

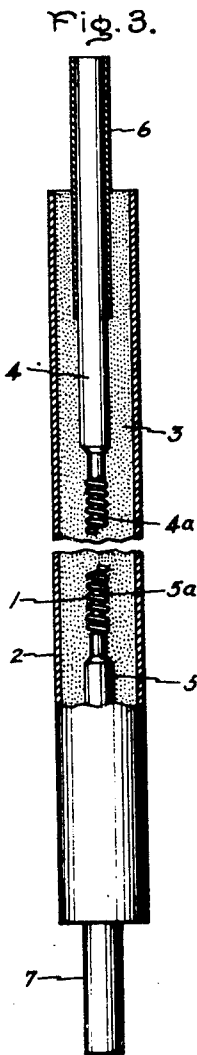
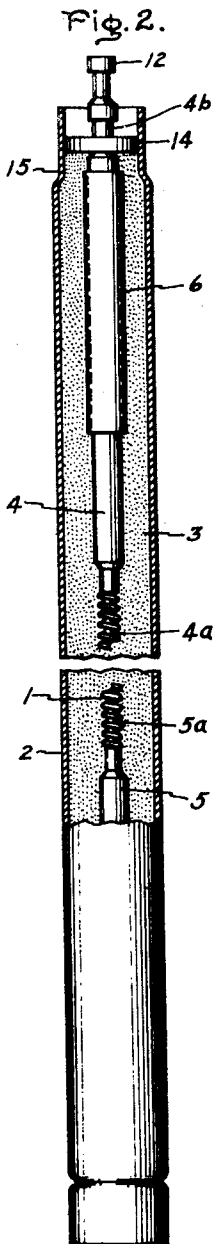
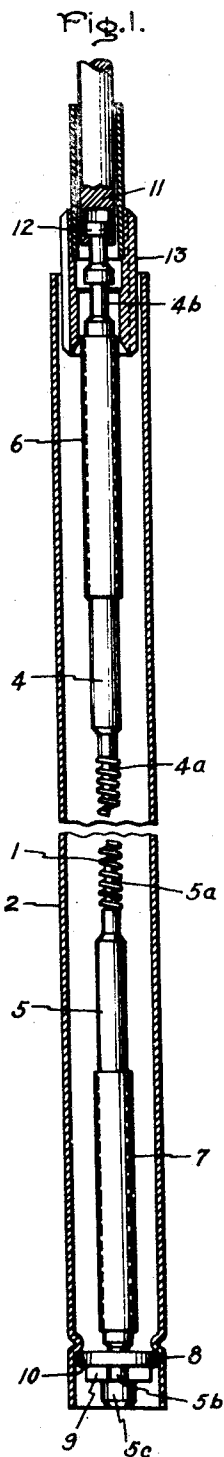
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O. G. VOGEL

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ELECTRIC HEATER

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Inventor:
Oliver G. Vogel,
by *Alfred V. Bobst*
His Attorney.

UNITED STATES PATENT OFFICE

2,490,934

ELECTRIC HEATER

Oliver G. Vogel, Oak Park, Ill., assignor to Hot-point Inc., a corporation of New York

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2 Claims. (Cl. 201-67)

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This invention relates to electric heaters, more particularly to electric heaters of the sheathed type, and it has for its object the provision in a heater of this character of an improved terminal structure and method of making it.

More specifically, this invention relates to sheathed electric heaters having a resistance conductor housed within a metallic sheath and embedded in a mass of electrically insulating and heat conducting material such as compacted powdered magnesium oxide, which mass holds the conductor in spaced relation with reference to the sheath. The powdered magnesium oxide may be compacted in any suitable way after it has been loaded in the sheath, but preferably it will be compacted by elongating the sheath and reducing its diameter, and this may be done by rolling or swaging. Also the heater comprises terminals which have inner ends located in the sheath where they are connected electrically with the resistance conductor, and also are embedded in the insulating mass so as to be held in proper spaced relation with the sheath. The outer ends of these terminals project from the sheath so that external electrical connections can be made with the terminals and hence with the resistance conductor that is in the sheath.

Preferably, these terminals are made of some base material, such as steel; steel is inexpensive, is readily machinable; and lends itself readily to standard welding techniques and facilities which is important when it is desired to weld the terminal to the conductor.

However, the steel has certain disadvantages; it is corrosive in certain mediums; it does not unite perfectly with certain desirable sealing materials used to seal the sheath ends, such as certain glass seals; and its electrical resistance is not as low as is desired in certain applications.

This invention contemplates an improved terminal structure which retains the steel terminals and attendant advantages, but which are provided with a layer or covering for the exterior surfaces of the terminals, at least the projecting sections thereof, having desirable properties which are not present in plain steel terminals.

In carrying out my invention, I make the terminals of the desired base metal, such as steel, and insert each terminal into a tube which is formed of a metal having the characteristics it is desired the surface of the finished terminal shall have. The tube is pressed tightly onto the terminal so as to firmly adhere to it and have good contact therewith. The tube is assembled to the terminal prior to the magnesium oxide compact-

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ing operation, and preferably prior to the assembly of the heating resistance and terminal with the sheath. Then after the tube has been slipped onto its terminal and the terminal and resistance conductor are assembled with the sheath, and the sheath loaded with the magnesium oxide, the sheath is rolled or swaged. As indicated, this operation compacts the magnesium oxide, and the magnesium oxide at the same time acts upon the tube to elongate it and reduce its diameter so as to cause it to bind tightly with the terminal. The tube has such a length and is so positioned that it covers the exterior side surface of the terminal, and also has a material length embedded in the magnesia mass.

For a more complete understanding of this invention, reference should be had to the accompanying drawing in which Fig. 1 is a vertical central sectional view taken through a sheathed electrical heating unit provided with terminal structure embodying this invention, and illustrating the resistance conductor and terminals in assembled relation with each other and the sheath and the terminal tubes assembled with the terminals, and the whole assembly ready for the operation of loading the sheath with the magnesium oxide; Fig. 2 is a vertical elevation mainly in section illustrating the sheath loaded with the magnesium oxide and ready for the magnesium oxide compacting step; and Fig. 3 is a vertical elevation mainly in section illustrating the finished heater.

Referring to the drawing, I have shown my invention in one form as applied to an electric sheathed heater provided with a helical resistance element 1 mounted centrally within a metallic sheath 2 and embedded in and held in spaced relation to the sheath by a mass formed of a suitable heat conducting and electrically insulating material 3, such as compacted magnesium oxide (Fig. 3). Also mounted in the ends of the sheath, centrally thereof, are a pair of rod-like terminals 4 and 5, which as shown have their inner ends embedded in the compacted mass 3 and are electrically connected with the ends of the resistance conductor while their outer ends project from the sheath, as shown, so that suitable external electrical connections (not shown) may be made. The terminals may be attached to the resistance conductor by providing threaded sections (not shown) upon the terminals on which the end turns of the conductor are wound, or they may be connected with the resistance conductor by being welded thereto as described and claimed in the copending application of Sterling A. Oak-

ley, Serial No. 595,721, filed May 25, 1945, and which application is assigned to the assignee of the instant application.

As pointed out above, the terminals 4 and 5 are made of a base metal which is inexpensive, which has the desired mechanical strength, which may be readily machined or worked, and which may be easily welded to the resistance conductor (if such connection is desired); steel is quite suitable and is preferable.

Mounted upon the terminals 4 and 5 and tightly interfitted therewith are tubes 6 and 7 which have such a length that they extend from the very outermost ends of the terminals well down into the insulating mass, as clearly shown in Fig. 3. The tubes 6 and 7 are made of a material which has the characteristics that it is desired the exposed projecting sections of the terminals have. For example, if it be desired to render the terminals non-corrosive, the tubes will be made of a suitable non-corrosive metal such as stainless steel, or nickel, etc. If it be desired to cause the terminals to more firmly adhere to glass seals, such as are frequently used in the ends of the sheathed heaters, the tubes would preferably be made of a suitable iron, nickel and cobalt alloy which has substantially the same thermal coefficient of expansion as the glass sealing material. If it be desired to provide a terminal connection of low electrical resistance, the tubes will be made of silver or copper. Thus, the tubes may be made of stainless steel, nickel, nickel-chromium-iron alloys, nickel-copper alloys, silver, copper, etc.

In making the heating unit of Fig. 3 the terminals 4 and 5 having the respective shapes and constructions shown in Fig. 1, preferably and as shown will have their inner ends 4a and 5a connected to the two ends of the resistance conductor 1 by welding as described and claimed in the aforementioned Oakley application.

Then the tubes 6 and 7 will be slipped onto the terminals into the positions shown in Fig. 1. The tubes should have relatively thin walls and their internal diameters should be such that the tubes fit the terminals quite snugly so as to prevent any of the insulating powder from getting into the spaces between the terminals and the tubes during subsequent loading and compacting operations. Preferably, also the tubes will be temporarily secured by prick punching them to the terminals, or by some similar means.

Then a washer 8 is threaded onto the outer reduced end 5b of the terminal 5 and is held thereon by means of a U-shaped clip retainer 9 which is held in place by the enlarged head 5c of the terminal. And the associated end of the sheath will be provided with an inwardly pressed bead defining a seat 10.

Then the assembly of the resistance conductor 1, the terminals 4 and 5 with the tubes 6 and 7 thereon and also the washer 8 assembled with the terminal 5 will be assembled with the sheath 2 so that the washer 8 is brought up against the seat 10. The washer closes its end of the sheath and also functions to hold the terminal 5 in the center line of the sheath.

The assembly is now ready to be loaded with the magnesium oxide powder. Preferably, this will be done in the loading apparatus described and claimed in the United States patent to John Lewis Andrews No. 2,316,659, dated April 13, 1943. As there described, the unit assembly is supported in the apparatus in an upright position with the end closed by the washer 8 lowermost. The mag-

nesium oxide is loaded by the apparatus into the upper end of the sheath, now open, while the upper terminal 4 is supported in its position of Fig. 1 in the upper end of the sheath and in the center line thereof by means of a loading hook 11, corresponding to hook 35 of the Andrews patent, and which engages a head 12 provided on the upper end of the upper terminal 4. The centralizer 45 of the Andrews patent is here identified by the numeral 13.

After the sheath has been loaded with the magnesium oxide, the loaded heating unit is removed from the loading apparatus and the upper end of the sheath is closed by a washer 14 which is threaded on the upper end 4b of the terminal 4, and this upper end of the sheath is crimped inwardly, as indicated by numeral 15, tightly to hold the washer in place.

Following this, the magnesium oxide is compacted by reducing the diameter of the sheath and elongating its length. This preferably will be done by passing the unit through the rolling machine described and claimed in the copending application of Sterling A. Oakley, Serial No. 483,699, filed April 19, 1943, now abandoned, and which application is assigned to the assignee of the instant application. The lower end of the heating unit, as viewed in Fig. 2, will preferably be inserted first into the first rolls of the rolling machine and for this reason the lower washer 8 need not be crimped in place as is the upper washer 14. However, if the sheath be elongated by swaging then the lower washer 8 also preferably should be secured by a crimped section similar to the section 15. The rolling operation elongates the sheath and reduces its diameter to the diameter shown in Fig. 3 in order highly to compact the magnesium oxide powder. And the magnesium oxide as it is being compacted transmits the forces of the rolls of the rolling apparatus to the tubes 6 and 7 so that they are also elongated in length and reduced in diameter and thereby caused tightly to fit the terminals. That is, the rolling operation not only compacts the magnesium oxide but it also tightly binds the terminals and tubes together.

After the unit has been elongated and reduced in diameter to compact the magnesium oxide, the ends of the sheath and the terminal ends with the washers 8 and 13 thereon are cut away and the sheath ends and magnesium oxide stripped away so as to expose the desired exterior lengths of the terminals, as shown in Fig. 3. This leaves the outer end surfaces only of the base metal of the terminals exposed. Usually no harm is done by leaving them so exposed but if desired they too may be covered as by means of a suitable solder or brazing material.

This invention may also be used to clad the terminals of the heater described and claimed in the copending application of Sterling A. Oakley and Rufus T. Staudt, Serial No. 634,274, filed December 11, 1945, now Patent No. 2,483,839, issued October 4, 1949, and which application is assigned to the assignee of the instant application. There the cladding tube would extend out beyond the sheath end to cover the portions of the terminals that are used for electrical connections while an inner section of the tube would be embedded in the magnesium oxide mass. Here the inner embedded sections of the tubes would be caused to grip the terminals tightly when the sheath is reduced in diameter and elongated in order to compact the insulating powder. In many instances this will provide sufficient electrical

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bonding between the tubes and the terminals. In those cases where it is desired that the tubes tightly adhere to the terminals throughout the lengths of the tubes, the tubes will be swaged or drawn down onto the terminals in a separate operation.

Because of the fact that the cladding tubes 6 and 7 so tightly grip the terminals 4 and 5 they are for all practical purposes integral with the terminals.

While I have disclosed particular embodiments 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. The method of making an electric heater which comprises connecting a terminal formed of a base metal to a resistance conductor, said terminal having an external electrical connection section, inserting a tube onto said terminal so as to encase said electrical connection section and a section contiguous thereto, said tube being formed of a selected material having a characteristic not present in the surface of said terminal, mounting the assembly of said resistance conductor, terminal and tube into a sheath, loading a compressible electrically insulating and heat conducting material into said sheath so as to embed said resistance conductor and the sections of said terminal and tube within said sheath, and elongating said sheath by reducing its diameter so as to compress said insulating material and simultaneously to elongate said tube and thereby reduce its diameter so as to cause it tightly to fit said terminal sections and to be frictionally secured thereto.

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2. The method of making a sheathed electric heating unit which comprises, connecting one end of a rod-like terminal to one end of a resistance conductor, placing over the outer end section of said terminal a tube formed of a selected material having a characteristic not present in the metal of which said terminal is made, inserting the assembly of resistance conductor, terminal and tube into a metallic sheath, loading said sheath with a powdered electrically insulating and heat conducting compressible material, and then elongating the length of said sheath by reducing its diameter to compact said insulating material and through the medium of said insulating material to elongate said tube and thereby reduce its diameter to cause it tightly to grip said rod-like terminal and to be frictionally secured thereto.

OLIVER G. VOGEL.

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