

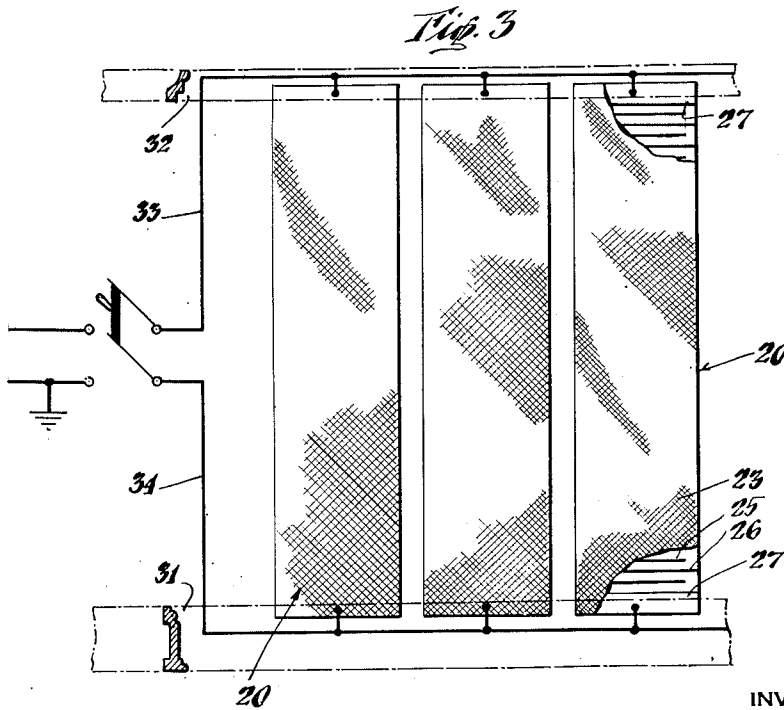
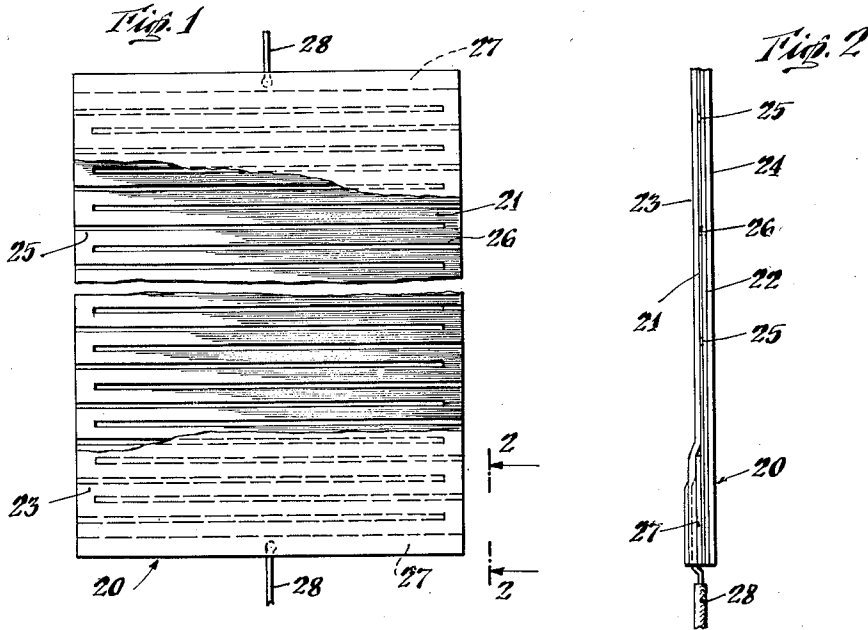
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ELECTRIC HEATER

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ELECTRIC HEATER

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6 Claims. (Cl. 219-19)

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This invention relates to improvements in electric heaters particularly to electric heaters having improved foil heating elements.

This application is a continuation in part of my copending patent application Serial No. 687,756 filed August 1, 1946, for Electric Heater and allowed on August 9, 1950, which has now become abandoned.

It is an object of the present invention to provide an improved electric heater particularly a low temperature electric heating element which is safe to use, which is relatively inexpensive to manufacture and install, which is compact and presents a smooth surface, which presents a relatively wide current path not readily subject to damage during handling or installation and which can be used for a wide range of heating applications.

Attempts have heretofore been made to provide foil heating elements. However, the prior attempts have had various disadvantages and have not proved to be commercially practical. Thus, the fusing point of certain of the foils suggested, such as tin, has been too low for many purposes and the fusing point of other foils including zinc and aluminum has been too high to provide a margin of safety against fire. Also, the resistance of these foils has been relatively low so that a comparatively narrow current path had to be provided whereby the heating element is relatively expensive to manufacture and is more subject to damage in handling or installation.

It is a particular object of the present invention to overcome the disadvantages heretofore encountered and to provide a commercially practical foil heating element of relatively high resistance and having a fusing point which is adequate for a good heating unit but is still low enough to provide an adequate margin of safety against fire.

In the accompanying drawing—

Fig. 1 is a front elevational view of an electric heating panel embodying my invention with the center area omitted and with portions of the several layers of material broken away to reveal the construction thereof;

Fig. 2 is a detail view in side elevation of the lower portion of the heating element in the direction of the arrows on line 2-2 of Fig. 1; and

Fig. 3 is a partially elevational and partially diagrammatic view of a plurality of heating panels showing the manner in which they may be connected to an electric heating circuit used as wall heating panels.

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My invention contemplates the provision of a low temperature electric heating element in the form of an electric resistance made from a relatively elongated strip or path of thin lead foil and suitably supported on a thin flexible sheet of insulating material. In addition to using foil of pure lead I may use lead with relatively small quantities of alloying materials which do not appreciably lower the unusually high resistance of lead or materially change its fusing point. For this purpose I prefer to use approximately 1 to 4% of antimony and of tin. The antimony and tin increase the strength of the lead without appreciably affecting the resistance or fusing point. The tin also increases the corrosion resistance of the foil. Also, the lead foil may have a very thin coating of tin on each side to facilitate the rolling thereof. By the expression "lead foil" I accordingly mean not only to indicate pure lead foil but also foil having relatively small quantities of alloying materials mixed therewith and suitable coatings applied thereto. The lead foil should be less than .002" in thickness and may vary considerably below this limit.

Foil made from lead, as defined herein, has a melting point which is high enough to make a practical heating element while at the same time it is low enough to provide the advantages of safety and automatic fusing if excessive temperatures are reached. Also, lead has the highest resistance of any available practical materials for this purpose so that the desired resistance and heat output can be obtained while at the same time using a relatively wide foil path for a feasible foil thickness.

Referring now to the drawing, it will be seen that my improved heater comprises a heating panel indicated generally at 20 and consisting of a lead foil heating element 21 of the type referred to above having a backing 22 of reinforcing insulating material such as paper and enclosed between two sheets or layers 23 and 24 of flexible insulating and reinforcing material adhesively secured in position. The backing 22 is laminated by a suitable adhesive to the heating element 21. The reinforcing and insulating layers 23 and 24 may be made either flexible or rigid but in either instance should be made of a suitable non-conducting material. In the illustrated embodiment the layers 23 and 24 are flexible and are made of paper, fabric, woven or felted glass fibre or the like.

In making the heating element the lead foil 21 is first secured to the supporting sheet 22. Thereafter, the foil sheet is formed into an elongated

gated tortuous current path in any suitable manner as by cutting the foil or fusing it along the parallel transverse lines 25 and 26 extending inwardly from the two edges of the sheet in alternate relationship to points adjacent the opposite edge as shown. In this manner a continuous zigzag path of lead foil is formed extending from the top of the sheet to the bottom thereof. The slits 25 and 26 extend through the foil sheet 21 only and the paper backing sheet 22 remains intact. In this manner the sheet 22 serves to support the foil element and preserve its shape even after it has been slit or cut in this fashion.

Because the foil is relatively thin and fragile, it is difficult to make a direct electrical connection between a wire lead and the foil. For this reason I have found that it is desirable to reinforce the foil or increase the thickness thereof throughout the area that the electrical connection is to be made using a thicker or stronger metal foil which can be readily soldered. I have found that a satisfactory connection can be made by means of the electrical connector shown in my copending application Serial No. 185,289 filed on September 16, 1950, for Metal Foil Heating Device, or by increasing the width of the upper and lower courses of the foil heating element and reinforcing these courses by means of copper strips 27 to which the wires may be directly soldered as shown in the accompanying drawing. In this manner the connection between the wire and foil is made in a reinforced area which can be readily soldered.

A strip of metal, such as copper or brass, less than approximately .003" in thickness produces very satisfactory results and it may be secured to the foil in any suitable manner as by heat and pressure, using a suitable flux.

When the reinforcing strips 27 have been secured in place lead wires 28 may be readily soldered thereto. Thereafter, the insulating and covering sheets 23 and 24 may be secured by a suitable adhesive over one or both surfaces of the heating element so as to completely cover the element and also over the connecting strips 27.

Heating panels of the type shown herein may be used as radiant heating units or for any other heating purposes. Among other uses for which the heating panels are suitable are that of wall, floor or ceiling heating units. In this connection the panel may be made to serve as a wall covering such as wallpaper and the outer surface of one of the reinforcing sheets 23 or 24 may be provided with suitable designs whenever desired. In Fig. 3, I have illustrated the manner in which the heating panels may be used as wall heating units with the lower edges disposed beneath a baseboard 31 and the upper edges disposed beneath a molding 32 and with the lead wires concealed beneath the baseboard and molding. When a plurality of panels are used in close proximity corresponding portions are of the same potential so as to eliminate any danger arising from short circuits. Thus, it will be seen that all of the upper ends of the panels shown in Fig. 3 are connected by lead 33 to one side of a source of electric current and all of the lower ends of the panels are connected by lead 34 to the other side of the source of electric current. It will be seen that the leads connect to the copper reinforcing strips 27 at the top and bottom of the panels.

For floor heating, the panels may be laid directly on the sub-flooring and the finished flooring laid thereon. Panels for this use can be readily constructed so that they will not be ad-

versely affected nor introduce a fire hazard if pierced by nails. If linoleum or asphalt tiles are used the panels are coated on both sides with a suitable adhesive and the tile or linoleum is superimposed thereon.

My improved heating devices may also be cemented to the outside of tanks to heat the contents thereof. They may also be cemented directly to various types of equipment, such as airborne equipment, which must operate at normal temperatures under extremely cold conditions. Also, my heating devices can be cemented to the containers of such equipment as a means of maintaining suitable operating temperatures.

In the illustrated embodiment of my invention the coverings 23 and 24 are of flexible construction. It will be understood that rigid reinforcing members may also be employed. Thus, the heating panel and the foil path may take many different forms and shapes and they may be used for many different heating purposes. My invention contemplates the provision of a heating device having a reinforced lead foil heating element of the type disclosed herein and it will be appreciated that the type of covering materials, the shape of the heating panel and the configuration of the foil path may be varied without departing from my invention.

From the foregoing, it will be appreciated that I have provided a heating device having an improved heating element which is relatively simple to manufacture and install, which can be used for a wide range of applications, which is relatively compact, which has a high factor of safety and which may have a relatively wide foil path so as to minimize damage to the unit during handling or installation. Modifications may, of course, be made in the illustrated and described embodiment of the invention without departing from the invention set forth in the accompanying claims.

I claim:

1. In an electric heating device, a heating element comprising a preformed unitary flexible sheet of lead foil less than .002" in thickness, said sheet having slits arranged to provide an elongated relatively narrow tortuous foil path of substantially uniform width throughout the greater portion thereof and with the foil in flat unfolded condition and a supporting sheet formed of thin flexible insulating material laminated to the foil.

2. In an electric heating device, a heating element as set forth in claim 1 in which the lead foil has a thin coating of tin on the surface thereof.

3. In an electric heating device a heating element as set forth in claim 1 having a flexible piece of slightly thicker metal secured and electrically connected to a portion thereof whereby electrical connections can be readily made to the element.

4. In an electric heating device, a heating element comprising a preformed unitary flexible sheet of lead foil less than .002" in thickness, said sheet having slits arranged to provide an elongated relatively narrow tortuous foil path.

5. An electric heating device as set forth in claim 4 in which the foil heating element is connected to a supporting backing of insulating material.

6. An electric heating device as set forth in claim 4 in which a flexible piece of stronger metal is secured and electrically connected to a portion of the lead foil whereby electrical con-

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nections can be readily made to the foil and a supporting backing of insulating material is laminated to the foil.

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REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
617,375	Voight et al.	Jan. 10, 1889
636,203	Helberger	Oct. 31, 1889
791,691	Hadaway, Jr.	June 6, 1905

Number
2,075,733
2,110,660
2,165,970
2,273,941
2,504,146

10

Number
77,262
224,648
225,627
447,453
550,433

6

Name	Date
Lazarus	Mar. 30, 1937
Doczekal	Mar. 8, 1938
Jaspers	July 11, 1939
Dorn	Feb. 24, 1942
Mossin	Apr 18, 1950

FOREIGN PATENTS

Country	Date
Germany	Sept. 25, 1894
Great Britain	Nov. 20, 1924
Great Britain	Dec. 8, 1924
Great Britain	May 19, 1936
Great Britain	Jan. 7, 1943