S. TROOD.

ELECTRICAL HEATING APPARATUS AND PROCESS OF MAKING THE SAME.

APPLICATION FILED JAN. 7, 1914.

1,234,973. Patented July 31, 1917.

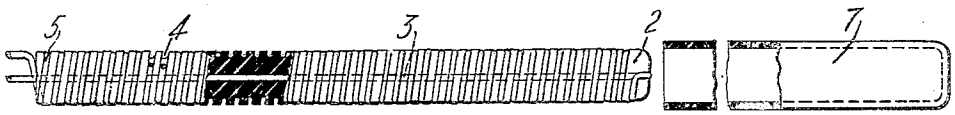


Fig. 1. Fig. 2.

Fig. 3.

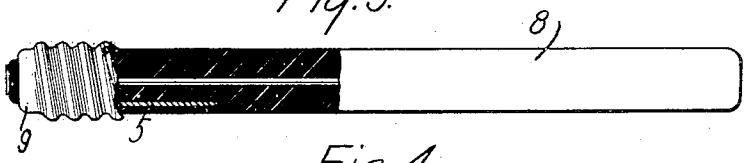
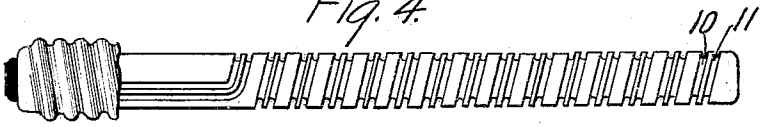


Fig. 4.



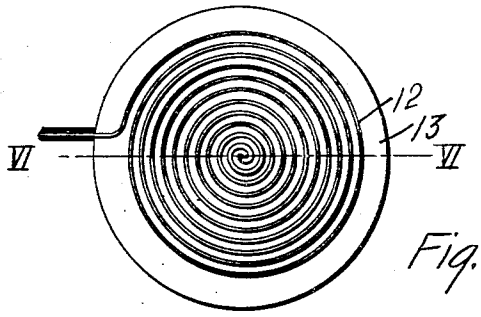


Fig. 5.

Fig. 6.

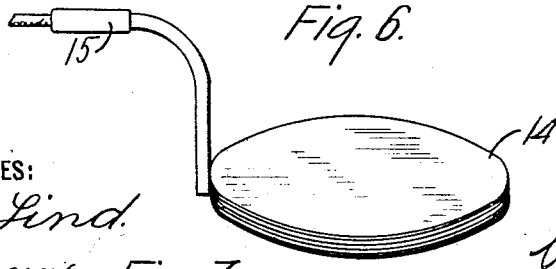


Fig. 7.

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ELECTRICAL HEATING APPARATUS AND PROCESS OF MAKING THE SAME.

1,234,973. Specification of Letters Patent. Patented July 31, 1917.

Application filed January 7, 1914. Serial No. 810,775.

To all whom it may concern:

Be it known that I, SAMUEL TROOD, a citizen of the United States, and a resident of Wilkinsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Electrical Heating Apparatus and Processes of Making the Same, of which the following is a specification.

My invention relates to electrical heating apparatus, and particularly to heating units in which conductors of high resistance are inclosed within electrical insulators which are good conductors of heat.

The object of my invention is the provision of a device of the character above indicated which may be raised to high temperatures without deterioration and which will combine simplicity and cheapness with efficiency and durability.

Briefly stated, my invention comprehends a wire or strip of a conducting substance inclosed between layers of fusible insulating material that are caused to unite by fusion in such manner that my complete heating unit is essentially a solid body of insulating material having the resistance wire or strip embedded therein.

In order to effect the desired result, I select an insulating material the melting point of which, while higher than any temperatures which are ordinarily reached in electrical heaters, is less than the melting point of the material composing the resistance element. I have found that fused silica is suitable for my purpose and is especially desirable because it transmits heat readily and also because its expansion, when heated, and its contraction, when cooled, are so small as to be negligible. My improved heating unit may therefore be rapidly heated or cooled without danger of breaking.

As a suitable resistance material, I prefer, at present, to employ metallic tungsten or molybdenum, since these metals fuse at higher temperatures than quartz.

The manner in which I construct my heating element may be best understood by reference to the accompanying drawings, in which Figure 1 is an elevational view, partly in section, of a quartz core with a wire coiled upon it, a portion of the wire being broken away to show the structure of the core. Fig. 2 is an elevational view, partly in section, showing a portion of the sheath surrounding the core and coil. Fig. 3 is an elevational view, partially in section, showing a completed heater unit equipped with a suitable terminal base. Fig. 4 is an elevational view of a modified form of quartz core and terminal base without the sheath. Fig. 5 is a plan view of the parts forming another type of heater. Fig. 6 is a section taken on the line VI—VI, Fig. 5, and Fig. 7 is a perspective view of a heater of the type shown in Figs. 5 and 6.

In constructing the heater shown in Figs. 1 to 4, I first provide a rod 2 of fused quartz having a hole 3 extending longitudinally through it and a helical groove of about the same depth as the diameter of the wire to be used. I coil a wire 5 in the groove 4 and draw the end through the longitudinal hole 3 so that both terminals of the wire may be at the same end of the rod. I then place the rod and its coiled wire within a sheath 7 and supply current to the wire in sufficient amount to heat the wire to a temperature slightly above the fusing point of quartz. The portions of the quartz in contact with the wire are consequently caused to fuse and become united at a large number of points. The spaces between the points at which quartz sheath makes contact with the heated wire serve to take up any strain due to the contraction of the wire upon cooling, and there is therefore no danger of breaking the sheath, even though it may be relatively thin. The completed unit 8 is then sealed into a suitable terminal base 9. The particular mode of attachment forms no part of my invention.

In Fig. 4 I have shown a modified form of core, which has two parallel helical grooves 10 and 11. The resistance wire is doubled and fixed, at its middle point, to the outer end of the core, the respective halves of the wire being then wound in the grooves 10 and 11. This arrangement brings both terminals of the resistance wire to one end of the heater without perforating the core lengthwise.

If very fine wire is used, it may be wound around a smooth core, the grooves being omitted. Very fine wire is required if the grooves are omitted in order to avoid rupture of the quartz by reason of the contraction of the wire upon cooling.

The flat heater shown in Figs. 5 to 7 is made by coiling a resistance wire or ribbon

12 between plates 13 of quartz or other suitable material, and causing partial fusion of the quartz, as described above. It is convenient to employ two coils inclosed between three plates, as shown in Fig. 6. The completed plate 14 may be provided with a handle 15, through which the terminal leads are drawn, in a manner well known in this art.

I may modify my process by selecting an insulating material composed of a mixture of vitreous ingredients having substantially the same co-efficient of expansion, when heated, as tungsten or molybdenum.

In order to prevent oxidation of the resistance metal during the fusion process described above, this operation should be carried out in a vacuum or in a non-oxidizing or reducing atmosphere such, for example, as hydrogen, nitrogen or carbon dioxid. If vacuum is employed, a suction connection may be applied directly to the article being treated, or the fusion may be carried out in a vacuum chamber. When an atmosphere of non-oxidizing gas is employed, the operation is performed in a chamber filled with the gas.

In the use of my heater elements, it may be found advisable to supply fuses in circuit with them, so that the circuit may be interrupted before the wire becomes sufficiently hot to melt the quartz. Since, however, quartz fuses at a much higher temperature than is required in the ordinary heating operations to which my device is adapted, no protective device will ordinarily be necessary.

It is obvious that many changes may be made in the process, in the materials employed, and in the structure of my device without departing from the spirit of my invention, and I therefore wish it to be understood that my invention is limited only by the scope of the appended claims.

I claim as my invention:

1. In an electric heater, the combination of a metallic resistance element with a homogeneous refractory insulating medium in which the resistance element is embedded, the insulating medium having a lower melting point than that of the resistance element.

2. In an electric heater, the combination of a conductor comprising tungsten with a refractory vitreous insulating medium in which the conductor is embedded, the insulating medium having a lower melting point than that of the conductor.

3. In an electric heater, the combination of a resistance element comprising tungsten with an insulating medium comprising fused silica in which the resistance element is embedded.

4. A process of forming a resistance unit for electric heaters, consisting in inclosing a resistance element between solid layers of a refractory vitreous insulating material having a lower melting point than that of the resistance element and fusing the insulating material.

5. The process of forming a resistance unit for electric heaters consisting in inclosing an electric conducting medium between solid layers of refractory insulating material having a lower melting point than that of the conductor and partially fusing the insulating material by passing an electric current through the conductor.

6. A process of forming a resistance unit for electric heaters, which comprises coiling a tungsten wire around a rod of fusible quartz, inclosing the rod and wire in a quartz sheath of suitable size to make contact with the wire and causing the sheath and the rod to unite by fusion by passing an electric current through the wire.

7. An electric heater comprising a resistance element, and a plurality of refractory insulating members, having a lower melting point than said resistance element, disposed on opposite sides thereof and fused together in proximity thereto, whereby said resistance element is embedded in said insulating material.

8. An electric heater comprising a member of refractory insulating material having a groove therein, a resistance element disposed in said groove and a second member of like insulating material disposed adjacent to said first member and said resistance element, and fused to said first member in proximity to said resistance element.

9. An electric heater comprising a helically-grooved rod of refractory insulating material, a resistance-element disposed in said groove, and a tubular sheath of like insulating material closely surrounding said rod and said resistance element, and intimately fused to said rod at a plurality of points in proximity to said resistance element.

10. A process of forming a resistance unit for electric heaters which consists in disposing a resistance element upon the periphery of a refractory insulating rod, closely surrounding said rod and resistance element with a refractory insulating sheath, and fusing said rod and said sheath together in proximity to said resistance element by passing electric current through said resistance element.

In testimony whereof, I have hereunto subscribed my name this 31st day of Dec. 1913.

SAMUEL TROOD.

Witnesses:
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M. C. MERZ.