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Shriver

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[54] **CLEAN-OPERATING BASEBOARD HEATER**

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[73] Assignee: **Orbit Manufacturing Company,** Perkasie, Pa.

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[52] **U.S. Cl.** **165/55**

[51] **Int. Cl.** **F24h 9/04**

[58] **Field of Search** 165/55, 57, 67, 68, 128, 129

[56] **References Cited**

UNITED STATES PATENTS

3,310,652 3/1967 Williams, Jr. 165/55

Primary Examiner—Charles S. Sukalo

Attorney—Howson & Howson

[57] **ABSTRACT**

A baseboard heater is provided with diffuser means having a series of apertures for causing heated air to the exit therefrom in a series of discrete upwardly flowing columns spaced from the wall against which the heater is mounted to reduce the tendency for the heated air to deposit entrained foreign matter on the wall. Preferred dimensional relations are disclosed for the apertures in the diffuser means to ensure satisfactory performance of the heater.

11 Claims, 7 Drawing Figures

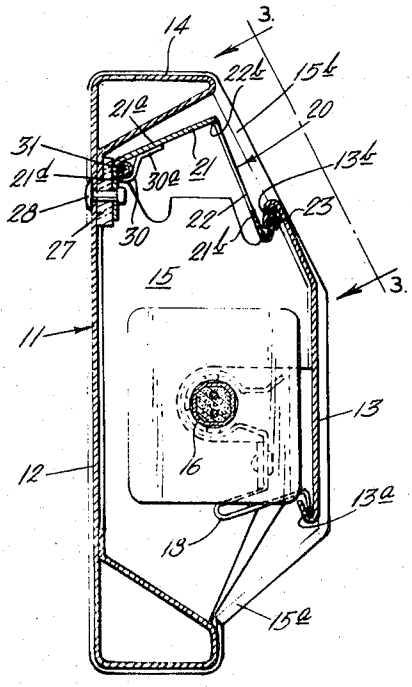


FIG. 1.

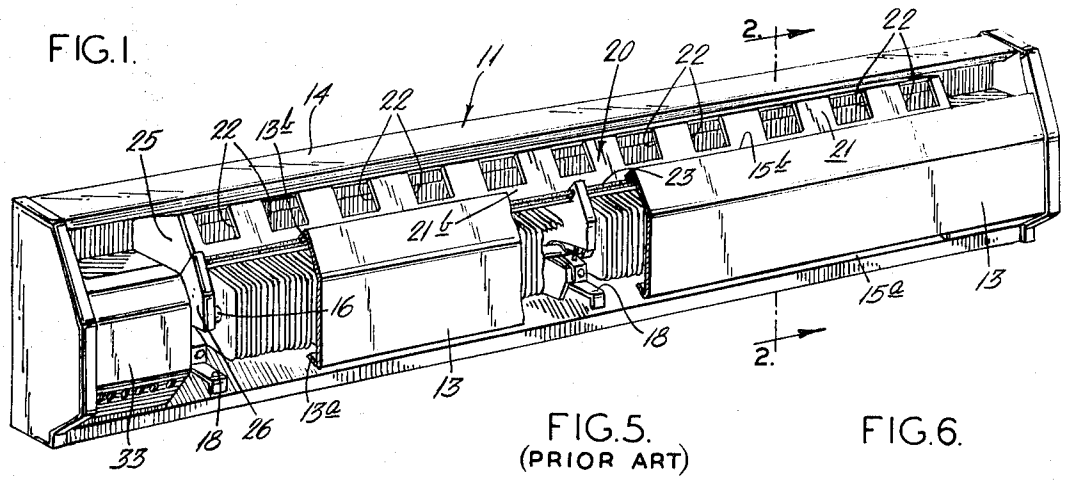


FIG. 5.
(PRIOR ART)

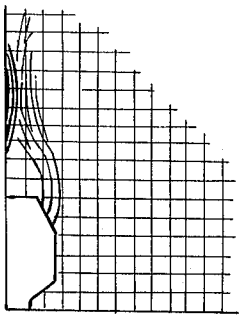


FIG. 6.

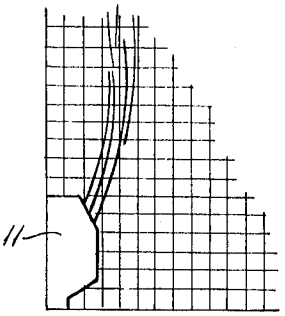


FIG. 2.

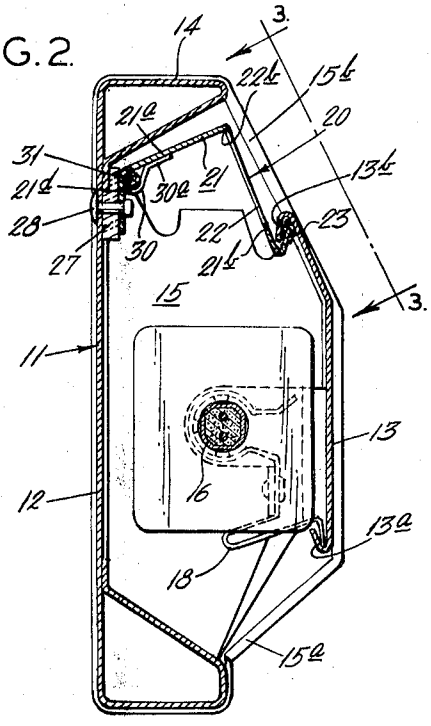


FIG. 7.
(PRIOR ART)

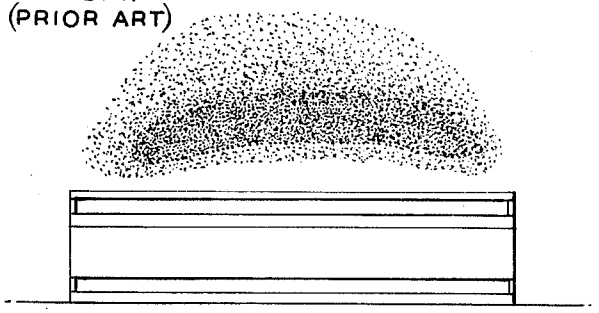
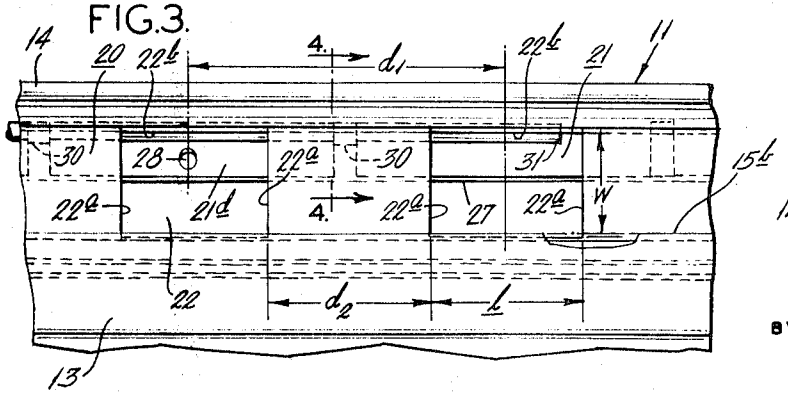


FIG. 3.



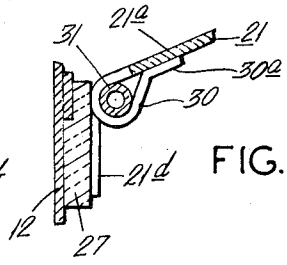


FIG. 4.

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CLEAN-OPERATING BASEBOARD HEATER

The present invention relates to baseboard heaters; and more particularly, the present invention relates to an electric baseboard heater having a diffuser structure which operates to alter the flow pattern of the heated air exiting from the heater to reduce the tendency for airborne foreign matter to become deposited on the wall above the heater.

It is known that a baseboard heater tends to cause airborne foreign matter such as dust to become deposited on the wall above the heater during the course of operation. After a few heating seasons, the deposited dust may accumulate to such an extent as to become readily visible to the naked eye. Thus, at periodic intervals the wall above the heater must be washed or repainted.

In order to enable the consumer to select an electric baseboard heater which operates for reasonably long intervals without depositing an undesirable amount of foreign matter on the wall, the National Association of Electrical Manufacturers has established a so-called "-Cleanliness Test" for rating the operational cleanliness of baseboard heaters. In order to obtain an acceptable rating on such test, heaters must not deposit more than a predetermined quantity of foreign matter on the wall in a prescribed time period. In the test, a small amount of iso-octane is burned in an enclosure in which the subject heater is mounted to create a large quantity of fine, black, carbon particles. The heater is energized for the prescribed time period and light reflectivity measurements are made on a sheet of white paper mounted on the surface of the wall above the heater. The reflectivity of the wall to impinging light is indicative of the operational cleanliness of the heater, with high reflectivity measurements indicating clean operation and low reflectivity measurements indicating less clean operation.

Heaters having structures capable of obtaining acceptable ratings on the aforementioned "Cleanliness Test" have been proposed by some manufacturers. For example, heaters having top shelves which extend three or more inches away from the wall deflect heated air away from the wall and thereby obtain acceptable cleanliness ratings. However, such shelf structures have not been entirely satisfactory since they project too great a distance into the room. As a result, useful floor space in the room is diminished; and in some instances, it has been noted that children tend to sit or stand on the shelf and cause it to bend downwardly.

There is a correlation between the air flow patterns produced by a baseboard heater in so-called "shadow graph" apparatus and the operational cleanliness of the heater. In shadowgraph apparatus, a beam of light is projected lengthwise of the heater through the heated air exiting therefrom to produce a shadow of the flow pattern on a light-reflective grid disposed normal to the heater at the end thereof remote from the light source. In the present invention, it has been discovered that when the shadowgraph air flow pattern is disposed substantially parallel to the wall and is spaced therefrom, the heater tends to operate in a clean manner.

With the foregoing in mind, it is the primary object of the present invention to provide a novel baseboard heater which is capable of operating with a relatively high degree of cleanliness.

It is another object of the present invention to provide an improved electric baseboard heater which possesses a relatively narrow top shelf and which is capable of attaining at least an acceptable rating on the NEMA Cleanliness Test.

More specifically, in the present invention, a baseboard heater having a housing with a rear wall, a front wall cooperating therewith to form an air flow passage, and heat producing means mounted in the passage, is provided with diffuser means which is mounted in the housing above the heat producing means and which has a series of apertures for causing heated air to exit from the housing in a series of upwardly flowing columns spaced apart along the length of the heater and spaced from the wall to which the housing is mounted. The diffuser means includes a horizontally elongated plate having an inverted L-shaped transverse cross-section with a deflector flange inclining upwardly and forwardly from the rear wall of the housing and an apertured flange spanning between the deflector flange and the front wall of the housing. There is provided means to mount the diffuser plate to the rear wall in a manner which reduces conductive heat transfer from the plate to the housing; and there is provided tab means on the deflector flange of the plate to mount an elongated temperature-sensing tube above the heat-producing means. In addition, downturned extensions on the ends of the deflector flange and a lip on the bottom of the apertured flange cooperate with end members and sealing means mounted along the front wall of the housing to ensure that heated air exists only through the aperatures.

These and other objects, features and advantages of the present invention should become apparent from the following description when taken in conjunction with the accompanying drawing in which:

FIG. 1 is a perspective view of a baseboard heater embodying the present invention and having portions of its front wall broken away to expose the finned-tube, heat-producing means mounted therein;

FIG. 2 is an enlarged sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is a view taken along line 3—3 of FIG. 2 to illustrate the configuration and spacing of the apertures in the diffuser means of the present invention;

FIG. 4 is an enlarged fragmentary view taken along line 4—4 of FIG. 3 to illustrate tab means on the diffuser means for mounting temperature-sensing means in the housing;

FIG. 5 is a schematic illustration of the air flow pattern produced in shadowgraph apparatus by a baseboard heater which does not have the diffuser means of the present invention;

FIG. 6 is a schematic illustration similar to FIG. 5 but of the air flow pattern produced by a baseboard heater having the diffuser means of the present invention; and

FIG. 7 is a schematic illustration of the dust pattern produced by the baseboard heater of FIG. 5 in the course of operation.

Referring now to the drawing, there is illustrated in FIG. 1 a baseboard heater embodying the present invention. The heater has a metal housing 11 with an upstanding rear wall 12 which mounts against the lower margin of a partition or wall in an area to be heated. A front wall 13 is removably mounted in the housing by

means of spring clips **18,18** engaging in a continuous upturned lip **13***a* extending along its lower edge. A relatively narrow top shelf **14** extends forwardly from the rear wall **12** and is provided by reversely forming into a triangular cross-section the upper margin of the rear wall **12** (See FIG. **2**). The rear and front walls **12** and **13**, respectively cooperate with the top shelf **14** to form an air flow passage **15** through the housing **11**. Heat producing means, in the present instance electrically energized finned tubing **16**, is mounted in the air flow passage **15** and operates to cause ambient air to enter the housing **11** through an elongated inlet **15***a* along the front of the housing and to exit from the housing **11** through an outlet **15***b* along the top of the front wall **13**. Although electrically energized finned tubing is preferred, the present invention may be employed satisfactorily in baseboard heaters having finned tubing through which hot water is flowed.

A heater having the aforedescribed construction and including a conventional inclined deflector in the air flow passage produces an air flow pattern in a shadowgraph substantially as shown in FIG. **5**. As illustrated therein, the air impinges on the wall at approximately 3 in. above the heater, the grid lines being 1 in. apart. As a result, foreign particles such as dust tend to become deposited on the surface of the wall above the heater in a pattern substantially as shown in FIG. **7** when subjected to the aforementioned NEMA Cleanliness Test. It is to be noted that dust pattern of FIG. **7** is relatively dark in an arcuate zone above the heater, indicating that the heater of FIG. **5** would not tend to operate as clean as desired.

According to the present invention, the operational cleanliness of a baseboard heater is markedly improved by causing heated air to exit from the front of the housing in a series of columns spaced forwardly of the partition to which the housing is mounted. To this end, diffuser means **20** having a series of apertures **22,22** (FIG. **1**) is mounted above the finned tubing **16** and in the air flow passage **15** in the housing **11**. The diffuser means **20** is substantially coextensive in length with the finned tubing **16**; and in the present instance, the apertures **22,22** are located at substantially equally spaced intervals therein. As may be seen in FIG. **2**, the diffuser means **20** includes a plate **21** having an inverted L-shaped transverse cross-section with an imperforate deflector flange **21***a* inclining forwardly and upwardly from the rear wall **12** and a flange **21***b* (in which the apertures **22,22** are formed) depending from and spanning toward the front wall **13** from the forwardmost extremity of the deflector flange **21***a*. Preferably, the deflector flange **21** *a* is inclined at an angle of substantially 75° with respect to the rear wall **12**; and the apertured flange **21***b* forms an included angle of substantially 105° with respect to the deflector flange **21***a*. In the illustrated embodiment, the deflector flange **21***a* is spaced from the underside of the top shelf **14** so as to prevent heated air from impinging directly on the top shelf and causing it to operate at undesirably high temperatures.

The deflector flange **21***a* operates to direct heated air forwardly through the apertures **22,22** in the apertured flange **21***b*. In order to prevent small currents of heated air from interfering with the flow of air through the apertures **22,22**, there is provided sealing means **23** between the diffuser plate **21** and the front wall **13** of the housing **11**. As may be seen in FIG. **2**, the sealing means **23** includes an elongated strip of heat-resistant resilient material mounted on a continuous upturned lip **24** extending along the lower front edge of the apertured flange **21***b*. The sealing strip **23** is engaged by a continuous rearwardly downturned lip **13***b* extending along the uppermost edge of the front wall **13**. Thus, the spring clips **18,18** operate to bias the front wall **13** downwardly to compress the sealing strip **23** and thereby effecting an air-tight joint between the diffuser plate **21** and the front wall **13**. In order to prevent the escape of heated air past the ends of the diffuser plate **21**, the deflector flange **21***a* has integral downturned extensions **25** (FIG. **1**) on each end which engage over members disposed transversely to the finned-tubing **16** and extending forwardly from the rear wall **12** as for example the left-hand member **26**.

For the purpose of securing the diffuser plate **21** in the housing **11**, there is provided mounting means which, in the present instance, includes a downturned extension **21***d* on the deflector flange **21***a* disposed along the rear wall **12**. Insulating means, in the present instance a layer of asbestos fabric **27**, is interposed between the extension **21***d* and the rear wall **12**; and positive attachment of the diffuser **21** to the rear wall **12** is effected by fasteners **28,28** which extend through the extension **21***d*, the asbestos fabric **26**, and the rear wall **12**.

As an additional advantage, the diffuser plate **21** of the present invention provides tab means **30** (FIG. **4**) for supporting a length of a temperature-sensing tube or probe **31** above and along a major portion of the finned-tubing **16**. The probe **31** operates in conjunction with a limit switch mounted behind a panel **33** (FIG. **1**) at the left-hand end of the housing to interrupt current flow to the finned tubing **16** in the event of a malfunction of the heater. As may be seen in FIGS. **2** and **4**, the tab means **30** comprises a series of narrow strips **30***a*, **30***a* which are integral with the deflector flange **21***a* of the plate **21** and which are turned reversely upon the underside thereof to support the probe **31**.

Certain dimensional relations are preferred for the apertures in the diffuser plate **21** if satisfactory operation of the heater is to be obtained. For instance, in a baseboard heater constructed substantially in accordance with FIGS. **1**, **2** and **3** and having finned tubing with a nominal heating capacity of 250 watts/foot, each aperture **22,22** should have a lengthwise dimension *l* (FIG. **3**) of 1.7 in. and a widthwise dimension *w* of 1.375 in. The apertures are spaced apart a dimension d_1 between centers which in the present instance is 3.7 in. or substantially 4 in.; the area of each aperture is 2.34 in. or substantially 2 ½ in.^{2}; and the spacing d_2 between the widthwise edges **22***a*, **22***a* of adjacent apertures is 2.0 in. In a heater constructed as above but having finned tubing with a lower nominal heating capacity of 150 watts/foot the preferred lengthwise dimension *l* of each aperture is 1.87 in. and the preferred widthwise dimension *w* is 1.00 in. The dimension d_1 of the spacing of the apertures is 3.87 in. or substantially 4 in.; the area of each aperture is 1.87 in. or substantially 2 in.; and the dimension d_2 between the widthwise edges **22***a*, **22***a* of adjacent apertures is 2.0 in. Preferably, the upper lengthwise edges **22***b*, **22***b* of the apertures in

each of the aforementioned heaters are spaced from the rear wall **12** of the housing a distance corresponding substantially to the distance between the widthwise edges **22***a*, **22***a* of the apertures.

Certain variations in the configuration, size and spacing of the apertures from the aforementioned preferred dimensional relations are permissable without adversely affecting the performance of the diffuser plate in the heater. There are limits, however beyond which satisfactory operation cannot be obtained. In determining the limits, cleanliness tests were conducted on a baseboard heater having finned tubing with a nominal capacity of 300 watts/foot and a diffuser plate with only a deflector flange forming a widthwise dimension *w* of approximately 1 ¼ in. between the front edge of the deflector flange and the top edge of the front wall **13**. The total lengthwise dimension of the deflector flange was 40 in. A series of baffles 2 inches wide were hooked over the front edge of the deflector plate; and they spanned therefrom to engage the inside edge of the downturned lip extending along the top edge of the front wall. The spacing between the baffles was varied; and cleanliness tests were conducted at the various spacings.

As a result of these tests, it was determined that the widthwise edges **22***a*, **22***a* of adjacent apertures in the diffuser plate **21** must not be spaced from one another closer than one-half of the lengthwise dimension *l* of the apertures **22,22**; and they must not be spaced from one another further than twice the lengthwise dimension *l* of the apertures **22,22**. In addition, the lengthwise dimension *l* of each aperture **22** must not be less than one-third nor greater than two-thirds of the center to center dimension d_1 of the apertures **22,22**; and, the lengthwise dimension *l* must be selected so as to provide a total area open to air flow of between one-third and two-thirds of the total area of the apertured flange **22***b*. Moreover, the ratio of length *l* to width *w* of each aperture must be between 1/1 and 4/1 for rectangular apertures. The widthwise dimension *w* in the test heaters was not varied; however, it is expected that some minor variations from this dimension would not materially affect the performance of the heater. Although rectangular apertures are illustrated in the preferred embodiment, apertures having non-rectangular configurations may be employed, for example circular or oval, in which event the aforementioned length/width ratios may be modified to provide the desired air flow areas in relation to the spacing between the apertures.

A baseboard heater constructed according to the aforementioned preferred dimensional relations produces a flow pattern in a shadowgraph substantially as illustrated in FIG. **6**. As may be seen therein, the bulk of the air flow is spaced more than 3 inches from the wall against which the heater is mounted; and because the heated air exits through apertures in the front of the housing, the air flows upwardly in discrete columns for about 3 inches before blending with ambient air.

Thus, baseboard heaters having the diffuser structure of the present invention are capable of operating during cleanliness tests in such a manner as to avoid depositing dust on the wall in sufficient quantities as to be readily visible to the naked eye.

In view of the foregoing, it should be apparent that diffuser means has now been provided for use in a baseboard heater to reduce the tendency for airborne foreign matter to become deposited on the wall above the heater during its course of operation.

While preferred embodiments of the present invention have been described in detail, various modifications, alterations and changes may be made without departing from the spirit and scope of the present invention as described in the appended claims.

I claim:

1. In a baseboard heater having a housing with heat-producing means mounted therein, said housing having an upstanding rear wall for mounting against a partition in an area to be heated and a front wall spaced from said rear wall to form an air flow passage across said heat-producing means in said housing, the improvement comprising: a diffuser plate mounted in said flow passage above said heat-producing means, said diffuser plate having a deflector flange extending forwardly from the rear wall of said housing and a flange depending from said deflector flange and spanning toward said front wall with a series of apertures therein spaced predetermined distances from one another and from said rear wall, each aperture in said series having a lengthwise dimension measured in a horizontal direction ranging substantially between one-third and two-thirds of the center to center spacing of said apertures with the ratio of length to width of each aperture being in a range of substantially 1/1 to 4/1, whereby air heated by the heat-producing means exits from said housing in a series of discrete columns to reduce the tendency for foreign matter carried by the heated air to become deposited on the wall above the heater.

2. Apparatus according to claim **1** wherein said front wall has a rearwardly downturned lip extending along its uppermost edge and said diffuser plate has an inverted substantially L-shaped transverse cross-section with a forwardly upturned lip extending along the lower margin of its apertured flange and projecting into the space defined by said front wall lip, sealing means carried on said upturned lip to engage against said front wall and prevent heated air from flowing upwardly through said space, and including an end member disposed adjacent each end of said heat-producing means and transverse to said plate for cooperating therewith to define a heated-air plenum above the heat-producing means so that heated air exists only through the apertures in the diffuser plate.

3. Apparatus according to claim **1** wherein said housing has a top shelf extending forwardly from said rear wall and terminating rearwardly adjacent said apertures, said top shelf being spaced upwardly from said deflector flange so that said deflector flange prevents heated air from impinging on the underside of said shelf.

4. Apparatus according to claim **1** wherein said heater has elongated temperature-sensing means disposed above said heat-producing means and extending along at least a portion of its length and including tab means integral with said deflector flange and located at spaced intervals for engaging and supporting said temperature sensing means.

5. Apparatus according to claim **1** including means mounting said diffuser plate to the rear wall of said

housing, said mounting means including an integral downturned extension on said deflector flange disposed along the rear wall of said housing, insulating means disposed between the rear wall of said housing and said extension, and means extending at spaced intervals through said extension, said insulating means, and housing rear wall for fastening said extension and hence said diffuser plate to the housing.

6. Apparatus according to claim 1 wherein said apertured flange has a predetermined widthwise dimension between said deflector flange and said front wall and each of said apertures has a widthwise dimension corresponding substantially to said dimension and a lengthwise dimension preselected to provide said apertured flange with a total area open to air flow in a range of substantially one-third to substantially two-thirds of its total area per unit length of said heat-producing means, the spacing between edges of adjacent apertures in said series being in a range of substantially one-half to substantially twice the lengthwise dimension of the adjacent apertures.

7. Apparatus according to claim 1 wherein each apertures has an upper lengthwise edge extending on the line of juncture of the plate-flanges and wherein the distance between widthwise edges of said apertures corresponds substantially to the spacing between said upper edge of the apertures and said rear wall of the housing.

8. Apparatus according to claim 7 wherein said heat-producing means has a capacity in a range of substantially 150 to substantially 375 watts per lineal foot and said apertures are spaced apart on substantially 4 inch centers with each aperture having an area in a range of substantially 2 $in.^2$ to 2.5 $in.^2$

9. Apparatus according to claim 7 wherein the capacity of said heat-producing means is substantially 300 watts per lineal foot and each of said apertures has an area of substantially 2 $in.^2$

10. Apparatus according to claim 7 wherein the capacity of said heat-producing means is substantially 150 watts per lineal foot and each said apertures has an area of substantially 2 ½ in^2.

11. Apparatus according to claim 1 wherein said deflector flange inclines at an angle of substantially 75° with respect to said rear wall and said apertured flange depends from said deflector flange at an angle of substantially 105°.

* * * * *