April 7, 1936. C. C. ABBOTT 2,036,788

ELECTRIC HEATING UNIT

Filed March 6, 1934

Fig. 1.

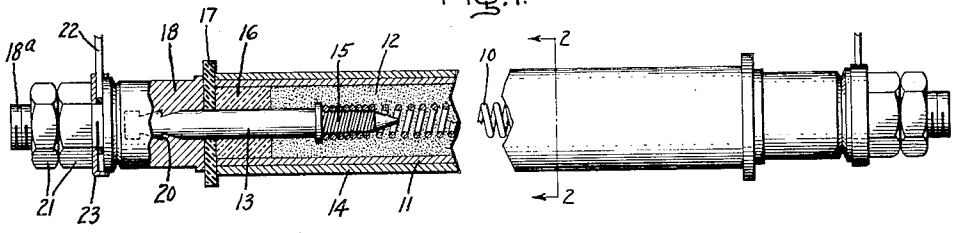
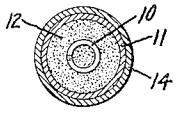


Fig. 2.



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2,036,788

ELECTRIC HEATING UNIT

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3 Claims. (Cl. 201—67)

This invention relates to electric heating units, more particularly to electric heating units of the sheathed type, and it has for its object the provision of an improved heating unit of this character.

This invention has particular application to sheathed heating units of the type described and claimed in my United States Patent No. 1,367,341 dated February 1, 1921. As there described, this type of heating unit comprises a resistance conductor encased by a metallic sheath and embedded in and supported in spaced relation with respect to the walls of the sheath by a powdered heat refractory electrically insulating material, such as magnesium oxide, compacted to a hard dense mass by reducing and elongating the sheath, as by rolling or swaging.

The metallic sheath of this heater is formed of a metal which is capable of being materially reduced and elongated, such as steel, in order that the insulating material can be compacted into a mass sufficiently dense to readily conduct heat from the resistance conductor to the sheath.

In certain applications, it has been found that sheaths formed of steel and other like commercially practical metals capable of being worked sufficiently to compact the insulating material will corrode or deteriorate and after a time fail completely. For example, it has been found that heaters having steel sheaths corrode and ultimately fail when used to heat water in certain applications, such as in the cooling systems of mercury arc rectifiers.

In this application, it has been discovered that pure nickel will not corrode or deteriorate as does the steel sheath, but it has been very difficult and practically impossible in certain cases to make an electric heating unit with a pure nickel sheath because nickel cannot be worked mechanically so as to compact the insulating material sufficiently. When subjected to the necessary reducing operations, the nickel splits up and cracks open, thereby ruining the heater.

In accordance with this invention, the heating unit is made with a sheath formed of steel, or some other mechanically strong metal capable of being worked sufficiently to compact the insulating material. After the sheath has been assembled with the resistance conductor and its insulating material and the sheath has been reduced and elongated in order to compact the insulating material, the sheath is slipped into or encased by a second sheath formed of nickel. This second sheath is then reduced and elongated just enough to cause it to grip tightly the inner sheath so as to effect a good thermal and mechanical connection between the two sheaths.

For a more complete understanding of this invention, reference should be had to the accompanying drawing in which Fig. 1 is an elevation partly in section of an electric heating unit embodying this invention; and Fig. 2 is a sectional view taken through the line 2—2 of Fig. 1 and looking in the direction of the arrows.

Referring to the drawing, this invention has been shown as applied to a sheathed heating unit of the type described and claimed in my above mentioned Patent No. 1,367,341 intended to be used to heat water in the cooling system of a mercury arc rectifier. Briefly, this heater comprises a helical resistance conductor 10 encased by a metallic sheat 11 formed of any suitable material, such as steel. The helical resistance element 10 is embedded in and supported in spaced relation with respect to the sheath 11 by means of suitable heat refractory electrically insulating material 12, such as powdered magnesium oxide. The powdered magnesium oxide 12 is compacted to a hard dense mass so as to readily conduct heat from the resistance element 10 to the sheath 11 by reducing and elongating the metallic sheath 11. This may be accomplished by swaging or rolling. The ends of the sinuous resistance element 10 are electrically and mechanically connected to suitable terminal members 13, the left-hand terminal only being shown.

As pointed out previously, the steel metallic sheath 11 will deteriorate and corrode in certain water heating applications, such as in cooling systems for mercury arc rectifiers and the like. The heater has a comparatively short life when used in such applications.

In accordance with this invention, the sheath 11 is covered by a second sheath 14, which is formed of any suitable metal which will not disintegrate or corrode in the presence of moisture and water, such as substantially pure nickel. Preferably, and as shown in Fig. 1, the sheath 14 will have substantially the same length as has the sheath 11.

The steel sheath 11 is assembled with the nickel sheath 14 after the sheath 11 has been assembled with its heating unit and the magnesium oxide 12, and the latter has been compacted. Thus, in making the heater thus far described, the resistance conductor 10 is me-

chanically and electrically connected with its terminals 13. This may be done conveniently in the manner described and claimed in my Patent No. 1,494,938, dated May 20, 1924. As there described, each terminal 13 is provided with a threaded portion 15 upon which the associated end turns of the helical resistance conductor are turned or screwed. The diameter of the helix is somewhat less than the diameter of the terminal at the roots of the thread so that the helix is extended somewhat when turned on. When the conductor subsequently contracts by reason of its resiliency on the threaded portion of the terminal, it will make a very good electrical and mechanical connection with the terminal.

After the conductor has been assembled with its terminals, it is threaded into the sheath 11 and is supported in a central position within the sheath by its terminals which are supported in any suitable manner, not illustrated. After this, the sheath 11 is loaded with the magnesium oxide 12 and then is reduced and elongated so as to firmly compact the oxide within the sheath, as described in my above-mentioned Patent No. 1,367,341. As pointed out previously, the sheath 11 may be reduced and elongated in order to compact the oxide 12 by rolling or swaging.

After this operation, the sheath 11 is fitted into or encased by the sheath 14. Preferably, the sheath 14 will have an internal diameter which will just permit the sheath 11 to be slid easily into it after the sheath 11 has been reduced and elongated to compact the oxide. Then the nickel sheath 14 is reduced and elongated just enough to cause it to tightly grip the inner sheath 11. In a specific example, the sheath 14 has an original internal diameter just sufficient to permit the sheath 11 to be slid into it, and then its diameter is reduced by approximately .010 or .015 inch. This reduction will be sufficient to cause the outer sheath 14 to grip the inner sheath 11 sufficiently tightly to effect a good thermal and mechanical connection between these members.

Arranged within the end portions of the inner sheath 11 are masses of electrically insulating sealing material 16, arranged to seal the heater against the passage of fluids, such as moisture and gases, through the ends of the heater. While any suitable sealing material 16 may be used, it is preferable to use glass having a high electrical resistance at the operating temperature of the heater. In making the seals, glass tubes having substantially the diameter of inner sheath 11, after it has been reduced, will be threaded upon the terminals 13, as shown in Fig. 1, then will be heated substantially to the plastic state, and then while pressure is applied allowed to cool. The glass 16 thus treated will be caused to adhere to the terminals 13 and to the surrounding inner walls of the sheath 11 with fluid impervious joints.

After the seals have thus been formed at the ends of the heater, suitable electrically insulating washers 17 are threaded on the terminals so as to cover the sealing material 16 and the end walls of the sheaths 11 and 14. These washers may be formed of any suitable insulating material, such as mica.

Then cylindrical metallic conducting plugs or connectors 18 are applied to the exposed ends of the terminals. These members may be secured to the terminals in any suitable manner, but I prefer to anchor them to the terminals by providing nicks 20 in the opposite sides of the terminals into which the metal of the connectors is forced or compressed. It will be understood that the members 18 will be formed of a suitable relatively soft material, such as brass, so that it will lend itself to the flattening or compressing operation. This method of securing the connectors to the terminals is described and claimed in my above-mentioned Patent No. 1,494,938.

Each lug or connector 18 is provided with a threaded portion 18_a upon which are threaded several nuts 21. These nuts serve to secure suitable leads 22 to the connectors. Preferably, cup-shaped washers 23 will be interposed between the inner nuts 21 and the leads 22, as clearly shown in Fig. 1.

While I have shown a particular embodiment of my invention, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made, and I, therefore, contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. An electric heater comprising a metallic sheath capable of being materially reduced and elongated, a resistance element within said sheath, heat refractory electrically insulating material within said sheath embedding said resistance element and compacted to a hard dense mass by elongating and reducing said sheath, a second metallic sheath formed mainly of nickel covering said first named sheath and fitted tightly thereto in good thermal relation with it by reducing and elongating said second sheath on said first sheath.

2. An electric heating unit comprising a steel sheath, powdered heat refractory electrically insulating material within said sheath compacted to a hard dense mass by reducing and elongating the sheath, a resistance conductor within said sheath embedded in said mass out of contact with said sheath, terminals connected to said resistance conductor projecting from said steel sheath, a second sheath formed substantially of pure nickel encasing said steel sheath and elongated and reduced in diameter sufficiently to give it a good mechanical and thermal relation with said steel sheath, and masses of electrically insulating sealing material within the end portions of said steel sheath surrounding said terminals and having fluid impervious joints with said terminals and the surrounding walls of said sheath.

3. An electric heater comprising a metallic sheath capable of being materially reduced and elongated, a resistance element within said sheath, heat refractory electrically insulating material within said sheath embedding said resistance element and compacted to a hard dense mass by reducing and elongating said sheath, and a second sheath formed of a selected material, which is incapable of being worked mechanically to reduce and elongate it sufficiently to compact said insulating material, covering said first sheath and reduced and elongated sufficiently to cause it to firmly grip said first sheath, whereby a good mechanical and thermal relation is established between said sheaths.

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