

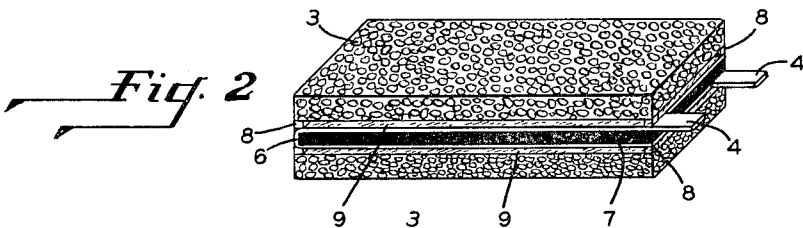
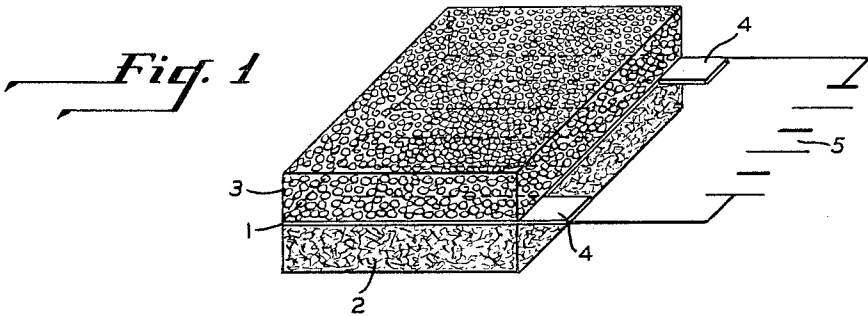
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N. E. HAGER, JR

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ELECTRICAL RADIANT HEATER HAVING CELLULAR AIR SHIELD

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INVENTOR
NATHANIEL E. HAGER, JR.

BY *Theodore L. Thomas*
ATTORNEY

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ELECTRICAL RADIANT HEATER HAVING CELLULAR AIR SHIELD

Nathaniel E. Hager, Jr., Lancaster, Pa., assignor to Armstrong Cork Company, Lancaster, Pa., a corporation of Pennsylvania

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ABSTRACT OF THE DISCLOSURE

An electric radiant heater has a metallic foil heating element adapted to be operated in the range of 100°–175° F. A 0.25"–1" air shield, transparent to the infrared radiation generated by the heating element and made of foamed or cellular polyethylene, polystyrene or poly (vinyl chloride) is positioned in front of the element to prevent ambient air from contacting the heating element, thereby restricting waste of heat by convection to the surrounding air. The foam air shield is coextensive in area with the heating element and may be either in direct contact with the element of spaced therefrom by a 0.01"–1" thick dead air space.

BACKGROUND OF THE INVENTION

Field of the invention

The invention relates generally to low-temperature electrical heaters wherein an electrically conductive metallic foil is used as a heating element.

Description of the prior art

U.S. Patent No. 2,545,805, Callender, describes an electrical heating panel having an electrically resistant heating element with transparent sheets positioned in front of the heating element to inhibit travel of air but to permit radiant heat rays to pass without substantial loss. The type of heating element and the type of air shield there disclosed make difficult the construction of a high efficiency heater.

U.S. Patent No. 2,682,596, Cox et al., describes a metallic foil heating element through which electrical current is passed in a serpentine configuration to generate heat by means of the electrical resistance of the foil. No teaching is provided to aid in constructing a high efficiency low-temperature electrical heater.

U.S. Patent No. 3,045,100, Mills, describes an infrared heater having a resistance element and sheets which may be of organic plastics such as polyethylene positioned in front of the emitter primarily to screen out unwanted infrared wavelengths.

These patents, and other art, do not enable one to build a simple, low-temperature, large-area radiant heater suitable for heating people or objects in open areas exposed to the wind or under other chilly conditions in which most of the heater energy would normally be carried away by moving air.

SUMMARY OF THE INVENTION

The invention contemplates a radiant low-temperature heater capable of emitting an increased amount of its energy output as radiation when exposed to substantial air movement. The heater comprises an electrically conductive metallic foil heating element adapted to be maintained at a temperature in the range of 100°–175° F. Positioned at a distance of up to about 1" in front of the heating element is a cellular air shield having a thickness in the range of about 0.25"–1" and being transparent to infrared radiation longer than 4 microns. The number, size and shape of cells in the cellular air shield is such

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that the infrared radiation passing through the shield from any given point on the heating element will pass through a maximum of 10 cell walls.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a simplified view of a heating unit of the present invention using a single shield, and

FIG. 2 shows a heating element in which the air shield is positioned in front of both faces of the heating element.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The heating element of the heater of the present invention will be an electrically conductive metallic foil which normally generates heat due to the resistance of the flow of a current of electricity. The shape of the heating element may be that of a series of strips or other shapes. An excellent configuration is that of the back-and-forth conductive path known as the serpentine configuration. The heating element may comprise a pair of opposing metallic foil electrodes separated by a thin layer of semi-insulating material of the type described in U.S. 3,311,862. In any case the heating element will be the actual radiating element having an emissivity of 0.7 or higher and which emits thermal radiation by virtue of its elevated temperature.

In many applications of the present invention the heating element will be mounted on an electrically and thermally insulating backing material. The backing material may serve as a support for the heating element. The backing material is also designed to prevent electrical short circuits and to minimize heat loss through the back of the heating unit of the present invention. Depending on cost and manufacturing factors, the backing material may comprise a variety of materials such as a cellulosic fiberboard, felt, cardboard, asbestos sheeting, resin-bonded glass fabric, resin-bonded fibrous materials such as mineral wool, glass fibers, asbestos, and the like, insulating resinous and rubber compositions such as low conductivity sheets and foams, and low conductivity ceramics such as cellular ceramics and cellular glass, and plasterboard and similar materials. The backing material is not a critical feature of the present invention since in some modifications of the heating unit the heater will emit infrared radiations both from the face and back of the heating element and an air shield will be positioned in front of both the face and back.

The metallic foil from which the heating element is made may be any of the metal foils such as copper, stainless steel, and other alloys. Since the heater of the present invention is designed to function at a relatively low temperature, the heating element and any electrical or thermal insulation need to be adapted to function at a temperature in the range of about 100°–175° F. It is this low temperature range of the heater which enables the use of cellulosic felts and papers as a backing.

The plastic cellular air shield will be substantially transparent to infrared radiation. Foamed or cellular polyethylene is the air shield of choice, although polystyrene and poly(vinyl chloride) can be used. The cell size in the plastic cellular air shield must be such that the infrared radiation which passes from any given point on the heating element through the air shield will not pass through so many cell walls that significant amounts of the radiation are reflected or absorbed. It has been found that a maximum of 10 cell walls can be used, preferably about 5. As a practical matter, if the cells in the air shield are smaller than about 0.1" then the radiation must pass through too many walls for good efficiency. If the cells are larger than about 1" in diameter, convection losses begin to take place inside the individual cells with attendant reduction in efficiency of the heater.

The air shield thickness will be in the range of about 0.25"-1" which, in conjunction with the cell size requirements, defines the nature of the plastic cellular air shield. The infrared absorption of most materials is too great to be used for infrared transmission longer than 4 microns. A range of about 4-20 microns is the region in which the heater of the present invention radiates by virtue of the low temperature of its heating element; it peaks at about 8-10 microns. For the heater to be reasonably efficient, the cellular plastic air shield should transmit more than about 50% of the infrared radiation emitted by the heating element of the heater.

The cellular structure of the air shield imparts strength and body to the air shield not possessed by thin films. Supporting structures such as chicken wire may be used if the heater is to be operated in an exceptionally windy area or in other areas where the air shield requires additional physical rigidity. The cells may be formed in conventional manner, or by use of a blowing agent in the plastic, or by vacuum drawing one sheet and adhering a second sheet to it. The function of the air shield is to force a large percentage of the heater output to take place by radiation by restricting conduction or convection. With these latter two methods of heat transfer, undue losses will occur and the efficiency of the output of the heater will be correspondingly reduced. It is for this reason that a small dead air space is an advantage between the heating element of the heater and the air shield. When a dead air space is used, a distance of the shield from the heater of 0.01"-1" will minimize heat buildup in the air shield itself while preventing the dead air space itself from becoming a means of convective heat exchange between the heating element and the air shield. Hot air currents begin to travel in the dead air space if the air shield is positioned more than about 1" from the heating element. As mentioned earlier, the cellular air shield may rest against the heating element.

In the drawings, in FIG. 1 the metallic foil serpentine heater 1 has an insulated backing 2 to prevent heat loss out the back. The plastic cellular air shield 3 rests against the heating element 1. Connecting tabs 4 on the heating element 1 connect the heating element 1 to a source of electrical power 5.

In FIG. 2, the heating element 6 is doubled back on itself, its two halves being separated by electrical insulation 7. The tabs 4 again serve as the means of connecting the heating element 6 to a source of electrical power. The cellular plastic layers 3 are positioned on both sides of the heating element 6 and are separated from the heater by the spaces 8 which, with enclosing walls 9 of plastic, glass, or other suitable material, creates a dead air space behind the walls 9 and between the heating element and the shields.

The surface of the heating element of the heater of the present invention need not be plane, but instead, may be so shaped as to radiate in a preferred direction. The en-

tire heater may be flexible within the limits of the material of its construction, or the heater may be rigidly constructed in any desirable predetermined shape.

In addition to using the radiant heaters of the present invention in outdoor positions or in large factory locations for keeping people warm, the heaters may be used to protect growing plants from cold or frost, to heat animal houses and greenhouses, and to serve in other locations where heat is needed at a specific area without wasting the heat on the heating of air.

I claim:

1. A low-temperature electrical radiant heater comprising an electrical conductive metallic foil heating element having means to be connected to a source of electrical power thereon and adapted to be maintained at a temperature in the range of 100°-175° F., and a plastic cellular foamed air shield of a plastic material transparent to infrared radiation of the wavelength generated by said heating element when operating at said temperature range and being substantially coextensive in size with said heating element and having a thickness in the range of 0.25"-1" and positioned in front of said heating element to prevent ambient air from contacting said heating element, the cells in said shield being hollow, the number, size and shape of cells in said cellular air shield being such that infrared radiation passing through said shield from any given point on said heating element will pass through a maximum of 10 cell walls.

2. A radiant heater according to claim 1 wherein said air shield is positioned by means of enclosing walls 0.01"-1" in front of said heating element to form a dead air space therebetween.

3. A radiant heater according to claim 1 wherein said metallic foil is copper.

4. A radiant heater according to claim 1 wherein said plastic cellular air shield comprises cellular foamed polyethylene.

5. A radiant heater according to claim 1 wherein the number, size and shape of cells in said cellular air shield is such that the infrared radiation passing through said shield from said heating element will pass through a maximum of 5 cell walls.

6. A radiant heater according to claim 1 where the diameter of the cells in said cellular air shield is in the range of .1"-1".

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ANTHONY BARTIS, *Primary Examiner*.