an electrically conductive flexible wire, applying a material to the covering adapted to give the covering desired heat detecting characteristics, drying the covering, and winding the covered wire said material being a substance selected from the group consisting of aluminum oxide, aluminum silicate, calcium oxide, chromic oxide, chromite, magnesium oxide, magnesium silicate, silicon carbide, titanium oxide, zirconium oxide and zirconium carbide.

5. A method of making continuous flexible heat or flame detecting elements of the class described, which comprises braiding a continuous flexible covering of fiber glass yarn on an electrically conductive flexible wire, and applying a material to the covering adapted to give the covering the desired heat detecting characteristics said material being a substance selected from the group consisting of aluminum oxide, aluminum silicate, calcium oxide, chromic oxide, chromite, magnesium oxide, magnesium silicate, silicon carbide, titanium oxide, zirconium oxide and zirconium carbide.

6. A method of making continuous flexible heat or flame detecting elements of the class described, which comprises spirally winding a continuous flexible covering of fiber glass yarn on an electrically conductive flexible wire, and applying a material to the covering adapted to give the covering the desired heat detecting characteristics said material being a substance selected from the group consisting of aluminum oxide, aluminum silicate, calcium oxide, chromic oxide, chromite, magnesium oxide, magnesium silicate, silicon carbide, titanium oxide, zirconium oxide and zirconium carbide.

7. A method of making continuous flexible heat or flame detecting elements of the class described, which comprises applying a continuous flexible covering of fiber glass yarn on an electrically conductive flexible wire, and applying a material having a negative temperature coefficient of resistivity to the covering said material being a substance selected from the group consisting of aluminum oxide, aluminum silicate, calcium oxide, chromic oxide, chromite, magnesium oxide, magnesium silicate, carbide, titanium oxide, zirconium oxide and zirconium carbide.

8. A method of making continuous flexible heat or flame detecting elements of the class described, which comprises applying a continuous flexible covering of fiber glass yarn on an electrically conductive flexible wire, and applying a slurry of refractory material to the covering to enable the covering to withstand relatively high temperatures said material being a substance selected from the group consisting of aluminum oxide, aluminum silicate, calcium oxide, chromic oxide, chromite, magnesium oxide, magnesium silicate, silicon carbide, titanium oxide, zirconium oxide and zirconium carbide.

9. A method of making continuous flexible heat or flame detecting elements of the class described, which comprises applying a continuous flexible covering of fiber glass yarn on an electrically conductive flexible wire, and impregnating the covering with a thermistor-like material said material being a substance selected from the group consisting of aluminum oxide, aluminum silicate, calcium oxide, chromic oxide, chromite, magnesium oxide, magnesium silicate, silicon carbide, titanium oxide, zirconium oxide and zirconium carbide.

10. A method of making continuous flexible heat or flame detecting elements of the class described, which comprises applying a continuous flexible covering of fiber glass yarn on an electrically conductive flexible wire, impregnating the covering with a thermistor-like material, and coating the covering with a refractory material said material being a substance selected from the

group consisting of aluminum oxide, aluminum silicate, calcium oxide, chromic oxide, chromite, magnesium oxide, magnesium silicate, silicon carbide, titanium oxide, zirconium oxide and zirconium carbide.

11. A method of making continuous flexible heat or flame detecting elements of the class described, which comprises applying a continuous flexible covering of fiber glass yarn on an electrically conductive flexible wire, applying a slurry of refractory material to the covering, and sintering the covering and material to produce a composition adapted to withstand relatively high temperatures said material being a substance selected from the group consisting of aluminum oxide, aluminum silicate, calcium oxide, chromic oxide, chromite, magnesium oxide, magnesium silicate, silicon carbide, titanium oxide, zirconium oxide and zirconium carbide.

12. A method of making continuous flexible heat or flame detecting elements of the class described, which comprises applying a refractory material to a continuous flexible fiber glass yarn covering on an electrically conductive flexible wire, and sintering the refractory material and the fiber glass yarn to produce a composition adapted to withstand relatively high temperatures said material being a substance selected from the group consisting of aluminum oxide, aluminum silicate, calcium oxide, chromic oxide, chromite, magnesium oxide, magnesium silicate, silicon carbide, titanium oxide, zirconium oxide and zirconium carbide.

13. A method of making continuous flexible heat or flame detecting elements of the class described, which comprises impregnating a continuous flexible fiber glass yarn covering on an electrically conductive flexible wire with a thermistor-like material said material being a substance selected from the group consisting of aluminum oxide, aluminum silicate, calcium oxide, chromic oxide, chromite, magnesium oxide, magnesium silicate, silicon carbide, titanium oxide, zirconium oxide and zirconium carbide.

14. A method of making continuous flexible heat or flame detecting elements of the class described, which comprises impregnating a continuous flexible fiber glass yarn covering on an electrically conductive flexible wire with a thermistor-like material and a refractory material, and sintering the refractory material and the glass yarn covering to produce a composition adapted to withstand relatively high temperatures said material being a substance selected from the group consisting of aluminum oxide, aluminum silicate, calcium oxide, chromic oxide, chromite, magnesium oxide, magnesium silicate, silicon carbide, titanium oxide, zirconium oxide and zirconium carbide.

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