METHOD FOR HEATING A SOLID SURFACE SUCH AS A FLOOR, WALL, ROOF, OR COUNTERTOP SURFACE

VERFAHREN ZUM HEIZEN EINER FESTEN OBERFLÄCHE, WIE EINES BODENS, EINER MAUER, EINES DACH ODER EINER ARBEITSPLATTE

PROCÉDE DE CHAUFFAGE D'UNE SURFACE PLEINE TELLE QUE CELLE DE PLANCHERS, DE PAROIS, DE PLAFONDS OU DE SOUS-PLAFONDS

(54) METHOD FOR HEATING A SOLID SURFACE SUCH AS A FLOOR, WALL, ROOF, OR COUNTERTOP SURFACE

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Description

Background of the Invention

1. Field of the Invention

[0001] The present invention generally relates to methods of heating various solid surfaces. Specifically, the invention relates to methods of heating floors, walls, roofs, or countertops by applying a heater element, such as a laminated composite heater element to the particular surface and energizing the heater element.

2. Description of the Prior Art

[0002] A variety of heater elements exist in the prior art. U.S. Patent No. 4,534,886, to Kraus et al., discloses an electrically conductive web composed of a non-woven sheet of conductive fibers and non-conductive fibers. The sheet is saturated with a dispersion containing conductive particles and is then dried. The Kraus et al. heater element is used primarily in heating pads.

[0003] International Application No. PCT/US94/13504 (Publication No. WO95/15670) discloses an electrically conductive composite heating assembly. The assembly has an electrically conductive non-woven fiber layer laminated between layers of fiberglass and other dielectric material. The assembly further has an abrasion resistant outer layer. The heater element is used on aerospace structures as an ice protection system to withstand the repeated mechanical stress and thermal cycles encountered in extremely harsh aerospace environments.

[0004] U.S. Patent No. 5,344,696 to Hastings et al. discloses an integrally bonded laminate that is used to thermally control a surface of an aircraft to which the laminate is bonded.

[0005] None of the prior art heater elements, however, have been successfully applied to floors, walls, roofs, or countertops.

Summary of the Invention

[0006] The present invention comprises a method as disclosed in the claims for heating the surface of a solid material, such as a floor, wall, roof, or countertop. The method comprises providing a heater element, disposing the heater element at a predetermined depth in the material, and energizing the heater element at prescribed intervals and temperatures, effective to heat the surface of the material.

Brief Description of the Drawings

[0007] Figure 1 depicts the construction of a composite heater element of the invention in a mold.

Detailed Description of the Preferred Embodiment

[0008] The present invention comprises a method for heating the surface of a solid material, such as a floor, wall, roof, or countertop. The method comprises providing a heater element, disposing the heater element at a predetermined depth and location in the material and energizing the element at prescribed intervals and temperatures which are effective to heat surface of the material.

[0009] The heater element of the present invention is a laminated composite, impermeable to water, and is of the type disclosed in U.S. Patent No. 5,344,696 (Hastings et al.), which is incorporated herein by reference. As disclosed in the Hastings et al. patent, the heater element comprises a durable outer ply, which is resistant to abrasion and impermeable to water, bonded to and through a conductive layer of fibers, and an integrally enveloping adhesive, which is adhered to the surface of a vessel. The conductive layer is connected to a source of electrical energy, and control means are adapted to control the temperature of the surface of the vessel. This laminated structure is considered preferable; however, it is contemplated that other structures may be used. For example, the heater element need not be a laminated structure. Rather, the heater element may comprise merely a layer of conductive fibers. This structure of the heater element is particularly useful if the material into which the heater element is embedded has dielectric properties that will evenly distribute the heat generated by the element.

[0010] The preferred heater element is available under the trademark Thermion™, which is manufactured by Aerospace Safety Technologies, Inc. Thermion™ is thin, light, flexible and may be translucent. The material is a laminate that provides even heating and can be formed to surfaces having a variety of different contours and shapes. Operational power can be derived from low or high voltage AC or DC power supplies.

[0011] As discussed above, the heater element may comprise a layer of conductive fibers that are directly embedded into the material. However, in this instance, the material must possess sufficient dielectric properties
to evenly distribute the heat generated by the fibers to the surface of the material. Thermoplastic materials typically possess these properties.

The heater element is disposed at a predetermined location and depth in the material. The depth and location may vary according to the particular material and type of heating required.

1. Residential/Commercial Building Use

The thin, unobtrusive nature of the heater element makes it suitable for use in ceramic and marble tiles, solid surface materials, Formica, linoleum, and any other floor, wall, roof, or counter covering available. The essential steps of the method of the present invention can be performed in several different ways.

A first variation in the method involves installing in the surface a pre-made panel, usually configured on a mold table for easy transfer to the final surface. As shown in Fig. 1, the pre-made panel comprises a fiberglass resin encapsulated heater element 1, further encapsulated in two fiberglass/resin cloths 5 and 5'. The pre-made panel also contains electrical leads attached to the heater element (not shown). The electrical leads extend outside of the panel and are attached to an electrical power supply. The laminate optionally can be constructed with multiple layers of the fiberglass resin encapsulated heater element 1. The multiple-layered heater element can provide greater control over the heat output from the assembly.

Figure 1 shows how a single layer pre-made panel is formed on a transfer table. The fiberglass resin encapsulated heater element 1 is placed on top of a mold table surface 9. A mold release wax 15 is disposed between the encapsulated heater element 1 and the table surface 9. A peel ply 19 is placed above the encapsulated heater element 1. A release ply 21 is disposed above the peel ply 19 and a bleeder cloth 25 is disposed over the release ply 21. Finally, a vacuum bag 29 is disposed over the release ply 21. A seal tape 11 surrounding the layers on the mold is attached to the table top surface 9, and can adhere to the vacuum bag 29 to create a tight seal. A vacuum supply 33 is used to evacuate the air between the layered material in order to bring the layers into close contact with each other and cure the resin, bonding the layers to create the laminate.

Referring to Fig. 2, a pre-formed panel may be installed below a variety of covering surfaces, such as ceramic, marble, or similar paver tiles. In a tile and grout environment 101, the sub-base, whether a floor or countertop, may first be covered by a particle board underlayment 100. Some builders choose not to use an underlayment, but its purpose is to aid in leveling the floor and build uniformity. A vapor barrier and one or more concrete base products are then applied over the underlayment set. At a minimum, the concrete 102 should be at least 1/2 inch thick for standard wet/dry environments, such as kitchen and bathroom floors and counters (see Figures 2 and 3). For standing water conditions, such as showers and exterior areas, the layer must be at least twice this thickness. Concrete serves a dual purpose. It limits the surface flexing and also acts as a water barrier. The vapor barrier further prevents water from passing to the wood below either by sweating or cracking of the concrete. A heater element 104 is disposed above the concrete base 102. The heater element 104 optionally contains a syntactic film layer 106 on the back/bottom side for bonding the element 104 to the concrete base 102. Film layer 106 replaces the mastic that would otherwise be required to set heater element 104 in place. Without a bonding film layer, the installer would smear the concrete base with a thin layer of mastic, alternatively referred to as 105, apply the heater element from edge to edge, minimizing air pockets, and roll the element flat against the concrete base 102. Once the heater element 104 is set, the normal process of installing tiles 101 can continue. If necessary, the panel may be punched with suitable tools to create holes or other shapes, as needed, and edge finished to protect against electrical shock. The holes, depending on their relative size and location, will have minimal to moderate effect on the heat output of the device.

As depicted in Figure 3, the heater element 104 can be installed under a countertop layer 108, such as a Formica or linoleum top layer, in a manner similar to tile, although the concrete base and vapor barrier are no longer required. In addition, Formica/linoleum installation generally utilizes contact adhesives which require additional processing known to those skilled in the art.

A second variation in the method of the present invention involves simultaneously constructing the composite heater element 104 at the time the floor, wall, or countertop material is constructed. For instance, the composite in Figure 3 may be constructed on the sub-surface 109 simultaneously as the other layers of material are applied over the heater element 104. This second method is particularly useful in the construction of formica and metal countertops. This method is advantageous in that custom-shaped heater elements may be easily incorporated below the finished surface of the material. For example, in the case of wood/concrete substrates, custom-shaped heater elements may be bonded under the finished surface of the material. In carrying out this method, the heater element is disposed on a solid, clean surface, and epoxy resin is applied to bond the element to the material. The composite may also be vacuum cured and heated, if desired. The vacuum process regulates the heater resin content in conjunction with the fiberglass selected. After the curing process is complete, the top surface of the material may be finished, as desired. In the case of Formica, a contact adhesive is applied between the element and the top surface before they are joined. Thereafter, the composite is rolled to complete the process.

As depicted in Fig. 4, a third variation in the method of the present invention involves providing a
heater element 104 without the fiberglass outer layers or resin and encapsulating the element 104 within the finished material at the factory/production level. Such an installation is suitable for solid surface 112 materials such as Corion®, or any other thermoplastic formed item that has sufficient dielectric strength to isolate the electric heater element from the surface, and that allows cohesive bonding through the heating element. Most structures developed by liquid process molding are excellent candidates. The placement of the heater element 104 can be accurately controlled providing heat as near to the surface as is practical and safe. Using standard counter depths, the heaters can be pre-formed to run front to back allowing the surface to be cut to length, and end finished. A front to back orientation refers to the direction of current flow.

**[0020]** Different configurations of heater placement and orientation may be accomplished at the time of production, allowing for custom needs. Some circumstances may require surface heating in localized areas, for instance, the areas around a sink or other fixtures. The heater element may, therefore, be pre-cut to any particular pattern and may contain holes or cuts, as is necessary. For a field modification to a solid surface application, the surface could be cored within certain dimensions and edge finished, having minimal to moderate effect on the heater’s performance.

**[0021]** Additional residential/commercial building applications include roof de-icing as shown in Figure 5 and concrete walkways as shown in Figure 6. These applications could use the pre-made panels for convenience and quick installation. Such roof applications are suitable for neoprene, hot mopped, shingled or even metal style roofs. Figure 5 shows a typical application of the heater element 104 to a roof. Listed from bottom layer to top layer, the typical heater roof comprises a wood sheeting substrate 109, felt paper 113, heater mastic 111, the heater element 104, and the finished roof layer 115. The finished roof layer 115 may be of typical roof finish materials such as, neoprene rubber, metal, or the like.

**[0022]** Application of the heater element in a concrete walkway is depicted in Figure 6. The walkway contains a perforated panel 114, laid during construction over and above, or in place of, a remesh/rebar 116. The heater element 104 is disposed over the perforated panel 114. Finally, a top layer of concrete is disposed above the element.

**[0023]** The heater element may also be applied to rain gutters. Such application may be completed by use of any of the methods discussed. The particular method chosen depends on the installation and gutter product selected.

**[0024]** Additionally, the heater element may be applied to mirrors. Mirror application to prevent fogging is an example of a simple back side bonding. The heater may be a pre-formed panel or a formed-in-place installation. For radiant heat applications the methods are no different only the object selected to encase the material vary. Besides the possibility of heated pavers, diffused panels for a green house can incorporate the heated panels. The panels can be of simple or complex design and may provide winter environmental control and snow removal. Additional greenhouse installations could provide local heating as well for particular applications, such as lighting pairs for ice/snow protection and for heating/environmental control.

### Claims

1. A method for heating the surface of a solid material, comprising:

   - providing a pre-formed panel heater element (1) to the surface of the solid material, wherein said pre-formed panel heater element (1) comprises an inner layer composed of a fabric of electrically conductive fibers encapsulated between two fiberglass resin layers (5, 5'); two outer fiberglass/resin layers disposed on opposing surfaces of said inner layer and encapsulating said inner layer; and electrical leads connected to said conductive fibers and adapted to receive power from a power source; embedding the pre-formed panel heater element (1) at a predetermined location and depth from the surface of the solid material; and energizing the conductive fibers of the pre-formed panel heater element (1) effective to evenly distribute heat in the surface of the solid material.

2. The method of claim 1, wherein the material is a floor.

3. The method of claim 1, wherein the material is a wall.

4. The method of claim 1, wherein the material is a countertop.

5. The method of claim 2, wherein the floor is composed of ceramic or marble tiles.

6. The method of claim 2, wherein the floor is a concrete walkway.

7. The method of claim 4, wherein the countertop is made of a laminate.

8. A method for heating a solid surface material which possesses dielectric properties, comprising:

   - encapsulating a pre-formed panel heater element (1), having conductive fibers, within the
solid surface material during molding of said surface; and
energizing the conductive fibers of the pre-formed panel heater element (1) at prescribed intervals and temperatures which are effective to heat the surface of the material.

9. The method of claim 8, wherein the solid surface material is made of a thermoplastic.

10. The method of claim 1, wherein the pre-formed panel heater element (1) is a laminated composite which is impermeable to water.

Patentansprüche

1. Verfahren zum Heizen der Oberfläche eines festen Materials, das aufweist:

Bereitstellen eines vorgeformten Plattenheizelementes (1) für die Oberfläche des festen Materials, wobei das vorgeformte Plattenheizelement (1) eine innere Schicht, die aus einem Gewebe elektrisch leitender Fasern, die zwischen zwei Glasfaserharz-Schichten (5, 5') eingekapselt sind, zwei äußeren Glasfaser/ Harz-Schichten, die auf gegenüberliegenden Oberflächen der inneren Schicht angeordnet sind und die innere Schicht einkapseln, und elektrische Leitungen aufweist, die mit den leitenden Fasern verbunden sind und geeignet sind, um Strom aus einer Stromquelle aufzunehmen;

Einbetten des vorgeformten Plattenheizelementes (1) an einer vorbestimmten Stelle und Tiefe von der Oberfläche des festen Materials; und

Energieversorgung der leitenden Fasern des vorgeformten Plattenheizelements (1), um gleichmäßig Wärme in der Oberfläche des festen Materials zu verteilen.

2. Verfahren nach Anspruch 1, wobei das Material ein Boden ist.

3. Verfahren nach Anspruch 1, wobei das Material eine Wand ist.

4. Verfahren nach Anspruch 1, wobei das Material eine Arbeitsplatte ist.

5. Verfahren nach Anspruch 2, wobei der Boden aus keramischen oder Marmorfliesen besteht.


7. Verfahren nach Anspruch 4, wobei die Arbeitsplatte aus einem Laminat besteht.

8. Verfahren zum Heizen eines Materials mit fester Oberfläche, das nichtleitende Eigenschaften aufweist, das aufweist:

Einkapseln eines vorgeformten Plattenheizelements (1), das leitende Fasern im Material mit fester Oberfläche aufweist, während des Formens der Oberfläche; und

Energieversorgung der leitenden Fasern des vorgeformten Plattenheizelements (1) bei vorgeschriebenen Intervallen und Temperaturen, die wirksam sind, das Material mit fester Oberfläche zu heizen.

9. Verfahren nach Anspruch 8, wobei das Material mit fester Oberfläche aus einem thermoplastischen Kunststoff besteht.

10. Verfahren nach Anspruch 1, wobei das vorgeformte Plattenheizelement (1) ein Schichtverbundmaterial ist, das für Wasser undurchlässig ist.

Revendications

1. Procédé pour le chauffage de la surface d’un matériau massif, comprenant les étapes consistent à :

fournir un élément chauffant (1) en panneau préformé à la surface d’un matériau massif, le dit élément chauffant (1) en panneau préformé comprenant une couche intérieure composée d’un tissu de fibres électriquement conductrices encapsulé entre deux couches (5, 5’) de résine renforcée de fibres de verre ; deux couches extérieures de résine/fibres de verre disposées sur des surfaces opposées de ladite couche intérieure et encapsulant ladite couche intérieure ; et des conducteurs électriques reliés auxdites fibres conductrices et adaptés pour recevoir de l’énergie d’une source d’énergie ;

incorporer l’élément chauffant (1) en panneau préformé à un emplacement et à une profondeur prédéterminée par rapport à la surface du matériau massif ; et

alimenter en énergie les fibres conductrices de l’élément chauffant (1) en panneau préformé pour répartir régulièrement la chaleur dans la surface du matériau massif.

2. Procédé selon la revendication 1, dans lequel le matériau est un sol.

3. Procédé selon la revendication 1, dans lequel le matériau est un mur.
4. Procédé selon la revendication 1, dans lequel le matériau est un faux plafond.

5. Procédé selon la revendication 2, dans lequel le sol est composé de carreaux de céramique ou de marbre.

6. Procédé selon la revendication 2, dans lequel le sol est un trottoir en béton.

7. Procédé selon la revendication 4, dans lequel le faux plafond est réalisé en stratifié.

8. Procédé pour chauffer le matériau d'une surface massive qui possède des propriétés diélectriques, comprenant les étapes consistant à :

   encapsuler un élément chauffant (1) en panneau préformé doté de fibres conductrices dans le matériau de la surface massive pendant le moulage de ladite surface ; et
   alimenter en énergie les fibres conductrices de l'élément chauffant (1) en panneau préformé à une périodicité et à des températures prescrites qui sont efficaces pour chauffer la surface du matériau.

9. Procédé selon la revendication 8, dans lequel le matériau de la surface massive est un thermoplastique.

10. Procédé selon la revendication 1, dans lequel l'élément chauffant (1) en panneau préformé est un composite stratifié imperméable à l'eau.