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3,026,604

METHODS OF MAKING ELECTRIC RESISTANCE HEATERS

Filed Oct. 29, 1958

2 Sheets-Sheet 1

Fig. 1

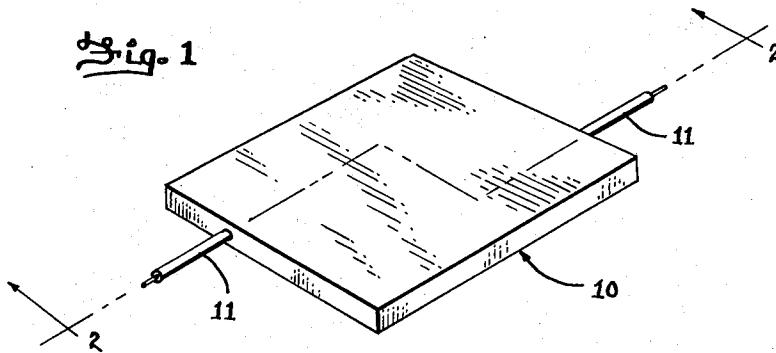


Fig. 2

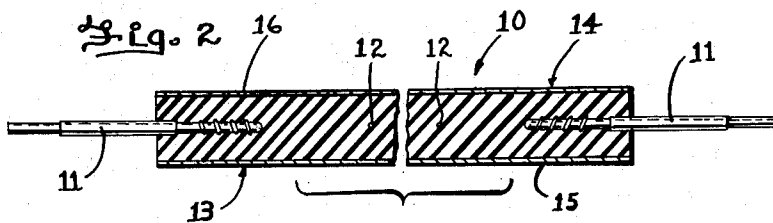


Fig. 3

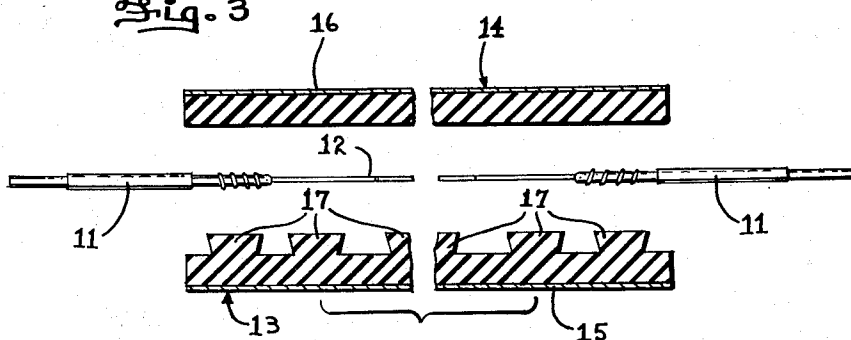
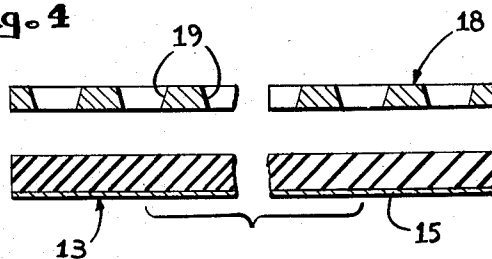


Fig. 4



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Fig. 5

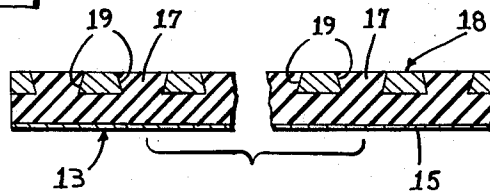


Fig. 6

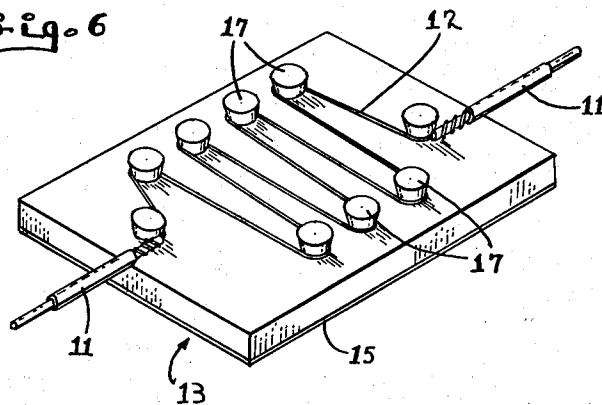
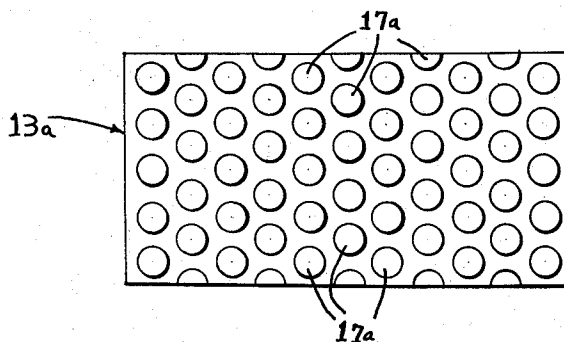


Fig. 7



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METHODS OF MAKING ELECTRIC RESISTANCE HEATERS

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3 Claims. (Cl. 29—155.63)

The present invention relates to methods of making electric resistance heaters, more particularly to heaters of the type wherein a resistor conductor is embedded between two sheets of flexible, rubber-like material which are bonded together to seal the resistor therebetween and provide a unitary assembly, and the principal object of the invention is to provide new and improved methods of making such heaters.

Heaters of the general type herein contemplated find wide usage wherever a highly flexible unit having relatively low heat output is required. Such heaters may be readily secured to irregularly shaped objects to be heated or may be used in the manufacture of heating pads or the like. Such heaters find additional utility since their bonded construction makes them impervious to moisture.

In the past, heaters of the type under discussion have been expensive to manufacture because of the costly steps involved in their construction and because of some of the special equipment necessarily used. One such prior art item of equipment has been a winding form upon which the resistor conductor is wound to provide the desired heating pattern. This form usually comprises a plate from whose surface a plurality of pins project in a predetermined pattern. Since most prior art methods required that at least one of the sheets of material between which the resistor is embedded be impaled upon the pins, the latter are necessarily small in diameter and needle sharp at their free ends. The difficulty of winding a resistor conductor upon such a form will readily be appreciated. Moreover, the cost of making such a form and of maintaining it, since the fragile pins are easily bent or broken, is considerable.

The present invention completely eliminates the heretofore required winding form and permits the resistor conductor to be wound upon one of the sheets of material between which the resistor conductor is embedded. Other advantages will readily become apparent from a study of the following description and from the drawings appended hereto.

In the drawings accompanying this application and forming a part of this specification, there is shown, for purpose of illustration, embodiments which the invention may assume, and in these drawings:

FIGURE 1 is a perspective view of a heater constructed in accordance with the present invention,

FIGURE 2 is an enlarged, broken sectional view generally corresponding to the line 2—2 of FIGURE 1,

FIGURE 3 is an exploded, broken sectional view of the heater parts seen in FIGURE 2,

FIGURES 4 and 5 are broken sectional views illustrating respective stages of manufacture of the present heater,

FIGURE 6 is a reduced size perspective view illustrating still another stage in the manufacture of the heater, and

FIGURE 7 is a reduced size plan view of a detail of another embodiment of the invention.

As seen in FIGURE 1, the present heater takes the form of a flat, generally rectangular body 10 having an insulated lead 11 extending from opposite edges thereof to which suitable electrical connections may be made. It is to be understood, however, that body 10 may be formed to any suitable configuration other than rectangular de-

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pending upon its ultimate use and may readily be bent to a curved or other non-flat configuration because of its flexibility.

Briefly and with reference to FIGURE 2, body 10 of the heater comprises a resistor conductor wire 12 arranged in a desired heat generating pattern and entrapped in a mass of flexible, heat resistant dielectric material such as cured silicone rubber or the like. A layer of glass fiber cloth is bonded to opposite sides of the mass of cured material to strengthen the heater body. Such cloth layers, however, may be eliminated if desired. Note that the connections between the leads 11 and the resistor wire are also embedded in the mass of material for protective purposes.

The various parts of which the present heater is formed are shown in FIGURE 3 to comprise two sheets 13 and 14 of silicone rubber between which is interposed the resistor conductor 12 having leads 11 secured thereto. The outer face of each sheet 13 and 14 preferably carries a respective layer 15, 16 of glass fiber cloth or the like as hereinbefore mentioned. In the position of parts shown, the upper face of the lower sheet 13 has a plurality of projections 17 formed therein in a desired pattern for a purpose to be disclosed.

The novel manner in which the projections 17 are formed in the face of sheet 13 is illustrated in FIGURES 4 and 5. With reference to these figures, a metal plate 18 having a plurality of apertures 19 formed therein in a pattern corresponding to the desired pattern of projections to be formed in the sheet, is pressed against the uncured silicone rubber face of the sheet. Sufficient pressure is employed to cause the readily deformable, uncured rubber to flow into the apertures in the plate. The sheet is then subjected to a curing operation to stabilize its configuration and permit removal of the plate without damaging the projections formed in the sheet.

It is an important feature of the present invention that each of the projections 17 is preferably tapered so that it is smaller in size at its base where it emerges from the sheet than it is at its free end. The purpose of so forming the projections will later appear. The tapered projections 17 may readily be provided by so forming the apertures 19 in the plate 18 that they are smaller in size at the plate side adjacent the sheet 13 than they are at the opposite plate side. Obviously, the projections could, if desired, be formed to other shapes merely by changing the shape of the apertures in the plate.

Following removal of sheet 13 from the plate 18 as hereinbefore disclosed, the resistor 12, to the opposite ends of which the respective insulated lead wires 11 are secured, will be wound upon the projections 17 (see FIGURE 6) formed in the presently cured sheet 13. Note that the sheet 13 itself thus supplants the prior art winding form. It will readily be apparent that as a result of the tapered construction of the projections 17, the resistor will tend to lie flat against the face of the sheet 13 after being wound upon the projections. With the resistor wound upon the projections, it is to be noted that those ends of the leads 11 which are secured to the resistor wire are within the confines of the sheet 13 for a purpose to appear.

Following winding of the resistor upon the projections of sheet 13 as above described, the uncured silicone rubber face of sheet 14 will be disposed against that face of sheet 13 having the projections 17. The sheets will thereupon be pressed together with sufficient force to cause the readily deformable uncured rubber face of sheet 14 to flow into the interstices between the projections 17 of sheet 13 and about the resistor 12 and the connected ends of the leads 11 so as to completely fill any voids between the sheets. The assembly will thereupon be subjected to a curing operation to permanently bond the two sheets to-

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gether with the resistor and the ends of the wire leads entrapped and sealed therebetween. Following this curing operation, the completed heater seen in FIGURE 1 may be incorporated into, for example, a heating pad or the like or may be secured to a body to be heated by any suitable means.

FIGURE 7 illustrates another embodiment of the invention wherein there is seen a sheet 13a which is similar to sheet 13 heretofore described. Sheet 13a, however, differs from sheet 13 in that the projections 17a are arranged in a different pattern. In sheet 13, the projections 17 are arranged in accordance with a specific desired pattern which the resistor is to assume and thus only those projections necessary for the desired resistor pattern are provided. In sheet 13a however, the projections 17a are relatively closely spaced across the entire face of the sheet so that the resistor may be wound in many different patterns thereon without changing the arrangement of the projections. Thus, when winding a resistor on sheet 13a to a given pattern, only those projections necessary will be used. The remaining projections, not needed for this pattern, will be ignored. Accordingly, the sheet 13a provides considerable flexibility of arrangement of the pattern in which the resistor may be wound and is thus particularly applicable for use when but a small number of heaters of a given pattern are to be made.

In view of the foregoing it will be apparent to those skilled in the art that I have accomplished at least the principal object of my invention and it will also be apparent to those skilled in the art that the embodiments herein described may be variously changed and modified, without departing from the spirit of the invention, and that the invention is capable of uses and has advantages not herein specifically described, hence it will be appreciated that the herein disclosed embodiments are illustrative only, and that my invention is not limited thereto.

I claim:

1. The method of making an electric resistance heating element, which comprises the following steps in numbered order (1) pressing the apertured face of a rigid member against and into the face of a sheet of uncured pliant dielectric material to deform the sheet face by extruding uncured material at said face into the member apertures (2) partially curing said material to stabilize the sheet (3) stripping said rigid member from said sheet whereby the stabilized extruded material forms projections extending from said sheet at its deformed face (4) winding a resistor wire about said projections to a desired heating pattern (5) placing a covering sheet of uncured dielectric material flatwise against said deformed face (6) pressing

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the two sheets together to embed said projections and said resistor wire into said uncured covering sheet and (7) simultaneously finishing the cure of the partially cured material and completely curing the uncured material to permanently bond the two sheets.

2. The method of making an electric resistance heating element, which comprises the following steps in numbered order (1) winding a resistor wire about the small neck portion of each of a plurality of projections which taper from a small size at the face of a sheet of partially cured dielectric material to a larger size at the free end of the projection to hold the resistor wire against lateral displacement from said sheet (2) placing a covering sheet of uncured dielectric material flatwise against said face of said first named sheet in position overlying said projections (3) pressing said sheets together to embed said projections and resistor wire into said uncured covering sheet, and (4) simultaneously finishing the cure of the partially cured material and completely curing the uncured material to permanently bond the two sheets.

3. The method of making an electric resistance heating element, which comprises the following steps in numbered order (1) pressing the face of a rigid member against and into the face of a sheet of uncured rubber to deform the sheet face by extruding uncured rubber at said sheet face into a plurality of holes in said rigid member, each hole opening at said face of said member and tapering from a small size at such face to a larger size inwardly of such face (2) partially curing said uncured rubber to stabilize said sheet (3) stripping said rigid member from said stabilized sheet, the extruded rubber forming projections, each of which tapers from a small size at the face of said sheet to a larger size at the free end of the projection (4) winding a resistor wire about the small size portion of said projections to a desired heating pattern (5) placing a covering sheet of uncured rubber flatwise against said deformed face in position overlying said projections (6) pressing the two sheets together to embed said projections and resistor wire into said uncured covering sheet, and (7) simultaneously finishing the cure of the partially cured rubber and completely curing the uncured rubber to permanently bond the two sheets.

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