United States Patent

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[54] ELECTRIC INFRARED HEATER

1 Claim, 5 Drawing Figs.

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[51] **Int. Cl.** **H05b 3/28**
[50] **Field of Search** ..... 219/553, 345, 354, 528—9, 549, 544; 117/126, 169

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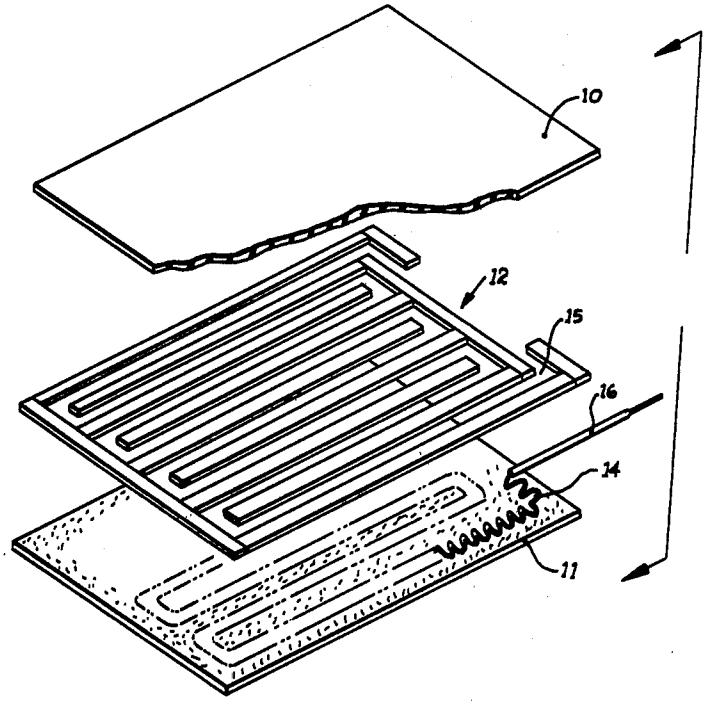
ABSTRACT: An electric heater for emitting infrared radiations having a plurality of insulating elements adhesively sandwiched between a pair of superimposed sheets to form a maze therein with a zigzag passageway, and a continuous infrared radiating element disposed in the passageway with terminals at both ends thereof. The sheets are composed of fibrous aluminum oxide and silicon dioxide and interstices in the sheets are filled with silicon dioxide particles to provide a good emitter of infrared radiation having an emissivity factor of about 90 percent.



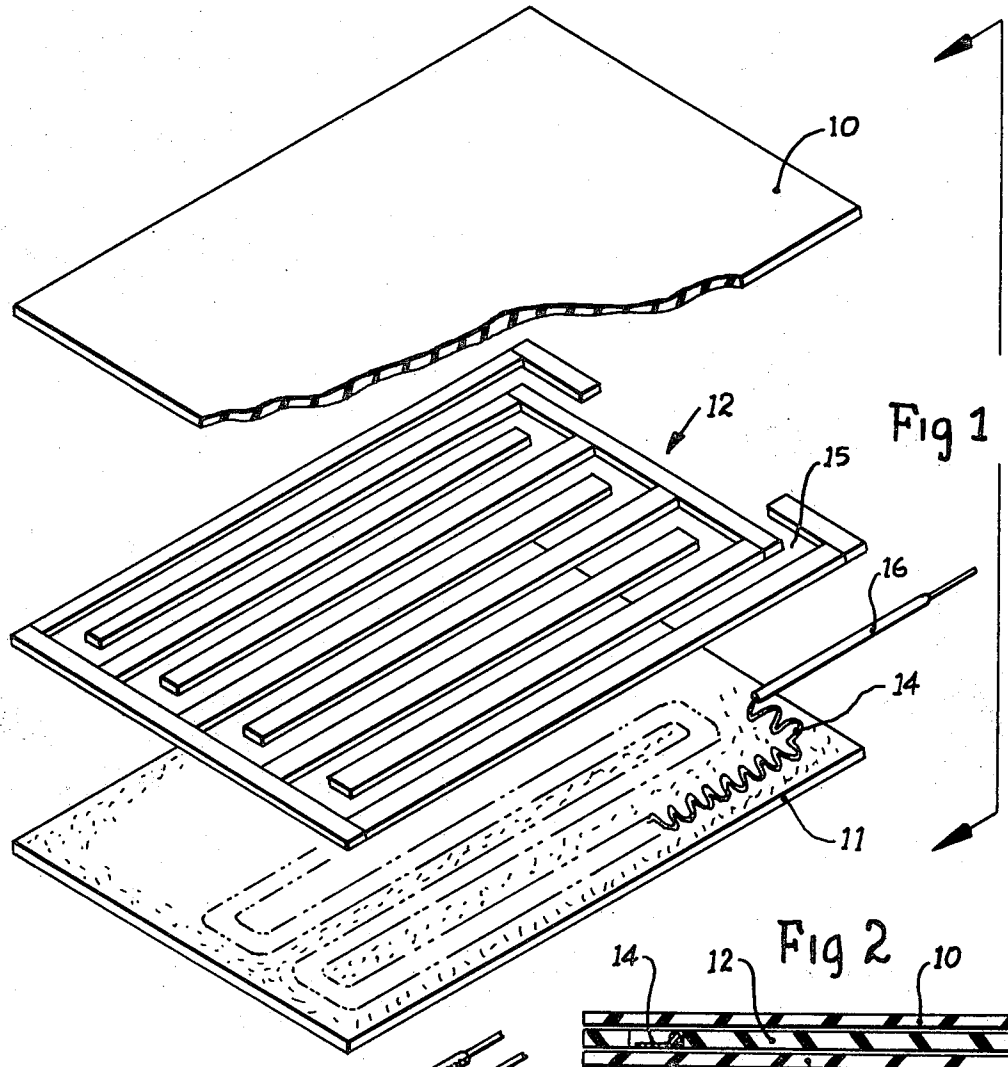


Fig 1

Fig 2

Fig 3

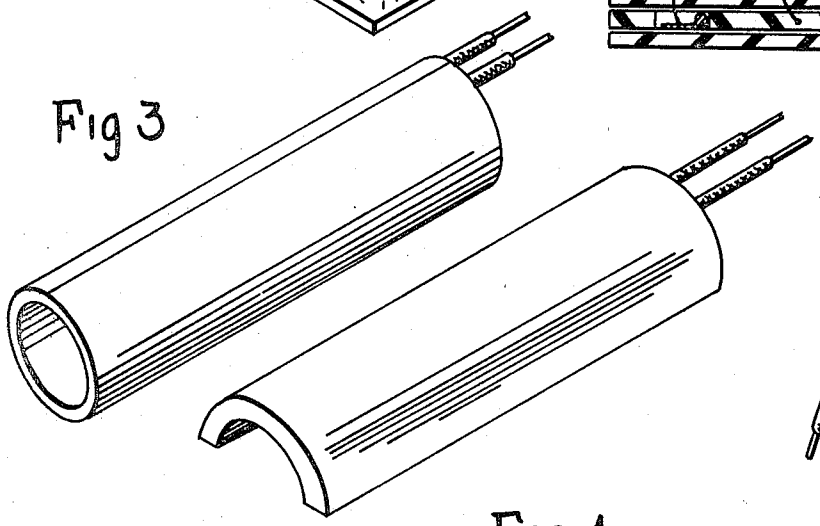


Fig 4

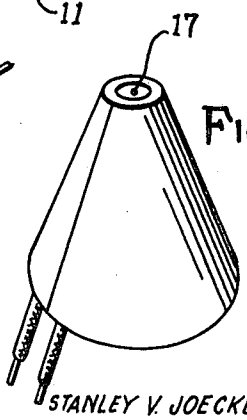


Fig 5

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ELECTRIC INFRARED HEATER

This is a division of application Ser. No. 600,840 filed Dec. 12, 1966.

The present invention relates to infrared heaters and, more particularly, to such heaters utilizing elements which have been converted from a heat insulating feltlike cloth material to a cardboardlike material for emitting infrared radiations, and to the method of so converting the material.

Accordingly, an object of the present invention is to provide such a method which is simple and economical.

Another object is to provide such a method for producing elements which are readily assembled with other elements to form the heaters.

Another object is to provide such a method which enables the elements to be produced in any desired shape or from with a heating or infrared radiating element sandwiched therebetween.

A further object is to provide such a method for producing heaters of a shape or form adapted to enclose objects to be heated.

Other and further objects will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

In the drawings:

FIG. **1** is a fragmentary exploded perspective view of a flat heater.

FIG. **2** is a fragmentary sectional view of a section of the heater shown in FIG. **1** illustrating the heater as assembled.

FIG. **3** is a perspective view of a tubular cylindrical heater.

FIG. **4** is a perspective view of a hollow semicylindrical heater.

FIG. **5** is a perspective view of a hollow generally conical heater.

Referring now to the drawing in detail and, more particularly to FIGS. **1** and **2**, there is shown a heater of the type described hereinbefore which generally comprises a pair of superimposed sheets **10** and **11** having a continuous zigzag maze **12** sandwiched therebetween and adhesively secured thereto, and a continuous infrared radiating element **14** disposed in a passageway **15** of the maze and having terminals **16** connected to the element **14** in any suitable manner, as by a heliarc weld and extending outwardly of the heater.

Preferably, a sheet of aluminum (not shown) or other suitable light-reflecting material covers the outer surface of one of the sheets **10** and **11**, so that radiant energy is emitted only from the other sheet.

The heater shown in FIGS. **1** and **2** may be used as a stove by placing cooking utensils thereon, or may be used as a radiant heating panel for electrically heating buildings and the like.

In FIG. **3**, a heater is shown having a tubular cylindrical shape. Such a heater may be used for cooking frankfurters or heating other elongated objects placed within the heater. Heat is uniformly applied to all sides of the object without rotating the object itself. Further, a pair of such circular heaters may be concentrically arranged for cooking hamburgers, steaks and the like disposed therebetween.

In FIG. **4**, a hollow semicylindrical heater is shown. This heater may be used for heating the top of an article placed thereunder.

In FIG. **5**, a hollow generally conical heater is shown which has a vent or opening **17** at the apex. Such a heater may be used for roasting a piece of meat by placing the meat therein or for heating other objects. Here again, heat is uniformly applied from all sides and from the top without changing the position of the object.

The maze **12** is constructed of strips of heat insulating material composed of fibrous aluminum oxide and silicon dioxide and having the consistency of a feltlike cloth and being capable of withstanding temperatures up to 2,300° F. Such a material is sold under the trademark "Fiberfrax" by Carborundum Co.

The sheets **10** and **11** are fabricated by the method about to be described from the same material of which the maze is constructed. The sheets **10** and **11** are cut to a desired shape and size from a larger sheet of material. The sheets are immersed in an aqueous solution containing finely divided silicon dioxide particles and a dispersing agent, such as an inorganic detergent. The aqueous solution preferably consists of ratio of 55 to 1 of the silicon dioxide particles and disbursing agent. The former is obtained under the trademark "Ludox" (Dupont) and consists of

Colloidal silica as SiO_2	30.0 %
Ratio wt. SiO_2/Na_2O	95
Chloride as NaCl	0.04 %
sulfate as Na_2SO_4	0.05 %
Viscosity at 25° C. cps	3.6
pH at 25° C.	9.8
Surface area B.E.T. method	
M2g Silica	210.0
Approx. particle diameter	15 mu.
Turbidity	21

The dispersing agent is obtained under the trademark "Pluronic" (Wyandotte) and consists of 40 percent hydrophylic polyoxyethylene and 60 percent polyoxypropylene.

The sheets are immersed in the above-mentioned solution for a sufficient duration of time, for example from about one-half minute to about 4 minutes, to allow the sheets to become completely saturated with the solution and to fill the interstices with silicon dioxide particles while maintaining the solution at a temperature of between about 80° F. and about 125° F. The excess of the aqueous solution is drained from the sheets by placing the sheets on a perforated rack (not shown). Thereafter the sheets are dried slowly to remove moisture therefrom.

In the drying procedure the sheets are allowed to lose moisture slowly for about 24 hours at between about 80° and about 90° F. or by subjecting them to infrared heat for about 6 or 7 hours.

The dry sheets no longer have a feltlike consistency but will be hard and stiff, like thick cardboard. In addition, the thermal conductivity of the sheets will have changed drastically. Whereas formerly the sheet material was a very good heat insulator, it now has become a relatively good conductor of heat. Since the interstices in the original fibrous material have been filled with silicon dioxide particles, the material now is a very good emitter of infrared radiation and has an emissivity factor well about 90 percent.

The heater, shown in FIGS. **1** and **2**, is constructed by arranging maze strips, as sown, on one of the sheets and adhesively securing them thereto with a silica-alumina cement which can withstand temperatures up to 2,300° F. The passageways **15** of the maze **12** are filled with the heating element **14** and the terminals **16** thereof are secured to the sheet. The passageways **15** are filled with the cement just described to secure the heating element **14** therein. More of the cement is placed on the maze strips and the other sheet is superimposed to sandwich the maze and the heating element **14** between the sheets **10** and **11**. Pressure is applied so that the sheets remain in closure contact with the maze structure while drying the cement for several hours to produce a thin two-sided infrared generator. The above silica-alumina cement preferably consists of:

SiO_2	57.0 percent
Al_2O_3	41.0
Na2O	0.8
B_2O_3	0.6
MgO	0.4
Trace Ingredients	0.2

The heaters shown in FIGS. **3** to **5** are built by securing the maze **12** and the heating element **14** between sheets which have not been dried completely but are still pliable, shaping the resulting structure to its desired form, and then drying the same very slowly, so that the heat insulating properties of the maze strips will not be affected adversely.

From the foregoing description, it will be seen that the present invention provides an improved infrared heater and a simple and practical method of making the same.

As various changes may be made in the form, construction, and arrangement of the parts herein, without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matters are to be interpreted as illustrative and not in any limiting sense.

I claim:

1. An electric heater for emitting infrared radiations comprising a pair of superimposed sheets, a plurality of insulating elements composed of aluminum oxide and silicon dioxide and being sandwiched and adhesively secured between said sheets to form a maze therein, said maze having a zigzag passageway formed therein, and a continuous infrared radiating element disposed in said passageway, electrical terminals connected to the ends of said infrared radiating elements and extending from said insulating maze, said sheets being composed of fibrous aluminum oxide and silicon dioxide having interstices therein filled with silicon dioxide particles to provide an emitter of infrared radiation having an emissivity factor of about 90 percent, said sheets being capable of withstanding 2,300° F.