

July 16, 1957

E. F. CHANDLER
PANEL HEATING DEVICE

2,799,764

Filed Oct. 15, 1953

2 Sheets-Sheet 1

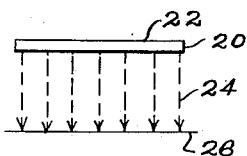


Fig-1

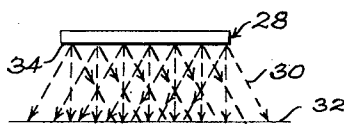


Fig-2

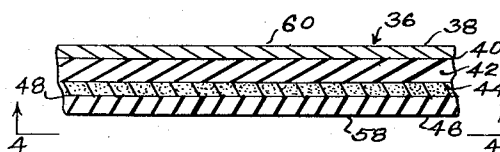


Fig-3

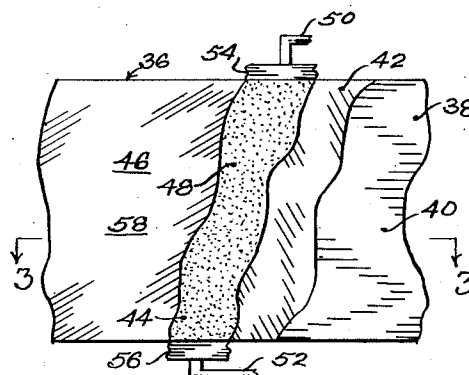


Fig-4

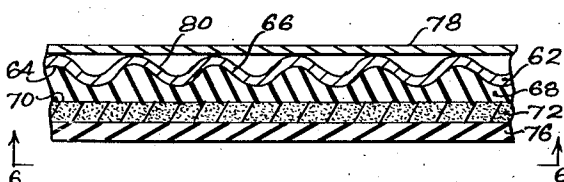


Fig-5

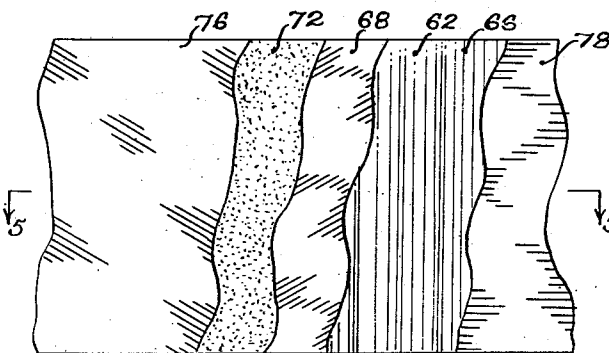


Fig-6

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2 Sheets-Sheet 2

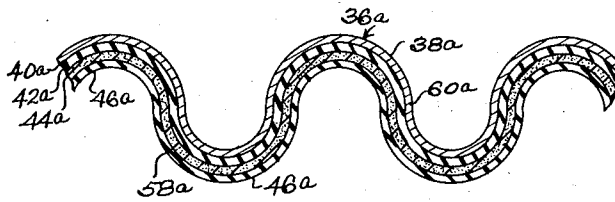


Fig. 7

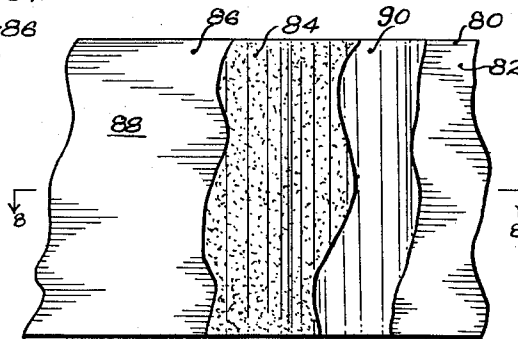
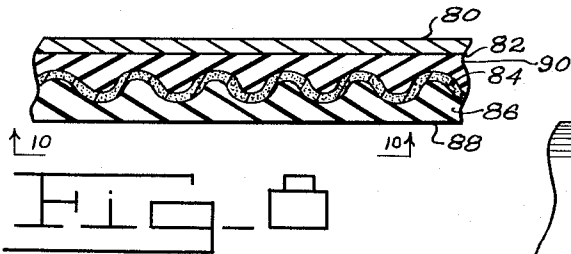


Fig. 10

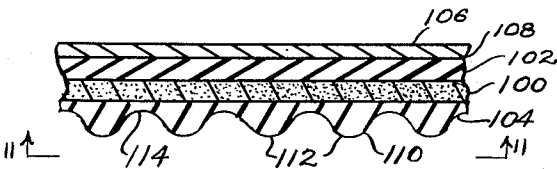
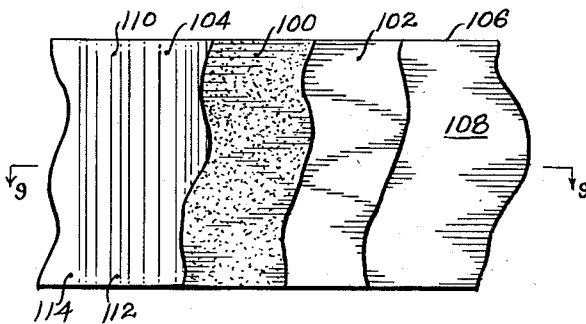


Fig. 9



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2,799,764

PANEL HEATING DEVICE

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Application October 15, 1953, Serial No. 386,209

3 Claims. (Cl. 219—34)

This invention relates to improvements in heating devices and apparatus, and the construction and use thereof.

An object of the invention is to provide a novel and improved radiant heating panel, which is thin and flexible enough to be applied to a wall substantially in the manner of wall paper, so as to radiate heat therefrom into a room in which it is situated.

Another object of the invention is to provide a novel and improved radiant heating panel in which the construction is such that there is multi-directional heat radiation, with the effect of radiation ray diffusion, which provides comfortable body warmth, without the annoying sensation of more concentrated direct ray impingement upon the body.

A further object of the invention is to provide a novel and improved radiant heating panel and device which may be made fully automatic, quickly raising the room temperature to the predetermined level, and holding it thereat, and which includes such use of automatic thermostatic temperature controlled switches and the like, as is needed for the particular installation.

Still another object of the invention is to provide a novel and improved method of making a radiant heating device, including electrodeposition of a metallic heat reflective layer, eliminating the need for laminar fabrication, and thus making possible continuous production of the product as a composite sheet device of the desired width and length, ready for installation.

Still a further object of the invention is to provide a novel and improved radiant heating device and element which includes a reflective layer of metallic material, which is substantially non-planar, so that the heat rays received from the ray generating element and impinging upon said metallic reflective layer, are diffusely reflectively cast in the general direction outwardly from said reflective layer, but in non-parallel reflected rays, so that the occupants of a room in which the device is installed, are not subjected to intense radiant heat rays directly, but rather rays which are inherently diffused in nature, yet which are efficient and effective heating rays.

Another object of the invention is to provide a novel and improved radiant heating device which is simple in design, inexpensive to manufacture, has a minimum of elements, sturdy in character, and highly efficient in carrying out its intended heating objective.

A further object of the invention is to provide a novel and improved radiant heating element which is formed with considerable lack of thickness and hence substantial degree of flexibility, so that it may be easily applied to a wall, curved surface, ceiling or the like, in the manner of wallpaper, either adhesively, or by means of suitable fastening devices, being thus relatively unobtrusive and essentially unnoticeable in nature, taking on the appearance merely of a wall covering, and lacking the outward appearance of a heating device as such.

Still another object of the invention is to provide a novel radiant heating device of the character described, which is readily connectable to the usual electric power circuits,

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to derive energizing power therefrom, so that the heat dissipating portions thereof may be heated therefrom, and wherein the construction is such that the individual unit areas comprising the surface thereof from which heat is to be radiated, will radiate heat uniformly.

This application is a continuation-in-part of my copending patent application, Serial Number 761,685, filed July 17, 1947, for Radiant Heating Element, now Patent No. 2,680,800, issued on June 8, 1954.

These and other objects and advantages of the invention will become apparent from the following description of a preferred embodiment thereof, as illustrated in the accompanying descriptive drawings, forming a part hereof, and in which,

Figure 1 is a sectional schematic representation of a radiant heating device showing the emission of a beam of parallel heat rays, and wherein the area subjected to the rays is substantially the same as the area of the source of heat rays.

Figure 2 is a schematic view representing a radiant heating device according to the invention, in which the heat rays are also angularly emitted from the device in a manner whereby the area subjected to the rays is greater than the area of the emission source, the rays being generally indicated by the broken lines bearing arrows, as also indicated in Figure 1.

Figure 3 is a sectional elevational view in fragment, taken substantially on plane 3—3 of Figure 4, and showing a preferred form of radiant heating device, the thickness of the parts being shown on an enlarged scale for clarity of illustration.

Figure 4 is a plan view of the device of Figure 3, as might be seen on viewing plane 4—4 of Figure 3, the view being in fragment, and showing the various layers cut away, so that they are all visible in part.

Figure 5 is a fragmentary sectional elevational view taken substantially on plane 5—5 of Figure 6, and showing a preferred form of radiant heating device according to the invention, the reflective layer or sheet being shown shaped for multi-directional ray reflection and direction.

Figure 6 is a plan view in fragment, as might be seen on viewing plane 6—6 of Figure 5, the view being differentially cut away, to expose the various layers to view in turn.

Figure 7 is a fragmentary sectional elevational view showing another form of radiant heating device according to the invention, in which the entire assembly of layers is shaped for multi-directional heat radiation and reflection.

Figure 8 is a sectional elevational view showing still another form of radiant heating device according to the invention, with shaped heat generating element, as taken on plane 8—8 of Figure 10.

Figure 9 is a sectional elevational view showing a further form of radiant heating device according to the invention, with shaped outer heat emitting layer.

Figure 10 is a face elevational view of the device of Figure 8, as shown on viewing plane 10—10 of Figure 8, the view being partly broken away layer by layer to illustrate its construction.

Figure 11 is a face elevational view of the device of Figure 9, as might be seen on viewing plane 11—11 of Figure 9, the view being partly broken out layer by layer to illustrate its construction.

While electrical contact means is shown only in Figure 4, it will be understood that such or other electrical contact means may be applied to opposite edges or ends of all the embodiments shown in the various drawings, being omitted only for clarity. Where a section or length of such sheet or panel material is cut off from a greater length for use in a particular place, it is understood that electrical connection may be made to either the opposite ends or edges of the resistance unit, such as 44, 72, 44a,

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84, or 100, in the various forms shown. For uniformity in current distribution and flow, it is preferable for the contact elements, such as 54 and 56, to be as long as the edge they contact.

In the use of radiant heating devices, it has been found that where there is a direct ray impingement upon the body, or upon the head, from above, or from the side or floor, considerable bodily discomfort results, so that such direct directed ray devices must be quickly turned off to avoid such uncomfortable feeling for any length of time. The present invention teaches means whereby multidirectional heat rays are emitted from the heating device, the rays from the heat ray generator being reflected by a reflector element forming a major element of the device, and while they are given a general emission orientation, that is, to say, outwardly from the reflective element, yet they are not substantially parallel rays, and thus take on the aspects and characteristics of diffused rays, with a high degree of bodily comfort attainable.

Devices made according to the present invention may be made in panels of varying thicknesses, from very thin to quite thick, depending upon the modified form of the invention applicable, the thin forms being particularly suitable for direct attachment to a wall of a room, its ceiling or floor, for emitting radiant heat rays into the room for the bodily comfort of the occupants thereof. Similarly, the devices may be made in continuous sheets which may be flexible, and capable of being rolled up like wallpaper, according to one modified form, or made with inherent resilience and/or stiffness as needed, according to another modified form of the invention. Use is also made of permanent shaping of various elements forming the devices, each according to a particular modification of the main inventive idea, all being directed to the main objective of providing efficient heating, without bodily discomfort, and all the other mentioned advantages.

In order to understand clearly the nature of the invention, and the best means for carrying it out, reference may now be had to the drawings, in which like numerals denote similar parts throughout the several views.

According to a simplified form of the invention, there is provided a radiant heating device, in sheet or strip form, and including several layers or laminations, one of said laminations having an electrically conductive element forming the same or carried thereby or embedded therein, and adapted to be heated under the influence of electric current from a source connected thereto, and another of said laminations being disposed adjacent to said first lamination and presenting thereto a heat reflecting surface of high relative efficiency, whereby heat generated by said first lamination is radiated from but one surface of said sheet or strip, and in which the device is so shaped or one or more of its elements are so shaped, as to give the radiant heat rays substantially multi-directional orientation.

Referring now to Figure 1, it is seen that here is a radiant heating device generally indicated at 20, and including a heat dissipating device with ray reflective means at 22, so that the heat rays are emitted as at 24 substantially mutually parallel in direction, being thus substantially directed in a body, toward a surface 26 to be heated thereby, which may be the body of an occupant of a room in which the device 20 is disposed, or other surface. Figure 2 shows schematically a representation of a device according to the invention, in which there is a radiant heating device generally indicated at 28, including a heat ray generating or heat dissipating device with ray reflection and orientation means, so that the heat rays 30 which are emitted from the device 28, are generally oriented toward the surface which is to be heated, which may for example be the surface 32 or any other surface, curved or planar, or body, that is to say, oriented away from the surface 34 or emitting surface of the device 28, which

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need not be planar as shown, but may be otherwise shaped as described hereinbelow, and the whole thing characterized by a multi-directional orientation or direction of the heat rays, so that, as seen in Figure 2, a much greater portion of surface 32 is subjected to said heat rays, than the net surface area of device 28 from which the heat rays leave the same.

Referring now to Figures 3 and 4, it is seen that there is shown a radiant heating device 36, in which there is a layer or sheet of reflective material 38 which may be a metallic foil or a sheet of paper or other sheet material provided with a reflective surface 40, such as a bright metallic film or coating, applied thereto or carried thereby or formed therein. At 42 is shown a layer or coating or element applied in any suitable manner to the bright reflective surface 40, which may conveniently be electrically insulating material, such as insulating varnish, thermoplastics, or other suitable insulating materials. Affixed to layer 42, or embedded or impregnated therein is a suitable electrically conductive means 44 of sufficient heat dissipative capacity and inherent resistance, to provide a substantial heating effect from current passing therethrough. A protective or outer layer, element or coating 46 which may be also electrically insulating like layer 42, may be applied to the outer surface 48 of the heat generating element 44. In the process of manufacture, the product shown, at a suitable stage, may be rolled, pressed or otherwise formed into a thin, dense, preferably flexible sheet, that is to say, the composite article including layers 38, 42, 44 and 46, may be so fabricated, into a unitary article, the layers of which are mutually adherent or held together in any suitable manner, adhesively or otherwise, for this purpose. It will be understood that in all the views included in the drawings of the present application, the applicant does not wish to be limited to the dimensions or shapes shown, since for clarity of illustration, the thickness of the element is shown on an enlarged scale and exaggerated somewhat. To energize the element 44, electrical current from a battery, or the power lines may be conducted by means of wires such as 50 and 52, and brushes 54 and 56 or electrical contact elements connecting ends or edges of the conductive element 44 at opposite sides or ends thereof. In other words, the connections are such that the current flows through the element 44, from and between opposite side edges, or end edges, or opposite corners, or otherwise, so that the passage of current therethrough results in the generation of heat due to the resistance of the element 44. The heat rays are reflected by the reflector element or layer 38, back toward emitting edge or surface 58, so that there is a strong heat radiation out of the device through surface 58, and little if any radiation out of the rearward surface 60 of the reflective element or layer 38.

As thus seen in Figures 3 and 4, the device has the characteristics of the heating device 20 shown in Figure 1, with its generally unidirectional orientation of the radiant rays in the directions of arrows 24. To give it multi-directional radiant ray orientation, as in Figure 2, the sheet device of Figures 3 and 4 may be placed in a molding press or other device, and shaped with undulations as shown in Figure 7, so as to be permanently so shaped, and it will then take on the characteristics of the device of Figure 2 substantially, that is to say, with radiant rays emitted from surface 58a in many directions, as induced by the shaping of the reflective layer or element 38a, and the heat generating element 44a. In Figure 7, the parts are numbered the same as the corresponding parts in Figure 3, but with the suffix "a" added to the numbers, since while the parts in Figure 7 may be the same construction as those of Figure 3, they are additionally shaped for multidirectional radiant ray egress, and thus are different from the relatively plane elements of Figure 3, that is to say, plane as shown in this particular fragment. By adhering the device of Figure 3 to a

curved or undulating base surface so as to conform to the curvature or shape of the base surface, then it is seen that the device of Figure 3 will also have multi-directional radiant heat ray direction.

In other words, the device shown in Figures 3 and 4 is an extremely thin and flexible composite article in sheet form, which can be shaped or draped directly onto a supporting surface, wall, ceiling or the like, or other surfaces, so as to conform to the shape or curvature thereof, and will thus necessarily when thus shaped or conformed to the curvature thereof, emit radiant heat rays outwardly from surface 58, strongly, but in diverse directions, so that there is a diffusion effect, the rays all or substantially all being reflectively directed by polished or shiny reflector surface 40 of element 38 toward and out of element 58, but in such multi-directional diffused ray beam form. One such shape is that shown in Figure 7, but I do not wish to be limited thereto as other shaped surfaces or molds may be employed to give the element other contours, with the ultimate objective achieved of multi-directional radiation of heat, but nevertheless in all cases away from the reflective element such as 38a, and out of surface 46a.

The material 38 or 38a, which is the reflective layer or element, may be a sheet of metallic foil, such as aluminum, nickel, copper, brass, or the like, or one formed by electro-deposition, and the foil or element 38a may be on the order of about 0.001 inch thick, more or less. If formed by electro-deposition, it may be much less in thickness as is well known in the said art. In any event, the reflective element or layer 38 or 38a may be coated with a thin film of a suitable thermoplastic varnish-like electrical insulating substance 42, or 42a, the outer surface of which is, at a suitable stage in the process of fabrication is impregnated with a finely divided carbon in powder or particle form, carbon black or other substance of similar characteristics, or metallic substance in such powder, flake or other form, capable of affording the conductive resistance needed to produce heat upon passage of electrical current therethrough, for the desired end result. Generally speaking, the resistance may be of an order to develop from 20 to 25 watts, approximately, per square foot, that is, or approximately 70 to 80 B. t. u., with a maximum temperature not in excess of about 125 degrees Fahrenheit, and operating at either about 115 or 230 volts power supply.

Preferably the insulating base material which is impregnated with the conductive resistance substance, that is, elements 42 and 44, or 42a and 44a, is one which, when the panel is completed, will remain relatively flexible, and retain its desirable characteristics of adhering to the reflective surface, 38 or 38a, holding the conductive heat dissipative material or layer in place, during the operating life of the panel or sheet. In other words, the devices shown in Figures 3 and 7, while illustrated with some substantial thickness, may actually be very thin and flexible, not much thicker than wallpaper, and just as flexible and able to conform to a wall shape or the like, with little if any obstruction to emission of the heat rays out through the coating or varnish layer 46. Among the materials from which a suitable insulating/impregnating film may be made for such purposes are the polyester resins and the epoxy family. The combination of epoxy resin with calcium carbonate in suitable form, is an example of a combination of desirable electrical and mechanical properties.

A product known commercial as "Scotchcast" produced by the Minnesota Mining and Manufacturing Co., is a hot pouring resin of the epoxy type which may be poured when heated to about 250 degrees, and setting at normal panel operating temperatures by the addition of a suitable hardener agent. Certain of the "Vinylite" resins and plastics, made by the Bakelite Company, silicone resins made by Dow, Corning Corp., of the lamonite bonding type and others of the silicone group are appli-

cable, as are the E. I. du Pont de Nemours & Co. "Mylar" polyesters. Cellulose, in certain of its forms, for example as a thin sheet and having a suitable adhesive applied to its surfaces, may, at the temperatures employed, take the place of the single plastic-varnish-like coating already referred to. However, simplicity of construction and low cost are factors in the carrying out of the present invention, and as there are a large number of usable materials available, it is not intended to limit the scope by naming a specific product or products, these being merely by way of example, and not of limitation. It is sufficient to select from the many suitable materials available ones which meet the requirements, the same falling within the range of one or more of the products mentioned and/or a combination of the same.

Thus, according to a preferred form of the invention, such a device includes a reflective sheet or layer, preferably metallic, having a coating preferably of non-rubber, plastic varnish-like material which while serving as an electrical insulator, also acts to retain a conductive resistance material embedded in its outer surface portion. Optionally a thin sheet of protective material, metallic or a suitably impregnated paper may be cemented to the outer face of the panel which may also afford a desired exterior finish, according to another modification. The finished product is moisture proof. The radiant heating device is energized by electric current conveyed to opposite edges of a given panel area by suitable contacts and wires connected to the power lines. Continuous heating therewith due to prolonged operation, produces no annoying or noxious odors. Individual room heating may be controlled thermostatically in any well known manner, by use of thermostatic controls in the circuit, responsive to room-temperature.

It has been found that polyethylene may be toughened and made more heat resistant by irradiation, bombarding of the polymer being accomplished by an electron beam from a modified X-ray unit. This may be done with the plastic sheeting or coating employed in making the present products, as a means for decreasing liability to sustaining damage from handling, for example, before it is applied to a working surface, and so on.

In the production of sheet form resistance elements, the resistivity of certain useful materials may be provided for and controlled by loading same with suitable conductive substances, such as for example, graphite. Nylon compositions, to this end, may carry copper, carbonal iron, nickel, and/or other suitable materials in suitable finely divided state, the quantity of conductive material governing the resistance and hence the thermal emission for a given voltage input.

Another material which may be used in the devices disclosed herein, is the so-called metallized textiles, in which the cloth, net or other material in thin sheet form, used as the base is treated in a manner to make it conductive in a manner, due to the resistance to the passage of electricity, to evolve heat. The resistance element thus made is light, strong and flexible, and well adapted for use as the thermal element in a heating panel according to the invention, such as element 44. It may be insulated from the metallic reflecting surface by a coating of a suitable plastic-varnish which may serve to adhere to said surface, or cause the heating element to adhere thereto. If desired, an outer sheet of kraft paper or the like, may be applied and retained by the adhesive to present a suitable exterior finish. Pressure may be applied to insure the desired product thickness and/or surface formation as taught by the disclosure herein.

Referring again to the drawings, Figures 5 and 6 show how the invention may be applied to another modification of the main idea. In this embodiment, there is a reflective sheet or layer 62, which may be formed of metallic foil, or a metallic layer formed by electro-deposition, which has a shiny or polished reflective surface 64 on at least one face, the layer 62 being preferably

shaped so as to be non-planar, with undulations or convolutions 66 formed therein, and extending therealong from left to right as viewed in the illustrations. The reflective layer 62 being thus shaped, corrugated or otherwise formed, is intimately secured to the insulating layer 68 which may be of any of the materials specified or mentioned as suitable for electrical insulating layers 42 and 46 of the devices of Figures 3 and 7, or other suitable materials, it being noted that the insulating material 68 lodges in the hollow portions of the convolutions of reflective member 66, and thus form a stiffening support therefor, to maintain the convolutions formed in the reflective layer 62. This is important, since the reflective layer 62 may be formed by electrodeposition right upon the insulating layer 68, and thus require such support which simultaneously defines the contour of the reflective layer. In any event, the convolutions may also be formed in both the reflective layer and the insulating layer 68, by use of a suitable mold engaging the insulating layer to shape it, and then conforming the reflective layer thereto and thereagainst, or in any other suitable manner. Next to the lower surface 70 of the insulating layer 68, is the resistance layer 72 which, like layer 44 of Figures 3 and 7, may be formed of any suitable resistance material as described therefor, including graphite, flake carbon, or carbon dispersion in a fluid medium which is allowed to dry, or other forms as mentioned, or metallic resistance coating also as mentioned, which will generate heat from electrical current passing there-through, from electrodes connected to opposite ends or sides or edges of the element 72 to an electric power source as described for Figure 4. Another insulating layer 76 of the same material as layer 68, or of paper or the like, may be coated onto the heat dissipative layer 72, to protect and insulate the same. Similarly, a backing layer 78 of paper, paperboard, cloth, or other suitable material may be secured to the rearward surface 80 of the reflective layer 62. All the layers will preferably be quite thin and flexible, and in fact may be little more than coatings, so that the total thickness of a completely assembled article or sheet may be actually on the order of that of cardboard, paperboard, wall paper, or other similar sheet materials, and of sufficient flexibility to permit bending, folding and otherwise conforming the same to walls, corners, and the like, or curvature thereof, and adhering the same thereto.

Figure 8 shows still another modified form of the invention, in which there is a reflective layer 80 of metallic foil, or material deposited by electrodeposition means, or other reflective well polished material having a reflective surface 82 which is oriented toward the heat dissipating and generating element 84, so as to direct and reflect the rays therefrom toward the heat emitting surface layer 86, to leave through its heat emitting surface 88. An insulating layer 90 is disposed intermediate the reflective layer 82 and the heat generating layer or element 84, and may be convoluted as shown to conform to the convoluted contour of the heat generating element 84 and to interfit closely therewith. Similarly the insulating layer 86 may have its inner surface also convoluted to conform to the convolutions or corrugations of the heat generating element 84 in the same manner.

Thus it is seen that by means of the radiant heating device shown in Figure 8, the radiant heat rays generated by the sheet heating element 84 will move outwardly therefrom either toward the heat emitting surface 88, from which they progress further out into the room or other space in which the device is used, to heat the same or objects or persons therein. At the same time, the rays which move toward the reflective element 80 will be substantially all be reflected back to the heat generating layer 84, raising its temperature and heat content, and thus increasing the heat radiated toward and out of the heat emitting surface 88 into the room for useful purposes in this objective. In this modification of the in-

ventive idea, it is seen that the insulating members or layers 90 and 86 are carried on opposite faces of the heat generating heat dissipating resistance layer 84, which is convoluted as shown, and it is clear that according to another modified form of the invention, the layers 90 and 86 may be merely coatings carried on opposite faces of the heat generating layer 84, so that they also are convoluted to conform to the curvature of the layer 84, the reflective barrier or layer 82 being similarly thin, and either plane and stretched or extending across the crests of the waves of the convolutions or corrugations and secured thereto in any manner, or, according to another modification, itself being convoluted in the manner shown in Figure 7. In all events mentioned, it is clear that there is multi-directional diffused heating which is directed by the reflective element 80 so that it substantially all leaves through surface 88.

Looking at Figure 9, it is seen that here is another modified form of the inventive idea, in which there is a heat generating heat dissipating resistance element 100 in sheet form, and formed in any manner described herein, either by carbon or metallic particles, or granules or the like, or otherwise, for dissipating heat therefrom on passage of electric current therethrough. Here the element 100 is substantially initially or normally plane, and disposed between the coatings or layers 102 and 104 which are insulating layers electrically. A backing layer 106 of polished or shiny surface 108 is carried on the rearward surface of the insulating layer 102, so that any heat coming toward the layer 106 is reflected back to the heat generating element 100 to raise its temperature and heat content. As also seen in Figure 9, the heat emitting layer 104 has its outer surface 110 shaped in the form of ridges or wave crests 112 and depressions 114, so that the heat rays emitted therefrom do not leave in parallel paths, but rather have their paths normal to the continuously changing curvature of the wave-like shape of the heat ray emitting surface 110, thus being multi-directional and diffused as it moves into the room which is being heated thereby and the occupants of which have their bodies warmed by impingement of the heat rays on their surfaces.

The devices according to the present invention thus cause radiant directed heat emission in a spray at various angles rather than mutually parallel heat rays which have been found to be somewhat uncomfortable to the occupants of the room. The emission of a concentrated beam of unidirectional, parallel rays causes body discomfort and annoyance under continued exposure, as in home or office heating. As distinguished therefrom, I have disclosed herein a heating element or panel from which the emission of parallel rays is practically eliminated or mostly reduced, and instead the rays are caused to fan out so as to project a pattern of heat rays, for example, on an opposite wall, which is somewhat greater in area than the emission source area. By such means the impact effect of the rays upon a body is noticeably reduced and brought well within the comfort zone. Also, by thus diffusing the rays, the heating effect is improved by distributing the thermal influence over a greater possible ray contact area.

In the embodiment of Figure 9, it is seen that the heat rays leaving the heating element 100 and ultimately arriving at the surface 110 of the undulated or corrugated surfaced emitting element 104, are focussed somewhat in the manner of a lens, on leaving the curved surface, and thus there is additional diffusion and spreading effect of the heat rays thereby.

Although I have described my invention in specific terms, it will be understood that various changes may be made in size, shape, materials and arrangement without departing from the spirit and scope of the invention as claimed.

I claim:

1. A radiant heating device comprising means in sheet form for generating heat upon the passage of electric current therethrough, first coating means on one face of said heat generating sheet means, forming electrical insulation thereon, heat ray reflecting means in continuous sheet form disposed so that said electrical insulation coating means is between said reflecting means and said radiant generating means, whereby rays entering said insulating coating from said generating means are reflected back toward said generating means, said heat ray reflecting means being shaped so as to be continuously non-planar, and being a metallic coating formed in a series of undulations, whereby said heat rays ultimately emitted by the side of said generating means opposite said first coating means are multi-directional.

2. A radiant heating device comprising means in sheet form for generating heat upon the passage of electric current therethrough, first coating means on one face of said heat generating sheet means, forming electrical insulation thereon, heat ray reflecting means in continuous sheet form disposed so that said electrical insulation coating means is between said reflecting means and said radiant heat generating means, whereby rays entering said insulating coating from said generating means are reflected back toward said generating means, said heat ray reflecting means being an electrodeposited coating carried on said first coating means and being shaped so as to be continuously non-planar, whereby said heat rays ultimately emitted by the side of said radiant heat generating means opposite said first coating means are multi-directional.

3. A radiant heating device comprising means in sheet

form for generating heat upon the passage of electric current therethrough, first coating means on one face of said heat generating sheet means, forming electrical insulation thereon, heat ray reflecting means in continuous sheet form disposed so that said electrical insulation coating means is between said reflecting means and said radiant heat generating means, whereby rays entering said insulating coating from said generating means are reflected back toward said generating means, said heat ray reflecting means comprising a very thin layer of metallic material secured to said first coating means by electrodeposition and being shaped so as to be continuously non-planar, whereby said heat rays ultimately emitted by the side of said radiant heat generating means opposite said first coating means are multi-directional.

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