April 17, 1956 H. P. BOVENKERK 2,742,556

HEATING PANEL

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Fig. 1.

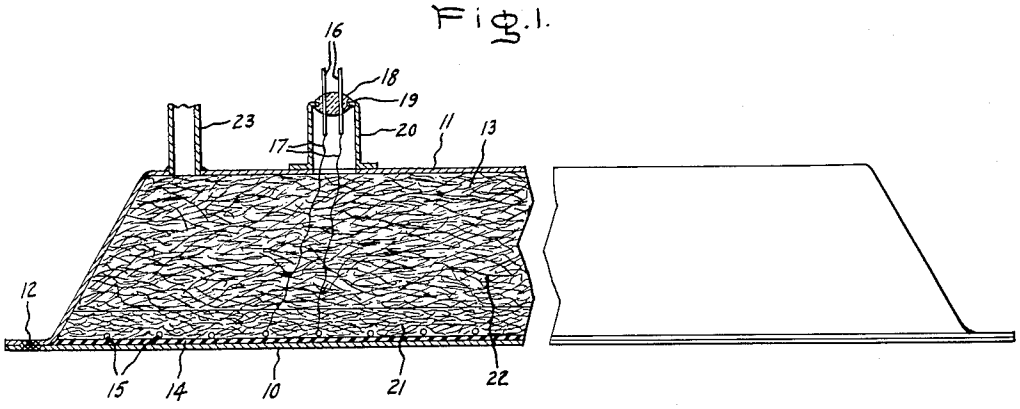
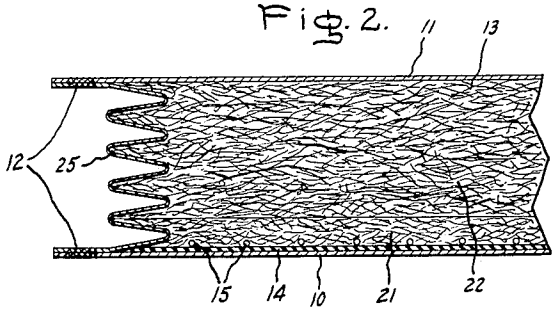


Fig. 2.



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2,742,556

HEATING PANEL

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11 Claims. (Cl. 219—19)

This invention relates to a heating panel suitable for heating a room; more particularly, the invention relates to a heating panel suitable for use as a wall structural member having incorporated therein a resistance heating element which will heat a room economically by electricity.

For many years, space heaters utilizing an electric resistance heating element have been in use. Formerly, such heaters consisted of a parabolic reflecting surface in the center of which was mounted a coiled section of Nichrome wire. More recently, such heaters have omitted the reflecting surface but operate in conjunction with an electric fan which blows air to be heated past the element. Other space heaters of recent years have included a water reservoir to temper the action of the heating element. While space heating by electrical resistance elements has many attractive features, in most localities the cost of electric power is high enough to make the cost of heating the ordinary house by electrical space heaters of the resistance type prohibitive.

Accordingly, it is an object of this invention to provide a resistance heater built into a wall panel having such effective thermal insulation that electrical space heating becomes economically feasible.

It is another object of this invention to provide a heating panel which is highly unidirectional with reference to heat flow.

It is another object of the invention to provide a heating panel suitable for incorporation as a structural member in a wall.

It is a further object of the invention to provide a thermally insulated radiant heat panel utilizing two types of thermal insulation to provide the best insulated panel at the lowest cost.

Briefly stated, in accordance with one of its aspects, this invention comprises a wall heating panel having a front and back metal surface in spaced relation, an electric heating element in the space between the surfaces adjacent the front metal surface and electrically insulated from the front metal surface, a blanket of temperature stable material overlying the heating element, and a blanket of mineral insulating fibers positioned in the space between the blanket of temperature stable material and the back metal surface.

Fig. 1 of the drawing is a broken sectional view of a heating panel made in accordance with this invention. Fig. 2 is a broken sectional view of an alternative panel construction.

A front metal surface **10** and a spaced back metal surface **11** are in gas-tight sealed engagement around their edges as by a weld **12**. The metal of which the surfaces **10** and **11** are composed is preferably of a type offering high resistance to the diffusion of gases therethrough. Alloys are also satisfactory for this purpose. The metal of which the surface **11** is composed should preferably have a low coefficient of thermal conductivity, but this is not necessary in the case of the surface **10** since, as will be subsequently explained herein, it serves

as a surface for the radiation of heat. Stainless steel and corrosion-resistant alloys such as "Monel" metal (an alloy containing copper and nickel) are satisfactory construction materials for the panel. Carbon steel is also satisfactory provided it is given a protective covering such as baked enamel or a coating of resin in order to prevent rusting. If the surface **10** is composed of carbon steel, the protective coating applied must be temperature-stable. Porcelain enamel will provide the necessary degree of temperature stability.

The surfaces **10** and **11** are spaced to define a chamber **13** which is mainted at a pressure of less than one millimeter mercury and preferably at a pressure of the order of ten to one hundred microns mercury. The front surface **10** is lined with an insulating material **14** such as mica or cloth made of silicon dioxide fibers. The layer of insulating material **14** serves the purpose of electrically insulating the metal surface **10** from a resistance heating element **15**. Thus, any form of electrical insulation which would not destroy the vacuum of the chamber **13** would be a suitable substitute for the silicon dioxide or mica previously set forth as the composition of the material **14**.

The heating element **15** is connected by means of lead wires **17** to a pair of electrodes **16** which pass in sealed engagement through a glass or ceramic element **18** which is in turn sealed in gas-tight engagement by means of a glass-metal seal **19** to a nipple **20** mounted on the metal surface **11**.

A blanket of heat stable material **21** is positioned in back of the resistance heating element **15**. The blanket **21** must be composed of material which is stable under the high temperature to which the element **15** is heated. Materials suitable for this purpose are aluminum oxide powder, aluminum oxide fibers, high-melting slag wool, mica, and silicon dioxide granules or fibers.

Occupying the space within the chamber **13** between the blanket **21** and back metal surface **11** is a blanket **22** of mineral insulating fibers such as glass wool or slag wool. It is not necessary that the blanket **22** have great stability at the temperature at which the heating element **15** operates since the blanket **21** protects the blanket **22** from the high temperature. In carrying out this invention, I prefer to form the blanket **21** of silicon dioxide fibers and the blanket **22** of glass fibers and to have the blanket **22** occupying most of the space **13**. Normally this will be over half the thickness of the panel. Glass fibers have insulating qualities equal to silicon dioxide fibers but cost less. Thus, by forming a mineral fiber laminate of the type illustrated, I obtain the best insulation at the lowest cost.

I prefer to form the blanket **22** of glass fibers after the manner disclosed and claimed by Strong and Bundy in application Serial No. 236,788, filed July 14, 1951, and assigned to the same assignee as the present application. The Strong and Bundy application discloses that superior heat insulation can be obtained if the individual fibers of the blanket **22** are randomly oriented with their axes in planes generally parallel to the plane of the panel surfaces. In other words, the axes of the individual fibers are generally perpendicular to the direction of heat transfer through the panel. It is preferable that the individual fibers have a diameter of less than one-thousandth of an inch and that the fibers be packed to a density in excess of ten pounds per cubic foot. In general, the finer the fibers, the better the insulation and the less dense the fibers have to be packed in order to provide good insulating qualities. There is no critical range of fiber size or blanket density nor is there a critical pressure range at which the chamber **13** must be maintained. The panel is an effective heating device at atmospheric pressure with fibers of a diameter greater than one-thousandth of an

inch packed to a density of less than ten pounds per cubic foot. Nevertheless, as the pressure and fiber diameter are decreased, and as the blanket density is increased, the heating and insulating qualities of the device are improved. It is to be understood that I do not herein claim as my invention anything shown or described in said Strong and Bundy application, which is to be regarded as prior art with respect to the present application.

The back metal surface **11** has mounted thereon an evacuation port **23** which is connected to a vacuum pump (not shown) during fabrication of the panel. In constructing the panel, I prefer to precompact the blanket of glass fibers in accordance with the method disclosed and claimed in Janos application, Serial No. 236,971, filed July 16, 1951, and assigned to the same assignee as the present application. In the structure of the Janos application, a blanket of glass fibers is compressed to the density desired for use, and while compressed, the blanket is heated to a temperature just below the softening point of the glass fibers. The compressive force is then removed after the blanket has cooled. The blanket then retains its compressed shape.

During the evacuation process, it is necessary that the mineral substances be heated in order to drive off occluded gases. This may be accomplished by connecting the electrodes **16** to a source of energy and utilizing the heating element **15** to bring the panel up to out-gassing temperature. This is done in addition to heating the entire panel in an oven. The heating element is outgassed at a higher temperature as it must operate at a higher temperature.

When the interior pressure of the panel is of the order of one millimeter mercury, the pressure against the sides of the panel is of the order of two thousand pounds per square foot. This pressure produces a very rigid structure even though the metal surfaces **10** and **11** are comparatively thin. Even a thin panel makes a satisfactory structural member in house or factory construction.

Fig. 2 illustrates a panel construction utilizing a breaker strip **25** to seal the edges of the panels. Such a construction diminishes the loss of heat along the edges of the panels.

During operation, the panel is preferably mounted on a wall. When the heating element **15** is energized the blankets **21** and **22** serve as reflectors directing the radiant heat toward the front surface **10** which intercepts the radiant energy and transfers it by conduction to a uniform level throughout the surface which then radiates the heat through the room. Thus, the high temperature radiant energy from the element **15** is converted to low temperature radiant energy from the surface **10**. Low energy radiant heat is much more comfortable to the occupants of the room.

During operation the back metal surface **11** remains cool. There is almost no heat loss through this surface from conduction, convection, or radiation.

While the present invention has been described with reference to particular embodiments thereof, it will be understood that numerous modifications may be made by those skilled in the art without actually departing from the invention. Therefore, I aim in the appended claims to cover all such equivalent variations as come within the true spirit and scope of the foregoing disclosure.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A wall heating panel comprising a front and back metal surface sealed in gas-tight spaced relation and defining an evacuated space, an electrical heating element positioned in said evacuated space adjacent said front surface, a blanket of silicon dioxide fibers overlying said heating element, and a blanket of mineral insulating fibers occupying the evacuated space between said blanket of silicon dioxide fibers and said back metal surface.

2. A wall heating panel comprising a front metal sheet and a back metal sheet in gas-tight spaced relation defining an evacuated space, an electrical heating element positioned in said evacuated space adjacent said front metal sheet, a silicon dioxide fiber blanket overlying said heating element, and a blanket of mineral insulating fibers occupying the evacuated space between said silicon dioxide fiber blanket and said back metal sheet.

3. A heating panel for positioning on a wall comprising a front and back metal sheet in gas-tight sealed spaced relation forming an envelope defining an evacuated space of substantially uniform thickness, a layer of heat stable electrically insulating material lining said front metal sheet in said evacuated space, an electrical heating element in contact with said electrically insulating material, a blanket of silicon dioxide fibers overlying said heating element, and a blanket of mineral insulating fibers occupying the evacuated space between said blanket of silicon dioxide fibers and said back metal sheet, said blanket of insulating fibers being over half as thick as the evacuated space in which it is positioned.

4. A heating panel comprising an envelope defining an evacuated space formed of a pair of spaced metal sheets in gas-tight sealed engagement around their edges, one of said sheets constituting the front of said panel and the other the back, an electric heating element in said envelope adjacent the front metal sheet but electrically insulated therefrom, a blanket of silicon dioxide fibers overlying said heating element, and a blanket of glass fibers positioned between said silicon dioxide fibers and the back metal sheet.

5. A heating panel comprising an envelope defining an evacuated space formed of a pair of spaced metal sheets in gas-tight sealed engagement around their edges, the pressure in said evacuated space being less than 1 mm. Hg, one of said sheets constituting the front of said panel and the other the back, an electric heating element in said envelope adjacent the front metal sheet but electrically insulated therefrom, a blanket of temperature stable heat insulating fibers overlying said heating element, and a blanket of glass fibers positioned between said heat insulating fibers and the back metal sheet.

6. A heating panel comprising an envelope defining an evacuated space formed of a pair of spaced metal sheets in gas-tight sealed engagement around their edges, one of said sheets constituting the front of said panel and the other the back, an electric heating element in said envelope adjacent the front sheet but electrically insulated therefrom, a blanket of temperature stable heat insulating fibers overlying said heating element, and a blanket of glass fibers positioned between said heat insulating fibers and the back metal sheet, said glass fibers having a diameter of less than one-thousandth of an inch.

7. A heating panel comprising a front and back metal sheet in gas-tight sealed spaced relation forming an envelope defining an evacuated space, an electric heating element in said evacuated space adjacent the front metal sheet, a blanket of mineral fibers selected from the group consisting of silicon dioxide and aluminum oxide over said heating element, and a blanket of glass fibers between said first-mentioned blanket of fibers and said back metal sheet.

8. A heating panel as claimed in claim 7 wherein the blanket of mineral fibers over the heating element is composed of silicon dioxide fibers.

9. A heating panel comprising a front and back metal sheet in gas-tight sealed spaced relation forming an envelope defining an evacuated space, an electric heating element in said evacuated space adjacent to, but electrically insulated from, said front metal sheet, a blanket of temperature stable heat insulating material behind said heating element, and a blanket of glass fibers between said temperature stable material and said back metal sheet, said blanket of glass fibers being compressed to a density in excess of ten pounds per cubic foot.

10. A heating panel as claimed in claim 9 wherein the individual fibers of the blanket of glass fibers have their

axes randomly oriented in planes generally parallel to the surface planes of the panel.

11. A heating panel comprising a front and back metal sheet in gas-tight sealed spaced relation forming an envelope defining a space of approximately uniform thickness in which the pressure is less than 1 mm. Hg, a cloth of silicon dioxide fibers lining said front metal sheet within said space, an electric heating element positioned in contact with said cloth, a backing layer of silicon dioxide fibers in contact with said heating element, and a blanket of glass fibers between said backing layer and said back metal sheet, said blanket being compressed to a density in excess of ten pounds per cubic foot and the individual fibers of said blanket being randomly oriented in planes generally parallel to the surface planes of the panel.

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