

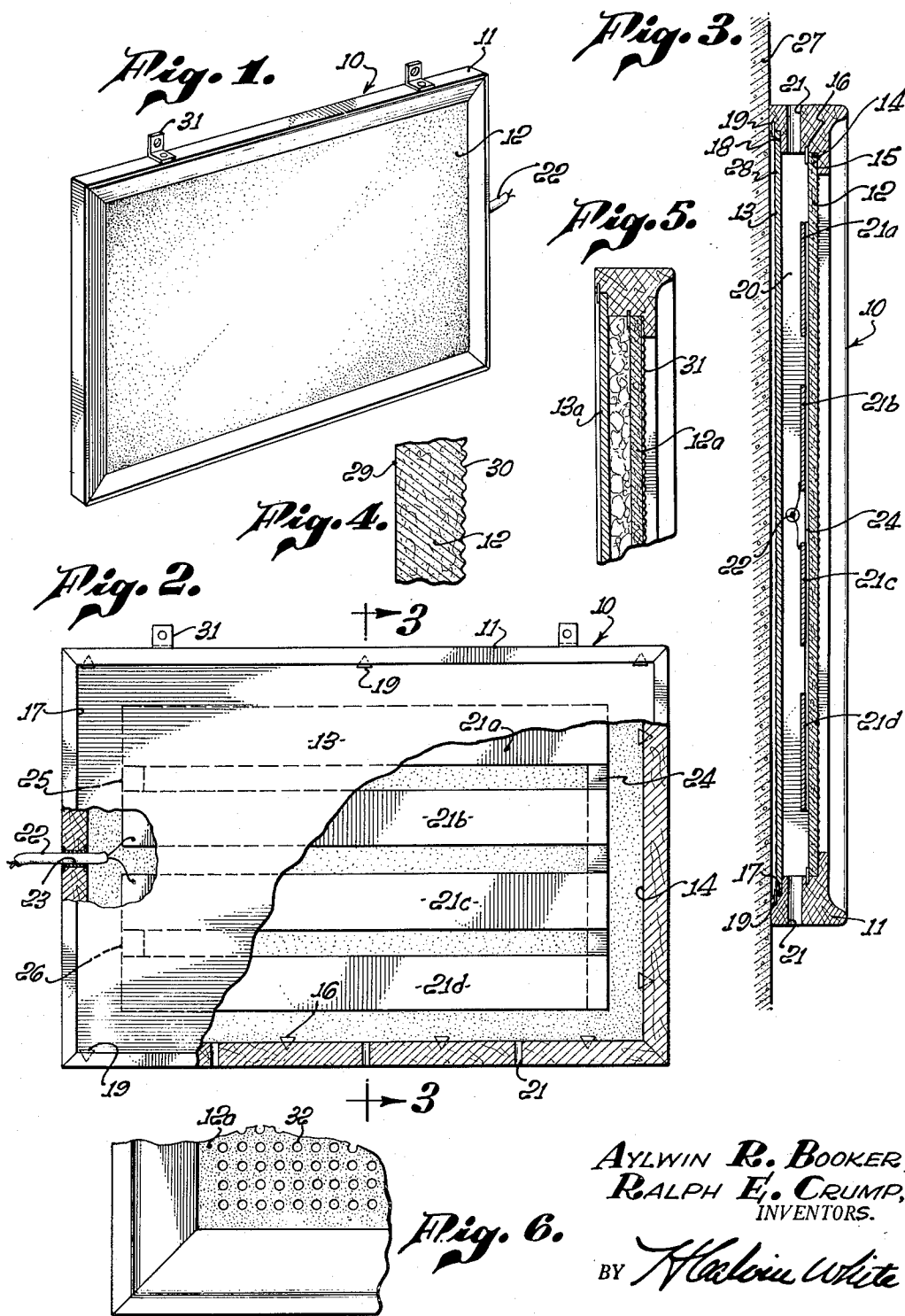
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ELECTRICALLY CONDUCTIVE FILM PANEL HEATERS

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1

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ELECTRICALLY CONDUCTIVE FILM PANEL HEATERS

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1 Claim. (Cl. 219—19)

This invention relates to improved panel type electric heaters particularly adapted in certain respects to be used as wall or ceiling heaters for warming persons by radiant heat.

A major object of the present invention is to provide a heater of a type comprising a base panel or board, and a heating element carried by the panel which is so designed as to radiate heat substantially uniformly over the entire area of the panel. Particularly contemplated is an arrangement of this type in which the heat is generated uniformly over the area of the panel providing maintenance of the entire panel at a relatively low, even, surface temperature, as a result of which the panel may be directly contacted by a person, or a piece of furniture or other article without danger of burning or charring.

To attain uniformity of heat emission, we employ as the heating element an electrically resistive heater film, which is applied to the surface of and extends across one side of the base panel. The film itself is formed of an electrically insulative or non-conductive binder and a multitude of electrically conductive particles distributed within the binder.

While the panel may under certain circumstances be formed of a wide variety of materials, as for instance plaster board, cement, or wood, it is desirable in order to assure best operating results that the panel have the following characteristics: (1) that it be electrically non-conductive and of high dielectric strength, (2) that it be so chosen or treated as to be water resistant and not able to absorb moisture, and (3) that it be so chosen as to not discolor, warp or otherwise deform under its normal operating temperature, or under the ambient temperatures to which it may be subjected when not in operation. The most desirable material for the purpose is an asbestos based wall board, such as the product sold by Johns Manville of New York, New York, under the trade name "Asbestocite—Type B." When such asbestos board or other porous material is used, the panel may be coated with a waterproofing agent to give it the desired water resistance. As will be understood, the purpose of the waterproofing is to prevent the development of a short circuit by moisture absorbed into the panel.

A particular object of the invention is to provide a panel type heater which is so designed as to form a compact portable unit adapted to be easily and removably mounted to a wall, ceiling or wherever desired. For this purpose, we prefer an arrangement which includes two generally parallel panels, a forward one of which acts as the heat radiating member, and the rear one of which may serve as a shield for minimizing the rearward radiation of heat from the heater film toward a wall or ceiling to which the heater is mounted. The heater film is desirably applied to the inner or rear surface of the front one of these panels, while the exposed surface of that panel may be irregularized to increase its effective area and the radiation of heat therefrom. The two panels may be spaced apart to provide heat insulation, hence a temperature drop between the front and rear panels.

2

In panel heaters embodying the invention, it is desirable to provide a heat reflective sheet or coating of low emissivity at long wave length to minimize the absorbed heat, hence produce a lower temperature on the back panel. Where the above described double panel type unit is employed, this coating may be carried by the front surface of the rear panel.

To improve both the appearance and ease of handling of the heater, the panel or panels may be contained within a frame. Where two panels are used, this frame may contain air circulation openings communicating with the air space between panels to provide for an amount of free convective circulation of air through the device. Also, in some instances, I find it desirable to mount a picture at the forward side of the panel, so that the unit may have the appearance of and be hung as a framed picture. To prevent discoloration of the picture by the heat of operation, the picture should be printed on a sheet of asbestos based paper.

The above and other features and objects of the present invention will be better understood from the following detailed description of the typical embodiment illustrated in the accompanying drawing, in which:

Fig. 1 is a perspective view of a panel type heater unit embodying the invention;

Fig. 2 is a rear view, partly broken away, of the Fig. 1 unit;

Fig. 3 is an enlarged fragmentary vertical section taken on line 3—3 of Fig. 2;

Fig. 4 is a further enlarged fragmentary section through the forward asbestos board panel of the heater unit;

Fig. 5 is a fragmentary section through a variational form of the invention; and

Fig. 6 is a fragmentary front view of a second variational form of the invention;

Referring to Figs. 1 to 4, the heater unit 10 there shown includes a rectangular frame 11 of a construction similar to the ordinary picture frame, and within which are contained a pair of parallel spaced panels 12 and 13 (see Fig. 3). The frame may typically be formed of a suitable hard wood, such as oak or walnut, and may be of any convenient size, as for instance about 2' by 3'. The forward one of the two panels or boards 12 is received within and dimensioned in correspondence with an inner rectangular recess 14 in the frame. Panel 12 is retained in position against a frame shoulder 15 by a number of triangular metal retaining elements 16 driven into the frame and engaging the rear side of the panel. The rear panel 13 is received within an enlarged rectangular rear recess 17 in the frame, and is retained in position against shoulder 18 by triangular retaining elements 19.

The panels 12 and 13 are so mounted and so dimensioned as to provide between them an air circulation space 20. While the board may of course be of any convenient thickness, a preferred thickness is between $\frac{3}{16}$ " and $\frac{5}{16}$ ". The thickness dimension of the air gap 20 may typically be between about 1" and $1\frac{1}{2}$ ". To provide for convective air circulation through space 20 between the two panels, the top and bottom portions of frame 11 contain a number of air circulation openings 21 communicating with space 20.

Before insertion into position within the frame, the forward panel 12 is coated continuously about its entire surface area, including its front and back sides and peripheral edges, with a waterproof material adapted to prevent the absorption of any appreciable amount of moisture into the panel. The water proofing material used for this purpose is desirably of an electrically non-conductive or insulative character and may be of a suitable thermo-setting resinous plastic material, preferably an alkyd or modified phenolic resin. A resin which has

been successfully used for this purpose is that sold by Inter Chemical Corp. of Elizabeth, N. J., under the name "Paladin," this material being a phenolic resin modified with thermoplastic components.

The heating element proper comprises a number of parallel horizontally elongated electrically resistive films, **21a**, **21b**, **21c** and **21d**, bonded to and extending across the rear surface of forward panel **12**. These films are applied to panel **12** after the water-proofing process, and are thus not directly attached to the panel but rather to the water-proofing coating on the panel surface. The films **21a**, **b**, **c** and **d** are of a known type comprising an electrically non-conductive binder, preferably a resinous plastic material, and a multitude of minute electrically conductive particles (the bulk of which are desirably not above 40 microns in size) distributed in uniform electrically conductive relation within the film. The conductive particles may be of more than one material, as for instance a suitable metal and carbon, and may be intermixed with a resistance material such as a metal oxide. A typical formula for the heater films **21a**, **b**, **c** and **d** is the following:

Silver flake.....	37 parts.
Antimony oxide.....	31.7 parts.
Graphite.....	31.7 parts.
Alkyd resin.....	83.3 parts (60% solids).
Xylene solvent.....	110.4 parts (used in application of film).

The four heater film strips are suitably connected together and to a power supply line **22** which extends through an opening **23** in a side of the frame. Fig. 2 illustrates a preferred connection arrangement, in which all four of the strips are electrically connected together at their right ends by an elongated electrically conductive bus **24**, and the left ends of the film strips are connected together in upper and lower pairs by buses **25** and **26**. The two wires from power supply line **22** are then connected to the upper and lower left hand buses **25** and **26**, so that the two upper parallel-connected heater film strips **21a** and **21b** are as a unit connected in series with the two lower strips **21c** and **21d**. A control switch **125** may be connected into the heater circuit as shown.

Bus strips **24**, **25** and **26** may be formed of electrically conductive films similar to but considerably more highly conductive than the resistor films **21a**, **b**, **c** and **d**. In particular, each of the bus strips may comprise a suitable non-conductive binder containing a sufficiently large number of electrically conductive particles to give the bus strips practically no resistance. A highly satisfactory composition for these bus strips is one in which the binder is a modified alkyd resin and the conductive particles are silver flakes predominantly not above 40 microns in size.

To supplement the effect of rear panel **13** in preventing rearward loss of heat toward a wall **27** to which the heater is mounted, we attach to the forward side of panel **13** a highly heat reflective coating or sheet of material **28** of a material having low emissivity at long wave length to minimize the heat absorbed by panel **13**. Coating **28** is preferably of an area to cover the entire forward face of panel **13**. This coating is desirably composed essentially of a suitable shiny or polished metal, and preferably comprises a heat reflective aluminum paint or mirror type silver reflective coating.

To discuss now the type of material from which the forward panel **12** is formed, it is first of all highly desirable that the material of this panel be electrically non-conductive and have a very high dielectric strength, to prevent the development of short circuits through the board or the shocking of an individual by contact with the board. Also, as previously mentioned, it is desirable that the board be either so chosen or treated as to be incapable of absorbing a substantial amount of moisture,

since absorbed moisture could have the effect of rendering the material electrically conductive. Preferably, the board is chosen or treated to be incapable of absorbing any moisture at all, and it certainly should not, even after prolonged exposure to water, absorb moisture over about 2% of the weight of the panel itself. Since panel materials which are most desirable for other reasons are usually porous and water absorptive, I prefer to attain the desired water resistance in panel **12** by coating it with a water-proofing material, as previously discussed in some detail. It will be understood however that where the panel material may itself be of a non-water absorbing nature, there is of course no necessity for applying the water-proof coating to the panel.

In addition to having the above characteristics, the material from which panel **12** is formed should be rigid and desirably so chosen as not to warp, otherwise deform or discolor under the temperature, moisture and other conditions which may be encountered in use. As will be understood, warpage of the panel could have the effect of cracking or changing the resistance characteristics of the resistor films. The operating temperature of the present devices is preferably around 100° F., and may for certain uses range up to about 225° F. The material of panel **12** is therefore preferably chosen to withstand without warpage, deformation or discoloration, temperatures up to about 250° F.

The selection of material for forming the rear panel **13** is less critical than the choice of material for the forward panel **12**, since the rear panel does not carry any of the heating elements. It is necessary merely that the rear panel be of a material which is rigid and preferably adapted to withstand temperatures up to about 225° F.

In order to give the front and rear panels **12** and **13** the above discussed characteristics, we preferably form both of these panels from an asbestos based material, formed primarily of asbestos fibers which may be integrated by a suitable binder. A highly satisfactory asbestos based material which may be used for this purpose is an asbestos board, such as the product sold under the name "Asbestocite—Type B" by Johns Manville. This material is composed essentially of asbestos fibers and Portland cement as a binder, in addition to which it contains certain inert fillers.

As seen best in Fig. 4, the forward panel **12** is so shaped as to have a smooth rear surface **29** extending across its rear side and to which the heating elements are mounted, and a stippled forward surface **30** having a large number of irregularities over the entire front side of panel **12** to increase the radiating area and heat radiating capacity of the panel. In preparing the forward panel, the uncoated asbestos board may first be heated to a temperature (say about 400°) sufficiently high to drive out any contained moisture. The panel may then be removed from the heating furnace, and the previously discussed water-proof coating material applied to all of its outer surfaces. Where the water-proofing material is of a thermosetting nature, the heat remaining in the panel will be sufficient to cure the material. Resistor strips **21a**, **b**, **c** and **d** and bus strips **24**, **25** and **26** may then be applied to the water-proof coating material at the rear side of panel **12** and thermally or otherwise cured. As will be understood, the water-proof coating material is tightly bonded over its entire area by its curing process to the surface of the asbestos board, and the resistor strips and bus strips are similarly tightly bonded to the water-proof coating.

In use, the heater unit shown in Figs. 1 to 4 may be applied to a wall **27** in any suitable manner, as by a pair of mounting brackets **31** (see Fig. 2). Supply line **22** is then connected to a source of power, typically 110 volts, 60 cycles A. C., or 110 volts D. C. to pass electricity through the resistor strips and cause them to produce heat. A large amount of the heat is conducted through

5

panel 12 to its forward side from which it is radiated into the surrounding area. Some of the heat is emitted rearwardly from the resistor strips and is then reflected back toward panel 12 by heat reflective coating 28 on the rear panel. The air gap 20 serves as a thermal insulation, and the natural convective circulation of air upwardly through air space 20 and frame openings 21 carries away and into the surrounding area enough heat to prevent excessive rise in temperature of rear panel 13.

Fig. 5 represents a variational form of the invention which is similar to that of Figs. 1 to 4, but in which a sheet of material 31 carrying a picture extends across the forward side of forward panel 12a, so that the unit gives the appearance of being merely a framed picture. The picture sheet 31 preferably is formed of an asbestos based paper, such as the product sold by Johns Manville under the trade name Quinterra. This asbestos paper may be secured to panel 12, preferably across its entire area, by any of various conventional adhesives, such as a wheat paste or an animal glue. The face of panel 12 is stippled even when a picture sheet is applied, in which case the stippling serves the dual purposes of (1) irregularizing the picture sheet to give it a very pleasing canvas-like appearance, and (2) providing small channels between the picture sheet and panel which allow for a bleeding off of gases formed in the adhesive, to thus prevent the formation of bubbles behind the picture. When a picture sheet 31 is applied to panel 12, the previously discussed water-proof coating of the panel may be applied to the face of the picture sheet, to prevent oxidation or other deterioration of the adhesive and picture ink upon heating of the panel in use.

In the Fig. 5 form of the invention, the space between panels 12a and 13a is filled with a suitable heat insulating material, to increase the resistance to rearward transmission of heat from the device. This insulating material may typically be a compressed rock wool type of material, such as that sold by Johns Manville under the name of "Spuntex."

Fig. 6 represents a further variational form of the in-

6

vention, which is the same as that of Figs. 1 to 4 except that front panel 12a is formed to have a large number of apertures 32, which facilitate the air circulation between forward and rear sides of the panel.

We claim:

A heater comprising a pair of spaced generally parallel panels, and an electrically resistive heater film carried by a first one of said panels at a side thereof facing the second panel and comprising an electrically insulative binder and minute electrically conductive particles distributed in electrically conductive relation within said binder, a heat reflective coating applied to a surface of said second panel at a side facing said film and first panel and reflecting the heat produced by said film toward said first panel, there being an air space between said film and said reflective coating to reduce heat transmission toward the reflective coating and second panel, both of said panels being formed of asbestos board, a frame extending about and carrying both of said panels and containing top and bottom air circulation openings communicating with said air space, a waterproof resinous plastic coating applied to and entirely about said first panel, and an electric cord extending through an opening in said frame and electrically connected to said film, said first panel having a large number of irregularities at a side opposite that at which said film is carried to facilitate the radiation therefrom of heat produced by the film.

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