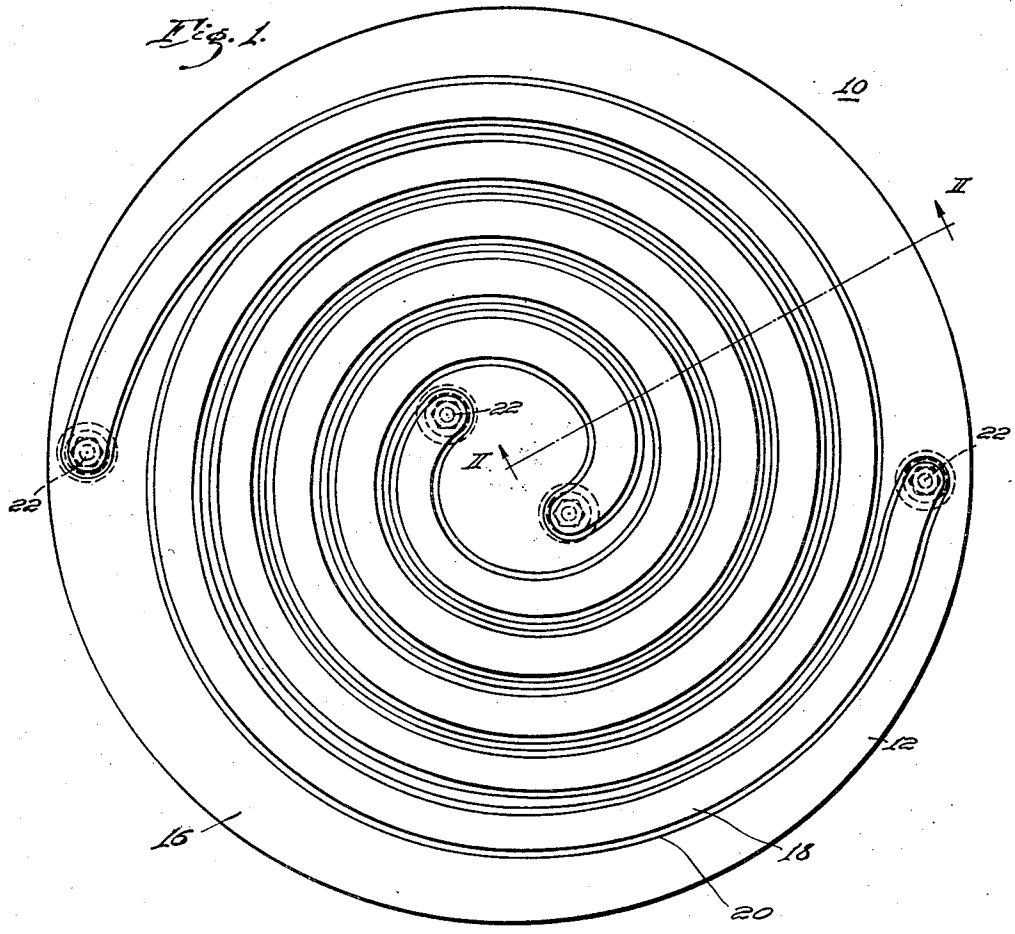
Aug. 4, 1942. H. M. ELSEY 2,292,065

MAGNESIUM OXIDE INSULATION

Filed Aug. 3, 1940

Fig. 1.



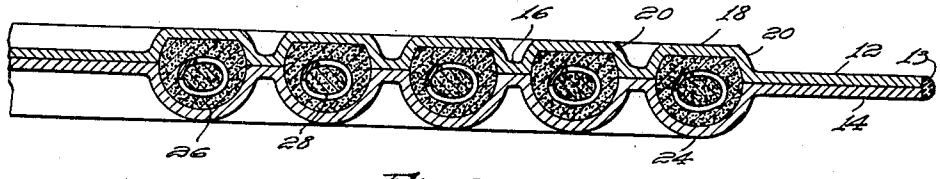


Fig. 2.

WITNESSES:

E. L. Keesling.

A. Shapore

INVENTOR

Howard M. Elsey.

BY

Ezra D. Savage

ATTORNEY

Patented Aug. 4, 1942

2,292,065

UNITED STATES PATENT OFFICE

2,292,065

MAGNESIUM OXIDE INSULATION

Howard M. Elsey, Oakmont, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application August 3, 1940, Serial No. 350,571

11 Claims. (Cl. 201—64)

This invention relates to an insulating composition, and more particularly an insulating composition for electrical heaters.

In producing insulated electrical heaters, it has been found difficult to produce an insulation of uniform homogeneous composition which is capable of being deposited as a mud about the electrical heating element and drying into a solid without excessive shrinkage and cracking taking place. The insulating composition is required to withstand high temperatures encountered in such service without deteriorating or corroding the parts of the electrical heater. It has been difficult to insulate such heater elements, the existing methods requiring considerable care in practicing the steps thereof while the results are not always uniform or acceptable as fulfilling the dielectric requirements.

An object of this invention is to provide a composition which when deposited on a resistor element will dry into a dense homogeneous refractory which has good electrical characteristics.

A further object of this invention is to provide for an insulated electric heater, the insulation of which is a dense homogeneous refractory capable of meeting service requirements.

Other objects of the invention will become apparent from the following description when taken in conjunction with the accompanying drawing, in which:

Figure 1 is a plan view of an electrical heater; and

Fig. 2 is a section of the heater of Fig. 1 on lines II—II.

In practicing this invention, any of the well-known metallic electrical resistance members may be employed, particularly coiled metallic heating wires such as 28, illustrated in Fig. 2 of the drawing, as are commonly utilized in the heating units of electric roasters, strip heaters, range units, hot plates and the like. The service requirements of these resistor elements are that the elements should be electrically insulated from an enclosing metallic sheath or from other portions of the apparatus. In addition, the insulating composition about the heating element should be such as to prevent corrosion of the element. Furthermore, the insulating composition should be of such a nature that it will readily permit the heat developed by the element to flow therefrom without excessive temperatures being developed.

In order to satisfactorily insulate a heating element, such as shown in Figs. 1 and 2 of the drawing, it has been found that the insulating material prepared as a plastic composition should not shrink excessively or crack after deposition about the heating element and drying. The insulating composition should be capable of hardening into a refractory body of a dense and homogeneous nature which will have good dielectric strength and a high thermal transfer.

Referring to Fig. 1 of the drawing, there is illustrated an enclosed or sheathed electrical heater 10. The heater 10 is fabricated from two preformed upper and lower encasing plates 12 and 14 forming a sheath for a plurality of resistance elements. The upper plate 12 is stamped to produce a series of upraised flat portions 18 and a series of depressed portions 16. The upper portions 18 and the depressed portions 16 of the upper plate 12 are connected by rounded sloping side portions 20 to produce spiral grooves. The lower plate 14 is subjected to a stamping operation which produces a series of rounded grooves 24 corresponding to the groove configuration in the upper plate 12. As will be noticed, there are two series of interlinked spiral grooves in the heater 10. However, any desirable number of such spirals may be provided on a single heater. The space defined by the groove 24, and the flat top 18 and rounded sides 20 of the several spirals contains the resistance element 28. Surrounding and imbedding the resistance element 28 is an insulating refractory composition 26 which has the characteristics herein called for.

The refractory composition 26 of this invention, which has been found suitable for the service requirements herein listed is prepared from a base of magnesium oxide. Magnesium oxide which is commercially available, contains approximately 90% to 92% MgO. The balance includes a small quantity of water, silica, carbonates and alkali oxides. For application to the resistor the magnesium oxide is ground to a fine powder. In some instances ground magnesium oxide which will pass from 100 mesh to 300 mesh screens has been found to have desirable characteristics for this application.

The magnesium oxide may be modified in order to impart an improved electrical resistivity thereto by adding from 1% to 5% of boric acid or kaolin. These additions are ground to the same fineness as the magnesium oxide.

Heretofore, magnesium oxide has been applied as an insulating composition in the electrical art generally by suspending in an aqueous carrier. The water reacted with the magnesium oxide to form magnesium hydroxide. However, considerable difficulty is encountered in drying an aque-

ous magnesium oxide composition. The first stage in drying removes the excess water. Thereafter the magnesium hydroxide begins to decompose under the application of heat to produce water, which escapes as steam, and magnesium oxide. The production of water by dehydrating the magnesium hydroxide results in an excessive shrinkage of the partially dried material and further causes an uncontrollable and excessive amount of cracking. Such a final product is not satisfactory for the service requirements such as are required of electrical heaters.

It has been discovered that a suspension of magnesium oxide in ethyl alcohol having 5% or less of water, including absolute ethyl alcohol, overcomes the unsatisfactory drying characteristics of the prior art magnesium oxide material. Furthermore, the ethyl alcohol suspensions are exceedingly stable. From 50 to 80 parts of ethyl alcohol per hundred parts of magnesium oxide will produce a thick mud-like composition suitable for application to resistance wire. The addition of from 1 to 5 parts of weight of boric acid or kaolin to the magnesium oxide may also be made to the suspension.

A suitable composition embodying ethyl alcohol is as follows: 7 ounces of finely ground magnesium oxide is stirred in 150 cubic centimeters of 95% or higher ethyl alcohol until a thick, creamy mud-like mixture is produced. This mud may be deposited about heating elements such as 28 and shaped by molding or extrusion to fit the heating element grooves. Other methods of applying the mud to the heating wire may be employed. The covered heating wire may be dried either in the open atmosphere, under hoods, or within heated ovens. The mud will dry more rapidly than when water is used and produces a solid which resembles plaster of Paris in appearance. There will be very little shrinkage and cracking is substantially eliminated by the use of this suspension in ethyl alcohol. The molded insulation may be inserted into the grooves of plates 12 and 14, conductor connections 22 attached to the resistor element, and the plates united by welding at 13.

In some instances, absolute ethyl alcohol when used with a magnesium oxide powder which will pass a 300 mesh screen produces a mud which has highly satisfactory plasticity characteristics and is readily applied to the heating wire. If the magnesium oxide is relatively coarse in texture, a slight amount of water in the alcohol solution will produce a composition having a greater degree of plasticity. Accordingly, 95% ethyl alcohol would be preferable to absolute alcohol in such a case.

In some instances, heaters of a commercial design in which a minor amount of cracking may be tolerated may be insulated with a mud in which the ethyl alcohol has up to 15% water.

In the case where kaolin or boric acid additions are made, a slight amount of water assists in causing a reaction of the magnesium oxide with the boric acid to form a magnesium borate. Magnesium borate and magnesium oxide mixtures have somewhat improved insulating characteristics over that of magnesium oxide alone. One part of water to ten parts of ethyl alcohol may be used for this composition.

The ethyl alcohol is a satisfactory liquid for producing the insulating mud when it contains small additions of other alcohols, such as 10% of methyl alcohol. In some cases, additions of up to 10% of other organic liquids which will not react with magnesium oxide have been added to ethyl alcohol without impairing its good carrier characteristics. Accordingly, the term "alcoholic solution" is intended to apply to ethyl alcohol modified with up to 10% of non-reactive additions. The presence of more than 5% water within the ethyl alcohol with magnesium oxide alone is to be avoided since the reaction of the water and magnesium oxide will result in the production of cracks during the drying.

The mud produced by suspending magnesium oxide in ethyl alcohol may be used for forming refractory plates such as can be used in the electrical industry for separating electrical conductors. These refractory plates will have good thermal and electrical characteristics.

While the description and drawing have been directed to a specific type of heater, other electrical heaters, such as those made by enclosing resistance elements within a tube and pouring in the insulating mud are contemplated as coming within the purview of the invention.

Although this invention has been described with reference to a particular embodiment thereof, it is, of course, not to be limited thereto except insofar as is necessitated by the scope of the appended claims.

I claim as my invention:

1. A composition of matter to provide for a refractory insulation comprising essentially magnesium oxide suspended in absolute ethyl alcohol.

2. A composition of matter to provide for a refractory insulation comprising essentially powdered magnesium oxide and ethyl alcohol; the ethyl alcohol having less than 15% water, the whole forming a mud.

3. A composition of matter for application to members for providing a refractory cooperative with the members, comprising essentially powdered magnesium oxide and ethyl alcohol having less than 15% water to suspend the magnesium oxide, the composition when applied to members and the ethyl alcohol being evaporated producing a solid, non-cracking refractory residue having good heat transfer and high dielectric characteristics.

4. A composition of matter in the form of a thick mud-like suspension for application to members to provide for a refractory cooperative with the members comprising a suspension of 100 parts of magnesium oxide in 50 to 80 parts of ethyl alcohol solution having less than 5% water and 10% or less of organic liquids substantially non-reactive with magnesium oxide, the composition producing a substantially solid, non-cracking refractory residue when the liquid has been evaporated.

5. A composition of matter suitable for application to members to provide for an electrically insulating refractory, comprising 100 parts magnesium oxide, 1 to 5 parts by weight of one or more materials selected from the group consisting of boric acid and kaolin and 50 to 80 parts of ethyl alcohol solution having less than 15% water.

6. An electric heater comprising in combination a sheath, a resistance element disposed within and spaced from the sheath and a dense, electrically insulating refractory within the sheath filling the space between the resistance element and sheath, composed essentially of magnesium oxide deposited from an ethyl alcohol solution having less than 5% water, the ethyl alcohol solution being evaporated.

7. An electric heater comprising in combina-

tion a sheath, a resistance element disposed within and spaced from the sheath and a dense, electrically insulating refractory within the sheath filling the space between the resistance element and sheath, composed essentially of magnesium oxide and from 1% to 5% thereof of one or more selected from the group kaolin and boric acid deposited from an ethyl alcohol solution having less than 15% water, the ethyl alcohol solution being evaporated.

8. An electrical heater comprising a resistance element and an electrically insulating refractory imbedding and surrounding the resistance element, the refractory comprising essentially a dense, non-cracking body of magnesium oxide deposited from a liquid carrier consisting of ethyl alcohol with less than 5% water.

9. An electrical heater comprising a resistance element and an electrically insulating refractory imbedding and surrounding the resistance element, the refractory comprising essentially a dense, non-cracking body of magnesium oxide and from 1% to 5% of at least one material of the group consisting of kaolin and boric acid deposited from a liquid carrier consisting of ethyl alcohol with less than 5% water.

10. The method of insulating an electric resistor wire suitable for use in heaters comprising the steps of depositing on the resistor wire a mud-like suspension of magnesium oxide in ethyl alcohol having less than 5% water and heating the suspension to effect evaporation of the ethyl alcohol to produce a homogeneous, dense electrically insulating refractory about the wire.

11. The method of insulating electric resistor wire suitable for use in heaters comprising the steps of depositing on the resistor wire a mud-like suspension of magnesium oxide with about 1% to 5% of one or more materials selected from the group consisting of kaolin and boric acid in ethyl alcohol having less than 15% water and heating the suspension to effect evaporation of the ethyl alcohol to produce a homogeneous, dense electrically insulating refractory about the wire.

HOWARD M. ELSEY.