May 18, 1937. E. L. WIEGAND 2,080,647

METHOD OF INSULATING ELECTRICAL RESISTOR HEATING ELEMENTS

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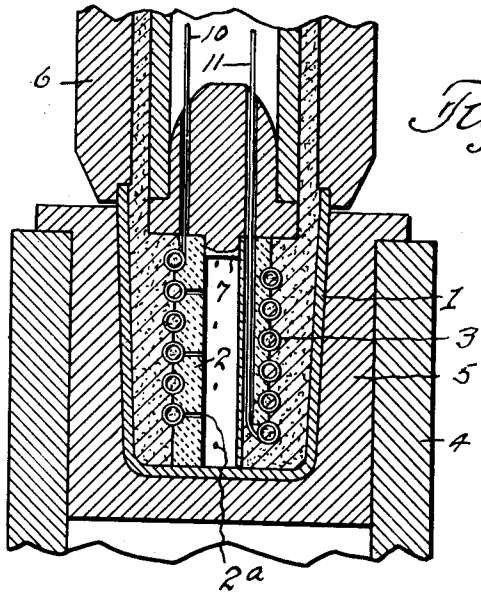


Fig. 1

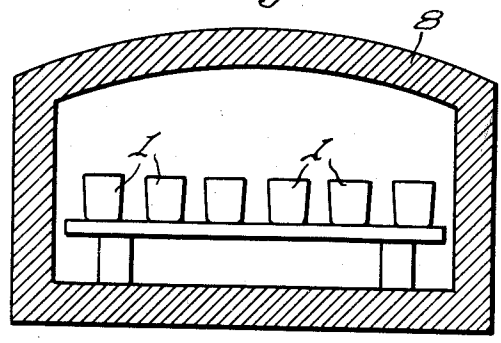


Fig. 2

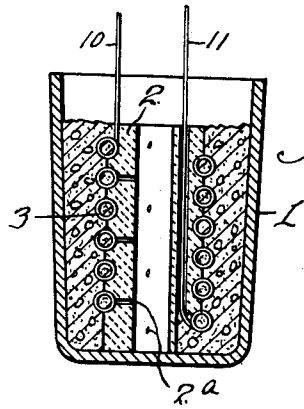


Fig. 3

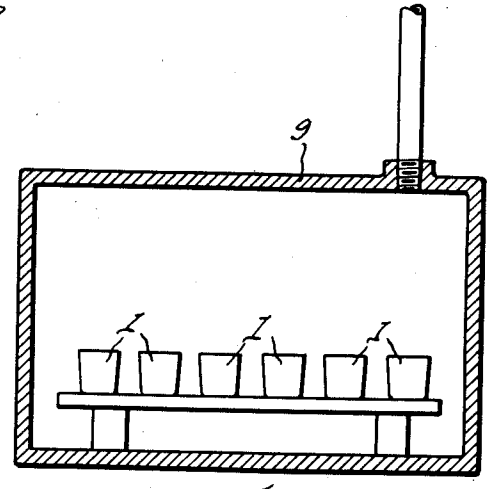


Fig. 4

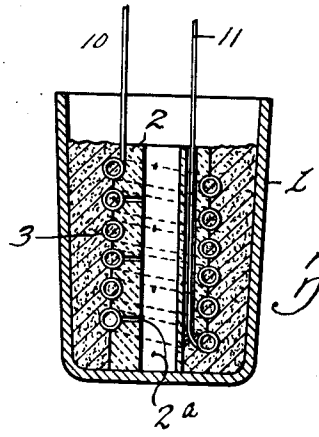


Fig. 5

INVENTOR.

E. L. Wiegand

BY Hull, Brock & Wick

ATTORNEY.

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METHOD OF INSULATING ELECTRICAL RESISTOR HEATING ELEMENTS

Edwin L. Wiegand, Pittsburgh, Pa.

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13 Claims. (Cl. 201—64)

This invention relates to an electrical resistance heating unit and method of forming the same.

One of the main objects of the invention is to provide a method of forming electrical heating elements by an extrusion process in which the insulating material consists originally of comminuted metallic magnesium admixed with a suitable material which acts as a lubricant and adapts the comminuted metalic megnesium to the extrusion process.

My method contemplates the use of comminuted or powdered metallic magnesium which is to be converted into an insulating medium by the application thereto of steam under pressure which converts the metallic magnesium into magnesium oxide.

Another object of the invention is to provide an electrical resistance heating unit which consists essentially of an electric resistor surrounded by and embedded in a mass of magnesium oxide admixed with a refractory jell such as bentonite jell.

A further object of the invention is to provide a method of forming an electrical resistance heating unit which consists essentially in extruding about an electrical resistor a mass of finely divided metallic magnesium admixed with a suitable quantity of refractory jell, such as bentonite jell, or other suitable material such as an inorganic lubricant, then heating the unit so formed to reduce the moisture content and then oxidizing the metallic magnesium by means of steam under pressure.

A further object of the invention is to provide an electrical heating unit of the character described which can be commercially produced by the extrusion method hereinbefore referred to.

The use of metallic magnesium which has been converted into magnesium oxide by means of steam under pressure, as an insulator is well known. However, it has been difficult heretofore to secure rapid and complete oxidation of the metallic magnesium because the deep and thorough penetration of the solid magnesium is interfered with by the oxide itself during the process of formation thereof. I have found by experiment that comminuted metallic magnesium of about 100 to 200 mesh mixed with bentonite jell produces a mixture which is sufficiently mobile to permit it to be extruded about the resistor. The bentonite jell is boiled down until it is of about the consistency of a soft soap. The finely divided particles of metallic magnesium of about 100 to 200 mesh are then added until the mixture has a putty-like or plastic consistency. The proportion of the materials is preferably about as follows:

	Per cent by weight
Metallic magnesium of 100 to 200 mesh	70 to 90
Bentonite	10 to 30
Water	Enough to render mass extrudable

This mixture is then introduced into an extrusion machine such as disclosed in the United States Letters Patent of Edwin L. Wiegand and Albert P. Wiegand, No. 1,924,474, issued August 29, 1933 and extruded about an electrical resistor under pressure. The unit thus formed is then dried slowly in an oven to drive off the moisture, leaving a porous spongy mass of metallic magnesium. This mass is then treated with steam under pressure which thoroughly permeates the mass and produces a very thorough and uniform oxidation of the metallic magnesium.

It is to be understood that other materials may be used in place of the bentonite jell such as a jell of zirconium hydrate or a jell of magnesium hydroxide. This material used as a lubricant is preferably such that it can be volatilized out without forming an appreciable amount of carbon and at a temperature sufficiently low to avoid a kindling point of rapid oxidation or such as would react with the comminuted metallic magnesium in such a way as to create an explosion or thermit reaction and it must be such a material as will not chemically attack or otherwise injure nickel chrome or nickel chrome iron resistor material.

With the comminuted metallic magnesium and extrusion method of applying the material to the resistor, a process results which is capable of being rapidly and uniformly executed as the comminuted metallic magnesium is mixed with the bentonite or other ceramic jell and then dried out immediately after extruding which provides a porous spongy mass of metallic magnesium which permits the rapid and thorough, rapid and uniform oxidation of the metallic magnesium.

In the accompanying drawing, I have disclosed somewhat diagrammatically the manner in which the method is practiced. In the drawing Fig. 1 is a vertical sectional view disclosing the step of filling a sheath by extrusion with comminuted metallic magnesium admixed with bentonite jell or other suitable material; Fig. 2 discloses an oven for drying out the material; Fig. 3 is a vertical sectional view of one of the heating elements after the drying operation; Fig. 4 is a vertical sectional view of an autoclave in which the heating elements are treated with steam to reduce the metallic magnesium to magnesium oxide; and

Fig. 5 is a vertical sectional view of a heating element after it has been moved from the autoclave.

In the drawing, the reference character 1 designates a metallic sheath in which is arranged a core 2 formed of suitable material on which is positioned a resistor coil 3 which is partially embedded in grooves provided in the core. The reference character 4 designates a suitable base member which is adapted to receive a collar 5 having an opening or recess therein of a suitable size to receive the sheath. The insulating material which consists of finely divided metallic magnesium admixed with bentonite jell or other suitable material is extruded into the sheath through a nozzle 6 which is provided with a projection 7 which engages the upper end of the core. The material is extruded within the sheath and through and about the resistor. The unit so formed is then placed within an oven 8 for a sufficient period of time to thoroughly dry out the insulating material and to expel the moisture therefrom. This heating of the element so formed drives off the moisture, leaving a porous spongy mass of metallic magnesium such as shown in Fig. 3. The element so formed is then placed in the autoclave 9 and treated with steam under pressure which thoroughly permeates the mass and produces a very thorough and uniform oxidation of the metallic magnesium.

When the metallic magnesium is converted into magnesium oxide by the steam, considerable expansion takes place which creates a considerable pressure and causes the insulating material to thoroughly permeate the coils of the resistor and to place the entire contents of the sheath under considerable pressure.

The reference characters 10 and 11 designate the protruding ends of the resistor which project upwardly from the heating element. In Fig. 5 the heating element is disclosed as it will appear when removed from the autoclave. In order to complete the heating element a suitable closure (not shown) is applied to the sheath which effectively closes the same. The core 2 may be provided with suitable bores or passageways 2a to facilitate the delivery of steam immediately adjacent the coils of the resistor.

It is to be understood that the embodiment of the invention herein described is merely illustrative and is not to be considered in a limiting sense as various changes may be made in the details of the process as well as in the proportions of the material without departing from the spirit of my invention.

The amount and proportion of water and refractory jell used is varied in accordance with the type and size of the heating element and the character and length of the resistor. It is desirable to use the smallest amount of water possible in order to render the mass extrudable. It is also quite possible to extrude the insulation forming material about a resistor disposed within a suitable mold and the method is not limited to a sheathed type of heating element. The invention is therefore of general application and not limited except in accordance with the scope of the appended claims.

Having thus described my invention, what I claim is:

1. The method of forming an electrical heating unit which consists in surrounding an electrical resistor with a mass containing finely divided particles of metallic magnesium and a volatile lubricant for rendering the mass mobile, then heating the unit so formed to reduce the lubricant content and then oxidizing the metallic magnesium.

2. The method of forming an electrical heating unit which consists in extruding about an electrical resistor a mass containing finely divided particles of metallic magnesium and a volatile lubricant for rendering the mass mobile, then heating the unit so formed and oxidizing the metallic magnesium.

3. The method of forming electrical heating units which consists of covering an electrical resistor with a mass containing finely divided particles of metallic magnesium and a volatile lubricant, then heating the unit so formed and oxidizing the metallic magnesium by means of steam.

4. The method of forming an electrical heating unit which consists in extruding about an electrical resistor a mass containing a mixture of finely divided particles of metallic magnesium and a sufficient quantity of lubricant to render the mass mobile and to form a binder for the magnesium, then heating the unit so formed and passing steam through the mass to oxidize the metallic magnesium, said lubricant consisting of a jell containing a lubricant which can be volatilized without forming an appreciable amount of carbon.

5. The method of forming an electrical heating unit which consists in surrounding an electrical resistor with a mass containing finely divided particles of metallic magnesium and a refractory jell containing a volatile lubricant, then heating the unit so formed to reduce the moisture content and oxidizing the metallic magnesium.

6. The method of forming an electrical heating unit which consists in extruding about an electrical resistor a mass containing finely divided particles of metallic magnesium and bentonite jell, then heating the unit so formed to reduce the moisture content and oxidizing the metallic magnesium.

7. The method of forming an electrical heating unit which consists in covering an electrical resistor with a mass containing finely divided particles of metallic magnesium and a refractory jell containing magnesium and a lubricant that will volatilize when heated without forming an appreciable amount of carbon, then heating the unit so formed to reduce the moisture content and oxidizing the metallic magnesium by means of steam.

8. The method of forming an electrical heating unit which consists in extruding about an electrical resistor arranged in a useful shape a mass of finely divided particles of metallic magnesium admixed with a lubricant for facilitating the flow of the mixture, then oxidizing the metallic magesium to form magnesium hydroxide and then dehydrating the resulting magnesium hydroxide to form magnesium oxide.

9. The method of forming an electrical heating unit which consists in extruding about an electrical resistor arranged in a useful shape a mass of finely divided particles of metallic magnesium admixed with a lubricant for facilitating the flow of the mixture, then oxidizing the metallic magnesium by means of steam to form magnesium hydroxide and then dehydrating the resulting magnesium hydroxide to form magnesium oxide.

10. The method of forming an electrical resistance heating unit which consists in extruding about an electrical resistor a mass of finely comminuted metallic magnesium admixed with

a lubricant containing volatile material, then heat treating the article so formed to remove the volatile material, then treating the material so as to oxidize the comminuted metallic magnesium and to convert it into magnesium hydroxide and then dehydrating the magnesium hydroxide to convert it into anhydrous magnesium oxide.

11. The method of making an electrical heating unit which consists in arranging a resistor upon a core within a container, then filling the container by extruding about the resistor under pressure a mass of finely divided metallic magnesium admixed with a lubricant, then heating the unit so formed to drive off any volatile material in the lubricant and to oxidize the metallic magnesium and to convert it into anhydrous magnesium oxide.

12. The method of forming an electrical heating unit which consists in covering an electrical resistor with a mass containing finely divided particles of metallic magnesium and a refractory jell containing a lubricant that can be volatilized at a sufficiently low temperature to avoid rapid oxidation and without forming an appreciable amount of carbon, oxidizing the metallic magnesium to form magnesium hydroxide and dehydrating the magnesium hydroxide to convert it into anhydrous magnesium oxide.

13. The method of forming an electrical heating element which consists in covering an electrical resistor formed of nickel chrome or nickel chrome iron with a mass of finely divided particles of metallic magnesium admixed with a jell which acts as a lubricant and which can be volatilized without forming an appreciable amount of carbon and at a sufficiently low temperature to avoid rapid oxidation and being of such nature that it will not chemically react with metallic magnesium or form an explosive mixture and will not attack or injure nickel chrome or nickel chrome iron resistor material, oxidizing the metallic magnesium to form magnesium hydroxide and then dehydrating the magnesium hydroxide to form anhydrous magnesium oxide.

EDWIN L. WIEGAND.