June 30, 1936. C. C. ABBOTT 2,046,102

ELECTRIC TERMINAL CONNECTION

Original Filed July 30, 1931

Fig. 1.

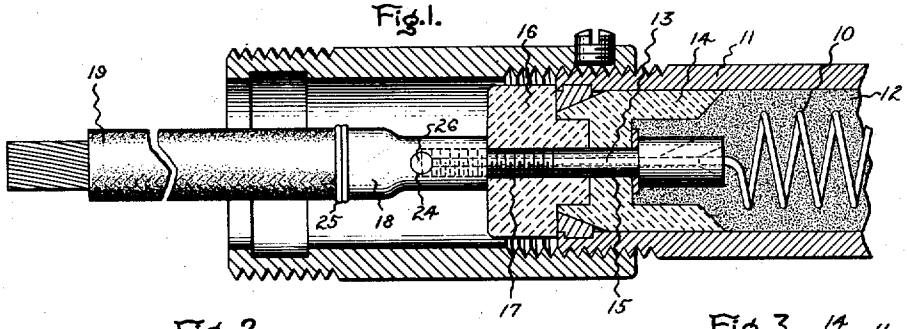



Fig. 2.

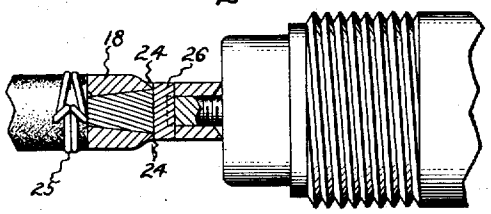



Fig. 3.

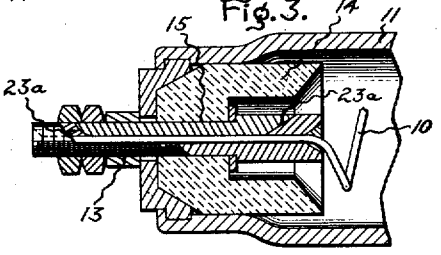



Fig. 4.

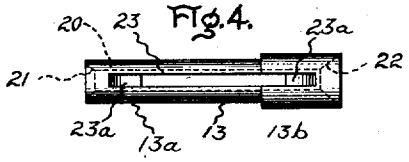



Fig. 5.

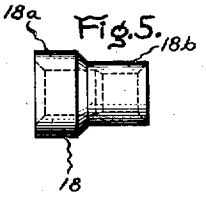
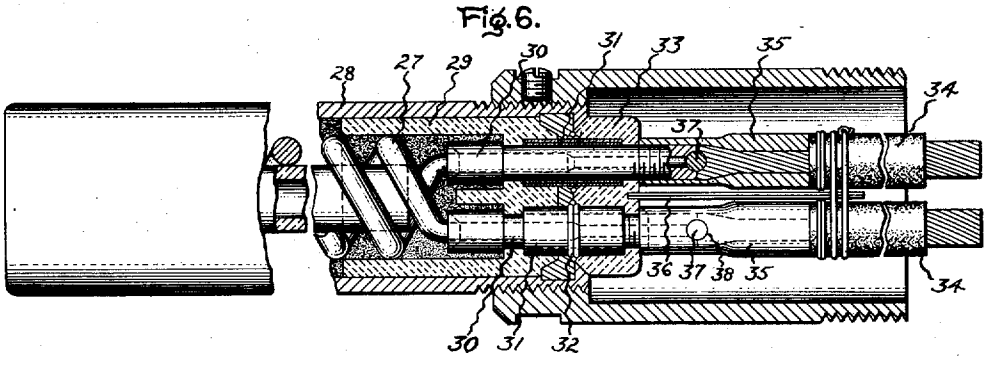



Fig. 6.




Inventor:
Charles C. Abbott,
by Harry E. Dunham
His Attorney.

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# UNITED STATES PATENT OFFICE

2,046,102

## ELECTRIC TERMINAL CONNECTION

Charles C. Abbott, Pittsfield, Mass., assignor to General Electric Company, a corporation of New York

Original application July 30, 1931, Serial No. 554,046. Divided and this application August 13, 1932, Serial No. 628,693

5 Claims. (Cl. 173—263)

My invention relates to electric terminal connections, and more particularly to terminal connections for electric heating units and the like, and has for its object the provision of improved connections between the resistance conductor of the heating unit and its terminal members and between the terminal members and the heater supply leads, and an improved method for effecting these connections.

Although not limited thereto, my invention has particular application to electric heating units of the sheathed type.

In accordance with my invention, I provide a hole through each terminal and countersink or otherwise provide suitable recesses in the ends of the terminal communicating with the hole. The resistance element of the heating unit is then inserted in the hole and brazed to the terminal through the recesses, the latter being filled with the brazing material. This material effects a very good electrical and mechanical connection between the terminal and resistance conductor. If desired, and it is usually preferable to do so, a slot may be arranged in the terminal between its ends and communicating with the hole, the resistance element being brazed to the terminal through the slot.

The connections between the terminals and leads are effected by means of suitable connector members. Each connector is compressed on its lead to provide a strong mechanical and good electrical connection therewith; and preferably will be secured to its terminal by means of a threaded connection. To insure the electrical connection between the terminal and connector, I insert between them a material having good electrical conductivity, such as a suitable brazing material, the connector being arranged so that this material also is in electrical contact with the resistance conductor and lead.

This application is a division of my copending application, Serial No. 554,046, filed July 30, 1931, and which has issued as Patent No. 1,991,591, dated February 19, 1935.

For a more complete understanding of my invention, reference should be had to the accompanying drawing, in which Fig. 1 is a fragmentary view in section illustrating a portion of an electric heating unit provided with electric terminal connections arranged in accordance with my invention; Fig. 2 is a fragmentary view illustrating a portion of the heater of Fig. 1, and more particularly the connection between the terminal and lead connector arranged in accordance with my invention; Fig. 3 is an elevation partly in section of the heater of Fig. 1 partially completed, parts being broken away so as to illustrate certain details of construction of my electrical connections; Fig. 4 is a plan view on an enlarged scale of a terminal used in the heater of Fig. 1 and formed in accordance with my invention; Fig. 5 is an elevation in section of a connector member used in this heating unit and arranged in accordance with my invention; and Fig. 6 is an elevation of an electric heating unit provided with terminal connections of modified form arranged in accordance with my invention.

Referring to the drawing, I have shown my invention as applied to sheathed wire heating units of the type described and claimed in my above-mentioned copending application, Serial No. 554,046, filed July 30, 1931. The heating unit shown in Fig. 1 of the drawing comprises a helical resistance conductor 10 mounted within a metallic sheath 11 and embedded in a suitable compacted, powdered, heat refractory insulating material 12, such as magnesium oxide. Terminals 13 (only one shown) are secured to the opposite ends of the resistance element. Each terminal 13 is received in a suitable supporting block of insulating material 14 secured in the end portion of the sheath, this insulator being provided with a substantially centrally arranged aperture 15 in which the terminal is received and passed to the exterior of the sheath where it projects for an appreciable distance.

As shown (Fig. 3), the supporting insulator 14 is open to the exterior of the sheath. A suitable terminal insulating block 16, formed from some suitable electrically insulating material, such as porcelain, is provided on the exterior of the unit over the open end of the insulating block 14. This insulator 16 is provided with an aperture 17 in which the associated terminal is received.

The terminal 13 is sufficiently long to project somewhat from the terminal insulator 16, and the projecting end as shown is threaded. On this end is threaded a connector member 18 which is secured to a suitable supply lead 19.

In Fig. 4, I have shown in detail the terminal member 13. It will be observed that this terminal member is of tubular form and is provided with a portion 13a of comparatively small diameter, and a portion 13b having a larger diameter, the latter portion serving as an abutment cooperating with the supporting block, as shown, to prevent withdrawal of the terminal from the sheath. The terminal member is provided with a hole 20 extending throughout its full length, the end portions of

the terminal being counterbored so as to provide recesses 21 and 22 communicating with the hole. The terminal is further provided with a slot 23 extending longitudinally thereof and throughout a substantial portion of its length, the bottom of this slot communicating with the longitudinal hole 20. As shown, the end walls 23a of the slot taper downwardly toward each other, or, in other words, flare outwardly from the hole 20. In assembling the helical resistance element with its terminal, a straight end portion of the conductor is inserted through the hole 20 from the right-hand end of the terminal, as viewed in Fig. 4, and passed through the hole to such an extent that its end will be brought substantially to the bottom of the left-hand recess 21. After the resistance element has thus been assembled with the terminal, the resistance element is brazed to the terminal through the end recesses 21 and 22 and the slot 23, the recesses and slot being filled with the brazing material, which integrally unites the terminal with the resistance element. It will be understood that any suitable brazing material may be used. I have found that silver solder is quite satisfactory for this purpose. I have found that this arrangement provides for a substantially perfect electrical connection between the resistance element and its terminal.

After the terminal has thus been secured to the resistance element, the portion 13a is provided with external threads for the purpose of receiving the connector 18 which secures the lead 19 to the terminal.

The lead 19 is attached to the terminal 13.

As shown in Fig. 5, the connector 18 is provided with an enlarged portion 18a having an aperture therethrough and a reduced portion 18b having an aperture therethrough, this second aperture being provided with an internal thread. The bared end portion of the conductor of the lead is inserted in the aperture provided in the enlarged portion 18a, and this portion is then reduced in diameter, as by swaging, so as to compress it on the conductor. The effect of this operation is to leave a head on the end of the conductor as is clearly shown in Fig. 2. This effectively prevents the withdrawal of the lead from the connector. After the connector has thus been secured to the lead, the connector is provided with a pair of apertures 24 (Figs. 1 and 2) communicating with the reduced threaded portion of the connector at points adjacent the bared end of the lead. If desired the insulator of the lead may be secured by means of a wire band 25 wrapped about the insulation adjacent the connector. The connector is then threaded on its terminal member 13.

The connector 18, the adjacent bared end of the lead conductor 10 and the brazing metal in the recess 21 of the terminal 13 are brazed through the openings 24, the spaces between the lead conductor and the end of the terminal being filled with brazing metal 26. This brazing metal, as before, preferably will be silver solder.

It will be observed that the connector has its end bearing on the terminal insulator 16 undercut somewhat so as to provide a knife-edge to bear against the insulator. The purpose of this knife-edge is to prevent damage to the insulator in the event the connector be screwed down too tightly on the terminal. In other words, if the connector be screwed down too tightly the knife-edge will give way before the insulator will and thus the latter will be protected.

The above heating unit has a very strong mechanical and electrical terminal connection construction. It will be observed that the electrically conducting metals arranged in the end recesses 21 and 22 of the terminal and also in the longitudinal terminal slot 23 are in contact with a considerable area of the end of the resistance conductor 10 and also with the terminal so as to effect a very good electrical connection between these members. Moreover, it will be observed that the electrically conducting metal 26 arranged between the resistance conductor and leads insures the electrical connection between these members.

In Fig. 6, there is illustrated a heating unit similar to the heating unit shown in Fig. 1 but which has its terminals brought out at the same end of the unit rather than at opposite ends, as is the case of Fig. 1, and which is provided with terminal connections of a slightly modified form. This heating unit comprises a resistance element 27 with its ends at one end of its sheath 28.

The resistance conductor 27 is supported at the terminal end in suitable cup-shaped insulating member 29. Terminals 30 for the conductor project from the end of the sheath. The insulating supporting member 29 is provided with a pair of apertures in which these terminals rest and through which they pass to the exterior of the sheath. These terminal members, as shown, are provided with reduced portions which pass through the apertures provided in the support 29 and with enlarged portions which rest on the inner bottom surface of the support.

The outer end portions of the terminal apertures provided in the insulator 29 are enlarged somewhat, as shown, and in these enlarged portions are placed suitable insulating sleeves 31, formed from some suitable insulating material, such as sheet mica. It will be observed that these insulators extend for a considerable distance downwardly into the insulator 29 and project for a substantial distance from the outer surface of the insulator. These sleeves may be secured by means of threads 32 wrapped about them and formed from some suitable material, such as asbestos. Placed over the projecting portions of these insulating sleeves and the projecting end portions of the terminals is a terminal insulator 33, formed from a suitable electrically insulating material, such as porcelain. This member, as shown, is provided with a pair of apertures for receiving the projecting ends of the terminals, these apertures being enlarged to accommodate the mica sleeves 31. It will be observed that the outer ends of the terminal apertures provided in the support 29 and the inner ends of the apertures provided in the terminal insulator 33 are countersunk or otherwise enlarged to provide an annular chamber for the threads 32 when the insulator 33 is applied.

Suitable leads 34 are provided with connectors 35 which, as shown, have threaded connections with the terminals 30.

In order to increase the electrical strength at the terminal end of the heating unit, a suitable barrier or sheet 36, formed of a suitable electrically insulating material, such as mica, is interposed between the connectors 35.

The terminals 30 in this case are somewhat smaller in diameter than are the terminals of the unit of Figs. 1 and 2, by reason of the fact that there is less available space for the terminals in the single ended unit of Fig. 6. In view of this the end portions of the resistance conductor are reduced somewhat, as shown in Fig. 6,

and the holes provided for them in the terminals are shaped accordingly. This arrangement is advisable in order to strengthen the terminals at their threaded portions.

The terminals are secured to the resistance element 27 in substantially the same manner as are the terminals 13 secured to the resistance element 10 of the heater of Fig. 1.

Thus, the leads 34 are attached to the terminals by means of the connector members 35. These connector members are of substantially the same construction as are the connector members 18 of the heater of Fig. 1 and are secured to their leads in substantially the same manner. The connector members 35, as shown (Fig. 6), are threaded on their associated terminals 30. After the connectors are screwed on, they are brazed to the associated terminals by means of a suitable brazing material 37, such as silver solder, through apertures 38, provided in the connectors. This brazing metal integrally unites the connectors, terminals and resistance element and thereby insures the electrical connection between the resistance element and its supply leads.

The terminal insulator 33, together with the insulating sleeves 31 and the insulating sheet 36 provide a very strong electrical terminal arrangement for the heater.

While I have shown 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. In a terminal, a metallic terminal member provided with a longitudinal passageway therethrough, a conductor received within said passageway, said terminal member having conical recesses at its ends communicating with said passageway and cooperating with said conductor to define chambers around said conductor and also with a slot intermediate said recesses arranged longitudinally of said terminal and communicating with said passageway, and brazing material filling said conical recesses and said slot and brazed to said conductor and terminal member so as to integrally unite said members.

2. In a terminal, a conductor, a lead for said conductor, a metallic tubular terminal member surrounding one end portion of said conductor with the end of said terminal member substantially at the end of said conductor, said terminal member having a recess in its end adjacent said end of said conductor, an electrically conducting brazing material within said recess filling said recess and brazed to said conductor and terminal so as to integrally unite said members together, a separate metallic tubular connector receiving the end portion of said lead and having a portion arranged to surround the end portion of said terminal member, said connector and said lead arranged so that when said connector is applied to said terminal the end of said lead is adjacent said brazed connection between said terminal and conductor, said tubular connector being provided with apertures, and an electrically conducting brazing material placed within said connector through said apertures brazed to said connector and said end of said lead and also to said brazing material within said recess in said terminal so as to integrally unite said conductor with said lead.

3. The method of securing a lead to a conductor which comprises providing a metallic terminal member having a passageway therein and a threaded portion on the exterior of said member, inserting said conductor in said passageway so as to extend substantially throughout the full length thereof and securing said terminal to said conductor, providing a metallic connector member having a passageway therein and a portion of said passageway threaded to receive the threaded portion of said terminal, inserting the conducting member of said lead in the unthreaded portion of said passageway and compressing said connector member on said conducting portion to secure said member thereto, providing apertures in said connector substantially at the juncture of its threaded and unthreaded portions, threading said connector member onto said terminal and then brazing said connector member to said terminal through said apertures provided in said connector.

4. The method of securing a lead to a conductor which comprises placing said conductor within a metallic tubular terminal member, the end of said conductor substantially at the end of said tubular terminal member, brazing said ends of said conductor and tubular terminal member together, placing said lead within a tubular connector member with the end of said lead intermediate the ends of said tubular connector member, compressing said connector member onto said lead to electrically and mechanically connect them together, placing said connector member on said terminal member so that the ends of said lead and said brazed connection between said terminal member and said conductor are adjacent, providing apertures in said connector member adjacent the juncture of said lead with said brazed connection, introducing brazing material through said apertures into said connector member and brazing said material to said lead and to said brazed connection.

5. The method of securing a solid metallic connector member to a conductor which comprises forming said connector member with an enlarged portion of substantially uniform diameter from end to end, and a reduced portion in axial alignment with said enlarged portion of substantially uniform diameter from end to end, the juncture of said portions defining a shoulder, providing said member with a passageway arranged longitudinally of said large and small portions, said passageway having two portions of relatively large and small substantially uniform diameters, the portion of larger diameter extending through the large portion of said metallic member and beyond said shoulder to a point in said smaller portion of said member and the smaller portion of said passageway extending from said point through the said smaller portion of said member to the end thereof, inserting said conductor into said passageway of larger diameter to the end thereof, and then reducing the diameter of said larger portion of said connector substantially to the diameter of said smaller portion thereof whereby an enlarged head is provided on the end of said conductor which is securely anchored by the metal walls of said connector member.

CHARLES C. ABBOTT.