United States Patent [19]

Brandenburg, Jr.

[11] **3,786,230**

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[54] **RADIANT HEATER**

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[21] Appl. No.: **207,875**

[52] **U.S. Cl.** **219/345,** 165/49, 165/56, 219/352, 219/358, 219/377, 219/537

[51] **Int. Cl.** **H01b 1/02,** H01b 3/02

[58] **Field of Search** 219/339, 342, 345, 219/350–358, 377, 536, 537; 165/51–56, 49

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Attorney—Harvey B. Jacobson

[57] **ABSTRACT**

A radiant heater with a panel forming corrugations and having at least one heating element mounted on one of the corrugations. The panel is mounted at a distance from a surface partially defining a space to be heated for permitting fluid circulation between the panel and the space. The heating element is arranged in a groove defined at the apex of a convex surface defined by the corrugation, and is arranged facing the space defining surface. When a plurality of heating elements are provided, a thermostat having a set of contacts for each heating element is provided for actuating at least a portion of the elements at a predetermined temperature different from that for the other heating elements.

7 Claims, 8 Drawing Figures

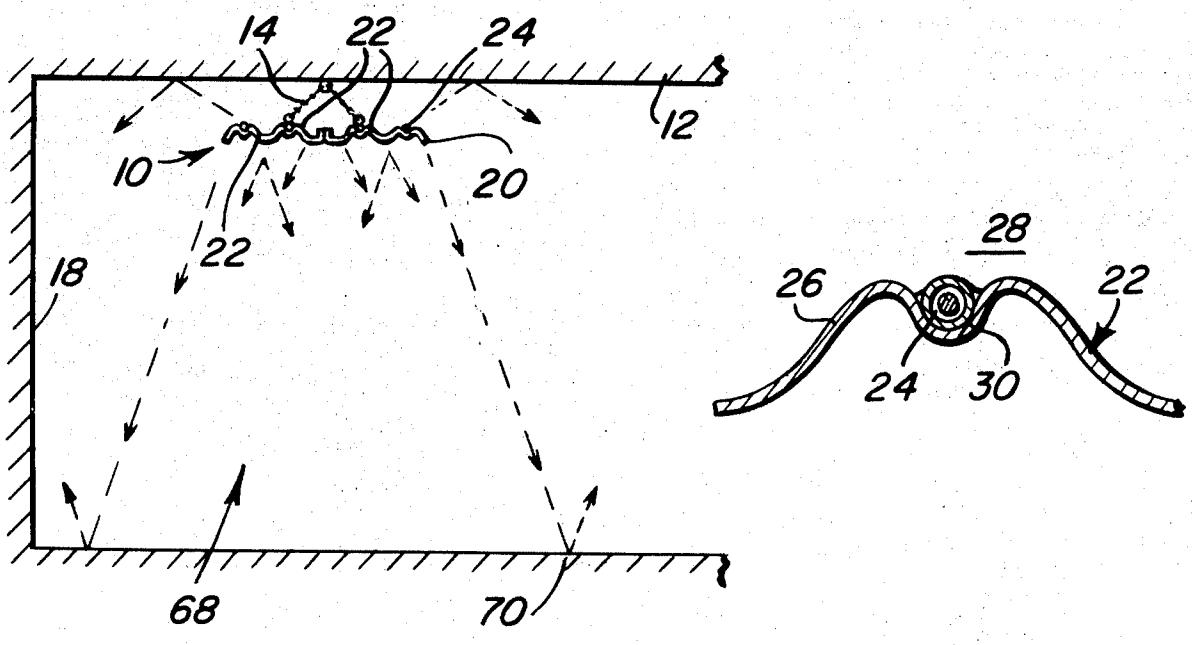


Fig. 1

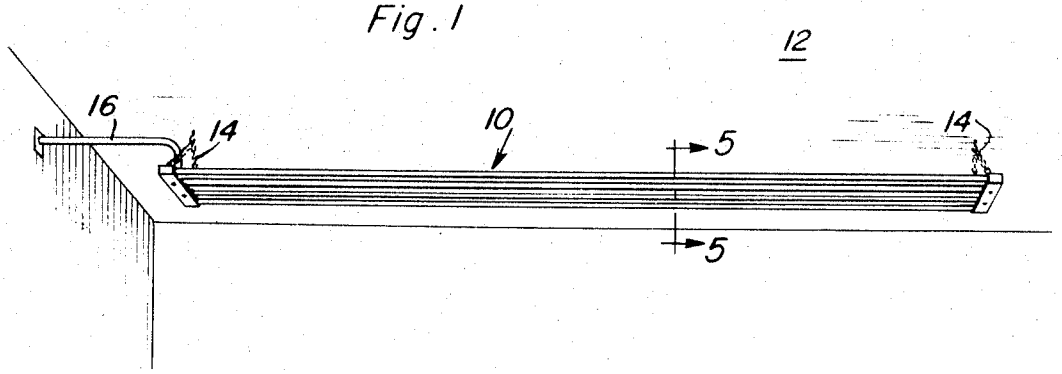


Fig. 2

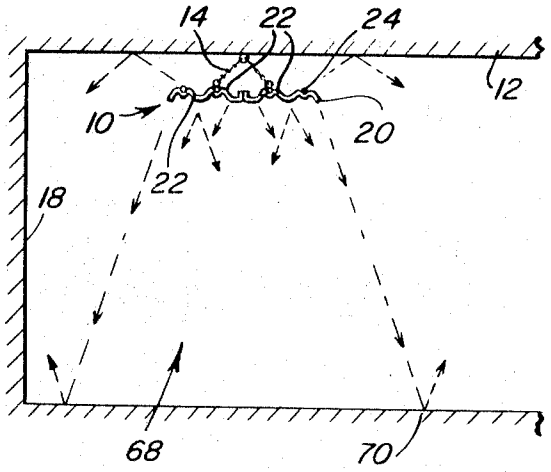


Fig. 3

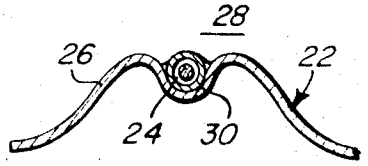


Fig. 4

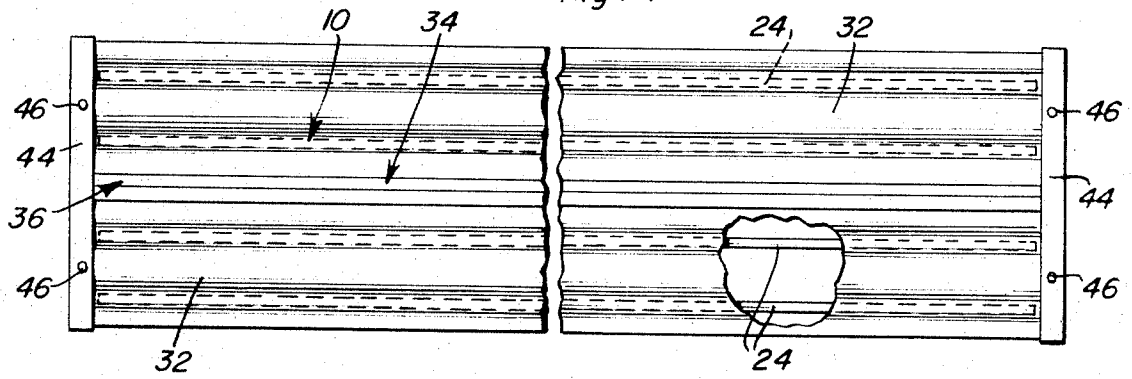


Fig. 7

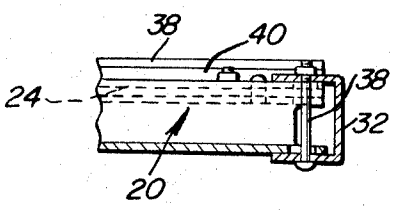


Fig. 8

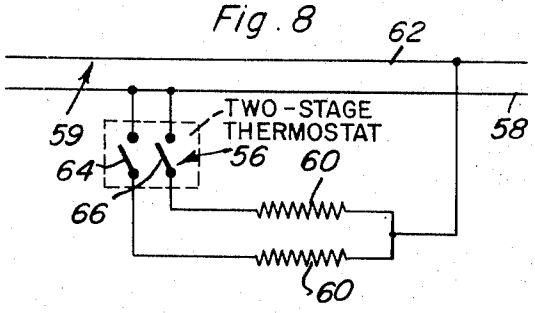


Fig. 5

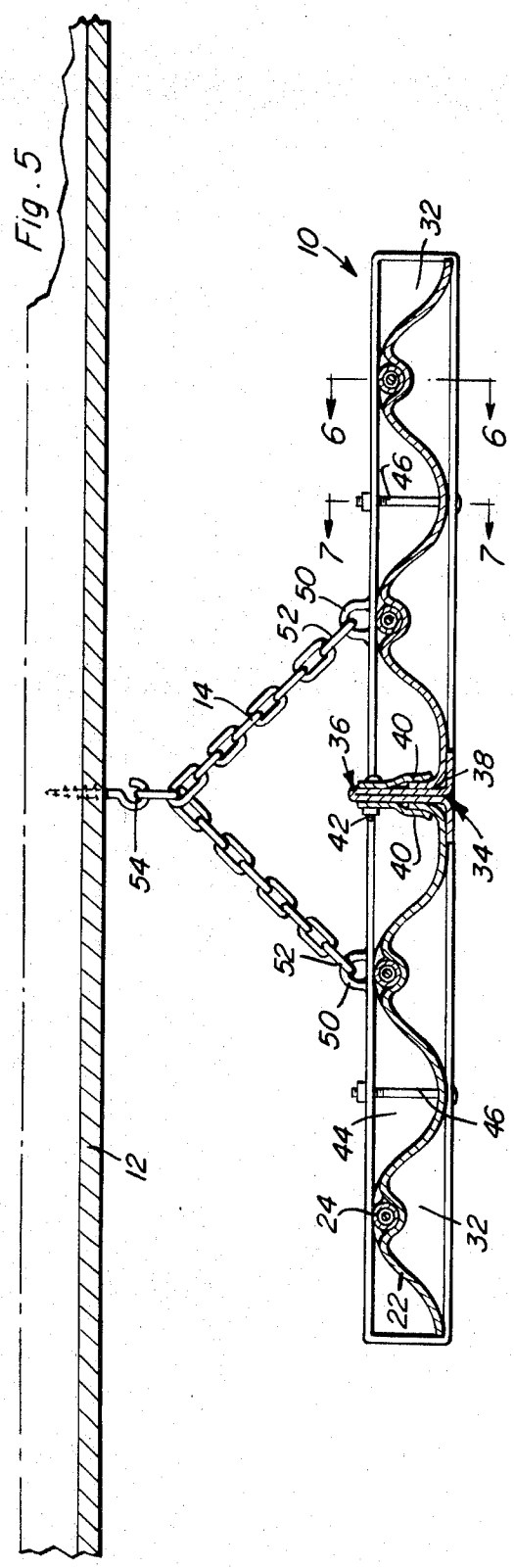
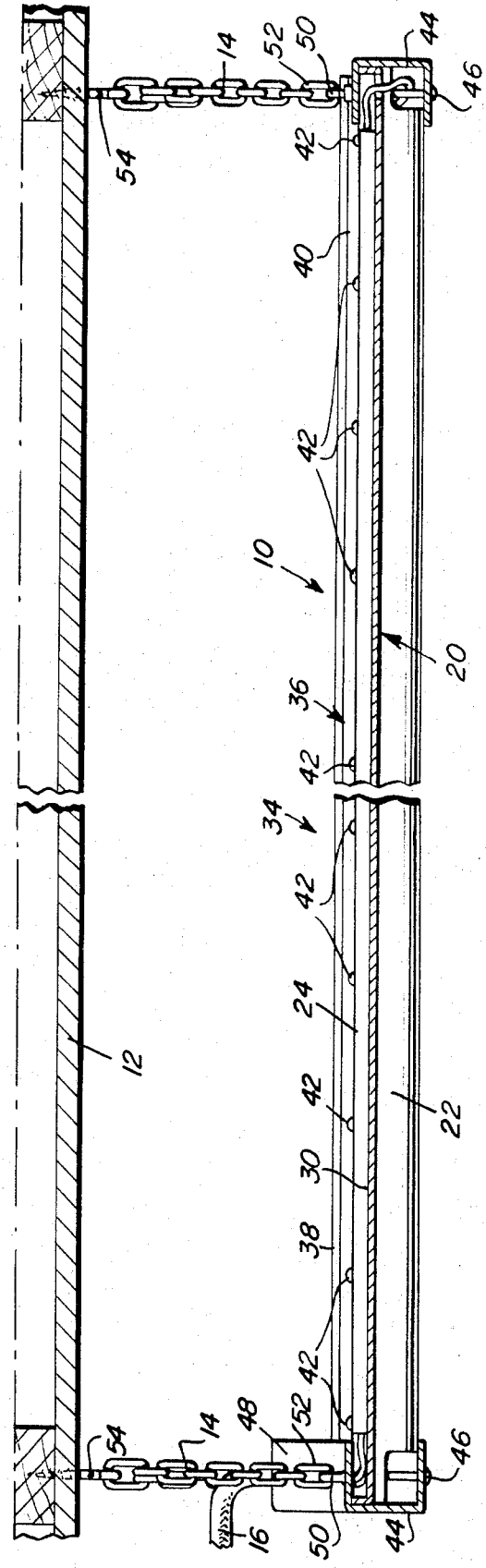

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Fig. 6


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RADIANT HEATER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to radiant heating, particularly a radiant electric panel heater intended to be suspended from a ceiling.

2. Description of the Prior Art

Radiant heating panels are known which are suspended from, for example, a ceiling with their heating elements directed downwardly. Their flat panels, however, are very directional and do not cover a large area. Radiant heaters are also known that use corrugated panels. An example of such a heater may be found in U. S. Pat. No. 2,469,963. This type of heater, however, is intended to be mounted in, for example, a ceiling with insulation provided for preventing the radiated rays from going upwardly. The known heaters using corrugated panels locate the heating elements in concave portions of the corrugations for focusing the rays into the space to be heated. This arrangement has the disadvantage of not providing uniform temperature distribution in the space to be heated.

A further problem encountered with the known radiant heaters is that although they generally are maintained at high temperatures in the range of, for example, 2,200° Fahrenheit to 4,000° Fahrenheit, it has been found that they must operate at least 80 percent of the time for efficiency and optimum comfort when used in an area having an outside design temperature, of, for example, 0° Fahrenheit. The known radiant heaters have the disadvantage that they are not suitable for operation of up to 80 percent of the time.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a radiant heater which will heat evenly a space to be heated. It is a further object of the present invention to provide a radiant heater which will have at least one heating element operating at least 80 percent of the time.

These and other objects are achieved according to the present invention by providing a radiant heater with a panel forming corrugations and having a heating element mounted on one of the corrugations, means for mounting the panel at a distance from a surface partially defining a space to be heated for permitting fluid circulation therebetween, and arranging the heating element for facing the surface.

A preferred embodiment of the present invention has the one corrugation form a convex surface with an apex defining a groove, and the heating element mounted in the groove.

It is possible, especially to realize the feature of almost continuous operation, to provide a plurality of heating elements and an equal number of corrugations defining grooves, each heating element mounted in a respective groove.

A preferred embodiment according to the present invention for realizing the almost continuous operation of the the radiant heater has means provided for actuating at least one of the heating elements at a predetermined temperature different from that for the other element. When this feature is used, the panel preferably has a plurality of sections, each section associated with a heating element, and means are provided for connecting the sections together for permitting thermal expansion of one of the sections independently of an adjacent section. This construction effectively prevents warping of the panel due to uneven heating.

The radiant heater according to the present invention is preferably suspended from a ceiling by at least two longitudinal elements, such as chains, each having a pair of spaced ends connected to the panel.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view showing a radiant heater according to the present invention suspended from a ceiling.

FIG. 2 is a schematic, vertical longitudinal sectional view through a space to be heated, and showing an end view of a radiant heater according to the present invention.

FIG. 3 is an end sectional view showing a detail of a radiant heater according to the present invention.

FIG. 4 is a top plan view, partly cut away, showing a radiant heater according to the present invention.

FIG. 5 is a sectional view, on an enlarged scale taken generally along the line 5—5 of FIG. 1.

FIG. 6 is a vertical longitudinal sectional view taken generally along the line 6—6 of FIG. 5.

FIG. 7 is a fragmentary sectional view taken generally along the line 7—7 of FIG. 5.

FIG. 8 is a schematic diagram showing a control system for modulating the heating elements of a radiant heater according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 of the drawings shows a radiant heater **10** according to the present invention suspended from a ceiling **12** by means of chains **14**, and supplied with electric power through a conduit **16**. It is to be understood that radiant heater **10** could be spaced by rigid members (not shown) from, for example, a wall **18** (FIG. 2) if desired.

Radiant heater **10** has a panel **20** forming corrugations **22**. A plurality of heating elements **24**, four being shown in the drawings, are mounted on corrugations **22**. Panel **20** is arranged at a distance from ceiling **12** for permitting fluid , such as air, to circulate between panel **20** and ceiling **12**, and heating elements **24** are arranged facing ceiling **12**.

FIG. 3 shows a corrugation **22** which forms a convex surface **26** with an apex **28** having a wall defining a groove **30**. A heating element **24** is mounted in groove **30** in a known manner, such as by a suitable, known adhesive material. Heating elements **24** may be tubular, as shown, or in the form of heating strips (not shown). Suitable, known heating elements which will operate in the range of 1,000 to 2,000 watts at 120 or 240 volts may be used. The material for mounting heating element **24** may be an epoxy material bonding the element to a, for example, aluminum panel **20**. The heating element **24** may be, for example, an aluminum tube three-eighths of an inch in diameter with resistance wire arranged in the center thereof.

FIGS. 4 to 7 show the construction of panel **20.** Panel **20** is preferably made up of a plurality of sections **32,** two being shown in the drawings. Sections **32** are joined together as at **34.** Means **26** for joining sections **32** together has a clamp **36** for forming a guide channel. This arrangement permits thermal expansion of one section **32** independent of an adjacent section **32.** The significance of this construction will be set out below. Clamp **36** is made up of a longitudinally extending wedge piece **38** and a pair of plate members **40** secured to piece **38** by a plurality of bolts and nuts **42.**

End covers **44** may be mounted on the longitudinal ends of plate **20** by means of, for example, bolts and nuts **46.** Covers **32** finish off panel **20** and provide for mounting a connection box **48** and mounting lugs **50.** The two spaced ends **52** of longitudinal chain **14** are connected to lugs **50.** Chains **14** can be fastened to a ceiling **12** as by, for example, screw hooks **54.**

Connection box **48** houses the distribution system for the various heating elements **24.**

FIG. **8** shows a circuit for two-stage modulation of a pair of heating elements **60.** A modulating thermostat **56** is connected between a line **58** of a power line **59** which may be a standard 110 or 240 volt line, and a pair of heating elements **60.** Elements **60** are in turn connected to one line **62** of power line **59.** For a 240 volt system, elements **60** may be connected to ground instead of line **62.** Thermostat **56** may be a suitable known type such as that sold under the designation "Mears M7M" One contact, for example, contact **64,** is set close at a predetermined temperature. The other contact, for example, contact **66,** is set to close at a temperature slightly below that for contact **64.** This temperature difference, may be, for example, 1 degree F. Thus, heating element **60** in series with contact **60** may be selected to satisfy the normal heating requirement with at least 80 percent operation. This permits element **60** to operate in an efficient manner, and to maintain a steady heat in the space to be heated **68** (FIG. **2**). While only one contact **66** is closed, heater **10** uses only one-half the total rated wattage. Each element **60,** which may be, for example, two heater elements **24,** is associated with a section **32** so that thermal expansion of only the one section takes place. Only when the heating load becomes too great for one heating element **60,** does contact **64** close and bring the other heating element into operation.

It is known that every point of a surface emits a visible infra-red heat ray which travels away from that point in a straight line in any direction, but with greater intensity perpendicular to the surface, decreasing to zero intensity parallel with the surface, and decreasing intensity with distance. Corrugated aluminum panel has been found to provide most all points with maximum intensity, thus achieving optimum radiant comfort.

As can be seen from FIG. **2,** panel **20** radiates the rays in both directions from corrugations **22** and spreads them evenly over space **68,** which may be a room. The rays will tend to bounce-off floor **70** and wall **18** for additional diffusion. Panel **20,** and thus heater **10,** should be spaced about, for example, three inches from the lowest extending portion of ceiling **12** for optimum results. The portion of ceiling **12** adjacent panel **20** may be covered with a reflective medium for increasing the distribution of rays reflected toward ceiling **12** (FIG. **2**) and the ceiling itself becomes a radiant panel. Thermostat **56** and/or an off-on switch (not shown) may be provided and arranged at a suitable location in a surface defining the space **68.**

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

What is claimed as new is as follows:

1. A radiant heating panel for mounting on a wall surface of a space to be heated, comprising, in combination:

a. a corrugated, heat radiating panel;

b. means for mounting said panel adjacent to and spaced from a wall surface for permitting fluid circulation between the panel and wall surface, the corrugations of said panel including alternate concave and convex surfaces arranged facing a space to be heated partially defined by the wall surface, an apex of at least one of the concave surfaces being provided with means for defining a shallow, elongated groove open toward the wall surface; and

c. an elongated heating element mounted in the groove and arranged facing and radiating directly onto the wall surface.

2. Structure as defined in claim **1,** wherein there are a plurality of heating elements, and at least an equal number of corrugations defining grooves, each heating element mounted in a respective groove.

3. Structure as defined in claim **2,** wherein means are included for actuating at least one of the heating elements at a predetermined temperature different from that for the other heating elements.

4. Structure as defined in claim **2,** wherein said panel includes a plurality of sections having edges arranged side-by-side, each section having associated therewith at least one heating element, and means including clamp means forming a guide channel connecting said sections together at said edges for permitting independent thermal expansion thereof.

5. Structure as defined in claim **2,** wherein the space defining wall surface is a ceiling, and said means for mounting includes at least two longitudinal elements, each having a pair of spaced ends connected to said panel for suspending said panel from the ceiling.

6. Structure as defined in claim **1,** wherein said panel includes a plurality of sections having edges arranged side-by-side, each section having associated therewith at least one heating element, and means including clamp means forming a guide channel provided for connecting said sections together at said edges for permitting independent thermal expansion thereof.

7. Structure as defined in claim **1,** wherein the space defining surface is a ceiling, and said means for mounting is at least two longitudinally extending elements, each having a pair of spaced ends connected to said panel for suspending said panel from the ceiling.

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