Nov. 12, 1929. W. R. KING 1,735,168

TERMINAL FOR HEATING UNITS

Filed March 28, 1927

Fig. 1.

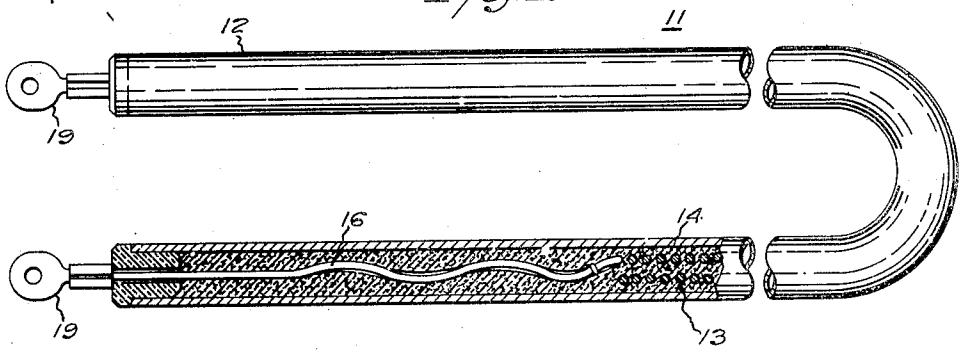


Fig. 2.

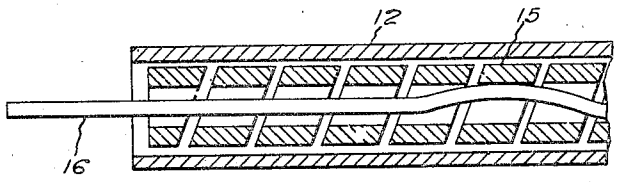


Fig. 3.

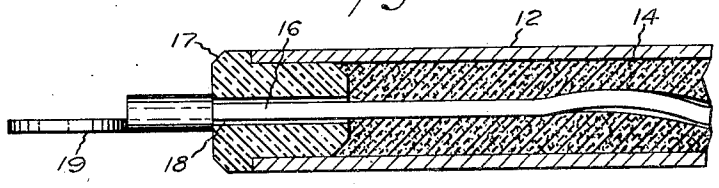


Fig. 4.

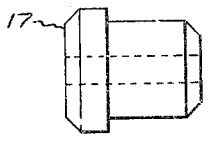
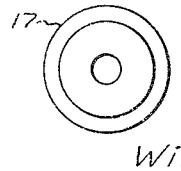


Fig. 5.



WITNESSES

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UNITED STATES PATENT OFFICE

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TERMINAL FOR HEATING UNITS

Application filed March 28, 1927. Serial No. 178,872.

My invention relates to electric heaters and particularly to encased tubular heating units.

An object of my invention is to provide an encased tubular heating unit embodying a particularly simple and efficient terminal construction.

In practicing my invention, I provide a tubular metal casing that may be bent into any desired shape, a helically-wound resistor member therein that is held tightly therein by expansively-oxidized electric-insulating material, and resilient pre-shaped terminal members at each end of the tubular casing, an electric insulating bushing, and a cable terminal secured to the projecting end of the resilient terminal wire.

In the drawings,

Fig. 1 is a view, partially in side elevation and partially in longitudinal section, of an electric heater embodying my invention.

Fig. 2 is a view of an end portion, on an enlarged scale, of an unfinished electric heater embodying my invention.

Fig. 3 is a view, in longitudinal section, of an end portion of a completed heater embodying my invention.

Figs. 4 and 5 are views, in side elevation and in front elevation, respectively, of an end bushing, and

Fig. 6 is a view in section of the tubular heater taken on line VI—VI of Fig. 1.

An electric heater 11 comprises an outer tubular metal casing 12 which may be of any kind of metal suitable for the temperature at which it is to be operated. Thus, if the heater unit is to be operated at relatively low temperatures a copper tube may be used, while a steel tube or a tube made of an alloy steel must be used if the temperature is to be much higher.

A helically-wound resistor wire 13 is located within the tubular casing 12 and the respective turns thereof are slightly separated from each other, as shown more particularly in Fig. 1 of the drawing. The resistor wire is held tightly within the casing 12 by means of a mass 14 of expansively-oxidized electric-insulating material consisting of magnesium hydroxide or oxide.

The method of making or producing the crystalline mass of electric-insulatng material is more particularly disclosed and claimed in re-issued Patent No. 16,340 to C. B. Backer. Briefly, the method is that of providing a helix of resistor wire located within an open helix 15 of a strip of initially-metallic magnesium and the location of these parts within a tubular casing, such as the casing 12, or a bundle of bars or wires of magnesium may be located within the helix. The assembly is then subjected, for a predetermined length of time, to the action of high-temperature steam which effects a change of the metallic magnesium into magnesium hydroxide or oxide, the material expanding to substantially 200% of its initial volume, whereby the resistor wire is tightly held within the tubular casing. The mass 14 of electric insulating material thus produced is composed more particularly of a substantially solid crystalline structure, whereby a highly efficient heat path from the resistor wire to the casing is provided, in addition to holding the wire firmly within the casing.

I prefer to make the longitudinal extent of the resistor helix 13 much less than that of the casing 12, and I provide a resilient terminal conductor 16 for each end of the casing. The outer-end portion of each of the terminal conductors 16 is substantially straight, while the inner-end portion is wavy or sinuous and is suitably connected to an end of the resistor wire 13. The helix 15 of initially-metallic magnesium extends to substantially the end of the casing at each end thereof so as to surround both end portions of the respective resilient terminal conductors 16. Upon treatment thereof, as hereinbefore described, the resilient terminal wire is tightly held by the expansively-oxidized magnesium hydroxide or oxide, substantially as shown in Fig. 1 of the drawing.

An insulating bushing 17, of some suitable refractory material and having a co-axial opening 18 therethrough, is provided at each end of the casing, the inner portion thereof being such as to closely fit within the casing 12, substantially as shown in Figs. 2 and 3 of the drawings.

A cable terminal 19 is provided at each end

of the heater and embodies an outer portion to which a supply-circuit conductor may be connected and an inner portion which may be folded over and around the end of the terminal conductor 16 and soldered thereto. The inner end of the cable terminal 19 abuts against the outer face of the bushing 17 in order to hold it securely in its operative position within, and at the end of, the casing 12.

In earlier devices employing expansively-oxidized electric insulating material of the kind disclosed and claimed in the above-mentioned Backer patent, relatively heavy and unyielding or non-resilient resistor members were employed, these being in the shape of substantially straight rods. It was found that these relatively stiff rods had a tendency to crush the mass 14 of expansively oxidized magnesium hydroxide or oxide during the final steps of manufacture of the heating units. The device embodying my invention provides a terminal wire that is heavier in lateral section than the resistor wire 13 and embodies two portions, one of these being sinuous or bent, in order that the expanded mass of electric insulating material may hold the same and prevent longitudinal movement thereof relatively to the casing 12. The outer-end portion thereof is straight and extends through an opening in an end bushing, which bushing is effective to prevent lateral movement of the terminal lead and also to retain the mass 14 within the casing. As the cable terminal 19 is securely mounted on the outer end of the terminal conductor 16, it holds the bushing 17 in its proper operative position and prevents any leakage of the mass 14 of electric-insulating material from the casing in case it becomes disintegrated to a slight extent during the handling or the use thereof.

Since a portion of the terminal conductor 16 is sinuous, a tortuous passageway is provided about and around the conductor which extends through a portion of the magnesium oxide for a distance substantially coextensive with the length of the conductor (see Figs. 1, 3 and 6). This passageway insures that steam will be permitted to flow through the tube to convert the portion magnesium metal helix 15 located in the middle portion of the tube 12 to the oxide of magnesium in the event that the metal located in the ends of the tube has been converted first, which is usually the case.

Various modifications may be made in the device embodying my invention without departing from the spirit and scope thereof and I desire, therefore, that only such limitations shall be placed thereon as are imposed by the prior art or are specifically set forth in the appended claims.

I claim as my invention:

1. The method of making a terminal structure for a resistance element located in a sheath or tube which consist in placing a resistance element in a sheath or tube, partially filling the space between the tube and the resistance element with metallic magnesium, pre-shaping a terminal conductor into sinuous form, securing one end of the terminal conductor to one end of the resistance element, inserting the terminal into the tube, and passing an oxidizing medium through the tube or sheath to convert the metallic magnesium to magnesium oxide in situ, whereby the sinuous terminal conductor is secured in place and provides an opening through the oxide at the ends of the tube through which the oxidizing medium may pass until all of the metal about the resistor element has been converted to magnesium oxide.

2. A terminal for a tubular heating unit having a tubular casing and a resistor therein, said terminal including an extended resilient terminal wire having an inner sinuous portion electrically connected to the resistor, and a substantially straight outer portion, a mass of electric-insulating material expansively oxidized in situ in the casing and holding the resistor and the sinuous portion of the terminal wire therein, a bushing of electric-insulating material in the end of the tubular casing and having the straight portion of the terminal wire extending therethrough, and a terminal secured to the terminal wire for holding the bushing in the casing.

In testimony whereof, I have hereunto subscribed my name this 22d day of March, 1927.

WILLIAM R. KING.