Aug. 28, 1962 D. KNOLL ETAL 3,051,816

BASEBOARD HEATER

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Fig. 1.

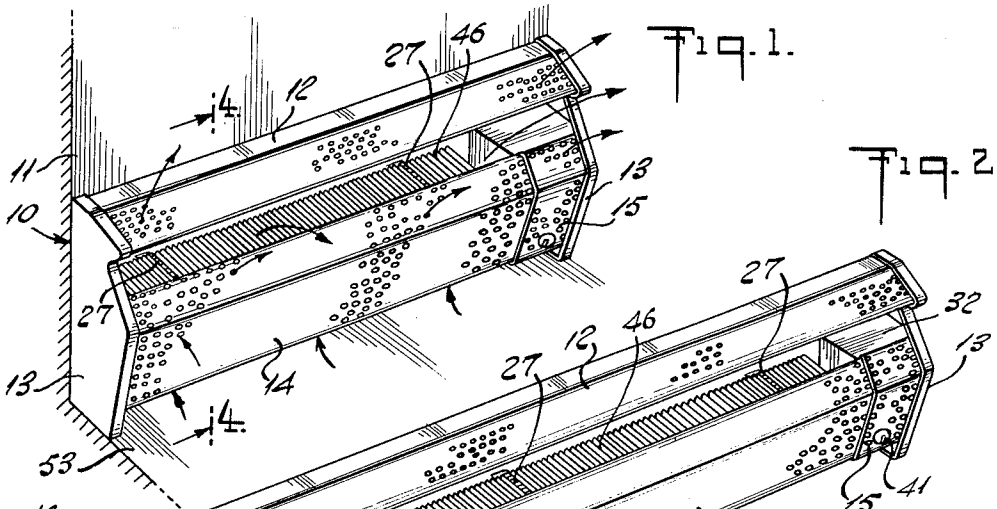


Fig. 2.

Fig. 3.

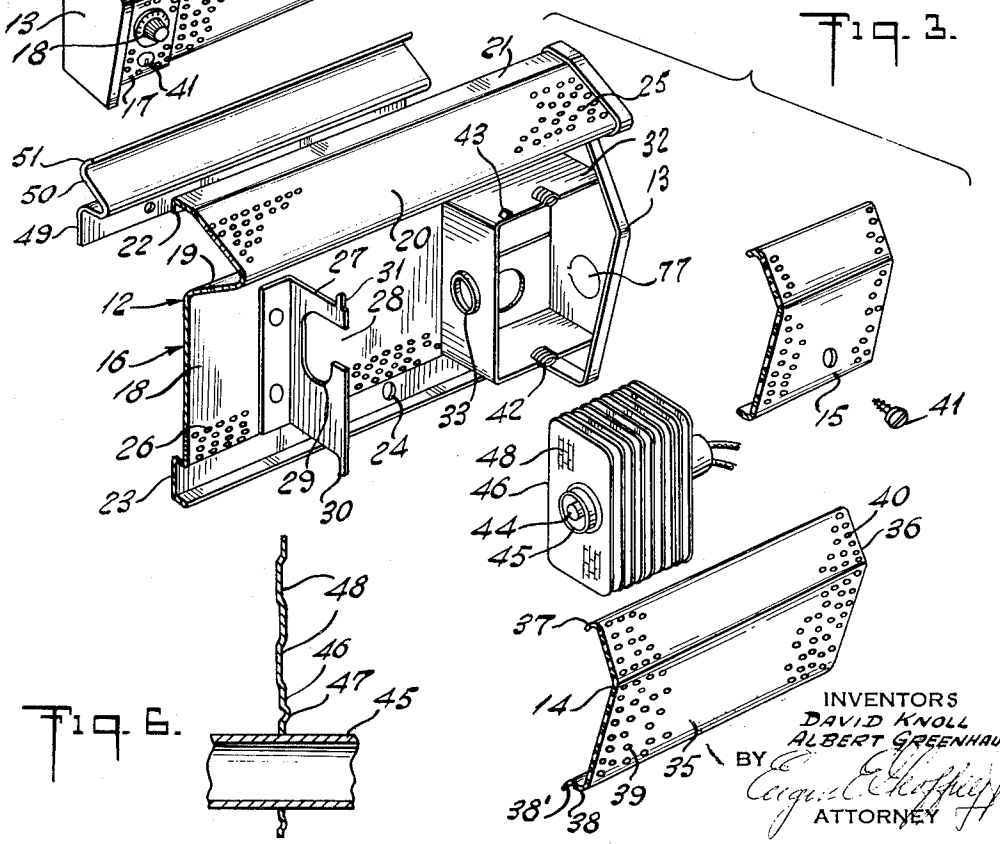


Fig. 6.

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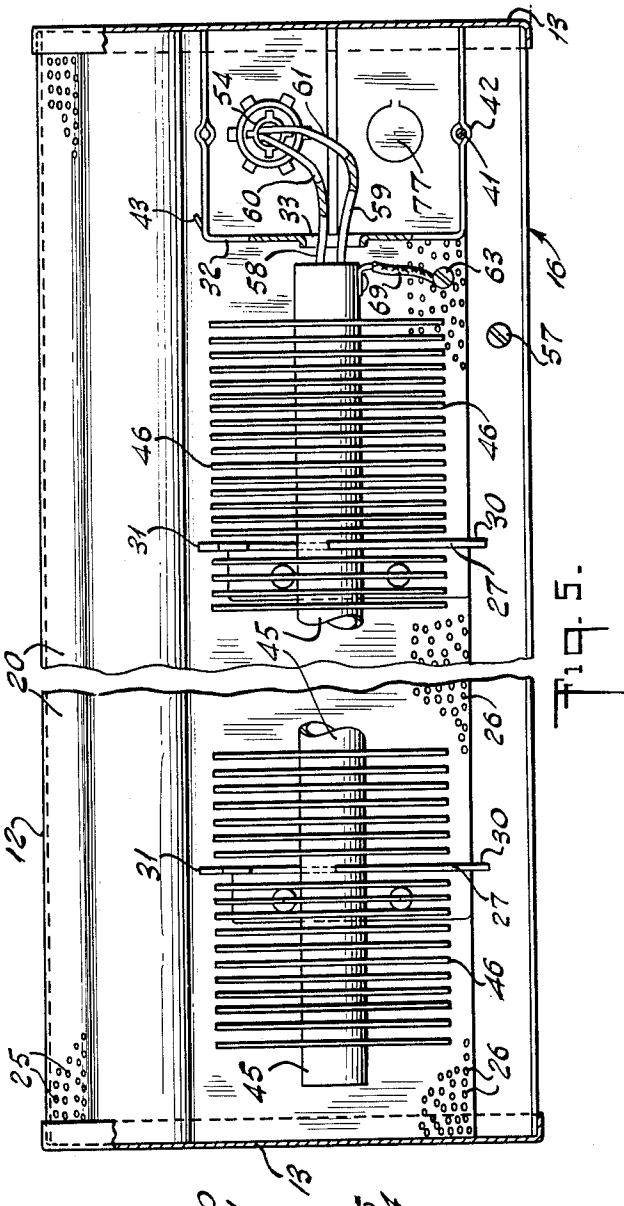


Fig. 5.

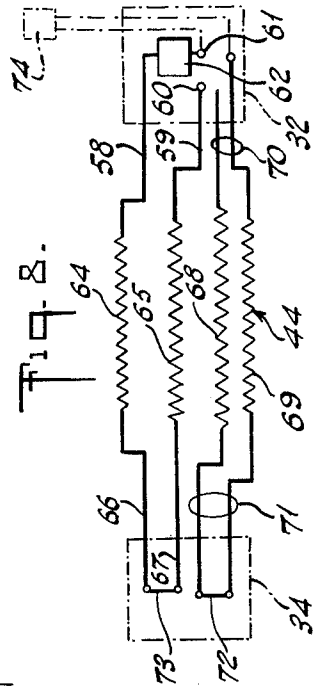


Fig. 8.

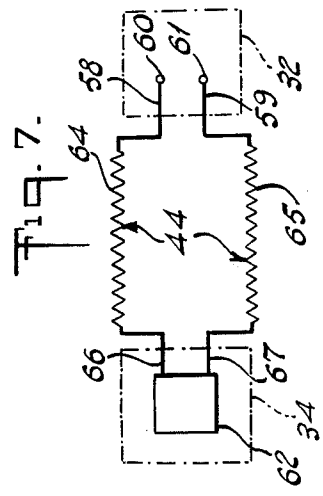


Fig. 7.

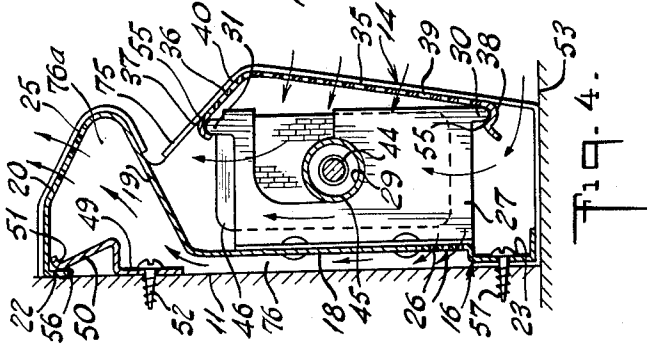


Fig. 4.

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BASEBOARD HEATER

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8 Claims. (Cl. 219—34)

The present invention pertains to improvements in heating apparatus and more particularly concerns a novel and improved heater of the baseboard type.

Among the various applications of localized electric heating one category is that involving the baseboard heater located at the foot or base-board zone of the wall. Prior known baseboard heaters have not been found satisfactory because of unduly high localized temperatures in order to obtain sufficient heating effect, danger to children, pets and furniture, high heat loss to the wall behind the heater and the creation of local convection currents of high temperature and relatively small volume with resultant uneven heating and a tendency to cause smudging of the wall above the heater. Other defects encountered have been difficulty of installation and servicing, undue obtrusiveness or unsightly appearance and the creation of noise due to contraction and expansion in the apparatus under temperature changes.

Accordingly one of the objects of the invention resides in the provision of novel and improved apparatus which overcomes the foregoing disadvantages of prior devices and provides additional advantages that will become evident from the description of the invention and the accompanying drawings.

Another object of the invention resides in the provision of a baseboard heater characterized by large air flow with relatively low surface temperature.

A further object of the invention resides in the provision of a baseboard heater in which a current of relatively cool air is maintained between the main heating chamber and the wall behind it, thus reducing heat loss to the wall, increasing useful heat output and creating a layer or air curtain between the main convection output and the wall above the heater by which any tendency toward smudging is materially reduced if not entirely prevented.

Another object of the invention resides in the provision of a heater having a novel and improved arrangement and organization of elements functioning to eliminate noise during thermal expansion and contraction, and by which installation or removal of the heat source is facilitated.

A further object resides in the provision of an improved baseboard heater including means for accurate thermostatic regulation and modulation.

A further object resides in the provision of improved mounting means for baseboard heaters by which the device may be quickly and easily secured to the wall in top sealing relation.

A further object of the invention resides in the provision of an improved readily removable front closure means allowing ready access to the heat source and its electrical connections.

Another object resides in the provision of improved baseboard heating apparatus of the above nature which is compact, attractive in appearance, and readily adaptable to a wide range of space decors and heating requirements.

Other objects and advantages of the invention will become evident from the following description and accompanying drawings, in which

FIGURE 1 is a perspective exterior front view of one embodiment of the invention;

FIGURE 2 is a perspective view of a modified embodiment of the invention including thermostatic control;

FIGURE 3 is an exploded perspective view of the right end portion of the embodiment shown in FIGURES 1 and 2, illustrating the novel structure and relationship of the component parts;

FIGURE 4 is a cross-sectional view of the heater of FIGURE 1 taken along the line 4—4 thereof and showing the cooperation of the heater with the supporting wall;

FIGURE 5 is a front view partly in section of the heater of FIGURE 1 with the front closure removed;

FIGURE 6 is an enlarged cross section of the heating element container sleeve and a diffusing fin;

FIGURE 7 is a simplified electrical diagram illustrating one arrangement of a heating element with the control thermostat; and

FIGURE 8 is a modified circuit diagram illustrating an arrangement utilizing a modulating thermostat, with a heater in accordance with the invention.

Referring to FIGURE 1, the numeral 10 generally designates a baseboard heated adapted to be installed at the foot of a wall 11. The housing of the device includes a main longitudinal supporting structure 12 to which end plates 13 are secured, a front closure plate 14, and a short front closure plate 15 at one end of and matching the main closure plate in general contour. The embodiment of the invention denoted by the numeral 16 in FIGURE 2 is the same as that of FIGURE 1 except for greater length and the inclusion of a second short closure plate 17 accommodating exterior adjusting parts of a thermostat 18. The main configurations and relationships of the component parts of the device, which are substantially the same in all embodiments, are shown in detail in FIGURES 3, 4 and 5.

Referring to FIGURES 3 and 4, it will be seen that the supporting structure 12 includes a flat vertical rear wall 18, a forward and upwardly sloping portion 19 above the rear wall portion, and a rearwardly and upwardly sloping portion 20 leading to a narrow flat top 21, the latter having at its rear edge a downwardly turned flange 22. The bottom zone of the plate 12 is formed as a rearwardly struck channel 23 adapted to be anchored to the wall 11 by fastening means extending through holes 24 as hereinafter set forth. The rearwardly sloping upper portion 20 is provided with perforations 25 throughout its length, and a narrow band of similar perforations 26 occupies the extreme bottom zone of the rear wall portion 18.

Forwardly extending brackets 27 are secured in longitudinally spaced relationship on the vertical rear wall 18, the number of such brackets being dependent on the length of the particular model of the device, i.e. the embodiment in FIGURE 1 contains two brackets 27, while the embodiment shown in FIGURE 2 includes three brackets. Each bracket 27 is formed with a recess comprising a front entry slot 28 and an inner portion extending downwardly to form an arcuate supporting saddle 29 (see FIGURE 3). Each bracket also has a small latching tab or extension 30 depending from the lower front corner thereof and a similar upwardly directed tab 31 on the upper edge of the bracket and spaced from the front corner.

An outlet or junction box 32 is formed in one end of the housing structure 12 and the inner face 13 has a circular opening 33 in general axial alignment with the retaining saddles, 29 in the brackets 27. In the embodiment shown in FIGURE 2, a second similar box 34 is provided at the other end of the housing.

The main front closure plate 14 consists of an out-

wardly inclined face portion 35 and a relatively narrow rearwardly inclined upper portion 36 which terminates in a downwardly curved inner edge 37 adapted to hook over the upper tabs 31 on the brackets 27, as shown in FIGURE 4. Similarly, the lower edge 38 of the closure plate 14 is turned inwardly and provided with an upwardly formed channel 38' constituting a snap latch for engagement with lower tabs 30 on the brackets 27 also as shown in FIGURE 4. Small buffers 55 of thin heat-proof resilient tape such as fiber-glass or the like are provided in the joints between the plate 14 and bracket tabs, for purposes hereinafter explained. Thus in operative position the closure plate 14 is firmly retained and supported on the brackets 27 in snap relation, the plate having sufficient resilience to facilitate installation and removal for servicing, cleaning and other purposes and at the same time have ample strength to prevent accidental loosening or removal.

The inclined face portion 35 of the closure plate 14 is provided throughout with perforations 39 and 40 which provide for the flow of air into and out of the housing.

The short end closure plates 15 and 17 while matching plate 14 in general contour and design are adapted to be secured in place by screws 41 engaging expanded sockets 42 formed in the lower edges of the junction boxes 32 and 34, the downwardly formed upper flanged edges of these plates being hooked over small retaining members 43 struck upwardly on the upper edges of the boxes.

In the illustrated embodiments of the invention, the heat source includes a suitable elongated resistance unit 44 (see FIGURE 3) insulatedly encased in a metallic tube or sheath 45. The heating element may be formed of any suitable material as for instance heavy-duty nickel-chromium wire or the like contained in ceramic tubing and may be provided with various alternative circuit arrangements as hereafter explained in connection with diagrams shown in FIGURES 6 and 7.

A large number of metal fins 46, preferably of rectangular configuration, are secured in spaced relation on the tube 45 to distribute the heat therefrom. The structure of the joints between the tube and fins is shown in enlarged fragmental detail in FIGURE 6, the thickness of the metal sections being somewhat exaggerated for clarity in illustration. While the fins may be attached to the tube in any desired manner in the instant illustration, they are formed with circularly corrugated inner rims 47 into which the tube 45 is expanded, thus establishing compression contact joints of high heat transmitting ability as well as permanently locking them on the tube. The fins 46 are also double-embossed in staggered checkerboard pattern as indicated at 48 to increase the heat emitting areas and also stiffen the thin metal fins.

To avoid undue complication of the drawings, only fragments of embossed pattern are shown in FIGURE 3, but it will be understood that all fins are so embossed throughout substantially their entire areas.

Referring again to FIGURES 3 and 4, the numeral 49 denotes a mounting strip adapted to be attached directly to the wall 11. This strip or bracket, which may be slightly shorter than the main housing, is formed with the general cross-sectional shape of a snap-latch, the rearwardly sloping upper portion 50 thereof terminating in a forwardly curved lip 51.

When the device is to be installed, the mounting strip 49 is first secured to the wall 11 by screws 52, location of the strip being readily made by means of a suitable template which determines the proper height of the device above the floor 53 (see FIGURE 4). Provision having been made for current supply for the device, as for example an armored cable and cooperating connector 54, the housing is snapped into place on the mounting strip with the rear flange 22 of the main plate 12 being moved downwardly into compressive retaining position between the wall 11 and the lip 51 of the strip 49. A thin layer of resilient tape 56, FIGURE 4, enveloping the flange and

secured thereto during manufacture, forms a cushion seal between the flange and both the wall 11 and the bracket lip 51 which contributes both to proper air current control and to noise prevention, as will be set forth hereafter in greater detail. The main plate 16 having been placed in proper position on the mounting strip as noted, screws 57 are inserted through the lower channel 23 to anchor the latter to the wall 11.

It will be understood, however, that the main support and location are provided by the strip 49 which may be placed at any convenient height to meet specific requirements; thus the bottom of the channel 23 need not extend to the floor but may be located at any desired distance above the latter, for example to clear existing corner moldings and the like.

The mounting of the heating unit in the housing whether made at the time of installation or during prior assembly, consists in moving the unit inward through the front slots 23 in the brackets 27, after which the unit is lowered until the tube 45 drops into the arcuate saddles 29 as shown in FIGURES 4 and 5, and the brackets 27.

In the single-ended embodiment of the invention as illustrated in FIGURE 5, the leads 58 and 59 of the heating element extend through the opening 33 into the junction box 32 and are connected with the supply conductors 60 and 61 entering through the connector 54. A ground connector 62, electrically joined to the heater core tube, is connected by means of a screw 63 to the main housing plate 16. The front closure plates 14 and 15 are secured in position as previously described, and the device is ready for operation.

For clarity in explanation, the foregoing assembly steps were described as being performed on installation. However, it will be obvious that the assembly of the main housing members and the heating unit may advantageously be provided at the factory or point of distribution, so that the installation of the unit proper entails only snapping the latter over the mounting strip 49 and anchoring it to the wall, completing the electrical connections in the junction box 32, and closing the latter by means of its plate 15.

In the forms of the invention embodying double-ended construction, as exemplified in FIGURE 2, the windings and connections of the heating element 44 are such as to provide a wide degree of flexibility in fulfilling various requirements as to heating capacity, degree of regulation, and ready adaptability to differing installation locations and available current supply facilities. Typical electrical arrangements to carry out these and related advantages are shown diagrammatically in FIGURES 7 and 8.

In the form illustrated in FIGURE 6 the two windings 64 and 65 of the heating element 44, instead of being internally connected and provided with a single pair of exterior leads 58 and 59 at one end of the tube 45 as shown in FIGURE 5, have separate leads 66 and 67 at the other end of the unit, these leads extending into the second junction box 34, where they are connected to a suitable thermostat 62.

In the embodiment illustrated in FIGURE 8, the heating element 44 includes a second pair of windings 68 and 69 provided with right-hand and left-hand lead pairs 70 and 71, thus forming a dual-circuit heating element. In the case shown, the left-hand leads 71 are joined by a suitable connector or splice 72 within the junction box 34, while the right-hand leads 70 are connected one via an exterior wall thermostat 74, to the main current supply conductors 60 and 61. Similarly the first windings 64 and 65 are connected in series by a connector or splice 73 and are also connected across the supply conductors 60 and 61, but include in series connected thermostat 41, the latter in this illustrative case being mounted in the right-hand junction box 32. Thus it will be seen that the heating unit comprises two parallel heating circuits, one controllable by the built-in thermostat and the other by the wall thermostat 74. In the usual mode of operation

with this arrangement, the main heating function is carried on by the first element circuit under control of the thermostat **41**, with the second circuit cutting in when added heat is required as detected by the modulating wall thermostat **74**. It will be evident that the inherent flexibility of the invention as to electrical and mechanical structural arrangement renders it readily adaptable to various other control combinations to suit particular service conditions and that beside the obviously advantageous comfort feature the double heating element provides long service life when used with either modulating or conventional controls.

In operation of this novel and improved heater the paths of the convection currents are as indicated by arrows in FIGURE 4. The air to be heated enters the heating chamber at the bottom of the housing below the closure plate **14**, passes upward through and about the finned heating unit, is deflected forward by the imperforate sloping portion **19** of the supporting structure **16**, and emerges partly through the wide opening **75** above the closure plate and partly through the perforations in the latter. This air stream is augmented by a large volume of air which flows inward through at least part of the perforations **39** in the inclined face **35** of the closure plate **14**. The flow of air into and out of the perforations **39** and **40** is governed at least in part by the temperature of the heating element and functions to maintain at least the lower part of the plate **35** at a relatively low temperature. In this way injury to individuals and furniture that may be moved in contact with the heater is minimized.

Referring again to FIGURE 4, it will be seen that the contour of the main housing plate **16** provides a space **76** between the rear wall **18** of the heating chamber and the room wall **11** on which the device is mounted. The previously described narrow band of perforations **26** affords a bottom inlet to the space **76** while top egress is provided by the perforations **25** in the upper portion **20** of the housing structure. When the device is in operation, any leakage of heat through the rear portion **18** of the main housing structure is caused by the air in the space **76**, creating a secondary convection current therein which enters through the bottom perforations **26**, moves upward through the space or flue **76** and emerges through the top perforations **25**. Thus a gently moving curtain of relatively cool air is established between the wall **11** and the main heater chamber, insulating the wall against significant heat absorption and dangerous temperature rise, while at the same time conserving the otherwise wasted heat to augment the previously described main convection output; furthermore the secondary air current functions to cool the top of the heater while passing through the cavity **76***a* thus protecting the top of the heater and wall joint from excess temperatures. As another advantage of the secondary convection current, it will be observed that this current on emergence also creates in effect a relatively cool and gently moving exterior air curtain between the heated air and the wall above the unit, which substantially prevents significant wall smudging.

A common fault of prior heating devices has been the tendency to generate noise with changing temperatures. Such noise frequently arises, for instance, in metal-to-metal joints and particularly in cases wherein frictional gripping initially resists movement due to unequal contraction or expansion until the forces of the latter overcome the restraint, whereupon sudden release causes snapping, creaking or crackling sounds. In the present invention such noise is substantially prevented.

In the case of the heating unit itself, the previously described permanent expansion joint between the tube **45** to the thin fins **46** effectively prevents significant movement between these members, while the embossed structure of the fins prevents them from buckling. The core tube **45** is not clamped to the brackets **27** but is merely supported in the saddles **29** with ample longitudinal clearance between the brackets and adjacent fins as previously set forth, so that as temperature changes occur the movement between the tube and brackets may take place gradually in direct response to the increasing or decreasing expansive or contractive forces, thus minimizing tendency to the production of sounds at the supporting joints. In addition the fins **46** are spaced from the surrounding walls and resilient tape buffers **55** and disposed in the joints between the main closure plate **4** and the supporting bracket tabs **30** and **31** to prevent metal-to-metal contact.

The foregoing description of the novel structures and operation of the invention have been made in connection with two illustrative unitary embodiments, but it will be readily seen that not only may the device be made in any desired standard lengths but also that two or more complete units of the same or different lengths may be combined in a single installation to meet any particular special locational application. The junction boxes are provided with back, end and bottom knock-outs **77** as shown in FIGURE 3, promoting convenience in adaptation to available supply wiring and in inter-connecting multiple units. The double-ended type of structure shown in FIGURE 2 obviously permits interchangeable right-hand or left-hand location of supply conductors and thermostats. Furthermore, while electrical heating means has been illustrated and described it is evident many of the advantages of the invention may be realized with other heating means as for instance hot water and steam by arranging the finned tubes to be inter-connected with appropriate conduits. Thus while the device has been set forth in typical preferred forms it is not limited to the exact embodiments illustrated, as various changes and modifications may be made without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. A base-board heater, comprising in combination a main housing adapted to be joined to a wall along the upper border of said housing, said housing including a rear partition below said upper border and thermally insulated from said wall, a front closure plate spaced from said rear partition to form therewith a heating chamber having an air inlet below said plate and an air outlet above said plate, said closure plate having a forwardly inclined perforated lower main face portion spanning the greater portion of the height of said heating chamber, and a heating unit supported within said chamber in spaced relation between said rear partition and said front closure plate.

2. The combination according to claim 1 wherein said closure plate includes a relatively narrow rearwardly inclined perforated upper portion adjoining said main face portion.

3. In a baseboard heater, in combination, an elongated main housing having upper and lower edge portions adapted to be joined to a wall, said housing including a rear partition below said upper edge portion and thermally insulated from said wall, a removable front closure plate spaced from said rear partition to define therewith an elongated heating chamber having an air inlet below said closure plate and an air outlet above said closure plate, said closure plate having a forwardly inclined perforated lower main face portion spanning the greater portion of the height of said heating chamber, an elongated electric heating unit supported in said chamber in spaced relation to said rear partition and said front closure plate, means forming an electrical junction box in at least one end of said housing and a thermostat in said box and in electrical circuit with said heating unit.

4. In a device of the character described, in combination, an elongated main housing member adapted to be joined to a wall along the upper rear longitudinal edge portion of said member; said member including a vertical

rear plate portion spaced from said wall to define therewith a convective flue, a forwardly inclined imperforate portion above and adjoining said rear plate portion and a rearwardly inclined top portion extending from said forwardly inclined portion substantially to said upper rear edge, said rearwardly inclined top portion being perforated to provide an air exit from said flue; means forming a bottom air inlet to said flue; a plurality of forwardly extending brackets secured to said vertical rear plate portion, each of said brackets being formed with an aperture having a bottom boundary comprising a supporting saddle and having a forwardly extending access slot to said saddle; an elongated heating unit including a central tube normally supported in said saddles and longitudinally movable freely therein, and a plurality of thin embossed fins expansively secured to said tube, said unit being spaced from said rear plate portion; a front closure member removably secured to said brackets in snap-latch relation and spaced from said heating unit, said closure member including a forwardly inclined perforated main face portion and a rearwardly inclined perforated upper portion; and means in at least one end of said device for connecting said heating unit to a source of electric current.

5. The combination according to claim 4 including thin buffer means in the attachment joints between said front closure and said brackets and resilient sealing means in the joint between said main housing member edge portion and said wall.

6. Space-heating apparatus including, in combination, a mounting strip adapted to be horizontally secured to a vertical surface at a predetermined height from the foot of said surface, a housing removably attachable to said strip for support thereby on said vertical surface, said housing having a top including a rear border portion overlying said strip when in said attached position, a front cover plate on said housing and defining therewith, a lower air inlet to said housing, and an upper air outlet from said housing spaced forwardly from said rear border portion, and electric heating means in said housing, said front cover plate having a forwardly inclined perforated main portion in substantially horizontal alignment with said heating means.

7. In space-heating apparatus, in combination, elongated mounting means adapted to be secured to a vertical surface at a predetermined height from the foot of said surface; an elongated main housing member, said main member including a rear top border portion adapted to overlie and to engage said mounting means to form

therewith and with said surface a sealing and supporting joint, a forwardly extending perforated top portion adjoining said rear border portion, a rearwardly extending imperforate portion extending below said perforate top portion, a vertical rear wall portion adjoining said inclined portion and spaced below and forwardly of said rear border portion to form an air space between said rear wall portion and said vertical surface in communication with the cavity between said rearwardly inclined portion and said perforated top portion; means forming a lower inlet to said air space; a plurality of forwardly extending brackets on said rear wall portion; a front closure member detachably carried by said brackets to form with said rear wall portion a heating chamber having a main air inlet and a main air outlet respectively below and above said closure member, said closure member including a forwardly inclined perforated main zone and a relatively narrow rearwardly inclined perforated upper zone; a finned electric heating unit supported in free longitudinal sliding relation by said brackets within said heating chamber and spaced from the walls of said chamber, said heating unit being bodily removable through the front of said chamber; end plates secured to said main housing member, and means forming an electrical junction compartment in at least one of said housing assembly.

8. The combination according to claim 7 including thin resilient means disposed in said sealing and supporting joint, and resilient silencing means at the attachment points between said brackets and said closure member.

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