

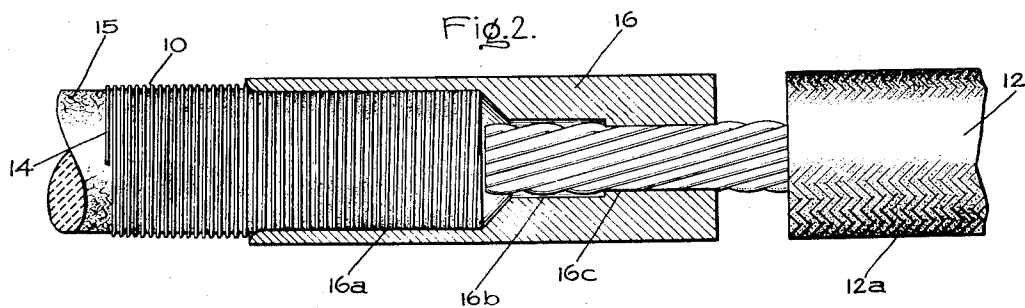
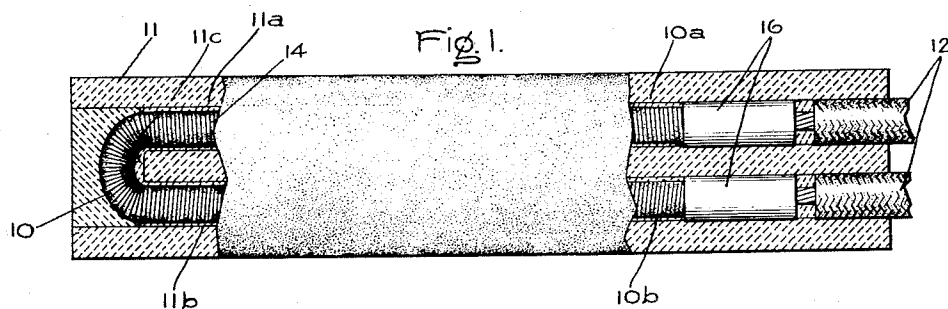
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C. C. ABBOTT

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ELECTRIC HEATER

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UNITED STATES PATENT OFFICE

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ELECTRIC HEATER

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My invention relates to electric heaters and has for its object the provision of a simple, efficient and inexpensive electric heater and method of making it.

Although it obviously has other applications, my invention is particularly useful in connection with electric heaters provided for relatively low temperature work. More specifically, my invention is particularly useful in connection with electric heaters employed to heat the lubricating oil of refrigerator apparatus.

In carrying my invention into effect in one form thereof, I provide a heating unit which comprises a supporting member upon which the resistance conductor is wound. Preferably, the supporting member will be formed from a suitable heat resistant material, such as asbestos. Each end of the resistance unit will be secured to a suitable lead by means of a terminal member which will be compressed, as by a swaging operation, about a portion of the turns of the coiled resistance conductor and the end portion of the lead. An electrically insulating sheath is provided to house the heating unit. Preferably, the sheath will be provided with a passageway shaped so that the heating unit when positioned within the sheath will have a substantially hairpin shape. Thus, in the finished electric heater, the end portions of the heating unit carrying the terminals are adjacent each other. Obviously, however, the heater may be formed in any suitable shape. Thus, the sheath may be substantially straight with the leads projecting from the opposite ends.

For a more complete understanding of my invention, reference should be had to the accompanying drawings in which Fig. 1 is an elevation partly in section of an electric heater embodying my invention, and Fig. 2 is a part sectional view illustrating the manner in which one end of the resistance conductor is connected to its lead, the view being taken to a larger scale than Fig. 1.

Referring to the drawings, I have shown my invention in connection with an electric heater comprising a heating unit 10 which is provided with an electrically insulating

sheath or housing 11 and a pair of leads 12. It will be understood that in service these leads will serve to connect the heating unit with a suitable source of electrical supply (not shown).

As shown, the heating unit 10 comprises an electrical resistance conductor or wire 14, which will be wound or coiled upon a suitable supporting member or core 15. Preferably, this supporting member will be made of a suitable heat insulating, flexible and slightly yielding material such as asbestos. A flexible and yielding asbestos cord may be used conveniently for the supporting member. Thus, the resistance conductor may be wound continuously upon a relatively long length of the asbestos cord, after which the cord with the conductor wound thereon may be cut into portions of the required lengths for the heating units.

The provision of the heat resistant, flexible supporting member 15 is an important feature of my invention. It will be appreciated that in an electric heater adapted for low temperature work, it is desirable to use a very fine resistance conductor in order to secure the required resistance. In order to use satisfactorily a very fine resistance conductor, I have provided the conductor with a heat resistant core which serves both to support the turns of the resistance conductor and to retain the various turns in their proper spaced relation. It will be observed that since the conductor is provided with a support which is slightly yielding, the conductor as it is being wound will slightly depress the outer surface of the support so that each turn of the conductor will form its own recess. By reason of this construction any displacement of the turns is prevented. It will be understood, however, that the asbestos supporting member 15 is sufficiently hard to provide a comparatively strong and firm support for the light conductor, it being yielding merely to the extent of permitting the resistance conductor to slightly depress its outer surface. In other words, the supporting member 15 will be one possessing substantial mechanical strength.

Each end of the heating unit will be suit-

ably connected with its lead member 12. In order to secure the end portion of the resistance conductor to its lead 12 in good mechanical and electrical relation therewith, I provide suitable terminal members 16. As shown (Fig. 2), each terminal member 16 is tubular in form and is provided with a stepped bore, one portion 16a of which will serve to receive the end of the supporting member upon which the resistance conductor is coiled while the other portions 16b and 16c of which will serve to receive the terminal end of the cooperating lead 12.

In assembling the terminal, it will be understood that the end of the support 15 will be inserted in the larger bore 16a of the terminal 16. The second step in assembling the terminal is to slightly compress or crimp the receiving or inner edge of the terminal. This insures that the terminal will be held in proper position with respect to the coiled resistance conductor during the subsequent swaging operation. Then the end portion of the lead 12 which, of course, will have been bared of its insulation 12a will be inserted in the smaller portions 16b and 16c of the bore. The terminal member 16 will then be subjected to a swaging or like process whereby its diameter will be reduced to such an extent that the terminal will be compressed into firm mechanical and good electrical contact with the end turns of the coiled resistance unit and the bared end portion of the lead 12. It will be observed, by reference to Fig. 2, that the terminal will be compressed about the end turns of the coiled conductor so that they will be depressed into the yielding surface of the asbestos support. As a matter of fact, it is preferable that the diameter of the asbestos supporting member itself be slightly reduced by the compressed terminal. It also will be observed that the smallest portion 16c of the bore will be compressed tightly about the bared lead while the end of the lead will be received in the slightly larger portion 16b of the bore. Thus, the extreme end portion of the lead will form a head which together with the compressed portion 16c of the terminal will practically prevent the lead from being pulled out. It will be understood that if it is desired, the terminal member 16 may be swaged to such an extent that its outer diameter will be substantially that of the outside diameter of the coiled conductor. Preferably, and as shown, the resistance end of the terminal will be rounded or bell mouthed so as to prevent injury to the resistance conductor during the swaging operation.

After both of the leads have been connected to the resistance conductor in the manner just described, the conductor is bent or otherwise shaped in the form of a hairpin so that in the finished heating unit

the terminals are adjacent each other (Fig. 1).

As has been pointed out, the heating unit will be provided with a suitable electrically insulating sheath or housing 11. Preferably, this sheath will be made of a suitable ceramic compound such as porcelain. In order to adapt the porcelain sheath for a ready assembly with the hairpin shaped heating unit, I provide the porcelain sheath with a pair of substantially parallel spaced passageways 11a and 11b, and on one end with a recess 11c into which the passageways open. As shown, the passageways extend from this recess longitudinally through the sheath to its opposite end where they open to the exterior of the sheath. In assembling the heating unit with the sheath, the heating unit will be drawn through the passageways 11a and 11b, respectively, so that the leg portions 10a and 10b will be received in the parallel passageways while the bent or U-shaped portion of the heating unit will be received in the recess 11c. It will be observed that in the assembled heater the leads 12 will be projected from the open ends of the passageways. Preferably, before the heating unit is positioned within the sheath, it will be dipped in a suitable liquid cement such as liquid porcelain cement. It will be understood that the entire heating unit including the terminal portions will be dipped in the liquid cement. This cement when hardened serves to anchor the windings and terminals within the sheath. Thus, in the event the asbestos support becomes charred or weakened by reason of excessively high temperatures, the turns of the wound conductor and likewise the terminals will be held in place.

After the heating unit has been assembled with its sheath 11, the recess 11c will be completely filled with a suitable liquid cement, such as liquid porcelain cement. After the recess has thus been filled, the heater will be placed into an oven and heated to a suitable temperature and for a suitable length of time so that the entire sheath casing will be dried until it becomes a hard porcelain mass.

It will be observed that I have formed an electric heater which not only will be mechanically strong and durable, but also will be of a comparatively inexpensive construction. The fine resistance conductor is rigidly supported upon the comparatively rigid core member 15 while the leads 12 will be effectively secured both mechanically and electrically with the resistance conductor. The asbestos support 15 will withstand relatively high temperatures without danger of deterioration or destruction.

It is to be noted that while I have described my invention specifically with reference to a heating unit adapted to low temperature work, the invention is equally useful in connection with high temperature heating units.

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

1. A heating unit comprising a supporting member, a resistance conductor wound upon said supporting member and a terminal member compressed about a portion of said supporting member in contact with the conductor turns wound upon said portion.

2. A heating unit comprising a yielding supporting member, a resistance conductor wound upon said supporting member and a terminal member compressed about said yielding supporting member so as to be in electrical contact with a portion of the turns of said coiled conductor.

3. A heating unit comprising a heat resistant supporting member, a resistance conductor wound upon said supporting member, a lead for said resistance conductor and an electrical conducting member compressed about a portion of the turns of said wound conductor and about a portion of said lead whereby said lead is secured to said resistance conductor.

4. An electrical heater comprising a heating unit having a yielding supporting member, a resistance conductor coiled about said supporting member, a lead for said resistance conductor and means for electrically connecting said resistance conductor and said lead comprising a tubular member compressed about a portion of the turns of said coiled resistance conductor and an end portion of said lead.

5. A heating unit comprising a wound resistance conductor, a terminal member for said resistance conductor having a portion surrounding a portion of the turns of said wound conductor and means associated with said turns for maintaining them in good electrical conducting relation with said terminal.

6. A heating unit comprising a flexible asbestos supporting member, a resistance conductor coiled about said supporting member, a lead for said resistance conductor and a tubular terminal member compressed about said supporting member so as to be in electrical contact with an end portion of said coiled resistance conductor, said tubular terminal member being compressed about the adjacent end of said lead whereby the lead is secured to said resistance conductor.

7. A heating unit comprising a substantially cylindrical asbestos support, a resistance conductor wound upon said support substantially to one end thereof, a lead for said resistance conductor positioned with one end adjacent said end of the cylindrical support and a tubular terminal member for electrically connecting said lead to said resistance conductor compressed upon the adjacent ends of said cylindrical support and said lead.

8. An electrical heating unit comprising a substantially cylindrical, yielding support, a

resistance conductor wound upon said support substantially throughout its length, a lead for each end of said coiled resistance conductor, each lead having one end positioned in substantial alignment with the associated end of the cylindrical support, and a tubular terminal for each end of said resistance conductor whereby said end is mechanically and electrically connected with the adjacent end of its associated lead, said terminal having a stepped bore, one portion of said bore being compressed about said end of the cylindrical support, while another portion of said bore is compressed about a portion of said lead whereby the adjacent end of said lead is provided with a head for preventing the withdrawal of said lead.

9. An electrical heater comprising an electrically insulating sheath having an open end, a supporting member mounted within said sheath, a resistance conductor mounted upon said supporting member, a lead projecting into said sheath through its open end and a terminal mounted within said sheath for electrically connecting said resistance conductor with said lead, said terminal being compressed about said supporting member so as to be in electrical contact with a portion of said electrical conductor.

10. A heating unit comprising an electrically insulating sheath having an open end, a yielding supporting member mounted within said sheath, a resistance conductor wound upon said supporting member and a terminal mounted within said sheath, said terminal being compressed about said yielding supporting member so as to be in electrical contact with a portion of said electrical conductor.

11. A heating unit comprising an electrically insulating sheath having an open end, a yielding supporting member mounted within said sheath, a resistance conductor coiled about said supporting member, a lead for said resistance conductor projecting from said open end and means for electrically connecting said resistance conductor and said lead comprising a tubular member mounted within said sheath and compressed about a portion of the end turns of said coiled resistance conductor and the end portion of said lead.

12. An electrical heater comprising a porcelain sheath having a passageway shaped in the form of a hairpin, the ends of said passageway being open to the exterior of the sheath, an asbestos supporting member mounted within said sheath so as to assume a substantially hairpin shape, a resistance conductor coiled about said supporting member substantially throughout its length, a lead for each end of said coiled resistance conductor, said leads being projected into the open end portions of said passageway so as to be in substantial alignment with the cor-

- responding ends of said support, and a tubular terminal member mounted within each leg of said passageway so as to receive the associated adjacent ends of said support and said leads, each terminal member being compressed about said adjacent ends so as to provide a firm mechanical and good electrical connection between the end turns of said resistance conductor and its leads.
13. The method of forming a heating unit which comprises winding a resistance conductor upon a yielding supporting member and then securing said resistance conductor to a lead by compressing a tubular terminal member about a portion of the resistance conductor and a portion of said lead.
14. The method of forming a heating unit which comprises coiling a resistance conductor upon a substantially cylindrical supporting member, then connecting a terminal member to the end of said coiled resistance unit and a lead by placing the adjacent ends of the supporting member and lead in a passageway formed in said terminal member whereby the terminal embraces the end turns of said coiled conductor and the end portion of said lead and then swaging said terminal into firm mechanical and good electrical contact with said resistance conductor and said lead.
15. The method of forming a heating unit which comprises winding a resistance conductor upon a yielding supporting member, then securing said resistance conductor to a lead by compressing a tubular terminal member about a portion of the resistance conductor and a portion of said lead and then surrounding said supporting member, resistance conductor and terminals with an electrically insulating covering.
16. The method of forming a heating unit which comprises coiling a resistance conductor upon a substantially cylindrical supporting member, then connecting a terminal member to the end of said coiled resistance unit and to a lead by placing the adjacent ends of the supporting member and lead in a passageway formed in said terminal member whereby the terminal embraces the end turns of said coiled conductor and the end portion of said lead, then swaging said terminal into firm mechanical and good electrical contact with said resistance conductor and said lead, and then placing said support together with the coiled resistance conductor and its terminals into an electrically insulating porcelain sheath.
17. The method of forming an electrical heater which comprises providing a heating unit by winding a resistance conductor upon a flexible supporting member, then shaping said heating unit to the form of a hairpin, then drawing the legs of said heating unit into an electrically insulating sheath having a recess in one end and a pair of spaced passageways opening into said recess so that said legs are positioned within said passageways, respectively while the bent portion of said unit is positioned within said recess, and then filling said recess with an insulating cementing material whereby a passageway of hairpin form is provided in said sheath for said heating unit.
- In witness whereof, I have hereunto set my hand this 25th day of April, 1929.
- CHARLES C. ABBOTT.