

April 29, 1947.

G. H. MOREY

2,419,848

ELECTRICAL HEATER AND METHOD OF MANUFACTURING IT

Filed April 28, 1945

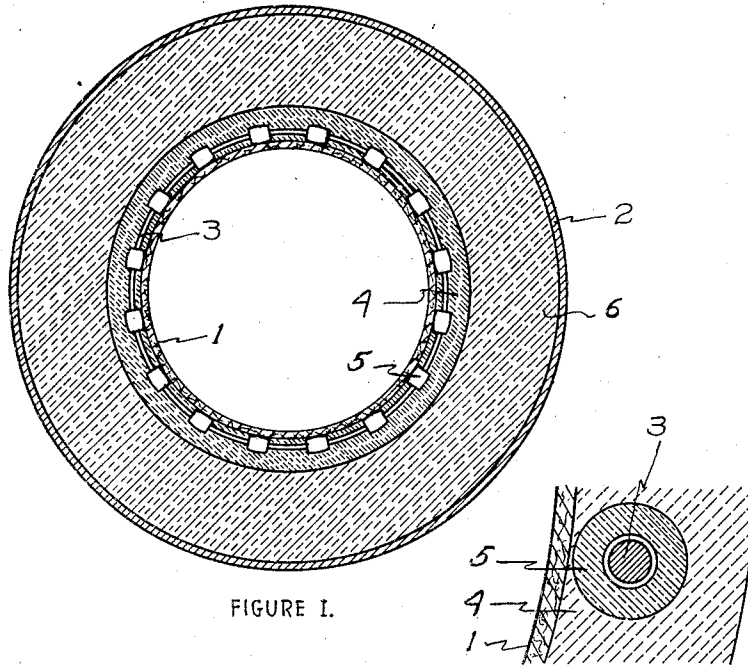


FIGURE I.

FIGURE III.

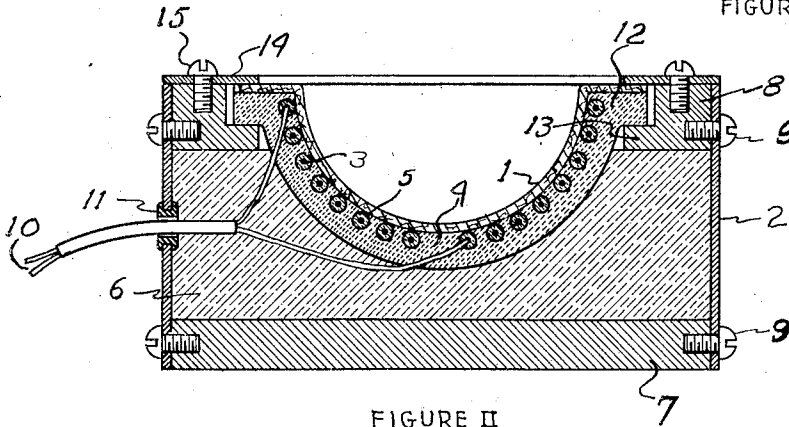


FIGURE II

INVENTOR:
GLEN H. MOREY
BY Benedict & Stuartwood
ATTORNEYS

UNITED STATES PATENT OFFICE

2,419,848

ELECTRICAL HEATER AND METHOD OF
MANUFACTURING IT

Glen H. Morey, Terre Haute, Ind.

Application April 28, 1945, Serial No. 590,845

12 Claims. (Cl. 219—38)

1

This invention relates to an electrical heater and a method of manufacturing it. More particularly, it relates to a heater for articles which conform in shape to the outline of the article to be heated, and to an improved method of incorporating a heating element in a refractory support shaped to conform to the outline of the article to be heated, said element being spaced in a desired predetermined manner for heating the article.

Electrical heating elements have been made which comprise a refractory supporting material having a coil or other type of metallic resistance heating element associated therewith. In certain instances, the supporting structure is of complex shape and may comprise channels cut or molded in the refractory when it is made, the channels having associated therewith spacers to prevent short circuiting of the heater and to maintain it in its proper position. For a flat heater, this is fairly satisfactory and may sometimes be used for other simple shapes which can be constructed of flat segments.

It has also been suggested that a heating element sewed to glass or asbestos fabric may be rested on or in a supporting structure containing comminuted refractories such as magnesia, powder, asbestos fibre and the like. This object, likewise, is more or less limited to fairly simple shapes. Moreover, it can only be used where the object rests inside of the pocket in the heating unit because neither the fabric nor refractory are rigid.

Another method of treating this problem has been to sew the heating element between layers of asbestos or other refractory fabric and to apply the jacket thus formed to the article. This is of great utility in connection with heating flasks and other spherical or partially spherical objects. However, when applied to valves, pipe bends and other types of objects more complex in structure, the jacket type element has its limitations.

It is an object of the present invention to provide a rigid heating element made to conform to articles of complex structure. It is a further object to provide a method of manufacturing such a heater. Another object is to provide a method for embedding a metallic resistance heater in a supporting refractory material without leaving the heating element exposed.

In a broad embodiment, the invention comprises a method of manufacturing a heater which comprises forming an envelope of the shape and approximate size of the article to be heated, sewing thereto a heating element comprising re-

2

fractory spacers which hold the element from the fabric, embedding the element and refractory spacers in a plastic refractory material, leaving connecting leads exposed, thereafter hardening said refractory so that it will retain its shape with the heating element embedded therein.

In another embodiment, the invention comprises a method for forming a heater, which comprises sewing or otherwise forming a fabric envelope or jacket to conform to the outline of an article to be heated, stringing beads or other spacers on a heating element, attaching said beads at spaced intervals to the fabric and embedding the beads in a plastic refractory material and thereafter treating it to harden the refractory thereby forming a heater of substantially the shape of the article.

In another embodiment, the invention comprises a heater having a supporting structure, insulating material therein, a rigid refractory having embedded therein a resistance heating element strung on spaced refractory beads. In addition, the heater may comprise a fabric lining for the pocket in said rigid refractory support, said fabric being attached to the spacers.

The heater of this invention has the advantage that it can be made to conform to the outline of an article to be heated so that heat may be uniformly applied. It has the further advantage that it can be made in sections conforming to various parts of an irregular object and the parts can be assembled around the object after it is in place. For example, a valve may be installed in a line and a heater, which is in two or more sections, may be applied to cover it except for the connecting lines and valve stem. This takes care of a difficult problem encountered where lines and appurtenances thereto must be kept hot.

Another advantage is that the element may be completely embedded in the refractory support preventing short circuits from metal oxide scale, etc. Moreover, when glass or asbestos fabric is used, the heater is used with glass or other breakable materials with greater safety because of the cushioning effect of the fabric.

The method of manufacture has the advantage that heaters can be made which could not be made before. By this method irregularly shaped heaters to be placed in or around articles of complementary shape can be supplied. Heretofore, this could not be done, at least by any practical method. The heaters can be made in sections and the sections connected in series or in parallel to heat the object. The method per-

mits the manufacturer to space the element in any desired way so as to put more or less heat into a given part of the article to be heated, depending on special needs.

The use of a combustible fabric permits a heater to be made entirely of rigid refractory such as fire clay cement, etc. which may be desirable in some types of service. The use of a refractory liner protects both the article and the refractory in which the element is embedded.

Fig. 1 is a plan view in section of one embodiment of the heater.

Fig. 2 is an elevation in section of one embodiment of the assembled heater.

Fig. 3 is a detail of the fabric, the refractory spacer, the heating element and the refractory, all in section and showing the relationship to each other.

Referring to the figures, 1 represents a fabric liner for the heater. This liner may be made of fire-proof material such as asbestos fabric, glass fabric, and the like, or it may be made of a combustible material which can be burned away after the heater has been formed into a rigid shape.

The fabric is sewed or otherwise shaped to conform to the outlines of the surface to be heated. In the present instance, it is illustrated as a heater to be applied to objects such as round bottomed flasks, but it is contemplated that any shape can be formed. If a fire-proof, non-combustible material is used, the fabric remains a part of the finished structure. It has the advantage of partially insulating the heater, protecting the refractory against chipping or cracking and also serving to cushion the article, which is important from the breakage standpoint, when applied to glass or earthenware vessels. If a combustible material is used, it is burned away after the refractory support has been hardened. In this case, ordinary cloth may be used or the liner may be formed of a plastic material which may be cast or molded in the proper form from a pattern, or from the article itself, rather than being sewed as would be the case with a fabric such as cotton cloth, glass fabric, asbestos fabric, and etc. The fabric jacket thus formed is then sewed to the heating element. The heating element may comprise any type of electrical resistance heater which is flexible and susceptible of being formed into shapes by bending. In general, it may comprise a wire or a helical coil, although by the use of properly designed refractory spacer elements in the form of ribbons may be used. The element may be strung upon beads which are of the refractory character. Usually the element is attached to the fabric by sewing the beads or other spacers to the fabric at frequent intervals. In this way, the element may be attached in any desired pattern in order to obtain the desired distribution of heat.

The bead may be sewed to the fabric by passing a thread on either side of it around the element and then through the fabric, or by passing the thread through the bead and then through the fabric. Alternatively, the bead or spacer may be sewed to the fabric and the element threaded through them. Clips may be sewed to the fabric and the element slipped into place afterward.

The thread used may be of glass fibre if it is desired to maintain the association between the fabric and the beads after the heater is completed. In this way, the threads keep it from being pulled out of place. If a combustible material is used and is to be burned away before

the heater is finally used, the thread may also be combustible, for example, cotton.

The element is indicated generally as a wire 3, and the bead or other spacer as 5. Fig. 3 shows the bead 5 and wire 3 in cross-section embedded in a refractory material 4 and with the fabric liner 1 associated with the inner wall formed by refractory 4. Fig. 2 shows how a number of turns of heating element may be incorporated in the simple semi-spherical shape illustrated. Fig. 1 shows the manner in which the wire is maintained in spaced relationship to the liner and the refractory material and how the beads are spaced from each other. The stitching is not shown but the manner in which it may be stitched is readily apparent.

The heater and rigid refractory heater may be enclosed in a supporting shell which may comprise a side wall 2 and bottom piece 7 which may be of steel or may be of asbestos board or other type of refractory board. A ring 8 is provided at the top of side wall 2 which is held to bottom plate 1 and ring 8 by screws 9. Ring 8 may be formed from a block of insulation material such as asbestos-gypsum board which is cut in L shape with a ledge 13 to support the heating unit. A circular top plate 14 may be placed upon the assembled heater and held in place by screws 15 extending into ring 8. The projecting rim 12 of the heater unit rests on ledge 13 and is held firmly in place by plate 14 which presses on rim 12. Extending through an insulated opening 11 in one of the side walls are the leads 10 to the heating coil which may be attached to a suitable power source.

The apparatus is formed by making the fabric envelope or jacket to conform approximately to the shape of the object to be heated. The heater may be in sections of more than one differing shape each corresponding to a part of the article. In this case, the jacket is made to conform to the shape of the part of the article to which it is to be applied. Beads 5 are strung on heating element 3 at spaced intervals and are sewed to the fabric. This may be done by looping part of the thread around the individual beads and passing the thread through the fabric. If it is desired to heat one particular portion of the article to a greater extent than another portion, the amount of heating element and its distribution can be such as to accomplish this by placing more of the element over certain parts than others.

A refractory cement or other plastic or moldable material which will harden into a non-conducting heat resisting rigid support is then molded around the envelope. This may be done by placing a predetermined amount of cement in a vessel having the proper dimensions and then embedding the beads and heating element in the cement by thrusting against the inside of the envelope with sufficient force and over enough area to push the beads into the plastic material and at the same time cause the plastic refractory to take the desired shape. The plastic material may contain a self-setting cement or may be dried and hardened by heating at a relatively high temperature. It should be of such a consistency that once it has been molded to the desired shape, it will hold it until it sets. To assist in the embedding operation, a pattern may be made having the shape the heating unit is to take and the fabric may be stretched around it, the refractory being molded to the outside.

After the beads and element are firmly embedded in the refractory material, it is dried and

may be burned at a high enough temperature so that it takes on a rigid permanent shape.

At this point, a refractory heating unit containing the element firmly embedded and protected from injury, short circuits, etc. has been obtained. The element may be large or small. It may be incorporated in some other supporting structure or may be used in the form just described.

The particular heater illustrated may be assembled by fastening side wall 2 to ring 8, putting the heating unit in place with rim 12 resting on ledge 13 and clamping it in place by screwing top 14 to ring 8. The leads 10 are carried through insulator 11. It is then inverted and an insulating material such as asbestos or magnesia 6 is packed into the interior. Finally, plate 7 is fastened into place.

This illustrates but one specific example of the many coming within the scope of the invention which is not limited to this exact device or method. The present method requires no skilled help other than a seamstress to cut or sew the envelope or jacket in the proper shape and then to sew the heating element to it. Semi-skilled labor can be used to form the refractory heating unit or in some instances this can be done with machinery. The heating units may be made in sections so as to conform to the outline of the portions of the article to be heated and to facilitate its application. These sections can be made in such a manner that they can be fastened together before or after being applied. Each unit may be incorporated in an insulated supporting structure if desired, which may be joined around the article to form the complete heater.

The insulating material 6 may comprise a loose powdered material such as magnesia or other insulating material to prevent the loss of heat from the inside out. Thus, the full benefit of the heater can be economically obtained.

The fabric liner 1 for the article receiving pocket in refractory 4 may be ribbed, if desired. This is advantageous when using glass or asbestos fabric, since it tends to absorb mechanical shock. This is especially useful with glass or other types of breakable articles which are to be heated.

It is an advantage of a heater made in this way that the heating element is fully protected by being embedded in the refractory and hence cannot be short-circuited by pieces of metal or oxides dropping into the pocket and crossing the resistance wires. This is one of the disadvantages of the former type of element where the element was exposed.

It should be kept in mind that the invention is not limited to the exact form shown. Instead of beads, refractory clips or other spacers may be used. The beads may be attached by sewing or clipping the fabric to the spacer. However, if high temperatures are to be used, the clips must be heat-resistant and, preferably, of non-combustible material.

Although the heaters are particularly adapted to heating the outside of articles, they may also be made to heat the inside. In this case, the fabric may be sewed into the desired shape, turned wrong side out and the element and spacers sewed to it. It is then turned right side out and the plastic refractory applied to the inside, embedding the element and causing the fabric to assume its form. The fabric in this case is on the outside and will rest against the inner sur-

face of the vessel. Heaters for concave surfaces may be made in a similar manner.

I claim as my invention:

1. A permanently shaped sectional heater which comprises a supporting shell, a heat-resistant non-conductor supported thereby, a plurality of refractory spacing members embedded therein sufficiently to be supported thereby and maintained in position so that the heating element, below set forth, is maintained by the spacing members in non-shorting relation according to a predetermined pattern, and a resistance heating element, said element being supported and maintained in position by said spacing members in such a manner that contact of the element with the article to be heated cannot occur.

2. The heater of claim 1 further characterized in that the spacing members comprise beads.

3. A rigid sectional heater permanently shaped to conform substantially to the size and outline of an article to be heated comprising a rigid refractory non-conductor having a surface permanently shaped and adapted to receive and lie generally in close contact with an article to be heated, said non-conductor having embedded therein at spaced intervals in non-shorting relationship according to a predetermined pattern a resistance heating element attached to refractory spacing members, said heating element and spacing members being embedded to such an extent that said heating element lies completely below the surface of the refractory non-conductor intended to lie in contact with said article so that contact of the heating element with the article to be heated cannot occur.

4. The heater of claim 3 wherein the spacing members comprise beads.

5. A method of manufacturing a rigid heater permanently shaped to conform substantially in size and outline to an article to be heated, comprising attaching spacing members and a resistance heating element to a form conforming approximately in size and shape to that part of the article to be heated so that the heating element is held by the spacing members in spaced relationship to the form, and in non-shorting relationship, embedding the spacing members and heating element in a refractory supporting material to such an extent that direct contact with said heating element and an article to be heated cannot occur when the heater is applied to the article, leaving connecting leads exposed, and hardening said refractory material.

6. The method of claim 5 further characterized in that the form is made of a flexible fabric.

7. A method of manufacturing a rigid sectional heater permanently shaped to conform substantially in size and outline to an article to be heated comprising making a fabric envelope or jacket conforming to the shape of the article, stringing refractory beads on a heating element, attaching the beads at spaced intervals to the outer periphery of the envelope thereby maintaining the heating element in spaced relationship, embedding the beads in a moldable refractory supporting material leaving connecting leads exposed and hardening the refractory.

8. A method of manufacturing a rigid sectional heater permanently shaped to conform substantially in size and outline to an article to be heated which comprises forming a form conforming to the shape of the article, attaching a heating element and spacing members thereto at predetermined spaced intervals, embedding the heating element and spacing members in a re-

7

fractory material and molding the refractory material to the shape of the form and then hardening the refractory so that it retains the shape of the article.

9. The method of claim 8 further characterized in that the envelope comprises asbestos fabric.

10. The method of claim 8 wherein the form is made of glass fabric.

11. A rigid sectional heater shaped to conform substantially in size and outline to an article to be heated, which comprises a rigid refractory member having a heating surface shaped to conform substantially to said article, said member being formed of hardened refractory cement, a fireproof fabric liner conforming in shape to said member, an electrical resistance element attached to said liner, spacing beads attached to the liner and embedded in said rigid member adjacent said heating surface, and a support for the sectional heater thus formed.

12. A rigid sectional heater comprising an article-receiving pocket permanently shaped to conform substantially in size and shape to the outlines of an article to be heated, said pocket

8

comprising a rigid refractory non-conductor having embedded therein at predetermined spaced intervals a heating coil strung on spaced refractory beads, and a fire-proof fabric lining for said pocket attached to the beads, insulating material surrounding at least a portion of the hard refractory material and a support for the heater.

GLEN H. MOREY.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,868,468	Thompson	July 19, 1932
926,695	Frost	June 29, 1909
1,765,572	Eichenberger	June 24, 1930
2,381,218	Jacob	Aug. 7, 1945

OTHER REFERENCES

Krantz et al., "Industrial and Engineering Chemistry," Dec. 15, 1940, pages 752-3.