April 12, 1966 J. J. FANNON, JR., ET AL 3,246,121

SPACE HEATER

Filed Dec. 29, 1961

4 Sheets-Sheet 1

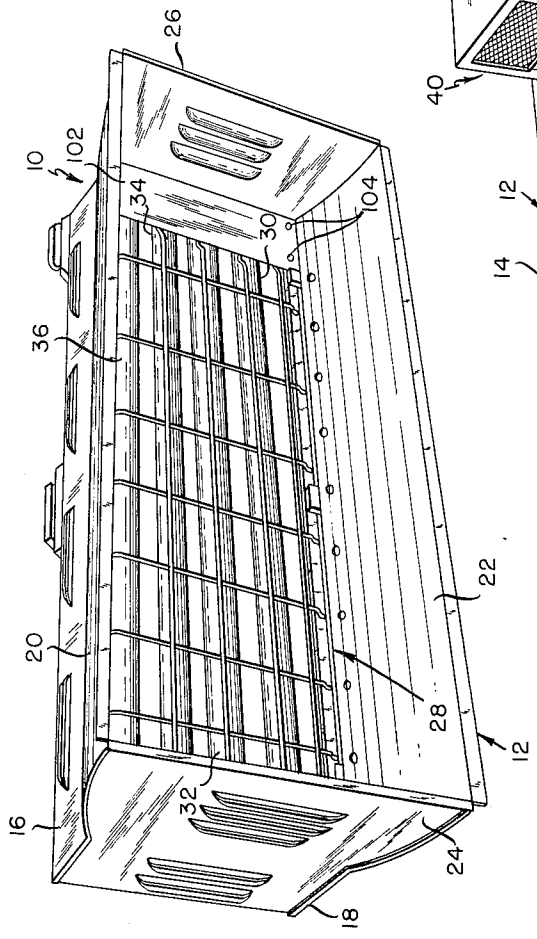


Fig. 1

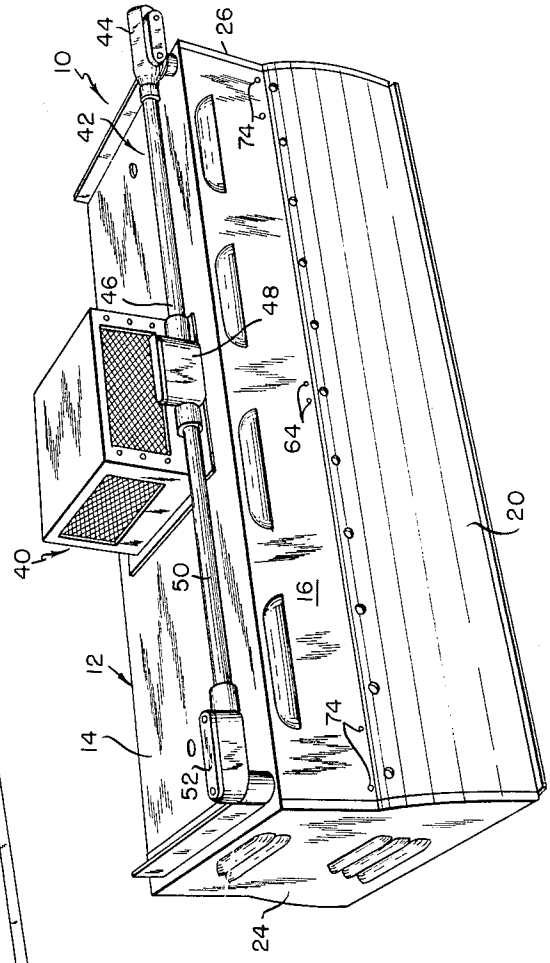


Fig. 2

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SPACE HEATER

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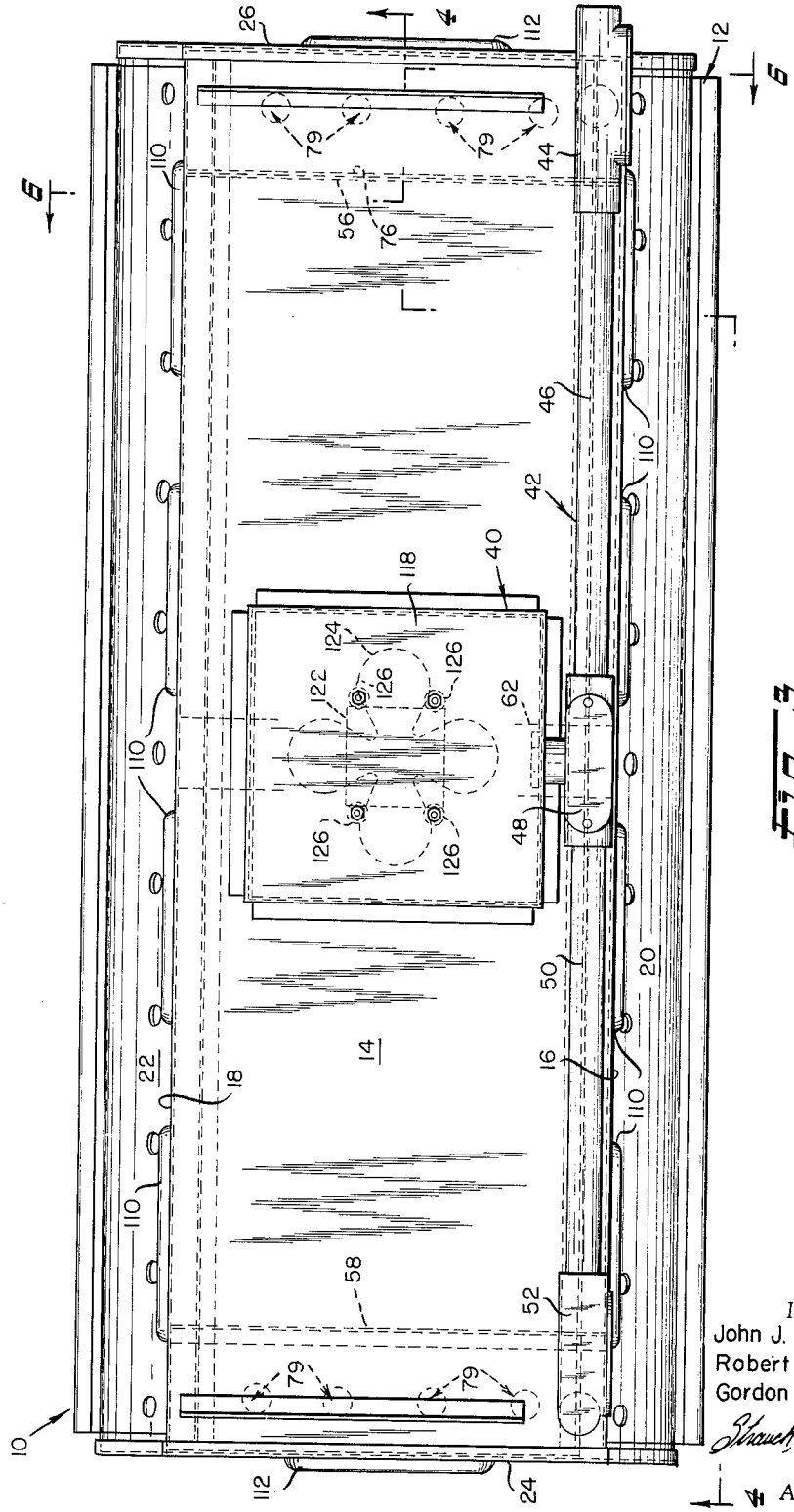


Fig. 3

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SPACE HEATER

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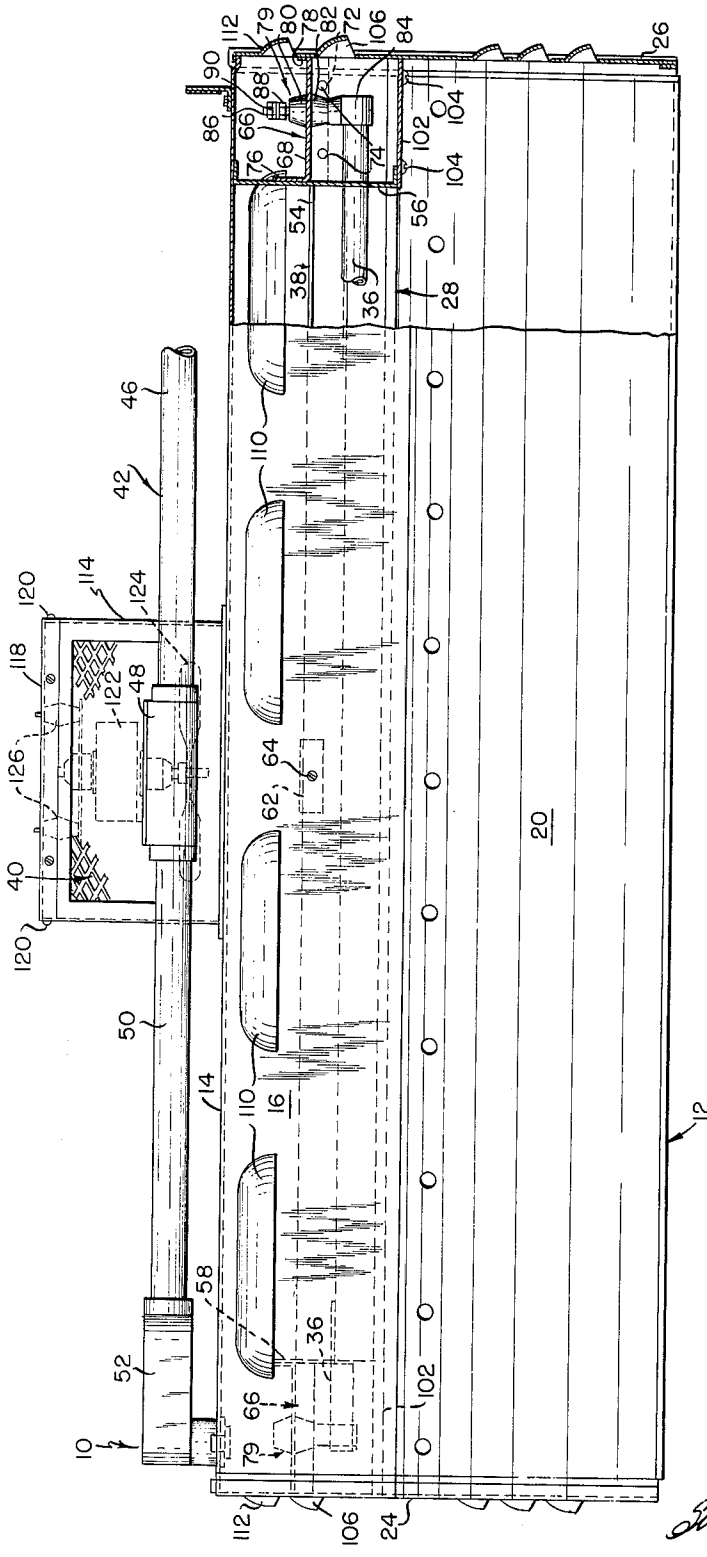


Fig. 4

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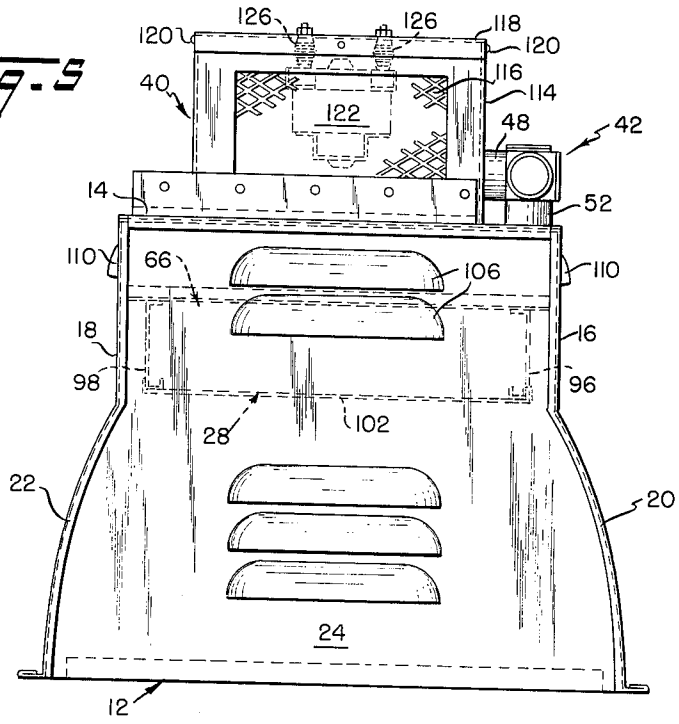
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SPACE HEATER

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Fig. 5



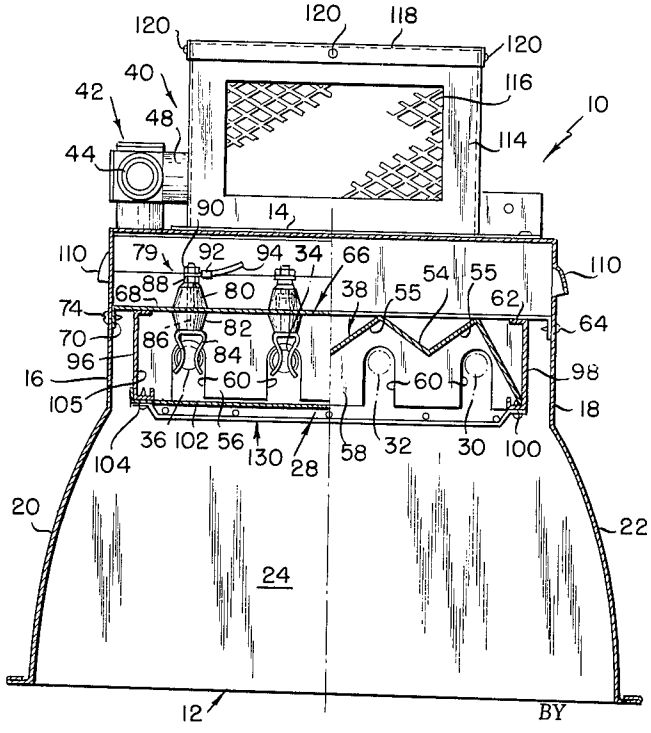


Fig. 6

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United States Patent Office 3,246,121 Patented Apr. 12, 1966

3,246,121

SPACE HEATER

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Filed Dec. 29, 1961, Ser. No. 163,256
11 Claims. (Cl. 219—347)

The present invention relates to space heaters and more particularly to improvements in the construction of the housing, reflector, radiant support and cooling structures for electrically powered radiant space heaters.

The principal object of the present invention is to provide an imporved infra-red electric space heater in which the radiant support structure and the adjacent portion of the reflector form a sub-assembly which, as such, can be installed in operative relation within a trough-shaped housing the terminal portions of the side walls of which form the remainder of the reflector.

A further object of the present invention is to provide a space heater of the type described above in which the sub-assembly embodies a plurality of parallel radiants in the form of quartz-type tubular infra-red generating electrically powered heating elements.

A further object of the present invention is to provide an electrically powered space heater of the type described embodying an air circulation arrangement in which air is circulated between the housing and the adjacent face of the sub-assembly to prevent over-heating of the reflector of the sub-assembly and the housing.

A still further object of this invention is to provide a space heater of the type described above in which circulation of cooling air is provided between the radiant supporting sub-assembly and the housing by an electric motor powered blower which is resiliently suspended upon the housing to isolate blower operation produced vibrations from the radiants and thereby prevent destructive high temperature radiant vibration incident to the circulation of cooling air.

These and other objects of the present invention will become more fully apparent by reference to the appended claims and as the following detailed description proceeds in reference to the accompanying drawings wherein:

FIGURE 1 is a perspective view of the space heater of the present invention as viewed from below;

FIGURE 2 is a perspective view of the space heater of FIGURE 1 as viewed from above;

FIGURE 3 is a top plan view of the space heater of FIGURE 1;

FIGURE 4 is a front elevational view partially in section, being taken substantially along the line 4—4 of FIGURE 3;

FIGURE 5 is a left end view of the space heater of FIGURE 1; and

FIGURE 6 is a transverse sectional view taken substantially along the line 6—6 of FIGURE 3.

Referring now to the drawings in detail, particularly to FIGURES 1 and 2, the space heater 10 of the present invention comprises a trough-shaped housing 12 having a top or base wall 14, initial side wall portions 16 and 18 which are substantially perpendicular to the base wall 14, diverging terminal side wall portions 20 and 22, and end walls 24 and 26. Wall 14 and wall portions 16, 18, 20 and 22 are all parts of a single sheet metal stamping. End walls 24 and 26 are separate sheet metal stampings secured to the ends of the main stamping. Mounted within the housing 12 is a plural radiant and reflector-equipped sub-assembly 28 comprising basically in the illustrated embodiment four elongated radiants in the form of electrically powered quartz-type infra-red generating heating elements 30, 32, 34 and 36, and a reflector 38.

As will become apparent presently, the sub-assembly 28 is supported within the housing 12 and in spaced relation to the base wall 14 and the side walls 16 and 18 to permit circulation of air therebetween. Circulation of air in this manner is effected by an electric motor powered blower unit 40 mounted on the center of the exterior of the base wall 14 of the housing 12 as is most clearly shown in FIGURE 2.

Electrical power is supplied to the radiants 30, 32, 34 and 36 and to the motor of blower unit 40 by electrical leads located within a rigid electrical conduit 42 comprising a T-fitting 44 fixed at one end to the base wall 14 and opening therethrough, a pipe 46 extending from the fitting 44, a T-fitting 48 connected to the end of pipe 46 and fixed to an opening into the housing of the lower unit 40, a pipe 50 extending from the fitting 48 and an elbow fitting 52 fixed to an opening into the other end of the housing 12 through its wall 14 and connected to the other end of the pipe 50.

The structure of sub-assembly 28 is better illustrated in FIGURES 4 and 6. As is there illustrated, the reflector 38 comprises an elongated sheet metal element 54 having a plurality of parallel longitudinally extending concavities or grooves 55 on its lower face and abutting at its opposite ends reflector end plates 56 and 58. The end plates 56 and 58 are formed with downwardly opening notches 60 into which the ends of radiants 30–36 may be inserted while they are being installed and through which the opposite ends of radiants 30–36 extend in their installed positions as is most clearly shown in FIGURE 4. At its center the sub-assembly 28 is supported in housing 12 by a U-shaped bracket 62 extending across the upper side of element 54 and fixed at its opposite ends to the interior of walls 16 and 18 of housing 12 by screws 64.

At each end of the reflector 38 the sub-assembly 28 includes a terminal carrier plate 66. Plates 66 have horizontal portions 68 extending across the housing 12 between side walls 16 and 18 and having downwardly extending flanges 70 and 72 (FIGURES 4 and 6) at their opposite ends by which they are secured to walls 16 and 18 by screws 74. Plates 66 form the end supports for sub-assembly 28 in housing 12. As is most clearly shown in FIGURE 4, plates 66 have upwardly extending flanges 76 by which they are secured to members 56 and 58 as by welding and upwardly extending flanges 78 at their opposite ends.

The radiants 30–36 are suspended and electrically and thermally isolated at their opposite ends from the terminal carrier plates 66 by electrical terminals 79. Each terminal 79 comprises upper and lower ceramic insulators 80 and 82, a metal terminal spring clip 84 and a bolt 86 extending through aligned apertures in the base of the clip 84, the ceramic insulator 82, the wall 68 of the member 66, the insulator 80 and threadedly engaged at its upper end by a retaining nut 88 and a lead clip retaining nut 90 between which the terminal clip 92 (FIGURE 6) of the lead wire 94 is clamped. Nut 88 is tightened on bolt 86 to clamp insulators 80 and 82 against plate 66. The apertures in plates 66 through which bolts 86 extend are sufficiently large to preclude contact between bolts 86 and plates 66.

Radiants 30–36 conventionally have stainless steel end ferrules which are received between the arms of clips 84 in electrical pressure contact therewith to complete the electrical connections between leads 94 and radiants 30–36.

Extending the entire length of housing 12 between the end walls 24 and 26 in adjacent spaced relation to the walls 16 and 18 respectively are a pair of opposed channel-shaped sheet metal members 96 and 98 (FIGURE 6). Members 96 and 98 are fixed to the central support member 62 and to the end support terminal carrier plates 66

at the ends of the housing **12**. The corrugated sheet metal member **54** of the reflector **38** is laterally lightly compressed between and is supported by the bottom side walls of the channel-shaped members **96** and **98** along its opposite longitudinal edges as indicated at **100** in FIGURE 6. Member **54** is retained in position by the members **66** and the member **62**, the upper surfaces of the topmost portion of each of the concavities being in resilient contact therewith, the axis of one of the radiants **30–36** being disposed substantially at the focus of each of the concavities.

The lower ends of the members **96** and **98** are joined at their opposite ends by plates **102** fixed thereto by screws **104**. Plates **102**, the members **68**, the reflector end plates **56** and **58** and the housing end plates **26** and **24** cooperate with the end regions of the members **96** and **98** to form chambers **105** enclosing the terminal clips **84** and the ends of the radiants **30–36**. Air is permitted to circulate through these chambers **105** through the recesses **60** in the reflector end plates **56** and **58** and the louver openings **106** in the end plates **24** and **26**.

As is apparent from the foregoing, the reflector member **54** and the channel-shaped members **96** and **98** cooperate with the walls **14**, **16** and **18** of the housing **12** to form a generally channel-shaped chamber extending longitudinally of the housing **12**, the sides of this channel-shaped chamber opening downwardly between the member **96** and side wall **16** and the member **98** and side wall **18** into the interior of housing **12** beneath the sub-assembly **28**. Louver openings **110** are formed through the side walls **16** and **18** of the housing **12** and louver openings **112** are formed through the end walls **24** and **26**. Louver openings **110** are in fluid communication with the channel-shaped chamber about the sub-assembly **28**. Air is introduced into this chamber through an opening (not shown) in the center of the wall **14** of the housing **12** by the blower unit **40**.

The blower unit **40** comprises a square housing **114** fixed to the center of the wall **14** and having inlet grills **116** in its sides and its opposite ends as is best shown in FIGURES 4, 5 and 6. The chamber defined by the square housing **114** is closed at its top by a cover-member **118** detachably fixed thereto by screws **120**. An electric motor **122**, having a blower rotor in the form of a fan **124** fixed to its rotor shaft, is resiliently suspended within the chamber defined by the member **114** from the cover **118** by a plurality of coil springs **126** of the form illustrated in FIGURE 4. By this structure, the vibrations of the motor **122** and its rotor **124** are isolated from the housing **12**. It has been found that isolation of the blower motor **122** and its rotor **124** from the housing **12** upon which the radiants **30–36** are mounted to prevent vibration of the radiants **30–36** when they are operating at high temperature greatly increases the useful life of the radiants.

The motor **122** is connected so that it is operating at all times that power is supplied to the radiants **30–36**. When the blower unit **40** is operating, ambient air is drawn in through the inlet grills **116**, forced downwardly into the housing **12** above the reflector **38**, distributed throughout the channel-shaped chamber to cool the reflector **38**, and discharged through the louver openings **110** and between the member **96** and the side wall **16** and the member **98** and the side wall **18** in the same direction as that in which the radiant energy is emitted by the radiants **30–36**. By this arrangement it will be noted that cooling air flows downwardly along both the interior and exterior surfaces of the side wall portions **16** and **18** and **20** and **22** of the housing **12**. The interior surfaces of the portions **20** and **22** of the side walls of housing **12** are highly polished and form extensions in the form of segments of parabolas which form extensions or continuations of the end segments of the reflector **38**. Since these side wall portions **20** and **22** are cooled by the air circulated on both their interior and exterior, there is no danger of over-heating of the housing **12** as the result of utilization of this portion of the housing **12** as a reflector. The radiants **30–36** may be thusly operated at their optimum temperature in the order of 1600° F. This temperature is achieved by formation of reflector **38** so that each of the radiants **30–36** is subjected to direct radiation from at least one other of the radiants **30–36**.

As will be noted from FIGURE 6, a protective wire grill **130** is fixed to the bottom of the unit **28** to prevent contact with the radiants **30–36** and to support the radiants **30–36** in the event they should become broken.

From the foregoing it is apparent that the components of sub-assembly **28** can be readily assembled as a unitary sub-assembly and the entire sub-assembly installed as a unit within housing **12**. Sub-assembly **28** is readily removable for maintenance and repair purposes. In the event reflector **38** deteriorates in use, it can be readily and economically replaced.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by Letters Patent is:

1. An electric space heater comprising:

(a) a trough-shaped housing having a base wall and depending non-planar side walls with the terminal portions of said side walls forming reflective surfaces,

(b) an elongated electrically powered radiant sub-assembly, said sub-assembly comprising a reflector and at least one electrically powered radiant, said sub-assembly being detachably suspended in longitudinally extending relation within said housing in adjacently spaced relation to the base wall of the trough thereof, said reflector being of generally trough-shaped configuration with the open side facing away from said base wall and said reflector being intermediate said base wall and said radiant with its side wall edges extending beyond said radiant and being adjacent said terminal portions of said housing side walls, and

(c) means for circulating cooling air between the adjacent surfaces of said sub-assembly and said housing to prevent over-heating of said housing by heat from the radiant of said sub-assembly.

2. The heater defined in claim **1** wherein said radiant is a quartz-type infra-red heating element.

3. The heater defined in claim **1** wherein the reflector of said sub-assembly is provided with:

(a) at least one longitudinally extending concavity in the face thereof remote from the base of said housing, said at least one concavity having said at least one radiant longitudinally disposed therein, and highly reflective surface means on the surface of the concavity of said reflector.

4. The heater defined in claim **1** wherein said air circulating means comprises an electric motor powered blower mounted on said housing and having its exhaust port opening into the space between said base wall and said sub-assembly.

5. The heater defined in claim **4** wherein said blower embodies:

(a) a blower housing mounted centrally upon the base wall of said heater housing and having a plurality of air inlet ports through the side walls thereof,

(a) an electric motor resiliently suspended within said housing, and

(c) a blower rotor fixed to the output shaft of said motor for rotation therewith.

6. The heater defined in claim **3** wherein said housing has a substantially flat base wall, first parallel side wall

portions extending substantially perpendicular to said base wall portion and embracing said sub-assembly and wherein said side wall terminal portions diverge outwardly from the ends of said side wall first portions remote from said base wall.

7. The combination defined in claim **6** wherein said housing side wall terminal portions form continuations of said reflector to co-act therewith to form a two-part reflector to direct radiant energy from the radiant of said sub-assembly outwardly from said trough-shaped housing.

8. The combination defined in claim **7** wherein the housing side wall terminal portions are substantially parabolic in form so that radiant energy from the radiant of said sub-assembly is directed in a substantially rectangular beam from said heater.

9. The combination defined in claim **3** wherein said reflector has a plurality of said concavities in parallel relation and wherein an elongated radiant is disposed in alignment with each of said concavities so that each concavity forms a reflector for the associated radiant.

10. The heater defined in claim **11** wherein each of said plurality of radiants is positioned to be exposed to radiation from each adjacent one of said radiants so that the operating temperature of the radiant surface of each of said radiants is substantially higher than that which would result solely from the passage of electrical current therethrough.

11. An infra-red generator comprising:

(a) a radiant,

(b) a reflector for focusing the radiation from said radiant, and

(c) a housing enclosing said reflector on three sides thereof,

(d) means mounted on said housing for discharging an air stream; and

(e) means for directing said discharged air stream over a major portion of the surface of said reflector facing away from said radiant and over the exterior and interior surfaces of said housing, said reflector being so constructed and arranged as to prevent contact between the air stream and said radiant by shielding said radiant from said air discharging means.

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