Dec. 14, 1965 R. A. WELCH, SR 3,223,827

ELECTRIC CONVECTION HEATER

Filed Aug. 1, 1962 2 Sheets-Sheet 1

FIG. 1

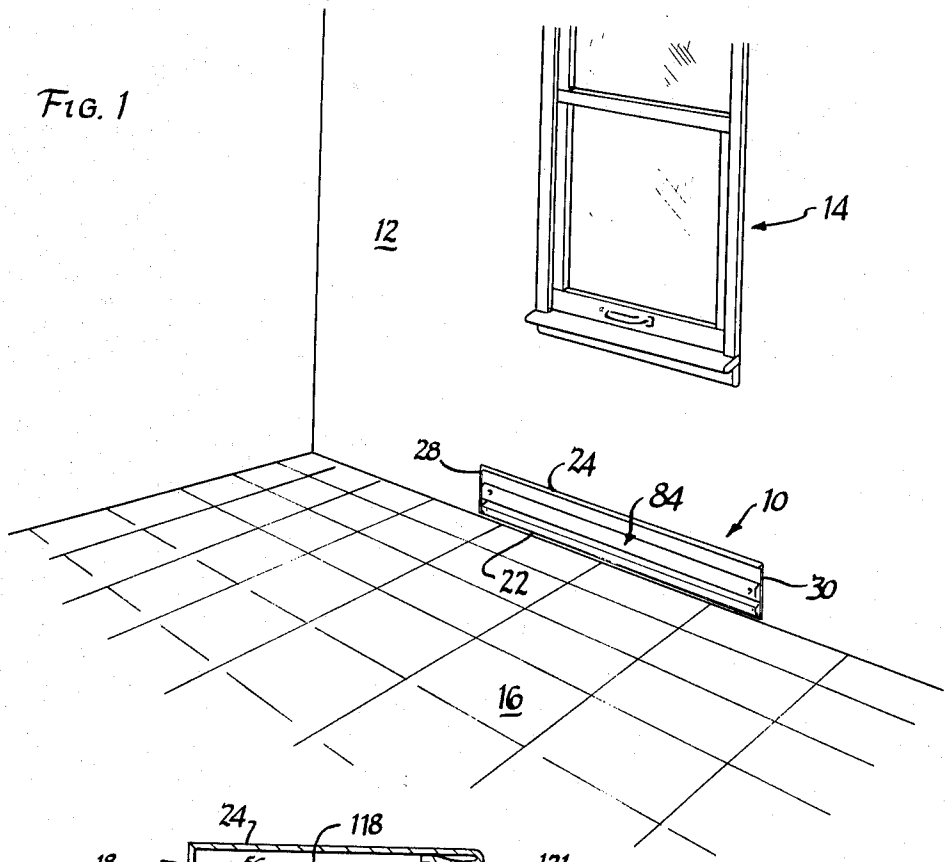
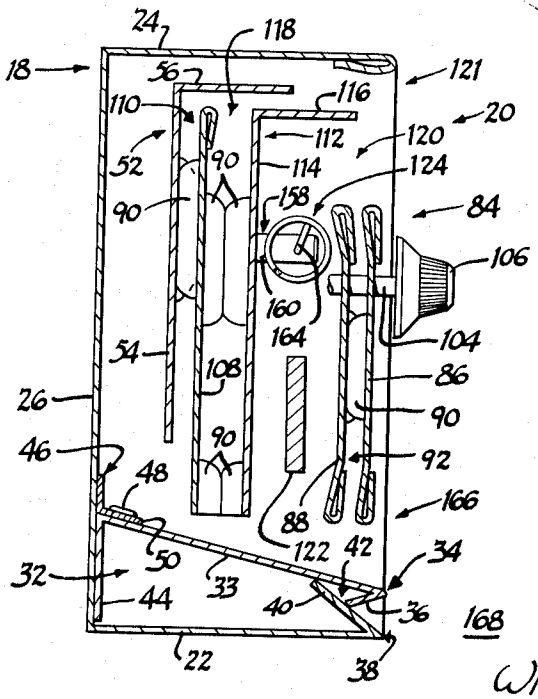


FIG. 3



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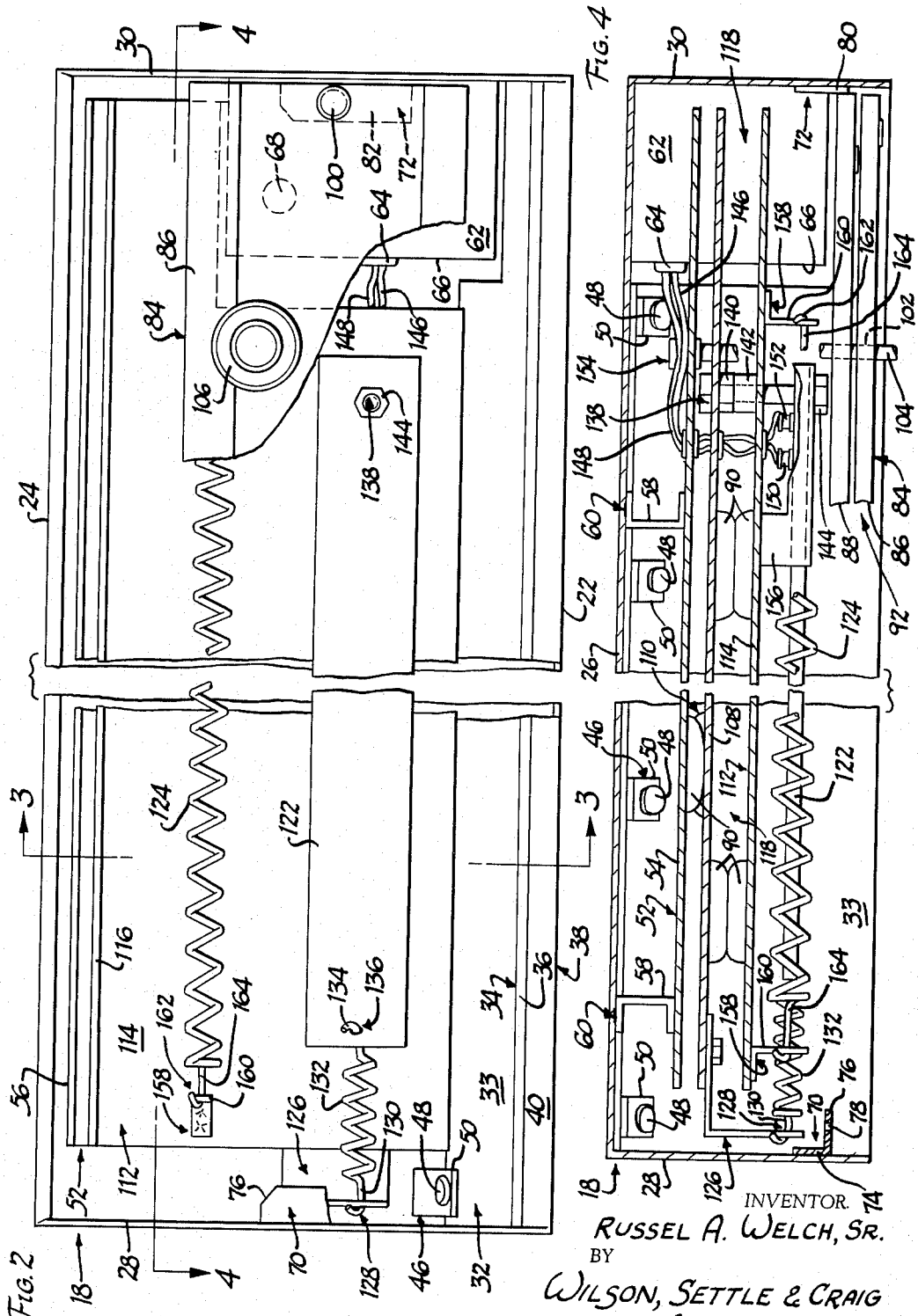


FIG. 2

FIG. 4

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ELECTRIC CONVECTION HEATER

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7 Claims. (Cl. 219—365)

This invention relates to space heaters, and more particularly to heaters of the convection type utilizing in combination a radiation-producing element and a cooperating thermal-equalizer element whereby radiant energy produced by the heating element is absorbed and evenly distributed to produce a uniform curtain of heated air.

THE PROBLEM

Heretofore, space heaters of the convection type, such as wall heaters powered by elongated electrical resistance heating elements, have been characterized by the fact that they produce streaks on the wall above the element. This is brought about by the fact that the heating element produces hot spots along its length. Naturally, the hot spots produce a greater flow of heated air than the adjacent cooler regions of the element, and the result is the undesirable streaking effect so well known.

This streaking is unsightly to home furnishings, walls, etc., and requires early redecoration. Also, the hot spots cause blistering of paint finishes on the housing of the heater itself, and this is an unsightly condition after a short period of operation.

In view of the foregoing, a susbtantial advance in the art would be provided by an electrical powered convection heater capable of producing a uniform curtain of heated air to minimize the above-mentioned streaking.

OBJECTS

An object is to provide a novel space heater of the electrically actuated convection type wherein an elongated, electrically actuated heating element is provided in cooperation with an adjacent thermal equalizer to produce a uniform, non-streaking curtain of heated air.

A further object is to provide a method for heating air wherein radiant energy is converted substantially completely into convection heat utilizing a novel absorbing housing in combination with a thermal equalizer for high efficiency.

A further object is to provide a novel electrically actuated space heater of the convection type capable of economically competitive production, but at the same time providing uniform heat flow and minimization of wall streaks, along with high efficiency.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

FIGURE 1 is a perspective view of the heater of the present invention mounted in a support wall of a domestic dwelling beneath a window, for the purpose of offsetting heat loss through the window;

FIGURE 2 is a front view, with parts broken away, of the heater of the present invention;

FIGURE 3 is an end elevational view in section taken along the line 3—3 of FIGURE 2; and

FIGURE 4 is a plan view in section taken along the line 4—4 of FIGURE 2.

Before explaining the present invention in detail it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since

the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

PERSPECTIVE VIEW

Briefly the present invention relates to a method and apparatus for producing convection heat from an elongated radiant heating element and an adjacent thermal equalizer or uniformizer to even out the hot spots of the heating element and thereby produce a uniform curtain of heated air free of streak producing hot columns of air.

In combination with the heating element and uniformizer or thermal equalizer, a novel convection housing is employed, containing a subjacent guard to protect a rug, floor or the like against radiant heat damage.

It is an important aspect of the present invention that through the design of the convection housing, substantially all radiation losses to the outdoor atmosphere, as through openings such as windows and doors in buldings, are eliminated. Thus the efficiency of the unit in terms of conversion of electrical energy into actual convection heat energy is improved. Thus, in accordance with the present invention, radiant energy is entirely converted into convection heat as a uniform curtain for improved efficiency, and smoother, more uniform curtain heat output to avoid wall streaking, to provide an advance in the art.

It is a further important aspect of the invention that because of the simplicity of parts, it is capable of economic production as a competitive unit for wide market distribution and the furtherance of electrical heating.

THE ENVIRONMENT

As shown in FIGURE 1, the heater **10** of the present invention is shown in one typical surrounding in which it is adapted to be utilized for heating space, as in a home. Thus, the heater **10** is suitably installed into a wall **12** beneath a window **14** to counteract heat losses through the window. It will be noted that the heater **10** is suitably positioned at baseboard level, just above the floor **16** to pick up cold air from the floor.

THE INVENTION

The housing

FIGURES 2–4 illustrate the heater of invention in its entirety as including a housing **18**, suitably made of sheet metal such as steel or aluminum, and of generally rectangular cross-section, as shown in FIGURE 3, with an open front **20** and with bottom, top and rear walls **22**, **24** and **26**. The ends of the unit are closed at **28** and **30**, see FIGURE 2.

As shown in FIGURE 3, an inlet air directing baffle is designated generally by the reference numeral **32**, and has a top **33** which extends forwardly and slopes downwardly from the rear wall **26**. It will be noted that the front end of the baffle **32** terminates in a reverse bend at **34**, providing an underlying lip **36** spaced the thickness of a rug above the bottom wall **22**. It will also be noted that the front end of the bottom wall **22** terminates in a reverse bend at **38**, forming an upwardly and rearwardly extending lip **40**. It will be noted that the underlying lip **36** engages a medial portion of the upturned lip **40** to form an air space **42** which serves as an insulating medium, preventing excess heat from being transferred by conduction to a rug or other combustible material placed in contact with the front portions **34**, **36**, **38**, **40**. It will be evident that the heating element, to be subsequently described, positioned above the baffle **32** will radiate to the baffle and that the baffle will absorb heat,

transmitting or conducting it downwardly to the reverse bend 34.

It will be noted that the air-directing baffle 32 includes a back wall 44, of vertical disposition. This provides very convenient assembly of the baffle 32 to the bottom of the housing by mere insertion of the baffle 32, the wall 44 providing elevation at the rear. Securement is provided by means of a generally L-shaped strap 46 having a self tapping screw 48 passed through the lower leg 50 thereof and into the back edge of the top 33. Thus, the air-directing baffle 32 is retained in appropriate assembled relationship to the bottom 22 and back 26 of the housing 18.

At the top of the unit and adjacent the rear wall 26 and top wall 24, there is provided a spaced L-shaped baffle 52 having its vertical leg 54 extending in spaced parallel relation to the back wall 26 and its upper horizontal leg 56 extending in spaced parallel relationship to the top wall 24. The L-shaped baffle 52 is attached in the housing 18 by means of U tabs 58 spot-welded to wall 26 as at 60.

As shown in FIGURES 2 and 4, the right end of the housing carries the terminal box 62, having a grommeted opening 64 in the left wall 66 thereof. The rear wall 26 of the housing 18, as best shown in FIGURE 2, is provided with an access opening 68 whereby electric wires, not shown, can be passed into the interior of the terminal box 62. Electrical connection is described in detail later herein.

As best shown in FIGURES 2 and 4, each end of the housing 18 is provided with an attachment clip or bracket 70, 72. The left-hand attachment clip 70 has a leg 74 secured to the left end wall 28 of housing 18, as by spot welding, and a leg 76 parallel to the open front 20 and having a fastening aperture 78 therein.

The right-hand clip or bracket 72 also comprises a leg 80, FIGURE 4, fastened to the right-hand end wall 30 of housing 18, as by spot welding, and a leg 82, FIGURE 2, extending parallel to the front opening 20 with a fastening aperture (hidden) therein.

As best shown in FIGURES 1, 2 and 3, a front cover plate 84 extends the length of the open front 20 and is of generally flat configuration with double walls 86 and 88. The walls 86 and 88 are provided with dimples 90 whereby they are connected to one another as by spot welding in spaced array to provide a gap 92 therebetween. The double walled structure 84 provides a cooler exposed wall 86 by the insulating layer of air therebetween, in the gap 92. Note that the upper and lower edges of walls 86 and 88 are bent over forwardly to be hidden from the radiant heater to avoid heat traps and metal distortion. Also, sharp edges are concealed by this type of construction.

At each end, the front cover plate 84 is provided medially with a securement opening, through which is passed a fastener having a head as at 100, see FIGURE 2. One opening is aligned with the aperture 78 of leg 76 of left-hand clip 70 and the other is aligned with the opening of the leg 82 of the right-hand attachment clip 72 and the snap fasteners 100 are inserted to hold the cover 84 in place. This construction provides easy and quick assembly or removal of the front cover plate 84 in the event service or adjustment is required for the unit.

As shown in FIGURE 4, an access aperture 102 is provided in the front cover plate 84, through which a thermostat control rod 104 is passed, after which the control knob 106 is applied to complete the assembly. Of course, when removing the front cover 84, the control knob 106 is first removed and then the front cover is snapped off.

The secondary rear baffle arrangement

As best shown in FIGURE 3, a secondary rear baffle 108 is connected to the vertical leg 54 of the rear L-shaped baffle 52 by spot welding as at the dimples 90. This provides a small space 110 between the secondary rear baffle 108 and the leg 54 of baffle 52, to reduce heat transfer for the unit rearwardly.

A tertiary rear baffle 112 of L-shaped configuration comprises a vertical leg 114 and a top horizontal leg 116. The vertical leg is also provided with dimples 90, it being noted that the dimples face toward similar dimples of secondary rear baffle 108 to give a double spacing 118 as compared to the single space air gap 110 between walls 54 and 108.

It will be noted that tertiary rear baffle 112 is separated from front cover plate 84 by a substantial space 120, of sufficient width to accommodate an elongated strip-type heating element 122 and the thermal-equalizer 124, both to be subsequently described.

Mounting of the strip heater 122 and thermal equalizer 124

As best shown in FIGURES 3 and 4, the vertical leg 114 of the tertiary rear baffle 112 provides the point of mounting of the strip heating element 122 and thermal-equalizer 124.

By reference to FIGURE 4, it will be noted that an L-shaped bracket 126 is provided at the left end of the vertical leg 114 of the teriary rear baffle 112, secured as by spot welding. An aperture 128 is provided to receive a hook end 130 of a support spring 132, having a second hook end 134 inserted through an opening indicated at 136 in the left end of strip heater 122.

As best shown in FIGURES 2 and 4, at the right end of the heater 122, a bolt 138 is provided that is locked at its head end by a lock nut 140, the bolt being inserted through a suitable aperture in the right-hand end of the vertical leg 114 of the tertiary rear baffle 112. A sleeve spacer 142 is next positioned on the bolt 138 and the electric strip heater 122 positioned thereon by means of a suitable aperture formed in the "dead" end of the heater and a second lock bolt 144 is applied to secure the assembly. By this arrangement, the heater 122 is positioned centrally of the space 120, FIGURE 3, between the vertical leg 114 of the tertiary rear baffle 112 and the rear wall 88 of the front cover plate 84. Suspension at the left end by means of the spring 132 accommodates contraction and expansion of the heater 122 during its heating and cooling cycles, in a manner to obviate any screeching or hissing noises that might otherwise develop.

The electrical wiring

As will be noted in FIGURE 4, two electric lead wires 146 and 148 lead from the terminal box 62 through grommeted opening 64 to insulated terminals 150 and 152 formed on the heater 122. A thermostat assembly 154 is connected into the lead line 146 and includes the control rod 104, previously mentioned, which passes through the access apertures 102 in the walls 86 and 88 of the front cover plate 84, and the control knob 106 is applied for controlling the heating unit 122.

Also, as shown in FIGURE 4, a shield 156 of generally L-shaped section is fitted over bolt 138 by a suitable aperture, being retained by the nut 144 to lie in protecting, spaced relation over the right hand end of heater 122. This provides a protective guard around terminals 150 and 152.

The thermal equalizer

As best shown in FIGURES 2, 3 and 4, the thermal equalizer 124 comprises an elongated coil that is stretched in parallel alignment above the heating element 122.

By reference to FIGURES 2 and 3, it will be noted that a bracket 158 is connected at each end of tertiary rear baffle 112 and having a forward leg 160 with an aperture 162. The hook ends 164 of the thermal equalizer are inserted into the aperture 162 for positioning and support.

Operation of the invention

From the foregoing description, it will be observed that the thermostatically controlled electric heater **122** is of elongated configuration, lying centrally in the space **120** between the front cover plate **84** and the rear baffle assembly **52, 108, 112.**

When electricity is introduced into the heater **122** it becomes radiantly hot, thus heating the surrounding air by thermal contact; and the heated air moves upwardly and out of the unit through the upper outlet, designated **121**, passing over the thermal-equalizer **124**, which provides distribution. Simultaneously, cooler air is drawn from the floor area **16** of the dwelling into the lower air inlet **164**, being directed upwardly into the unit by the inlet air-directing baffle **32**. Thus, the electric heater of the invention instantly becomes a convection unit for providing immediate comfort.

As the electric heater **122** continues to operate, a secondary action takes place. Thus, the heater radiates upwardly to the thermal-equalizer coil **124** as well as to the walls **88, 114, 116** and to the air-directing baffle **32, 33.** The thermal-equalizer absorbs this radiation heat uniformly along its length, and any hot spots developed along the length of the strip heater **122** are thereby leveled out by subsequent heat transfer to the air flowing upwardly through the passage **120.** This prevents the wall streaking that has heretofore characterized units of the prior art.

It will be noted that the strip heater **122** emits radiant heat energy toward the air pocket **42** provided by the lips **36, 40.** As previously mentioned, this air pocket **42** is a substantial insulating medium, effective to prevent excessive heat from being transferred down to the lip **40** and thus is isolated or insulated from a rug or other floor covering, indicated by the reference numeral **168.** Thus, a novel safety feature is provided in accordance with the present invention.

Complete convection

As shown in FIGURE 3 it will be understood that substantially all of the radiation produced by the heater **122** is absorbed by the front cover plate **84**, the wall **114**, the thermal-equalizer **124**, and the air-directing baffle **32, 33.** When the surfaces of these elements are dulled to prevent reflectivity, radiation losses are practically nil and all radiant energy produced by the unit **122** is converted into convection energy for highest efficiency. Thus no radiation losses through windows is encountered.

Thus, air flowing into the lower air inlet **162** passes upwardly around all surfaces of the heater **122**, the rear surface on front wall elements **88**, all surfaces of the rear baffles **52, 108** and **112**, providing thorough and complete convection flow produced from the radiation of the heater **122.**

It will be noted that the housing **18** is designed to provide air flow so calibrated as to control the continuous operating temperature of the heating element **122** for long and trouble-free operation. Also, the location of the heating element **122** in relation to the air flow has been so provided to properly control air flow in relation to current density utilized in the heating unit.

It is rather important that the thermal equalizer **124** be of a rather specific configuration and it has been found that a coil made of .065 inch diameter wire having eight turns per inch provides a particularly effective thermal equalizer. However, certain variations in the configuration of the thermal equalizer can be tolerated within the scope of the invention and it has been found that round wire and a ribbon-type wire can be used in forming this unit. From about ten to about three turns per inch can be tolerated in the equalizer to prevent the streaking heretofore encountered by the prior art.

The distance of the thermal equalizer above the heating element **122** is preferably maintained within the limits to produce best equalizing action. If too high, a portion of the rays is lost. If too low, the thermal equalizer may get too hot and tend to deflect. It has been found that when spaced in the range from about three-quarters of an inch to about one and three-quarters inch above the strip heater **122**, the equalizer provides very excellent operation.

While an electric strip heater **122** has been described in connection with the foregoing embodiment of the invention, it is to be understood that substantially any radiant of the strip type can be utilized. Thus, within the broad scope of the invention, a gas fired radiant or equivalent can be considered for use. This would include radiating quartz tube-type heaters also.

While the convection electric heater of the present invention has been described for use in a wallboard-type application, it is to be understood that the broad scope of invention would include such a unit or plurality of units in the same type of array in a domestic heating furnace or the like.

While the foregoing description has related to the use of the thermal equalizer coil being positioned above the strip heater, it is to be considered within the broad scope of invention to place it in the same relative position below the heater **122.** When so operating the equalizer thereby provides a readily accessible dust collector which can be cleaned by a mere rapping of the unit to dislodge the dust downwardly therefrom by gravity when the heater is not operating. Also, the thermal equalizer can be placed horizontally alongside the radiant. When so operating, it will, of course, be understood that the central passage **120** will be of suitable dimension to accommodate the arrangement of parts.

While the dimensions of the various spaces between the baffles of the invention are not to be considered limiting, it is advisable to keep all passages large enough for free air flow. It is also desirable to keep all return bends of the housing hidden from the radiant heater to avoid heat traps and metal distortion.

Materials of construction are preferably the heat absorbent metals, particularly in the radiant area. Steel and aluminum are typical of those which can be used.

In some units, longer than about 48 inches, it may be desirable to provide a central, third support **160, 162, 164** for the thermal equalizer coil **124**, intermediate the ends.

Also, within the broad scope of invention, the thermal equalizer coil would include a coiled tube filled with a heat-absorbent material of either the solid or liquid type.

In some instances it might be desirable to extend the length of the housing **18** and provide a humidifier therein, by connection with a suitable water supply, to raise the moisture content of the air as it flows through the unit.

Advantages of the present invention

In view of the shielding of the front cover, the front cover does not become hot and therefore danger of burning, as of children's hands, is avoided.

A further advantage of the present invention is that the thermal equalizer **124**, being positioned above the heating element **122**, acts as a decorative guard, effective to prevent entrance of children's hands that might come into contact with the high temperature heating element **122.** Of course, when used below the element, the thermal equalizer **124** will function in the same manner. In the foregoing disclosure, the broad scope of the invention contemplates placing a thermal equalizer above or below or both with respect to the heating element **122.** By operating with thermal equalizers, both above and below the element, complete guarding of the element is provided. When so operating, the further functional effect of the dust collector at the bottom and the decorative guard at the top will greatly enhance the aesthetic and practical aspects of the present invention.

I claim:

1. In a space heater of the convection flow type,

an elongated electric heating element,
a housing defining a passage at least partially surrounding said heating element to provide a convection flow of gas around said element,
an elongated coil-like body of radiant heat-absorbing material having angular spaced apart heat diffusing convolutions and positioned in generally parallel relation above said element and within said passage,
and said body being positioned in adjacent heat-absorbing spaced relation to said heating element to absorb heat of varying intensity from along the length of said element and diffuse the heat in all directions including between and above said diffusing convolutions and form the same into a uniform curtain equivalent to the effective length of said element for exchange back to the ambient atmosphere.

2. In a space heater of the convection flow type,
an elongated electric heating element of the radiant type extending generally horizontally,
an elongated coil-like thermal-equalizer positioned in parallel relation above said element and in radiant energy receiving adjacency thereto,
a rear baffle formed of spaced substantially parallel panels positioned in radiant energy receiving relation to said element,
means mounting said element and thermal-equalizer to said rear baffle,
a housing surrounding said element-coil rear baffle assembly,
said housing having a back wall, top, bottom and open front,
said rear baffle having a portion extending forwardly beneath said housing top,
means mounting said rear baffle to said housing to

support said element and said coil in spaced relation to said back wall, top and bottom,
and a front cover plate partially closing said open front to provide a lower cold air inlet and an upper heated air outlet.

3. A space heater as claimed in claim **2** and further characterized in that said housing is of generally rectangular section.

4. A space heater as claimed in claim **2** and further characterized in that said rear baffle comprises three separate panels.

5. a space heater as claimed in claim **2** and further characterized in that said elongated coil-like thermal-equalizer comprises about 3 to 10 turns per inch, each turn having a diameter of about ¾ of an inch.

6. A space heater as claimed in claim **2** and further characterized in that said front cover plate comprises at least two spaced apart panels.

7. A space heater as defined in claim **1** and further characterized in that said elongated coil-like body comprises an elongated tubular coil, said tubular coil being filled with heat-absorbing liquid.

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