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METHOD OF MAKING ELECTRIC HEATERS

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Fig. 1.

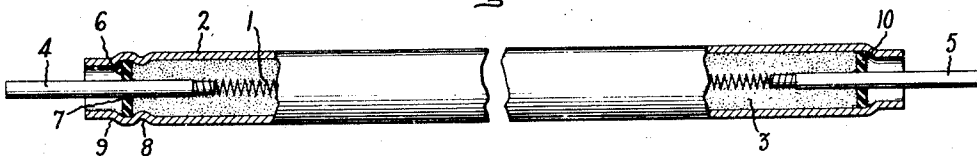
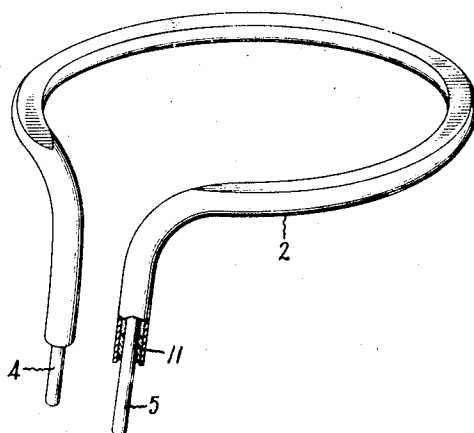


Fig. 2.



Fig. 3.



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METHOD OF MAKING ELECTRIC HEATERS

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5 Claims. (Cl. 201—67)

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This invention relates to electric heaters, and it has for its object the provision of improvements in electric heaters of the "sheath wire" type.

More specifically, this invention relates to electric heating units of the "sheath wire" type, such as disclosed in the United States Patent No. 1,367,341 to Charles C. Abbott, dated February 1, 1921. In heating units of this type, a resistance conductor is enclosed by a metallic sheath, and is embedded in a compacted mass of granular insulating material, such as magnesium oxide, which holds the resistance conductor in spaced relation to the sheath and electrically insulates it from the sheath. The insulating material may be compacted in any suitable way as by swaging or rolling the sheath. To the ends of the resistance conductor are secured terminals which have their inner ends embedded in the insulating material, and their outer ends projecting from the sheath so that suitable external electrical connections can be made. In the manufacture of the heating unit, the resistance conductor with its terminals attached is secured centrally in the sheath during the operation of loading the sheath with the insulating material, and during the preliminary compacting operations. And during the loading operation, one end of the sheath is closed, while the other end is left open so that the insulating material may be loaded through it into the sheath. Then the loading end is closed and the insulating material is compacted.

One arrangement, extensively used heretofore in the manufacture of such sheathed heaters, was to insert a resistance conductor with terminals attached to its ends into the sheath so that the ends of the terminals substantially coincided with the ends of the sheath; and to provide the outer end of one of the terminals with a rigid solid head, which head fitted into the associated end of the sheath and functioned both to hold the terminal in its proper relation with reference to the sheath and also to close this end of the sheath for the loading operation. The insulating material was then loaded through the other end of the sheath which was left open for this purpose; when the sheath had been filled, a metal washer was threaded on the terminal at this other end in order to close it. Usually, both ends of the sheath were preliminarily counter-

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bored or beaded to provide inner shoulders for seating the headed end of the lower terminal and the closing washer at the loading end, and the outer ends peened over or constricted so as to hold the washers firmly in place. The sheath was then swaged or rolled to compact the insulating material, and then it was annealed and formed into such configurations as might be desired in the final heating element. Following this, the ends of the unit were cut off to remove the washer and peened sections; and the ends of the sheath cut away, and the exposed parts of the insulating material removed in order to expose the desired lengths of the terminals for the external connections.

Then usually additional end sections of the insulating material were cored out in order to provide cavities in the ends of the sheath into which a sealing material, such as molten glass, could be inserted.

This invention contemplates an improved method of making heating units of the sheathed type which by comparison is very simple and inexpensive.

In accordance with this invention, the sheath at one end is provided with an inner shoulder as by beading, and the resistance conductor with the terminals attached to its two ends is inserted into the sheath; here, however, the terminals are allowed to extend beyond the ends of the sheath by an amount equal approximately to the projecting lengths desired in the finished heating unit. A washer is threaded over the terminal at the shouldered end of the sheath, preferably before the conductor and terminals attached are assembled within the sheath, and when they are assembled it bears against the shoulder for the purpose of closing the sheath at that end, and also for holding the terminal in its proper position in the end of the sheath. The sheath is then loaded with insulating material through the other end, and after it has been loaded a similar washer is threaded onto the other terminal at the loading end so as to close this end of the sheath. The sheath is then swaged or rolled so as to highly compact the material in the sheath.

The two washers are formed of a material which may be readily destroyed, and after the insulating material has been compacted, they are subjected to an agency which destroys them

and thereby removes them from the sheath. The removal of the washers provides cavities in the ends of the sheath into which the sealing material may be inserted. The washers may be formed of a material which will readily combust so that they may be destroyed by burning them out. Or they are made of an alloy having a low melting or fusing temperature, and may be destroyed by melting or fusing them.

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 of the sheath-wire type having a resistance conductor and its terminals assembled in it, and a compactible electrically-insulating and heat-conducting material loaded therein, and also having the combustible washers threaded on the two terminals and secured in the ends of the sheets; Fig. 2 is a view similar to Fig. 1, but showing the heating unit after it has been rolled or swaged so as to highly compact the insulating material, and after the washers have been burned out; and Fig. 3 is a perspective view, partly in section, of the heating unit formed into a spiral and flattened for use in connection with electric range surface units, and illustrating a sealing material placed in a cavity in one end of the sheath left by burning out the combustible washer at that end.

Referring to the drawing, this invention has been shown as applied to an electrical sheathed heater of the type described in the aforementioned Abbott patent. As shown, this heater comprises a helical resistance conductor 1 which is mounted within a metallic tubular sheath 2, and is embedded in and held in spaced relation with reference to the sheath by a compacted mass 3 (Fig. 2) formed of a suitable heat-conducting, electrically-insulating material, such as highly compacted granular magnesium oxide. The two ends of the resistance conductor 1 are secured to terminals 4 and 5 in any suitable manner, as by threading the end turns of the resistance conductor onto the terminals. The inner ends of the terminals also are embedded in the mass 3, and are held thereby in spaced relation with reference to the sheath, while the outer ends of the terminals project for a suitable distance from the sheath, as shown, so that the external electrical connections can be made. Preferably, and as shown, the resistance conductor 1 and the terminals 4 and 5 will lie in the longitudinal center line of the sheath.

In making the heater of Fig. 2 in accordance with this invention, the helical resistance conductor 1 is attached to its terminals 4 and 5 as described above, and then the assembly of resistance conductor and terminals is inserted into the sheath, the sheath having such a length and the aforesaid helix assembly positioned in such a manner that the outer portions of the terminals extend outwardly beyond the ends of the sheath by an amount equal approximately to the lengths desired in the finished heating unit.

Onto the terminal 4 is affixed a washer 6, the washer having a central aperture 7 which receives the terminal. Preferably, the washer will be assembled with the terminal prior to the assembly of the conductor and terminal with the sheath. And prior to the assembly of the washer with the sheath, the end of the sheath in which the washer is received is spun in so as to form an indentation or seat 8 against which the washer bears. The washer fits with sufficient tightness

to the terminal that it anchors it in its proper position with relation to the end of the sheath, as shown in Fig. 1.

The washer 6 has the characteristic that it will combust at temperatures such as the temperature the unit attains when it is annealed after the insulating material is loaded and compacted. Preferably, the washer will be made of a suitable fiber or plastic. In case a plastic is used the washer may be affixed by molding it to the terminal, if desired.

The sheath is now ready for the loading of the insulating material into it, and for this purpose, the sheath is secured in an upright position with the washer 6 lowermost, and the insulating material is loaded into the upper end of the sheath which is now open. While the sheath is being loaded, it is intermittently tapped to settle the insulating material, and also the terminal 5 which will now be uppermost is secured by some suitable means (not shown) centrally of the sheath and to prevent it moving inwardly of the sheath while the material is being loaded. The sheath may be and preferably will be loaded by use of the loading apparatus described and claimed in the U. S. patent to J. L. Andrews No. 2,316,659, dated April 13, 1943.

The sheath is loaded to a level not quite to the top of the tube, and into the space left at the top is inserted a washer-like closure member 10 which is the same as the washer 6, and which is threaded onto the terminal 5 in order to insert it into the tube. Following this, this end of the tube is crimped down in order to clamp the washer against the loaded insulating material 3 and to cause it to grip tightly the terminal 5. The other end may be crimped down in a similar way depending upon the process employed to compact the insulating material 3; we have found that it need not be crimped if rolling is used and this end is first introduced into the rolling machine rolls.

The heating unit is now ready for the compacting operation, and for this purpose the sheath is elongated and reduced in diameter, and preferably this will be accomplished by rolling the sheath. The washers 6 and 10 function to hold the terminals and resistance conductor centrally within the sheath during the preliminary rolling steps. The sheath is rolled so as to reduce its diameter sufficiently (see Fig. 2) to highly compact the insulating material 3.

It should be noted the the rolling operation will "iron out" the seat 8 and the crimped end sections, and will leave the sheath with a uniform diameter throughout.

As previously pointed out, it is customary after such mechanical treatment of the sheath to anneal it. The sheath is placed into a suitable annealing furnace for this purpose, and while it is being annealed its temperature usually will be raised sufficiently high to cause the combustible washers 6 and 10 to burn out, thereby leaving cavities in the ends of the sheath as shown in Fig. 2; if not, the washers may be fired additionally. It will be understood that Fig. 2 illustrates the heater in its final form except for the insertion in the cavities of the sealing material, if such sealing material be desired.

In high-temperature range units, such as shown in Fig. 3, it is generally desirable to use such sealing material, and preferably the sealing material will be glass inserted in a molten state, or inserted in the form of a bead and then melted, so as to cause it to adhere rigidly to the surfaces of the

terminals and sheath when it hardens. Such sealing material 11 is shown in one end of the sheath of the heater of Fig. 3.

As pointed out previously, the washers 6 and 10 may be made of an alloy or fusible metal which will melt or fuse at a relatively low temperature. These may be destroyed when the sheath is annealed or by additional firing.

It will be observed that sheath material is saved because shorter sheaths may be used in that it is not necessary to cut away the ends of the sheath in order to provide the desired projecting parts of the terminal elements for external connections, as in the practice heretofore generally used. Also, of course, it saves the insulating material, which was used heretofore to fill the cut-away parts of the sheath. It also eliminates the operations of the aforescribed method consisting in severing the sheath ends to remove the solid metallic closures, and severing of the ends of the sheath and stripping away of the compacted oxide to expose the terminals to make exterior connection sections. It further eliminates the step used heretofore of coring the oxide from the ends of the sheath in order to provide the cavities for the sealing material.

While we have shown and described particular embodiments of our invention, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from our invention in its broader aspects and we therefore aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of our invention.

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

1. The method of making an electric heating unit provided with a sheath, a resistance conductor in said sheath and a terminal portion in said sheath projecting out through an opening provided for it in a wall thereof a predetermined distance from the sheath, which method comprises, providing a resistance conductor with a terminal portion and a sheath with an opening in a wall thereof, inserting said conductor into said sheath so that said terminal portion projects therefrom and beyond said opening by an amount equal approximately to said predetermined distance, inserting into said sheath a compressible heat-conducting and electrically insulating material around and about said conductor, inserting a plug-like closure member formed of a readily destructible material into said sheath adjacent to said opening and surrounding said terminal portion in order to close said opening and to support said terminal portion projecting from said opening an amount equivalent approximately to said predetermined distance, compressing said insulating material into firm engagement with said resistance conductor and the inner end of said terminal portion and simultaneously supporting said terminal portion in position projecting said predetermined distance from said sheath, and then subjecting said closure member to an agency which destroys it in order to provide a void in said sheath adjacent to said opening and surrounding said terminal portion projecting said predetermined distance from said sheath.

2. The method of making an electric heating unit provided with a tubular sheath having a resistance conductor therein and having terminals connected to said conductor, predetermined lengths of which project from the ends of said sheath, which method comprises, providing an

open-ended tubular sheath, inserting said resistance conductor and terminals into said sheath so that the terminals have said predetermined lengths projecting from the ends thereof and also inserting into said sheath a compressible heat-conducting and electrically-insulating material, closing the ends of said sheath with closure members which are combustible, compressing said insulating material into firm engagement with said resistance conductor and the inner ends of said terminals and simultaneously supporting said terminals in position respectively projecting said predetermined lengths from the opposite ends of said sheath, and then heating said closure members to a temperature sufficiently high to burn them out in order to provide voids disposed in the opposite ends of said sheath and respectively surrounding said terminals respectively projecting said predetermined lengths from the opposite ends of said sheath.

3. The method of making an electric heater which comprises, providing an open-ended tube, connecting two rod-like terminals to the ends of a resistance conductor, threading a washer onto one end of one of said terminals, inserting the resistance conductor with the terminals attached into said tube so that the outer ends of the two terminals respectively project from the two ends of said tube, and so that said washer closes one end of said tube, loading a compactible electrically-insulating and heat-conducting material into the other end of said tube, threading a washer onto the other terminal so as to close said other end of said tube, working said tube to reduce the volume thereof between said washers so as to compact said insulating material into firm engagement with said resistance conductor and the inner ends of said terminals and simultaneously supporting the two terminals in position respectively projecting from the two ends of said tube, and then removing said washers in order to provide voids disposed between the opposite ends of said compacted insulating material and the adjacent opposite ends of said sheath and respectively surrounding said terminals respectively projecting from the opposite ends of said sheath.

4. The method of making an electric heater which comprises, providing an open-ended tubular metallic sheath, attaching terminals to the ends of a resistance conductor, threading a combustible washer on one of said terminals, inserting said resistance conductor with the terminals attached into said sheath so that the outer ends of the two terminals project from the opposite ends of the sheath and the resistance conductor is supported in the sheath between them, and so that said washer closes the associated end of said sheath and holds said terminal substantially centrally of the sheath, loading a compactible heating-conducting and electrically-insulating material into the other end of said sheath, threading onto the other terminal at said other end a combustible washer to close said other end, working said sheath to reduce the volume thereof between said washers so as to compact said insulating material into firm engagement with said resistance conductor and the inner ends of said terminals and simultaneously supporting said terminals in position respectively projecting from the opposite ends of said sheath, and elevating the temperature of said washers to the combustion point so as to burn them from said sheath in order to provide voids disposed between the opposite ends of said

compacted insulating material and the adjacent opposite ends of said sheath and respectively surrounding said terminals respectively projecting from the opposite ends of said sheath.

5 The method of making an electric heater which comprises, providing an open-ended tubular metallic sheath, applying terminals to the ends of a helical resistance conductor, threading a combustible washer on one of said terminals, inserting said resistance conductor with the terminals attached into said sheath so that the two terminals project from its opposite ends and the resistance conductor is supported in the sheath between them, and so that said washer closes the associated end of said sheath and holds its terminal substantially centrally of the sheath, loading a compactible heat-conducting and electrically-insulating material into the other end of said sheath, threading onto the other terminal at said other end a combustible washer to close said other end, working said sheath to reduce the volume thereof between said washers so as to compact said insulating material into firm engagement with the convolutions of said resistance conductor and the inner ends of said terminals and simultaneously supporting said terminals in position respectively projecting from the opposite ends of said sheath, elevating the temperature of said washers to the combustion

point so as to burn them from said sheath in order to provide voids disposed between the opposite ends of said compacted insulating material and the adjacent opposite ends of said sheath and respectively surrounding said terminals respectively projecting from the opposite ends of said sheath, and filling said voids with a sealing material.

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The following references are of record in the file of this patent:

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Certificate of Correction

Patent No. 2,483,839

October 4, 1949

STERLING A. OAKLEY ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 6, line 61, for the word "heating-conducting" read *heat-conducting*; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 24th day of January, A. D. 1950.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.