Nov. 10, 1970 D. C. WALLACE 3,539,770

ELECTRIC INFRARED HEATER

Filed Nov. 14, 1967

FIG. 1

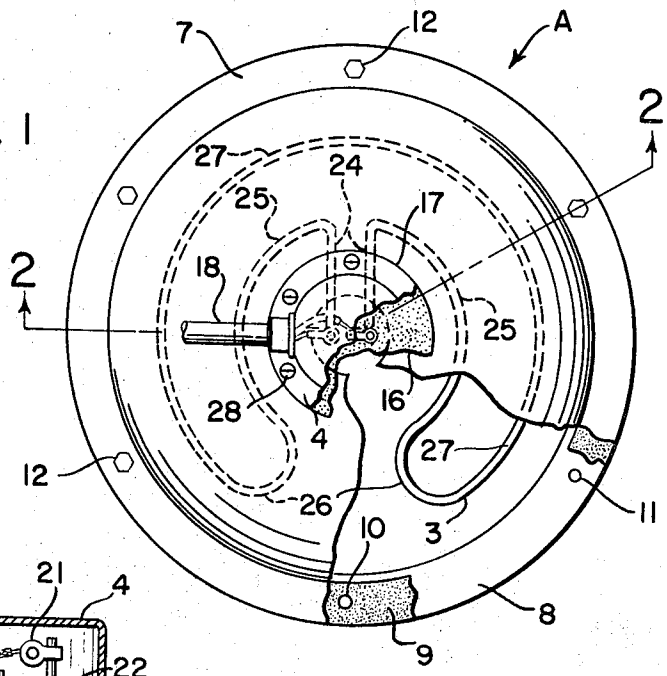


FIG. 2

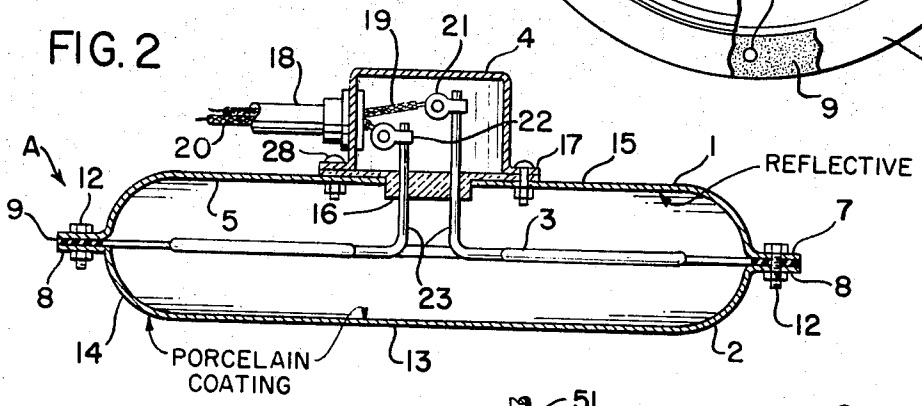
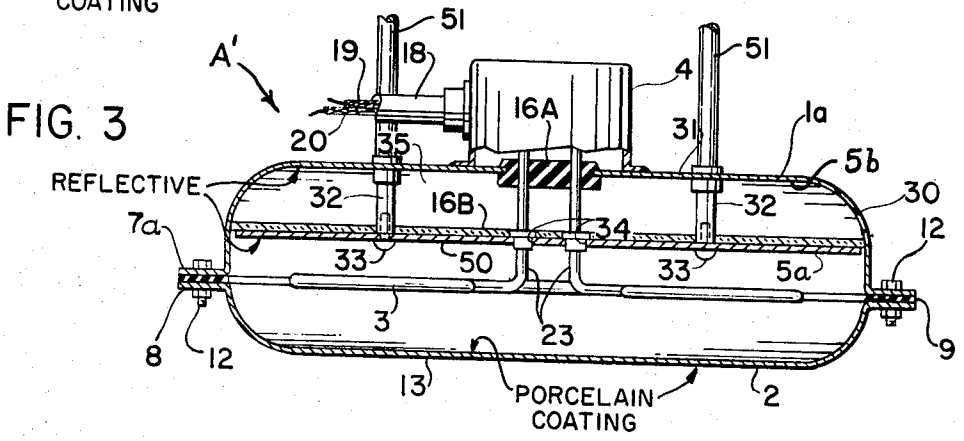


FIG. 3



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United States Patent Office 3,539,770 Patented Nov. 10, 1970

3,539,770

ELECTRIC INFRARED HEATER

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Filed Nov. 14, 1967, Ser. No. 682,883
Int. Cl. H05b 3/00
U.S. Cl. 219—345 3 Claims

ABSTRACT OF THE DISCLOSURE

An enclosed electric infrared heater having an electric resistance heating coil, a reflector positioned above the coil and a porcelain infrared emitted pan of large area below the coil. The emitter pan can be maintained at a temperature of 850° to 900° F. at which temperatures it has an emissivity of at least 0.86 and emits a major portion of its infrared radiation in the 3.0 to 5.0 micron wavelength band. For some reason the process of the invention increases radiation output by more than 10 percent as compared to the radiation output of conventional electric infrared heaters. The invention preferably includes a separate cover above the coil with the reflector mounted on said cover between the top of the coil and the bottom of the cover and spaced therefrom to provide an insulated air space.

DESCRIPTION OF THE INVENTION

The present invention relates to electric infrared heaters and more particularly to a novel type of electric heater which provides the highest percentage of its emissive output in the 3.0 to 5.0 micron wavelength band and which is much more efficient than previously known electric infrared heaters.

Electric heaters must be designed for high efficiency because of the high cost of electricity. Heretofere, conventional electric infrared heaters have relied upon high temperature emitters operating at temperatures above 1500° F. at which temperatures the highest percentage of infrared radiation is in the 2 to 3 micron wavelength band. I have discovered that the radiation output can be greatly increased, e.g., increased 10 to 15 percent, by use of a novel type of electric heater having a reflector above the heating coil and a low temperature infrared emitter of large area below the coil which emits most of the radiation in the 3.0 to 5.0 micron wavelength band.

The electric heater of the present invention employs a resistance heating coil which can be heated to a high temperature, a cover above the coil, an infrared emitter with a relatively large heating area, preferably 3 to 6 square feet, and a reflector either acting as a cover or carried by a cover and serving to reflect heat from the coil toward said emitter. The emitter has its surface portions formed of a material, such as dark porcelain, with an emissivity at 900° F. of at least 0.86 in the 3.0 to 5.0 micron wavelength band and is preferably heated to a temperature of around 800° to 950° F.

An object of the present invention is to improve the efficiency of electric infrared heaters.

Another object of the invention is to provide a simple, inexpensive, durable, compact, electric, infrared heater with maximum heat output and minimum operational cost.

A still further object of the invention is to provide a simple, inexpensive, electric heater suitable for heating a patio or an outside work area.

These and other objects, uses and advantages of the invention will become apparent from the following description and claims and from the drawings in which:

FIG. 1 is a top view on a reduced scale with parts broken away showing one embodiment of an electric infrared heater constructed according to the present invention;

FIG. 2 is a vertical section taken on the line 2–2 of FIG. 1 and on a larger scale; and

FIG. 3 is a vertical section similar to FIG. 2 showing a modified form of infrared heater constructed according to the invention.

Referring more particularly to the drawings, in which like parts are identified by the same numerals througout the several views, FIGS. 1 and 2 show one form of radiant heater A constructed according to the present invention having a bowl-like metal cover **1**, an infrared emitter pan **2**, a resistance heating coil **3**, a sealed junction box **4**, and a reflective surface **5** on the interior of the cover to reflect the heat to the emitter pan.

The cover **1** and the emitter pan **2** have marginal flanges **7** and **8** mounted on an anular asbestos gasket **9**. The circular holes **10** of the gasket **9** are aligned with the holes **11** of the annular flanges **7** and **8** to receive a series of bolts **12**, whereby the cover may be rigidly connected to the pan with the gasket sandwiched between the flanges.

As herein shown, the pan **2** has a flat horizontal bottom surface **13** and rounded sidewall portions **14**. The cover **1** is preferably similarly shaped and has a flat upper surface **15** parallel to the surface **13**. Insulating means are preferably provided between the reflective surface **5** and the junction box **4** to protect the wiring. As herein shown, a circular insulator **16** is mounted in the central circular hole of the cover coaxial with the annular marginal flange **17** of the junction box which is attached by the bolts **28** to the cover **1**. The electrical supply for the resistance element **3** extends through the electrical conduit **18** to the box **4** and includes a plurality of insulated wires, such as **19** and **20**, having connectors **21** and **22** connected to the vertical portions **23** of the coil **3**. The supply is usually 208 to 240 volts, alternating current.

As shown in the drawings, the heating coil **3** is in the form of a concentric resistance element having straight radial horizontal portions **24** extending outwardly from the unheated vertical portions **23** to the portions **25**, which form the interior circle of the coil. A pair of rounded end portions **26** connect the portions **25** to the circular outer portion **27** which forms the outer circle of the coil. Flat coils of this type are well known in the art. While the coil shown herein has only two concentric circles, it will be understood that a similar coil having 3 or more circles would also provide excellent results.

The upper and lower surfaces of the infrared emitter **2** must each have an area of at least one square foot and must be formed of a material which has an emissivity and absorptivity of at least 0.86 at 900° F. and which at that temperature will emit a major portion of its infrared radiation in the desired 3.0 to 5.0 micron wavelength band. Such material is preferably a glazed porcelain or the like with an emissivity and absorptivity of at least 0.9 at 900° F.

If desired, the sealed enclosure formed by the cover pan **1** and the emitter pan **2** may be partially evacuated and maintained at a subatmospheric pressure to minimize heat transfer by convection. Also the sealed enclosure may be filled with an inert gas, such as nitrogen or argon, or a gas with low heat conductivity.

A preferred form of infrared heater for carrying out the above process is shown in FIG. 3. This heater A' is almost the same as the heater A previously described, but the reflector cover is replaced by a deeper cover **1***a* having a reflector **50** mounted thereon as a separate element. The cover **1***a* is an inverted pan with a shape similar to that of the emitter pan **2**. The sidewalls **30** of the cover **1***a* are generally similar to the sidewalls of the cover **1** and have an annular flange **7***a* similar to the flange

7, but they can have a greater axial height to accommodate the reflector **50** and to provide an insulating air space between the reflector **50** and the cover **1***a*.

Like the cover **1**, the cover **1***a* has a flat top wall **31** which may be suspended by pipe hangers **51** or the like from a ceiling or overhead support. As herein shown, these hangers are extended to provide vertical supporting portions **32**.

The reflector **50** is rigidly mounted on the cover **1** or the pan **2** in any suitable manner. When the flange **7***a* is vertically spaced from the margin of the reflector, it is preferable to support the reflector from the cover. As herein shown, such support is provided by the portions **32** which are internally threaded to receive the attaching screws **33**. These hold the circular reflector coaxial with the pan **2** and the coil **3** and parallel to the coil and the flat walls **13** and **31**. The margin of the reflector is preferably located at the marginal wall or the marginal flange of the heater to provide a closed air space above the reflector.

The reflector **50** has a reflective surface **5***a* similar to the surface **5** and is spaced at least one inch from the top wall **31** to provide an insulating air space **35** above the reflector and to reduce the temperature of the cover. The reflector is covered by a layer **16B** of a suitable heat insulating material such as fiber glass wool or "Pyrowool." The thickness of the insulating layers is preferably at least one-half inch or so. The unheated vertical portions **23** of the coil extend through the insulator **16A** and are rigidly connected to and supported on the reflector **50** by insulated connectors **34**.

The construction and location of the infrared emitter pan **2** are critical in the practice of this invention. The bottom surface of the emitter **2** should be heated to a temperature of 700° F. to 1000° F. when the heating coil **3** is maintained at a temperature of 1400° F. to 1600° F. Best results are obtained when the bottom surface of the emitter is at a temperature of 800° F. to 950° F. The upper surface of the emitter pan is heated by radiation and preferably has an absorptivity of at least about 0.9 at 900° F. The lower surface of said pan must have an emissivity (i.e., total hemispherical emissivity) of at least 0.86 at 900° F. and preferably has an emissivity of at least about 0.9 at 900° F. Such lower surface must emit a major portion of its infrared radiation in the 3.0 to 5.0 micron wavelength band and is preferably formed of a non-metallic heat resistant material with a high emissivity such as a porcelain or the like. The preferred emitter pan comprises a sheet metal, such as aluminum, steel, etc., with a thickness of one-eighth inch or less coated on both sides with a dark colored porcelain having a high emissivity.

The emitter pan **2** must have a bottom surface with a relatively large surface area of at least one square foot and preferably has a surface area of 3 to 6 square feet. The bottom wall of the emitter pan may be hemispherical but is preferably generally flat for use with a flat heating coil. Such pan usually has a depth of 1 inch to 3 inches and a width or diameter of 15 to 40 inches, preferably 24 to 32 inches. Although the pan **2** usually has a flat bottom surface **13** and rounded sidewall portions **14**, as illustrated, the pan design can be varied by the introduction of decorative patterns. The configuration can also be varied to approximate more closely the shape of a saucer, bowl or even a hemisphere or, alternatively, can include some inverted curves so long as the pan configuration does not interfere with its installation. Similar changes in the design and configuration of the cover **1** are possible, especially when a separate reflector **50** is employed.

The cover **1***a* is preferably shaped like the pan **2** and usually has a height of 1 inch to 5 inches. It is usually formed of sheet metal, such as aluminum or steel, and may be painted or plated. The cover preferably has thin walls with a thickness less than ⅛ inch and preferably is rather light in weight. The cover fits on the emitter pan

to provide a sealed container or enclosure with a height of 3 to 8 inches. Such container preferably has a width or diameter 3 to 8 times such height.

In order to reduce heat loss through the cover, it is desirable to minimize its temperature as by employing inslating means such as **16B** or an air space between the reflector **50** and the cover. The heat transfer to the cover can also be reduced by providing it with an inner surface of low absorptivity or by providing it with a polished or reflective surface. As herein shown, the cover **1***a* has a reflective surface **5***b* similar to the surface **5**. Such reflective surface preferably has an area of 3 to 6 square feet and may have various shapes but is preferably generally flat.

The reflector **50** may have a small curvature but is preferably generally flat or generally parallel to the coil **3**. Its peripheral edges are located radially outward of the margin of the coil and within one-quarter inch of the marginal wall **30** of the cover or the marginal flange **8** of the emitter pan. The bottom reflective surface **5***a* of the reflector **50** preferably has a mirror-like finish and may be chrome plated or highly polished. The characteristics of the upper surface of the reflector **50** are not critical. The reflector may be made of a thin sheet metal or foil and may be made of aluminum or various other metals.

The reflector **50** is preferably spaced 2 to 4 inches from the top wall **31** of the cover to provide at least one insulating air space above the reflector to minimize the heat transfer to the cover. Of course, such heat transfer can be further reduced by partitioning the air space with aluminum foil or additional reflectors similar to the reflector **50**, but this is not essential. If desired, the sealed enclosure formed by the cover pan **1** and the emitter pan **2** may be partially evacuated or filled with an inert gas or a gas with a low heat conductivity as previously stated.

In the heater of this invention the heating coil is preferably the sole source of heat nad may be of conventional construction so as to emit the major portion of the infrared radiation in the 2 to 3 micron wavelength band. The electrical apparatus should be capable of heating the coil to a temperature of 1400° F. to 1650° F. or a temperature sufficient to provide the desired emitter temperature at the bottom surface **13**. The coil temperature should be maintained at 1400° to 1600° F. to provide the surface **13** with a temperature of about 800° F. to about 950° F.

The shape of the heating coil **3** may vary considerably but such coil is preferably generally parallel to the bottom wall of the infrared emitter **2**. The coil and said bottom wall are preferably generally flat. The width or diameter of the coil is generally in the range of 1 to 3 feet and is usually 2 to 4 inches less than the internal dimension or diameter of the flange **8** so that the periphery of the coil is disposed 1 inch to 2 inches from the margin of the emitter **2**. Such coil diameter or width is preferably 20 to 30 inches in most commercial heaters made according to this invention. The thickness of the individual turns of the heating coil may vary but is usually around 0.3 to 0.6 inch.

In an electric heater of the type shown in FIG. 3 the coil **3** is spaced about 1 inch to about 1½ inches from the reflector **50** and about 1 inch to about 1½ inches from the bottom wall of the emitter **2**. The bottom surface **13** is preferably maintained at a temperature of about 850° F. to about 900° F. For example, in a typical commercial electric heater the cover **1***a* may have a diameter of 31 inches and a height of 4 inches, the emitter pan **2** may have a diameter of 31 inches and a height of 2 inches, the coil **3** may have a diameter of 28 inches and a thickness of one-half inch, the insulating layer **16B** may have a thickness of one-half inch, and the reflector **50** may have a diameter of 29 inches. In such heater the upper surface of the coil **3** may be spaced a distance of about 1¼ inches from the reflector **50** and

its lower surface may be spaced the same distance from the bottom wall of the emitter pan 2 so that the lower surface of the pan is heated to a temperature of about 900° F. The upper surface of he pan would, of course, be at a substantially higher temperature. In such a heater the sheet metal pan 2 is preferably coated on both sides with a commercial glazed porcelain of dark color and high emissivity such as conventional A–19 porcelain. The exterior surface of the cover 1 may also be coated with porcelain or other heat resistant or corrosion resistant material, but this is not essential.

A typical heater made according to this invention having a rating of 6000 watts and a bottom surface temperature of 900° F. and suspended 8 to 16 feet above the surfaces to be heated can distribute the infrared energy to the solid objects below over a large area (i.e., up to a diameter of around 18 feet).

While the coil, pan and reflector, either with or without a separate cover, are designed in a planar circular form as depicted herein, the entire configuration of the heater can be changed with some resultant variation in the efficiency of the system. For example, the plan as shown in FIG. 1 can be changed to an oval, elliptical, square, rectangular, rhomboid, triangular or other shape. Similarly, the vertical section can be changed to assume a circular, rectilinear or other shape.

It will be understood that, in accordance with the provisions of the patent laws, variations and modifications of the specific methods and devices disclosed herein may be made without departing from the spirit of the invention.

Having described my invention, I claim:

1. An electric infrared space heater of exceptionally high efficiency comprising a substantially planar wide resistance heating coil, an infrared emitter below said coil comprising a round metal pan having a marginal portion radially outward of the periphery of said coil, said coil being spaced about one inch to about one and one half inches from the bottom of said emitter pan, said emitter pan having upper and lower surfaces covered with a porcelain having an emissivity of at least about 0.9 at 900° F., a cover above said coil and said pan comprising a round inverted pan having a marginal portion rigidly secured to the marginal portion of said emitter pan, said emitter pan and said cover providing a closed sealed oblate receptacle with a diameter of 1 to 3 feet, said heating coil being supported by said cover in a horizontal position generally parallel to the bottom of the emitter pan and having a diameter of at least one foot so that the periphery is closely spaced from the marginal portions of said pans, reflector means carried by said cover above and spaced from said heating coil for reflecting heat from the coil downwardly toward said emitter, said reflector means extending radially outward beyond the periphery of said coil, means for supplying an electric current to said heating coil for maintaining said coil at a temperature of at least 1400° F. and sufficient to heat the lower surface of said emitter pan to a temperature of 800° F. to 950° F., said lower surface having an area of at least 3 square feet and emitting the major portion of the radiation therefrom in the 3.0 to 5.0 micron wavelength band.

2. A high output infrared heater as defined in claim 1 wherein said sealed receptacle has a diameter of about 24 to about 32 inches and a height of about 3 to 8 inches and wherein said coil is circular and has a diameter of about 20 to 30 inches.

3. A high output electric infrared heater as defined in claim 1 wherein the marginal portion of said emitter pan comprises a radial marginal flange, said pan having a bottom surface with an area of about 3 to 6 square feet, the marginal portion of said cover comprises a radial marginal flange mounted on the flange of said emitter pan, the outer portions of the heating coil are spaced about one inch to about two inches radially inward from the marginal flanges, and said reflector means is mounted on said cover about one inch to about one and one half inches above the heating coil, said reflector means being spaced at least about two inches from the top wall of the cover to provide at least one insulating air space above the reflector means.

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ANTHONY BARTIS, Primary Examiner

U.S. Cl. X.R.

219—342, 347, 354, 461, 534, 553