July 12, 1966 F. J. SOUKEY ETAL 3,260,835

RADIANT HEATING SYSTEM

Filed Feb. 4, 1964 2 Sheets-Sheet 1

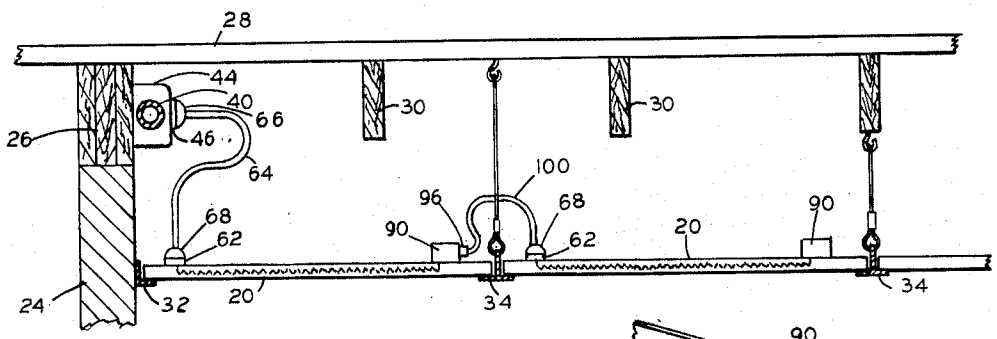


FIG. 1

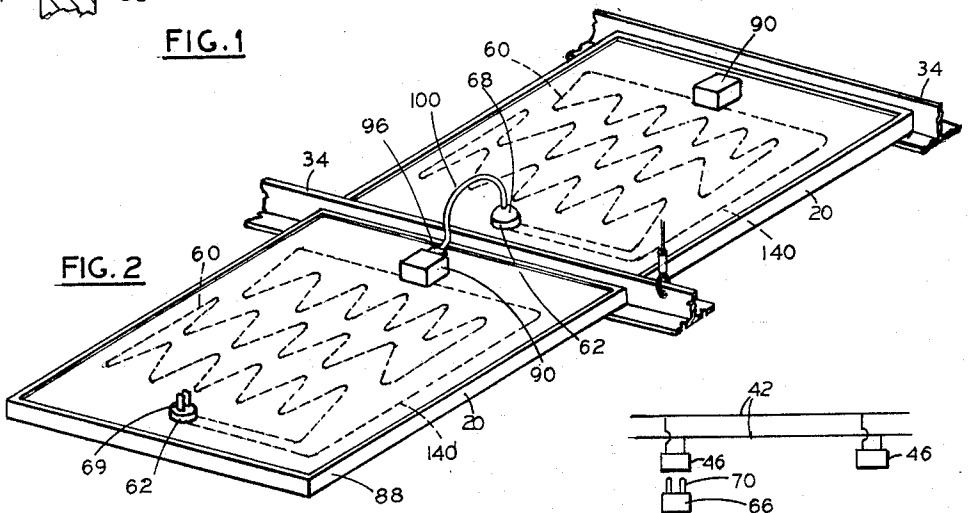


FIG. 2

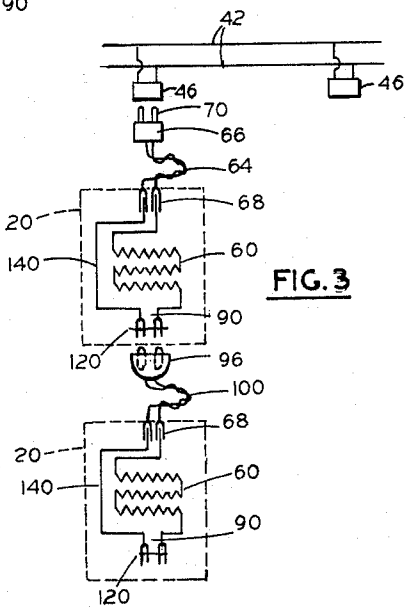


FIG. 3

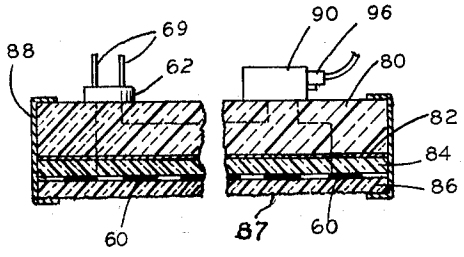


FIG. 4

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RADIANT HEATING SYSTEM

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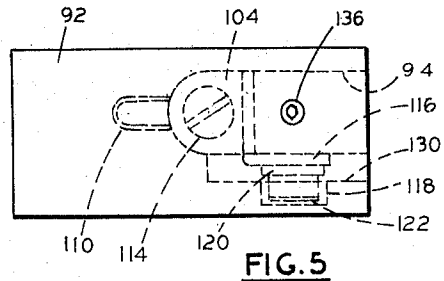


FIG. 5

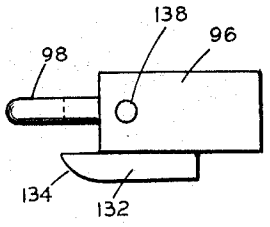


FIG. 6

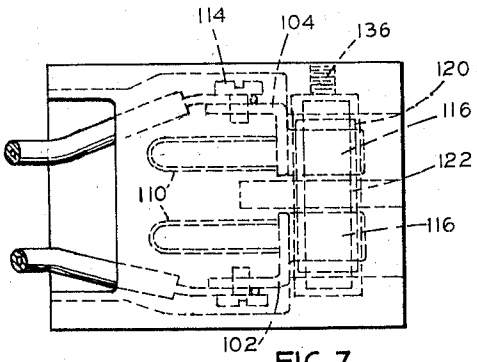


FIG. 7

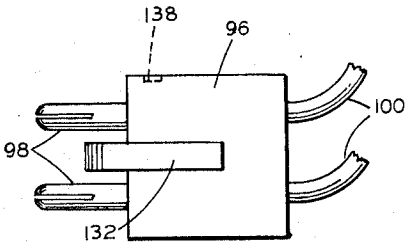


FIG. 8

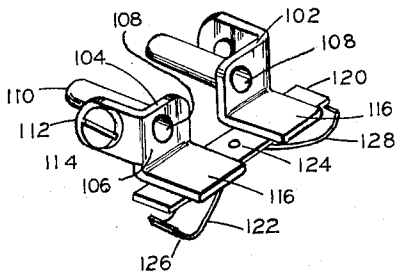


FIG. 9

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RADIANT HEATING SYSTEM

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Filed Feb. 4, 1964, Ser. No. 342,401
3 Claims. (Cl. 219—213)

This invention relates to electric radiant heating, and more particularly to radiant heating panels therefor.

The practice of providing a ceiling comprised of panels of standard size suspended from an overhead supporting structure such as floor joists, roof members, and in some cases a high ceiling is well known, as well as the use of radiant heat derived from electrical resistance units. However, it has been the practice to provide such radiant heating units as a part of a relatively permanent construction wherein difficulty is had when replacement or modification as to the number and location of such units is desired.

The present invention is directed to an electrically energized radiant heating system, wherein a single panel of standardized construction is readily included in a panel type ceiling construction, either singly or in pairs. The construction is such that when the panels are employed in pairs, a series connection of the heating units of a pair of panels is readily effected. Thus radiant heating panels of a single standardized construction adapted for connection to a 110 volt source of supply, are readily adapted for use on a 220 volt source when paired. The invention further has to do with the construction of the heating panel whereby connections are made by simple plug-in connectors, the use of which automatically establishes the circuit for the supply voltage to be used. The invention further has to do with provision for connecting the panels to a source of supply and in pairs in a manner such that the panels may be quickly installed, removed, replaced, or added to, the necessary connections being effected by simple plug-in operations. A further feature of the invention is the provision of a panel wherein the radiant heating circuit is automatically opened for series connection with a companion panel by a mere plug-in operation.

The above and other novel features of the invention will appear more fully hereinafter from the following detailed description when taken in conjunction with the accompanying drawings. It is expressly understood that the drawings are employed for purposes of illustration only and are not designed as a definition of the limits of the invention, reference being had for this purpose to the appended claims.

In the drawings wherein like reference characters indicate like parts:

FIGURE 1 is a sectional view of a ceiling installation with radiant heater panels installed;

FIGURE 2 is a perspective view of two adjacent radiant heater panels connected in series;

FIGURE 3 is a wiring diagram;

FIGURE 4 is a fragmentary enlarged sectional view through a radiant heating panel;

FIGURE 5 is a side elevational view of a panel socket;

FIGURE 6 is a side elevational view of a plug adapted for use with the socket;

FIGURE 7 is a bottom view of the socket of FIGURE 5;

FIGURE 8 is a bottom view of the plug of FIGURE 6, and

FIGURE 9 is a perspective view of conductor parts within the socket of FIGURES 5 and 7.

Referring to the drawings, there is shown in FIGURE 1, a fragmentary section through a ceiling construction wherein ceiling panels **20** are supported in a suspended manner from the flooring or other structure above. As

shown, a wall **24** is provided with a plate **26**, over which is laid a flooring **28**, having spaced joists **30**. Supported from the wall on angle members **32**, and inverted "T" sectioned members **34** suspended from the floor or joists by wires or links as indicated at **36** and **38**, are the ceiling panels **20**. While some or all of the panels may be radiant heating panels, it will be understood that such panels may be interspaced with ordinary panels of a standard type having no provision for heating, or with panels having lighting fixtures for example.

Along the plate and above the ceiling panels, is a conduit **40** for a heating power supply which in practice may be a circuit **42** capable of operating on 220 volts. Such conduit is provided with frequent outlet boxes **44** having plug-in receptacles **46**, the boxes being disposed preferably at intervals corresponding to the width of the panels. It will be understood that the spacing between angle members **32** and the "T" members **34** will be such as to accommodate panels **20** of a standard size, and that "T" members similar to members **34** and angle members **32** may also be provided at right angles to those shown to provide square or rectangular flanged frames of a size to receive and support the panels of a standard size. It will also be understood that in the usual practice, the supporting "T" and angle members **34** and **32** are installed at proper spacings to receive the panels after which each panel is inserted upward through the rectangular opening of the supporting members where the panel is to rest, and the panel is thereafter oriented and lowered so as to rest flat upon the flanges of the members **32** or **34** in forming the ceiling construction.

Each of the heating panels comprises a unit adapted for radiant heating of a prescribed wattage when operating on 110 volts. In order that panels may serve in a 110 volt supply circuit, or be used in conjunction with a second panel of identical construction in a 220 volt supply circuit, by connecting two panels in series, each panel comprises an identical resistance heating unit generally indicated at **60**. Each panel is also provided with a male plug **62** at one end, adapted to be connected to a receptacle **46** by a flexible two conductor cable **64** having a suitable plug **66** and receptacle **68** at its opposite ends. Such cable is of a length such that the connections may be made between a receptacle **46** and plug **62** prior to positioning the heating panel in its ultimate position of rest in the supporting frame members. The cable supplies the radiant heat panel with power from the power circuit **42**.

The two conductor cable **64**, for use with 220 volts, and for supplying two panels connected in series will in practice have its plug **66** provided with flat contact blades **70** lying in a common plane, as indicated in FIGURE 3. A similar cable **64** for supplying a single panel from 110 volts will have its plug **66** provided with two blades lying in spaced parallel planes.

Each radiant heater panel may have a heavy heat insulating and preferably fire resistant panel **80**, on the underside of which is positioned a heat reflective sheet **82**, and below which are two spaced glass panels **84** and **86**, between which is an electrical resistance heating grid **60** of a suitable wattage when energized by a source of power supply of 110 volts. The panel, sheet and glass plates may be secured together in any suitable fashion and may have a rectangular inwardly facing channel sectioned frame **88**, of sheet metal, stainless steel or other suitable material. The glass panel **86** may have a frosted or irregular under surface **87**, if desired.

At one end of each panel on the back or top side is postioned a plug **62**, and at the other end is a plug-in receptacle **90**. The receptacle may be of the type shown in FIGURES 5–9, if desired. As shown, the receptacle **90** comprises a housing **92** of insulating material which

may be affixed to the panel **80** in any suitable manner. The housing **92** is provided with an opening **94** to receive a plug **96** having spaced electrical contact pins **98** connected to a two wire flexible cable **100** having a receptacle **68** for making contact with the plug contacts **69** of the plug **62** of the second panel.

Mounted within the housing in suitable recesses are spaced electrical contact members **102** and **104**. Each contact member comprises a transverse conductive member **106** having an aperture **108** in which is affixed a contact sleeve **110** of a internal diameter to receive a contact pin **98**. The transverse member **106** is provided with an integral rearwardly bent portion **112** having a binding post screw **114**, and a forwardly extending foot portion **116** lying flush with the inside wall of the plug receiving opening **94**. A transverse slot **118** is formed in the housing member beneath the foot portions **116** of the contact members **102** and **104**. Disposed in the slot **118** is a conductor blade **120** adapted to contact the undersurfaces of the foot portions **116**, under pressure of a leaf spring **122** affixed to the center of the blade as by a counter-sunk rivet **124**. The free ends **126** and **128** of the spring slide on the bottom of the slot **118**, and urge the blade **120** upward in the slot into electrical contact with both foot portions **116** to provide an electrical connection between the members **102** and **104**.

Disposed between the foot portions **116** is a second slot **130** in the wall of the opening **94**, extending inwardly of the opening, and across the slot **118**. The plug **96** is provided with a camming rib or tongue **132** adapted to ride in the slot **130** when the plug is inserted into the opening **94**, and the camming end **134** of the tongue is adapted to engage the blade **120**, to depress the blade away from the contact feet **116**, against the urge of leaf spring **122**. Thus upon insertion of the plug **96** so that the contact pins **98** are received in the respective contact sleeves **110** to effect a connection therewith, the shunt connection between the contact members afforded by the blade **120** is broken.

To prevent the unauthorized removal of the plug **96**, a setscrew **136** in the side wall of the housing may be provided, the end of which may be seated in the recess **138** in the plug, when the plug is inserted into the housing opening **94**. Such setscrew may be of the typical Allen head type if desired.

It will be seen from FIGURES 2 and 3, that in each radiant heat panel, the heating grid resistance **60** is connected to one of the blades **69** of plug **62**, and to one of the contacts **102** and **104** of plug-in receptacle **90**, while the other blade **69** of plug **62** is connected to the other of the contacts **102** and **104**, as by a lead **140**.

In practice, two types of flexible cables **64** may be supplied, one with a plug **66** having contact blades lying in spaced parallel planes for use when the circuit **42** is operating at 110 volts, and the other with a plug **66** having spaced flat blades lying in a single plane for use when the circuit **42** is powered at 220 volts, it being understood that corresponding receptacles **46** will be employed. The flexible cables **100**, being supplied with plugs having round pins **98**, restricts the use of such cables to interconnecting two panels where the line **42** is powered at 220 volts.

It will be seen that each panel, whether to be used singly or in pairs is identical, and that when the panels are paired, the proper series circuit is automatically established by the mere insertion of the plug **96** into the plug-in receptacle **90**.

It will appear that in practice, the shunting blade, and its automatic operation may be eliminated, if desired, from the plug-in receptacle **90**, in which case a plug such as **96** having its contact pins connected together may be supplied for insertion into the plug-in receptacle **90** to complete the connection between the contact members **102** and **104**. A single panel of this type may thus be prepared for use in a 110 volt system, by employing such a plug, or the second panel of a pair of panels connected together by a cable **100**, may have its circuit completed by employing such a plug in the plug-in receptacle of the second panel.

It will be seen from the foregoing, that a panel ceiling construction can readily be provided with as many radiant heating panels as desired and by reason of the flexible cables and plug-in connections employed, the radiant heating panel can be inserted in place, or substituted for non-heating panels about as readily as non-heating panels are placed in position. By providing flexible cables of adequate length, connections for each panel may be made as necessary before placing the panels in final position in the suspended supporting frame work. The connections are made without the use of tools. Where panels are supplied for 220 volt use, one panel of each pair may be supplied with a cable **100** with its plug **96** locked in place in the plug-in receptacle **90**, by the setscrew **136**, so that error in installation and completing the connections are minimized. Although a two wire circuit **42** has been shown, which may be either a 110 volt circuit using panels all connected in parallel or which may be a 220 volt circuit using pairs of panels connected in series, and the pairs being connected to the 220 volt circuit in parallel, it will also be understood that the 220 volt circuit may also have a third wire connected to ground, and acting as a neutral, so that single panels connected in parallel can be connected to the neutral and one of the other wires, and other single panels connected in parallel can be connected to the neutral and the other wire. On the other hand where pairs of panels are connected in series and connected to the 220 volt circuit the third neutral wire or ground wire if provided, may be connected to the metal frame **88** of the panels or the reflector **82**, or to the supporting grids **32** and **34**, or any or all. The former connection to the frame may be effected by a three prong plug and receptacle and use of a three wire cable **64**, the plug **62** having a third contact connected to the metal frame **88**, or to the reflector **82** or both. Similarly the cable **100** may be three wire, one of which would carry the ground from one panel to the other of the pair connected in series. In such case the receptacle **90** and plug **96** will have a third contact and pin for effecting the connections.

It is well known that comfortable conditions within a room may be attained from radiant heat with air temperatures well below that generally considered normal. The system set forth provides for ready change as to the number of radiant panels to be used, it being merely necessary, to substitute radiant panels for non-radiant panels as desired and effect the necessary plug-in connections. Such changes are readily made without in any way affecting the building structure.

While a single form of the invention has been illustrated and described, and variations indicated, it is to be understood that the invention is not limited thereto. As various changes in the construction of various features and the arrangement may be made without departing from the spirit of the invention, as will be apparent to those skilled in the art, reference will be had to the appended claims for a definition of the limits of the invention.

What is claimed is:

1. An electrical radiant heating panel for use in a suspended ceiling construction comprising a rectangular supporting member of heat insulating material having a reflective sheet and a radiant heating electrical resistance applied to one side thereof, said member having on its other side and affixed thereto adjacent one end a plug having two contact blades, and adjacent the other end a receptacle having two contacts for receiving a complementary two contact plug, said receptacle having shunting means for establishing electrical contact between said contacts in the absence of a plug, and a series electrical circuit including said resistance, contacts and shunting means connected to said plug blades.

2. In a suspended ceiling construction having electrical radiant heating panels comprising an overhead supporting structure, panel ceiling support frames suspended from the over head supporting structure, a source of electrical energy having spaced outlets disposed between the supporting structure and said support frames, an electrical radiant heating panel supported in said frame, said panel having electrical resistance radiant heating means on the underside thereof, and a two contact blade plug, and a two contact plug-in receptacle disposed adjacent opposite ends of the upper side, said receptacle having an electrical shunt between the contacts thereof closed in the absence of a plug, and having a series circuit connected between the blades of said two contact blade plug and including the contacts and the shunt thereof of said receptacle and the resistance of said heating means, and flexible conductor means having plug-in connections at either end and connected to the plug of said panel and to an outlet of the source of electrical energy, whereby to establish a series circuit including the resistance heating means of said panel.

3. In a suspended ceiling construction having electrical radiant heating panels comprising a wall and overhead supporting structure, panel ceiling support frames suspended from the over head supporting structure, a source of electrical energy having spaced outlets disposed along said wall between the supporting structure and said support frames, and a pair of like electrical radiant heating panels disposed adjacent one another and supported in said frames, each of said panels having electrical resistance radiant heating means on the underside thereof, and a two contact blade plug, and a two contact plug-in

receptacle disposed adjacent opposite ends of the upper side, said receptacle having an electrical shunt between the contacts thereof in the absence of a plug and each panel having a series circuit connected between the blades of said two contact blade plug and including the contacts and the shunt thereof of said receptacle and the resistance of said heating means, flexible conductor means having plug-in connections at either end and connected to a plug of one of said panels and to an outlet of the source of electrical energy, and a second flexible conductor means having a plug at one end disposed in the receptacle of said one panel to open the shunt thereof and a plug connection at the other end for the contact blade plug of the other panel, whereby to establish a series circuit including the resistance heating means of both panels.

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