March 11, 1958 W. E. SCHMERTZ 2,826,669

BEAM HEATER

Filed Jan. 5, 1955

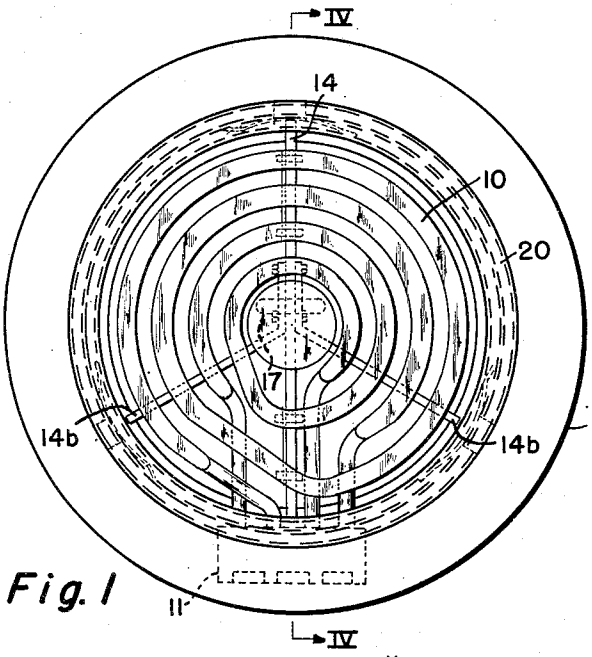


Fig. 1

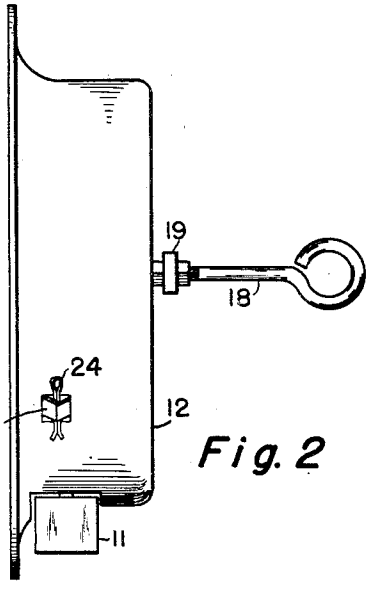


Fig. 2

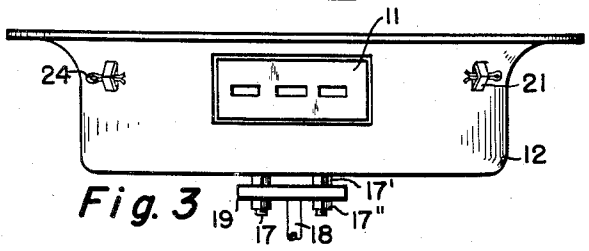


Fig. 3

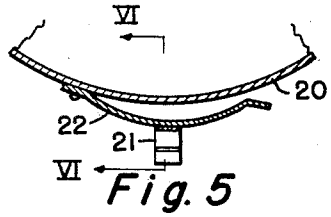


Fig. 5

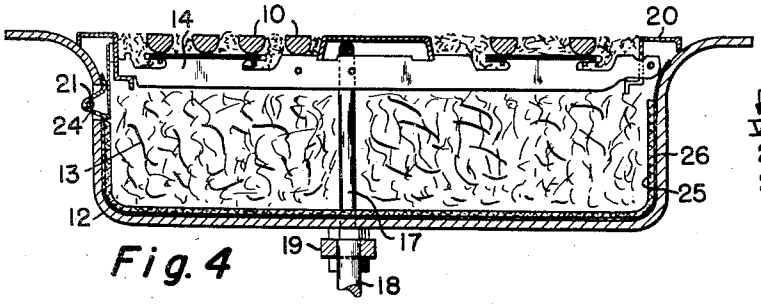


Fig. 4

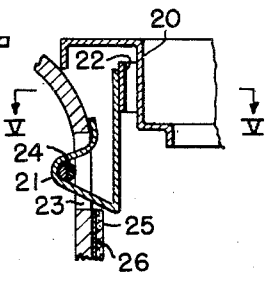


Fig. 6

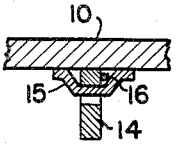


Fig. 7

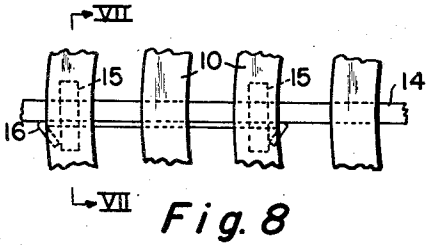


Fig. 8

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United States Patent Office 2,826,669
Patented Mar. 11, 1958

2,826,669

BEAM HEATER

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Application January 5, 1955, Serial No. 479,948

6 Claims. (Cl. 219—34)

This invention relates to heaters and particularly a heater adapted to transmit a directed beam of radiant heat.

An object of the invention is to produce means for electrically generating heat and for directing the heat so produced in the form of radiant energy so that a substantial portion of generated heat is effectively employed in a selected but somewhat limited region removed from the source of heat.

A further object is to produce what may be termed a beam heater in which a source of electrically generated heat is partially embedded in, or is backed up by a mass of fibrous material arranged so as to approximate a web-like structure or more especially a multiplicity of aligned screens, each acting as a reflector of heat rays and each tending to intervene in the path of such waves or rays and to prevent appreciable transmission of heat into and through the mass of fibrous material which backs up or forms a backing for the source of heat.

A further object is to produce a beam heater in which a heating element is partially embedded in a matrix formed of a confined mass of stainless steel wool so located with relation to the heating element that the exposed portions of the wool are heated by radiation and/or conduction and, together with such heating element, constitute a source of luminous energy which is capable of being directed for the purpose of delivering heat to a selected and to some extent limited region somewhat removed from the source of heat.

A further object is to produce a beam heater in which the heating element is partially embedded in a mass of fibrous material which acts as both high and low temperature insulation.

A further and more specific object is to produce a down beam heater in which an electric heating element is partally embedded in a reticulated matrix of heat-reflecting material so arranged with relation to such heating element that the major portion of the heat generated is directed downwardly in a diverging beam and into a region below and somewhat removed from the source of heat.

These and other objects are attained by means of apparatus such as illustrated in the accompanying drawings as an embodiment of my invention.

In the drawings:

Figure 1 is a plan view of a heater embodying my invention.

Figure 2 is a side elevation of the heater shown in Figure 1, a portion of an auxiliary part being broken away for convenience of illustration.

Figure 3 is a side elevation of the heater shown in Figure 1, the elevation being taken as if the heater were viewed from the line III—III associated with Figure 1.

Figure 4 is a transverse sectional view on an enlarged scale of the heater shown in Figure 1, the section being taken on the line IV—IV of Figure 1.

Figures 5 and 6 are fragmental sectional views, the section of Figure 5 being taken on the line V—V of Figure 6 and the section of Figure 6 being taken on the line VI—VI of Figure 5.

Figure 7 is a fragmental sectional view taken along the line VII—VII of Figure 8 and Figure 8 is a fragmental view of a portion of the electric heater shown as a part of the illustrated apparatus.

The heater shown as an embodiment of my invention is primarily adapted to be employed as a down-beam heater, i. e., as a heater which is located above a region or space to be heated. In the illustrated embodiment a well-known form of electric heating unit is employed as the heating element. The unit is shown as partially embedded in a confined mass of fine fibrous material, preferably stainless steel wool. The mass is confined within an enclosure located within an open sided casing which is, in effect, closed by the electric heating unit. The heating unit is located on, and spans the open side of the casing. As indicated, it forms a closure for the casing but is so arranged that one side of each heating element forming a part of the unit, is exposed and constitutes a source of radiant energy.

A feature of apparatus embodying my invention is that part of the steel wool which forms the embedding matrix for the heating unit, extends between the coils or heating elements of the unit and is located in heat receiving relationship with the elements and the arrangement is such that these fine fibers of steel wool are almost instantaneously heated to incandescence by the heating unit and form with it a source of radiant energy. The surface of the mass of steel wool which is remote from the heating unit is preferably surrounded by insulating material such as a mass of asbestos fiber or asbestos sheet formed in the shape of an enclosing cap.

The mass of stainless steel wool which constitutes the above mentioned matrix is substantially homogeneous, although it is more or less loosely packed within the casing. It approximates a retriculated mass or a structure such as is made up of a succession of screens located back of the heating unit and each of which tends to block the passage of heat rays rearwardly from the heating unit, constitutes a source of reradiated heat and is effective in directing heat forwardly in the direction of the heating unit. The mass of wool is not highly effective as a conductor of heat. It is, therefore, progressively cooler toward the rear surfaces thereof and the arrangement is such that the mass of fibrous material located back of the heating unit constitutes both high temperature and low temperature insulation. While the heating unit is receiving electric current, there is a marked temperature gradient within the fibrous mass back of the unit, the temperature decreasing as the distance from the unit increases.

Referring to the drawings the heater illustrated as an embodiment of my invention includes a heating unit **10** in the form of a plurality of more or less concentric coils or heating elements and which is of a type such as is usually employed as a heating unit for an electric stove. That is, the heating unit here illustrated is ordinarily termed a Calrod unit and, as illustrated, consists of a plurality of substantially concentric coils, each including in its make-up a tubular sheath enclosing an electrical resistance element embedded in a compacted mass of heat conducting but dielectric refractory material. As illustrated, the unit includes two heating elements which are more or less concentrically arranged and each of which is adapted to receive energizing current from a socket member **11**. The heating unit **10**, in effect, forms a closure for a cap-like casing **12**, i. e., a casing having an open side. The socket member **11** extends through an aperture formed in the peripheral portion of the cas-

ing 12 and is adapted to be connected to electric conductors for the purpose of delivering current to one or the other or both of the two heating elements disclosed.

The casing 12 and the heating unit 10 enclose a mass of stainless steel wool 13 which is clearly shown in Figure 4. As illustrated the wool 13 forms a substantially homogeneous but highly porous mass within the casing and a portion thereof extends between the adjacent coils or elements of the heating unit so that it is exposed on the open side of the casing and is located in direct contact with the elements of the heating unit. The arrangement is such that projecting portion is heated by conduction when the heating unit is receiving electric current.

As illustrated in the drawings, the unit 10 is supported on a frame portion 14 which is made up of three members, one of which extends diametrically across the several coils of the unit and occupies a position substantially parallel to the diameter of the casing 12. The other two elements 14*b*—14*b* of the frame portion are secured to the first mentioned element and extend substantially radially with relation to the unit and the casing. As is usual procedure, the bars which constitute parts of the heating unit are provided with frame-engaging straps 15 such as are shown in Figures 7 and 8 and each such strap is secured to one or another of the frame members by means of a locking strip 16.

The heating element per se and its support frame 14—14*b* and the details of construction in connection with the unit illustrated and such frame, form no part of my invention except that I have found it convenient both from the standpoint of manufacture and from the standpoint of expense, to employ standard type of heating elements in the production of beam heaters embodying my invention. It, however, is to be understood that my invention does involve a heating unit made up of one or more heating elements partially embedded in a substantially homogeneous but reticulated matrix which backs up the heating unit and is so arranged with relation thereto that parts thereof act with the unit in forming a source of radiant heat. In addition, the matrix functions to reflect and redirect heat waves emanating from the unit and from the exposed surface of the matrix so that substantially all the heat developed by the unit is projected forwardly and very little heat is expended ineffectually in heating portions of the matrix remote from the unit.

In the illustrated embodiment the heating unit is shown secured to the casing 12 by means of a U-bolt 17 which engages the transverse member 14 of the frame adjacent the center thereof and which projects through the rear wall of the casing. As shown in both Figures 2 and 3, the U-bolt is secured to the casing by nuts 17′ and is employed as a support for an eye-bar 18 which is shown secured to a plate member 19 apertured to receive the end of the U-bolt and which is secured thereto by means of nuts 17″. The bar 18 constitutes a support by means of which the heater may be suspended or otherwise mounted in the desired position.

The heating unit 10 is also supported by means of an encircling ring 20 which engages the ends of the frame members 14—14*b* and is secured in place on the casing 12 by means of spring clips 21. As shown by Figures 2 and 3, the ring 20 is provided with three such clips 21, each of which is anchored to the peripheral or substantially cylindrical portion of the casing 12. The cross sectional shape of the ring is generally Z-shaped and the web portion thereof is provided with apertures which engage and support the ends of the frame members 14—14*b*. Each spring clip 21 is shown as secured to a leaf spring 22 which is secured to the web portion of the ring 20 and is of such form that it tends to limit the inward radial movement of the clip carried by it. Each clip projects through an aperture 23 formed in the cylindrical portion of the casing, the arrangement being such that each clip will snap in place within its receiving aperture as the heating unit is moved to position with relation to the casing 12.

The upper flange of the ring 20 is shown in Figure 4 as lying in about the plane of the outer faces of the heating elements of the unit 10 and is provided with a right angle flange at its outer edge. This flange is of such length that it engages the outwardly curved face of the casing 12 and cooperates with the spring clips 21 and the U-bolt 17 in firmly securing the heating unit in place on the lip of the casing. Cotter pins 24 may be employed for firmly securing the spring clips with relation to the casing. As clearly shown in Figure 6, each clip is provided with an angular portion, the apex of which projects through the clip-receiving aperture formed in the casing. A cotter pin 24 engages the inner portion of the apex and, lying between the spring clip and the outer surface of the cylindrical portion of the casing, locks the ring in place on the casing with its right angle flange engaging the lip of the casing.

In Figure 4 I have shown a cap shaped asbestos container 25 enclosing the mass of stainless steel wool 13 and located within the casing. This cap shaped asbestos lining is shown as located between the wool and the casing and may be replaced by a layer of asbestos fiber so arranged as to intervene between the wool and the casing.

In the preferred embodiment of my invention I also employ an aluminum foil liner 26 for the casing. That is to say, the liner is located between the casing and the asbestos cap or fibers which enclose the mass of wool. The foil may be in the form shown or it may be crinkled so as to provide an interrupted air space between the wool and the casing 10. In either event, the surface of the foil liner 26 adjacent the asbestos lining is a polished surface and, therefore, acts to reflect heat waves back into the mass of wool and away from the walls of the casing.

From the foregoing it is apparent that the unit 10 when supplied with electric current constitutes a source of radiant heat or radiant energy. It will also be apparent that the portions of the stainless steel wool which are located between and in engagement with the heating elements of the unit, receive heat from the elements, and, under certain conditions of heating, become incandescent. It is also apparent that whether or not such portions of the wool are heated to incandescence they, together with the hot elements of the heating unit constitute a source of radiant heat which is capable of being beamed in selected directions. It is thus apparent that the heat transmitted by radiation in an expanding beam-like form may include heat rays of different length, i. e., heat rays emanating from highly incandescent parts of the heater as well as infra red rays which emanate from portions of the heater of substantially lower temperature.

It will also be apparent that even though the wool particles intervening between the heating elements of the unit may be heated by conduction or otherwise to incandescence, the fact that stainless steel is a poor conductor of heat will minimize the tendency of interior layers of the wool to receive heat from the so heated outer layer of wool. It is also apparent that while radiation from the heating elements of the unit and also from the heated strands of the wool will radiate in all directions, the mass of wool will tend to prevent appreciable rearward radiation of heat in the mass of wool. In other words, the fibers going into the make-up of the wool mass will intervene into the path of inwardly projecting heat waves or rays and will tend to reflect at least a substantial portion of each such ray toward the open side of the casing. In addition, investigation has disclosed that even while the heating unit is developing maximum heat and the fibers of wool lying between and contacting the heating elements are incandescent, there is a substantial drop in the temperature from the exposed surface of the wool to the rear wall of the casing. As at present advised this drop in temperature is occasioned by the known conductive characteristics of the wool

and the fact that the wool pack intervenes as a reflecting and reradiation medium and therefore prevents the radiant heat from permeating deeply into the mass of the wool.

A feature of the invention, as embodied in the illustrated apparatus, is that I have employed two types of insulating material to back up the heating unit forming a part of the apparatus. The stainless steel wool is employed for the double purpose of providing an insulating backing for the unit and of also providing instantaneous incandescence at the exposed surface of the unit, i. e., in connection with those fibers of the wool which lie between and in contact with the heating elements of the unit. From the standpoint of the insulating characteristics of the wool I term it a high temperature insulation, noting that the mass of fine fibers of steel are capable of being subjected to temperatures in the neighborhood of and higher than 1800° F., without physical change other than being heated.

I also employ in association with, and in fact in contact with the steel wool, an insulating material which I term low temperature insulation, i. e., insulation which may or may not be resistant to detrimental physical change when subjected to high temperatures such as noted, but an insulation which is highly effective in connection with lower temperatures such as are encountered at points somewhat remote from the heating unit.

With both types of insulation, the effectiveness of the insulating material is increased by the fact that it is employed in such a way that it is permeated by air spaces or air pockets. As a result of the use of two types of insulation the casing **12** may be maintained at a safe temperature even though a high temperature is being developed by the unit **10** and is available as a source of radiant heat at the exposed surface of the unit.

While I have illustrated and described but one embodiment it will be apparent that various changes, substitutions, additions and omissions may be made in connection with structural features of such embodiment without departing from the spirit and scope of the invention.

What I claim is:

1. A down beam heater including a cylindrical cap-shaped casing open on one side, a substantially homogeneous but loosely packed mass of stainless steel wool located in and substantially filling said casing, a Calrod heating unit secured to said casing in closing relationship with the open side thereof and including in its make-up a plurality of substantially concentric coils located in spaced relationship and partially embedded in said mass of steel wool with the exposed surfaces of said coils and of the steel wool intervening between said coils constituting a substantially unitary source of radiant heat emanating from said heater, and means for delivering electric current to said unit.

2. A down beam heater including a cylindrical, cap-shaped casing having an open side, a substantially circular Calrod heating unit located in closing relationship with the open side of said casing and consisting of a plurality of substantially concentric spaced coils, a reticulated matrix located within the space enclosed by said casing and said unit and consisting of a substantially homogeneous mass of stainless steel fibers completely filling said space and partially embedding the coils of said unit; insulating material located within said casing between said matrix and the cylindrical and circular wall of the casing; a supporting frame for said unit including a plurality of radiating arms secured to coils of said unit on the matrix side thereof; means for removably securing said frame to said casing, and means for delivering electric current to said coils.

3. A down beam heater including a cap-shaped cylindrical casing having an open side, a substantially circular Calrod heating unit located in closing relationship with the open side of said casing and consisting of a plurality of substantially concentric heating coils located in spaced relationship; a substantially homogeneous mass of stainless steel fibers substantially filling the space enclosed by said casing and said unit and partially embedding the separate coils of said unit; insulating material located within said casing between said fibrous mass and the cylindrical and circular walls of said casing; a support frame for said unit including a circular ring surrounding said unit and a plurality of radiating arms secured to coils of said unit and to said ring and located within the confines of said casing; and a plurality of snap springs for securing said ring to said casing on the open side of the casing.

4. A beam heater including a cap-shaped casing open on one side; a substantially circular electric heating unit secured to said casing in closing relationship with the open side thereof and including in its make-up a plurality of substantially concentric coils located in spaced relationship; a substantially homogeneous reticulated mass of stainless steel wool filling the space enclosed by said casing and said unit and with the fibrous material of said mass in contact with and extending between the coils of said unit in heat-receiving relationship therewith and forming with said coils a heat-radiating surface across the open face of said casing; and means for delivering electric current to said unit.

5. A down beam heater comprising a cap-shaped cylindrical casing open on one side; a substantially circular Calrod heating unit secured to said casing in closing relationship with the open side thereof; a reticulated metallic matrix located within the space enclosed by said casing and said unit, contacting with and partially embedding the coils of said unit; a low temperature insulating material partially enveloping the matrix and located between the matrix and said casing; and means for delivering electric current to the coils of said unit.

6. A beam heater comprising a cap-shaped casing open on one side; a substantially circular heating unit including in its make-up spaced, concentric coils located in closing relationship with the open side of said casing; a substantially homogeneous reticulated matrix located behind said unit within said casing and in which the coils of said unit are partially embedded, said matrix consisting of a substantially homogeneous mass of stainless steel fibers; a heat-insulating lining located within said casing behind said unit and partially enclosing said matrix; a metallic reflector located between said casing and said lining and enveloping said lining; and means for delivering electric current to said unit.

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