Nov. 27, 1934. A. J. KERCHER 1,982,139

ELECTRICAL AIR HEATER

Filed Jan. 19, 1931 4 Sheets-Sheet 1

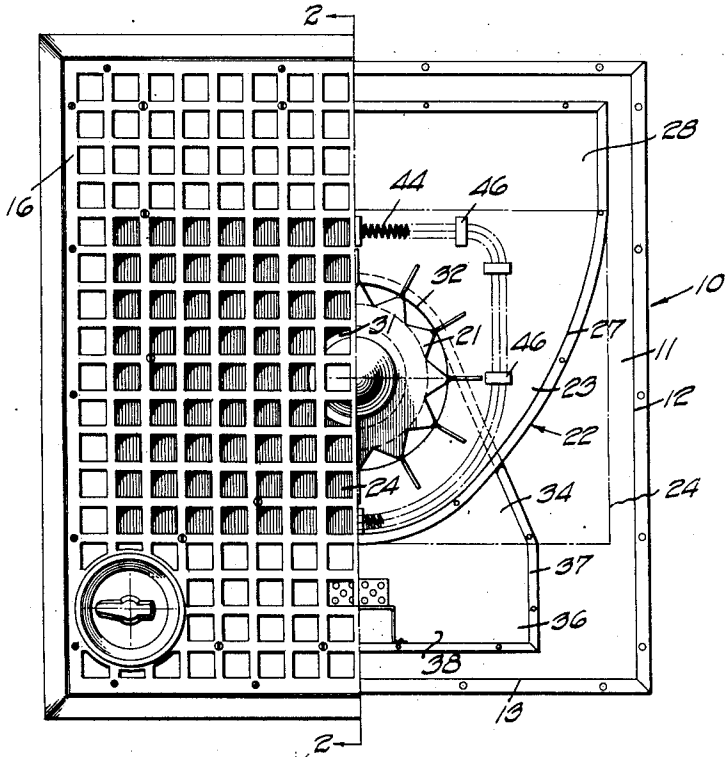

Fig. 1.

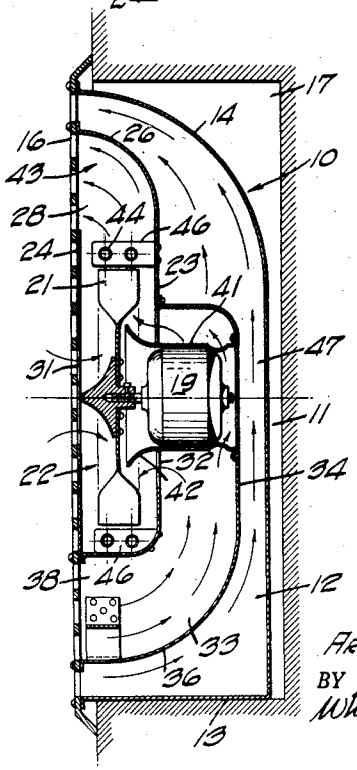

Fig. 2.

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Fig. 3.

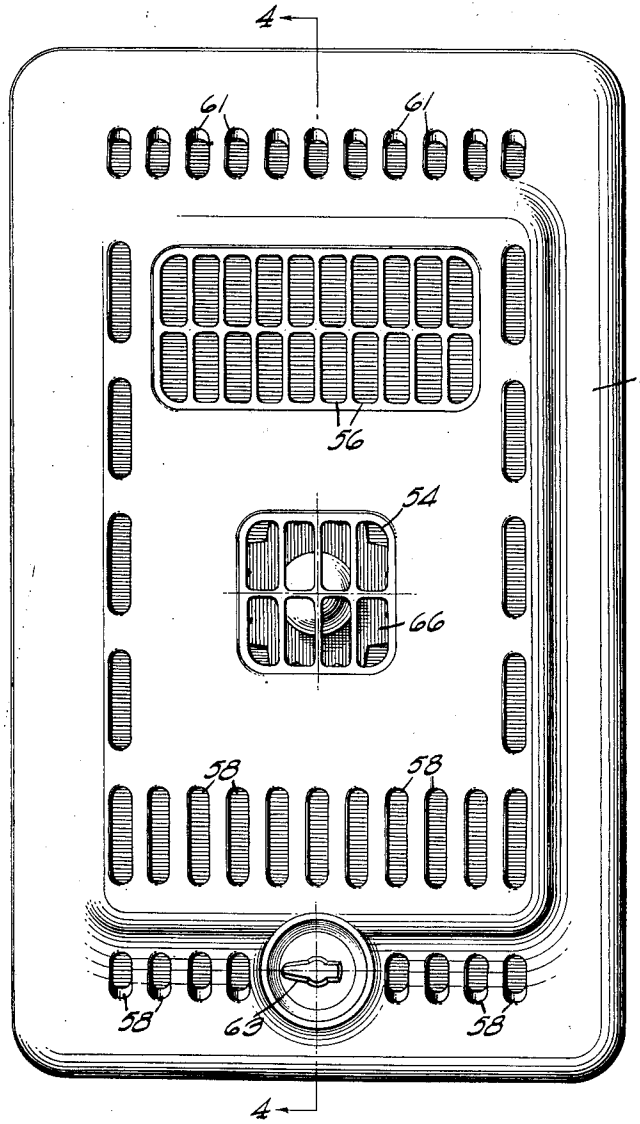
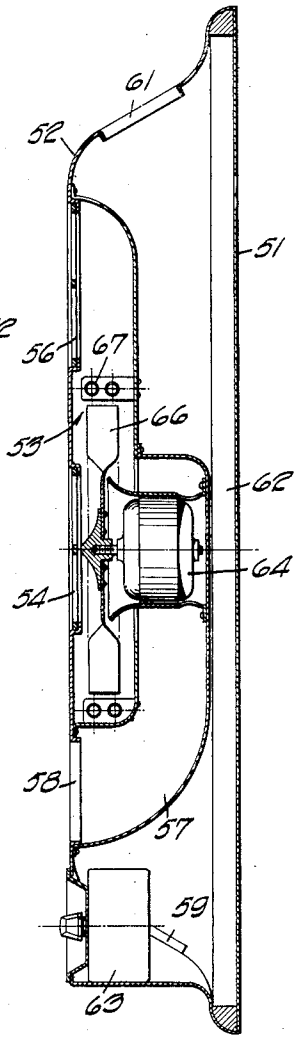


Fig. 4.



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ELECTRICAL AIR HEATER

Filed Jan. 19, 1931 4 Sheets-Sheet 3

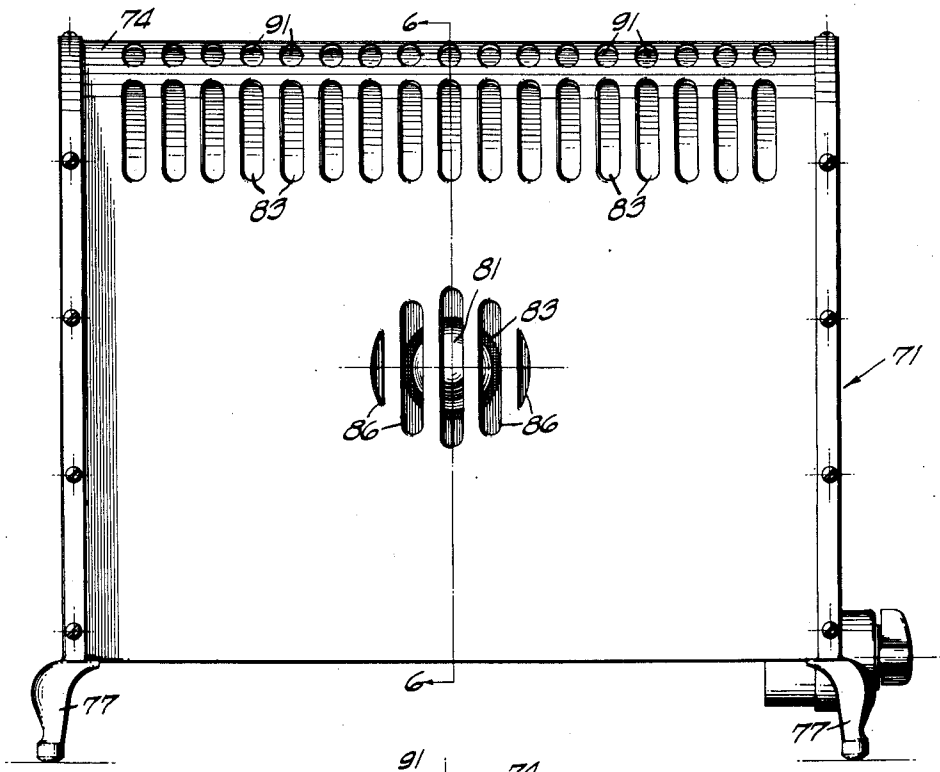

FIG. 5.

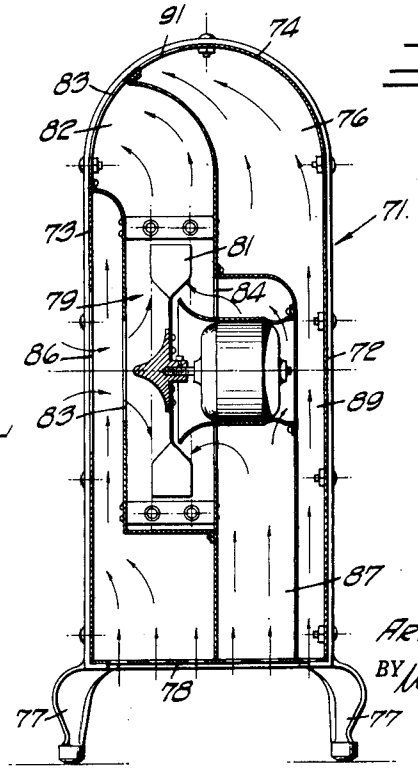

FIG. 6.

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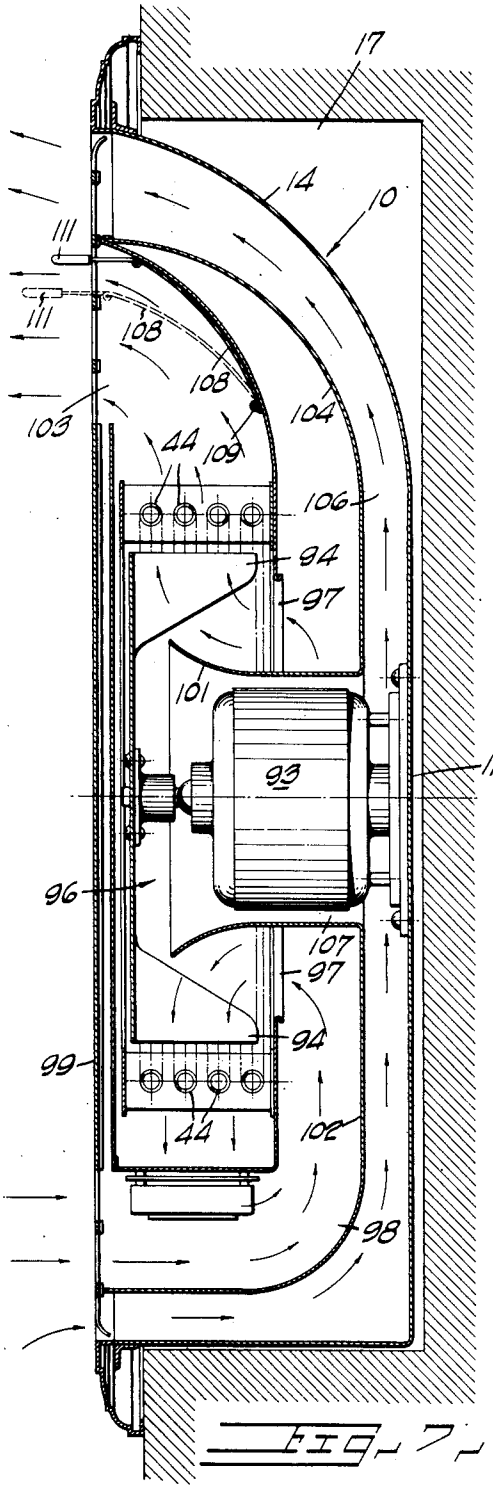

Fig. 7.

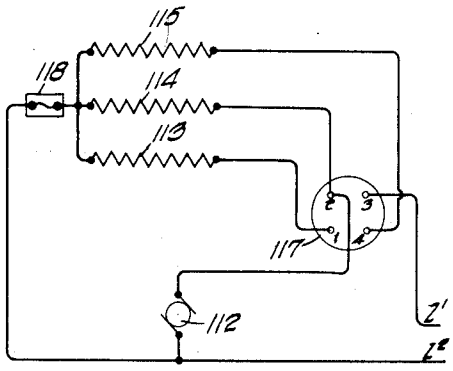

Fig. 8.

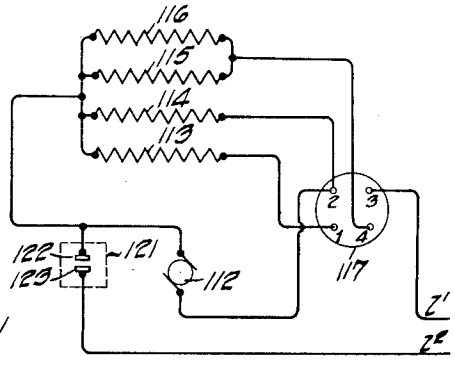

Fig. 9.

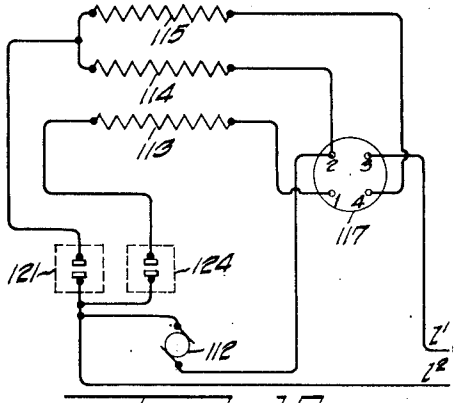

Fig. 10.

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UNITED STATES PATENT OFFICE

1,982,139

ELECTRICAL AIR HEATER

Arthur J. Kercher, Berkeley, Calif.

Application January 19, 1931, Serial No. 509,747

13 Claims. (Cl. 219—39)

This invention relates generally to electrical appliances adapted particularly for the heating of rooms of dwellings and other buildings. It relates particularly to that type of electrical air heaters in which a relatively large proportion of the heat developed by the electrical resistance or heating elements is imparted to circulative currents of air.

General objects of the invention are:—To devise an electrical air heater of the above type which will be relatively compact compared to its heating capacity; which will provide for relatively rapid circulation of air in the room thru the heater housing; which will be of relatively high efficiency; and which will operate in such a manner as to maintain the walls of the heater housing at a relatively low safe temperature.

Further objects of the invention will appear from the following description in which certain preferred embodiments of the invention have been set forth in detail in conjunction with the accompanying drawings. It is to be understood that the appended claims are to be accorded a range of equivalents consistent with the state of the prior art.

Referring to the drawings:

Figure 1 is a front view of an electrical air heater of the wall recess type, incorporating the present invention.

Fig. 2 is a cross sectional view taken along the line 2—2 of Fig. 1.

Fig. 3 is a front view of an electrical air heater of the wall hang-on type incorporating the invention.

Fig. 4 is a cross sectional detail taken along the line 4—4 of Fig. 3.

Fig. 5 is a front view of a portable type electrical air heater incorporating the present invention.

Fig. 6 is a cross sectional detail taken along the line 6—6 of Fig. 5.

Fig. 7 is a cross sectional detail of a wall recess type of electrical air heater incorporating the invention, and illustrating a modification of the general type of heater illustrated in Figs. 1 and 2.

Figs. 8, 9 and 10 are circuit diagrams illustrating electrical circuit connections which can be utilized with the invention.

Before explaining in detail the various forms of the invention illustrated in the drawings, it may be stated that in my invention a motor driven fan mounted within the heater housing is utilized for accelerating, inducing or forcing a rapid flow of air thru the heater housing. While fans or blowers have previously been utilized in connection with electrical air heaters, in my invention the heater structure is characterized by the fact that the currents of air flowing thru the heater housing are divided into primary and secondary currents, these currents being substantially isolated by the provision of separate air flow passages. As will be presently explained the primary air currents are preferably made relatively rapid by the action of the fan or blower, and effect major heating of the air within a room, while the secondary air currents form the useful purpose of maintaining certain walls of the heater housing at a relatively low safe temperature.

Referring to that form of the invention illustrated in Figs. 1 and 2, there is shown a housing 10 preferably made of metal, and including relatively upright back and side walls 11 and 12, a bottom wall 13, and a forwardly inclined top wall 14. The front of this housing is covered by a perforate wall or grille 16 which is suitably secured to the remainder of the housing. The housing is adapted to be positioned within a wall recess 17, whereby the grille 16 is substantially flush with the forward surface of the wall.

Mounted within housing 10 in a manner to be presently described, there is a suitable electrical motor 19. Mounted upon the shaft of this motor there is a rotatable fan or blower impeller 21. Surrounding impeller 21 there is a casing 22 which forms what can be termed a primary passage for circulation or flow of primary currents of air. The preferred form for casing 22 is apparent from an examination of Figs. 1 and 2. It will be noted that the back wall 23 of the casing extends in a plane substantially at right angles to the axis of rotation of impeller 21, and between this impeller and the back wall 11 of the housing. The forward wall 24 of casing 22 extends parallel to wall 23, and adjacent the inner surface of grille 16. The upper portion of wall 23 merges with a forwardly curved upper wall 26. The side walls 27 of the casing are curved as shown in Fig. 1, and extend between the edges of walls 23 and 24. The upper edge of wall 24 terminates short of the upper edge of wall 26, thereby forming a discharge opening 28 (Fig. 1). This opening 28 is relatively elongated by virtue of the fact that side walls 27 diverge upwardly, and extends across the upper portion of grille 16, whereby air delivered outwardly thru casing 22 is discharged outwardly thru the registering grille openings. Suitable openings are also provided in casing 22 for the inflow of air. Thus wall 24 is shown provided with an opening 31 which is substantially in alinement with the axis of rotation of impeller 21, and

which is in registry with certain of the more central openings in grille 24 as shown in Fig. 1. Another inflow opening 32 is in wall 23 and surrounds the motor 19.

To convey air to opening 32 in casing 22, an air flow conduit 33 is provided immediately below casing 22. This conduit 33 can be formed by relatively upright wall 34 which merges with a forwardly curved lower wall 36. Side walls 37 extend between the edges of walls 34 and 36 and the adjacent walls of casing 22. By virtue of the downwardly diverging character of walls 37 as shown in Fig. 1, the lower open end 38 of conduit 33 is relatively elongated as shown in Fig. 1, and is in registry with openings in the lower portion of the grille 16. The inner and upper end of conduit 33 delivers the air about motor 19 and thru opening 32 to casing 22. Motor 19 can be conveniently mounted within a shell 41 which in turn is mounted upon wall 34. The inner edge portion of shell 21 can be provided with a flared portion 42 to more efficiently direct air flow.

With the above described structure, it will be noted that upon operation of impeller 21, air will be drawn in thru the lower portion of grille 16, thru conduit 33, opening 32, and will be delivered by the impeller thru discharge opening 28 and openings in the upper portion of the grille. By virtue of the function of opening 28 to discharge air from casing 22 thru the grille and from the upper portion of the housing, the upper portion 43 of casing 22 can be designated generally a "discharge portion". As representative of suitable electrical means for heating the air caused to flow by operation of impeller 21, there is shown a plurality of coil resistance wires 44 carried by suitable support brackets 46, and arranged to surround the periphery of impeller 21.

To secure certain advantages, as for example ease of manufacture and to facilitate making repairs, the structure forming casing 22 and conduit 33, is mounted upon and carried as a unit by grille 16 as shown in Fig. 2. From an inspection of Figs. 1 and 2, it will also be noted that this entire structure when in operative position is retained in spaced relationship with respect to the back, sides, top and bottom walls of the housing 10. The space thus formed, indicated generally at 47 in Fig. 2, forms an upstanding flue for passage of convection currents of air. It will be noted that the lower end of this flue is in communication with the exterior of the housing thru openings along the lower edge of grille 16, below wall 36, and that likewise the upper end of flue 47 is in communication with the exterior of the housing thru openings along the upper edge of grille 16 above wall 26. Likewise the flue or above mentioned space is in communication with the exterior of the housing at both sides of the heated housing, thru the openings along the side edges of grille 16.

In operating the heater described above, assuming that current is supplied to the elements 44 and to the electrical motor 19, a rapid flow of air will occur thru casing 22 by virtue of rotation of impeller 21. The circulation of air is into the lower portion of the housing thru opening 38, and after being heated by contact with elements 44, the air is discharged in a generally horizontal direction from the upper portion of the heater housing thru opening 28. By virtue of proximity with elements 44, and also by virtue of contact with the heated currents of air, the walls of casing 22 will become heated to an elevated temperature, and a large part of this heat will be transmitted to air present in space flue 47. Thus an upwardly moving current of air is induced to flow thru this flue, the air currents flowing inwardly into the lower portion of the housing, and outwardly thru grille 16 above wall 26. Such a flow of convection currents of air serves to carry away heat transmitted to the walls of casing 22, to effectively deliver this heat to the air within the room, and at the same time the back, sides, top and bottom walls of housing 11 are maintained at a relatively low safe temperature. Even in the event that motor 19 fails to operate, sufficient heat will be carried away by such convection currents of air to prevent a fire hazard. In explanation of the appended claims it may be noted that casing 22 together with conduit 33 can be considered as forming a primary passage, while space or flue 47 can be considered as forming a secondary passage for air flow thru the heater housing.

That form of the invention illustrated in Figs. 3 and 4 is somewhat similar to the modification described above with reference to Figs. 1 and 2, except in this instance the heater is of such a form that it is adapted for hanging flat upon the wall of a room. Thus the housing in this instance is formed by a relatively flat back wall 51, together with a forwardly bulged front plate or wall 52. Air flow casing 53, corresponding to casing 22 of Figs. 1 and 2, is mounted upon the front wall 52, between this wall and back wall 51. Inflow and outflow openings 54 and 56 are formed in front wall 52, and therefore a wall corresponding to wall 24 of Figs. 1 and 2 can be omitted. Conduit 57 corresponding to conduit 33 of Fig. 2, communicates with the lower row of openings 58 in plate 52. A row of openings 59 in the lower portion of plate 52, below openings 58, and a row of openings 61 in the upper portion of the plate above openings 56, provides for inflow and outflow of convection currents of air induced to flow upwardly thru the space or flue 62, corresponding to flue 47 of Fig. 2. A manual switch 63 is indicated for controlling the current supply. Motor 64, impeller 66, and heating element 67, are arranged substantially the same as the corresponding elements shown in Figs. 1 and 2.

In Figs. 5 and 6 in which the invention is applied to a portable type of heater, the formation of the air flow casing for the air impeller, and the conduit for delivering air to the same, are somewhat modified. Thus in this case the heater housing 71 is formed of substantially parallel upright rear and forward walls 72 and 73 which have their upper portions merging to form a curved top wall 74. The sides or ends of the housing are formed by upright end walls 76. Suitable supporting legs 77 are provided to retain the housing in spaced relationship with the floor, and the bottom wall 78 of the housing is perforated to permit upward flow of air currents. Air flow casing 79, corresponding to casing 22 of Figs. 1 and 2, surrounds the rotatable impeller 81, and has a forwardly directed or curved discharge portion 82 communicating with an upper row of apertures 83 in front wall 73. Casing 79 is also provided with inflow openings 83 and 84. A certain amount of the air drawn in thru opening 83 can flow directly from the exterior thru openings 86 in front wall 73, and a certain amount of the air flowing thru opening 83 can be taken from the air flow occurring upwardly thru perforated bottom wall 78. Conduit 87, corresponding to conduit 33 of Figs. 1 and 2, extends

downwardly and communicates with the exterior of the housing thru the perforations in bottom wall 78. The structure forming casing 79 and conduit 87, is disposed in spaced relationship to the housing back wall 72, end walls 76 and top wall 74, to provide an upstanding space or flue 89 for flow of convection currents of air. The lower end of this flue is in communication with the exterior of the housing thru openings in bottom wall 78, while the upper end of the flue is in communication with the exterior of the housing thru a row of openings 91, immediately above openings 83.

That form of the invention illustrated in Fig. 7 is somewhat similar to that described above with reference to Figs. 1 and 2, in that it is also an air heater of the wall recess type. Utilizing the same designating numerals for the housing, it will be noted that the motor 93 is mounted upon the back wall 11 of housing 10. The impeller 94 is similarly disposed within an air flow casing 96 and is mounted upon the shaft of motor 93. Inflow of air into casing 96 is effected solely thru opening 97 surrounding motor 93, and this opening communicates with conduit 98 corresponding to conduit 33 of Figs. 1 and 2. The medial part of grille 99 is imperforate; upper, lower and side openings being provided for inflow and outflow of currents of air. Shell 101 surrounding motor 93 is flared to efficiently deliver air drawn into conduit 98 to the impeller 94. Wall 102 of conduit 98 is preferably extended upwardly behind the discharge portion 103 of casing 96, thus forming an upwardly forwardly sloped wall 104. By means of this construction two spaced walls are disposed between all parts of the heating elements and the back wall 11. In fact it is preferable to form conduit 98 as a part of a metal shell which entirely surrounds casing 96 and which has separate vertical side walls spaced inwardly from the side walls of the housing. The space or upstanding flue 106, between walls 102, 104 and back wall 11, can be in communication with the inflow side of casing 96 thru an annular opening 107 surrounding motor 93.

With an electrical air heater of the types described above it is desirable to provide some means for manually controlling the direction of discharge of heated air. Thus in Fig. 7 there is shown a curved vane 108, which is mounted within the discharge portion 102 of housing 96 by a suitable hinged connection 109. A handle 111 is secured to this vane and projects thru one of the openings in the front grille. By manipulating handle 111 vane 108 can be set at different angles, as for example the limiting position shown in dotted lines, or any intermediate position. Thus the angle of discharge of the hot air with respect to the horizontal, can be adjusted to suit convenience of particular conditions.

The circuit diagram illustrated in Fig. 8 can be utilized with any of the electrical air heaters previously described. In this case the fan or blower motor is indicated at 112, and the electrical heating means is divided into three elements 113, 114, and 115. Manual control switch 117 is provided with three terminals or contacts marked 1, 2, 3 and 4. Current supply line L_1 is shown connected to terminal 4, while current supply line L_2 is shown connected to one side of motor 112, and the common terminals of the elements 113, 114 and 115. A fuse 118 is shown connected in series with line L_2. This fuse can be of such a character as to open the circuit when the temperature is increased beyond a given maximum, and is mounted at some convenient point within the heater housing. In the event of occurrence of abnormal condition, as for example disruption of the fan or blower motor while the heating elements are operating at full capacity, fuse element 118 will open the circuit before a fire hazard is created. The other terminals of elements 113, 114 and 115 are connected to the contacts of switch 117 as shown and the other side of motor 112 is connected to contact 2. Switch 117 is provided with a manual control element having high, medium, low and off positions. In high position of the switch, contacts 1, 2, 3 and 4 are shunted together so that motor 112 is connected across lines L_1 and L_2 and whereby all of the heating elements are connected together in parallel. In medium position of switch 117 contact 3 is disconnected from contact 4, but contacts 1, 3 and 4 are shunted. Thus motor 112 continues to operate, but only elements 113 and 114 are connected in parallel across the current supply line. For low position of switch 117, contacts 2 and 3 are disconnected from contact 4 and line L_1 and only contact 1 is shunted with contact 4. Therefore only element 113 is in operation and fan motor 112 is disconnected. In this position of the switch all of the heat developed by element 113 is imparted to convection currents of air which are induced to circulate thru the heater housing, without the accelerating effect of the fan. For off position of the switch 112 all of the element and motor 112 are disconnected from the current supply lines.

In the circuit connection shown in Fig. 9 the electrical heating means is divided into four elements 113, 114, 115 and 116. Elements 115 and 116 are always shunted together in the manner indicated. Substantially the same connections are made between these elements and the contacts of switch 117, and with the current supply lines L_1 and L_2. However temperature responsive fuse 118 is omitted, and a temperature responsive or thermostat control switch 121 has its contacts 122 and 123 interposed in series with line L_2. Preferably switch 121 is mounted within the heating housing in the path of currents of air being drawn from the room into the heater, as for example as indicated in Fig. 2. When in such position it operates responsive to the temperature of the air within the room being heated. Manual operation of switch 117 to its different operating positions, is substantially the same as has been previously described with respect to Fig. 8. However if in any one position of the switch, the temperature of the air within the room rises to a predetermined value, depending upon the setting of switch 121, the contacts of this switch automatically open to interrupt further supply of current both to the heating elements and to the fan motor 112. When the temperature of the air within the room drops down below a given predetermined value, the contacts 122 and 123 are automatically closed, to reestablish operation of the heater. For low position of switch 117, it will be noted that switch 121 only controls the supply of current to element 113 and not to the fan motor 112.

The circuit diagram of Fig. 10 differs from that described with respect to Fig. 9 in that another temperature responsive switch 124 is utilized in addition to switch 121. Likewise in this instance one side of fan 112 is connected directly to line L_2 rather than in series with the contacts of switch 121. Common terminals of elements 113 and 115 are connected to one of the contacts of

switch 121, while the corresponding terminal of elements 115 is connected to one of the contacts of switch 124. The other contact of switch 124 is connected to line L_2. Switch 124 therefore only controls supply of current to element 113. Switch 124 is preferably adjusted so that its contacts will automatically open when the temperature of the air of the room is at a certain value, substantially lower than the value required to open contacts of switch 121. Therefore assuming high position of switch 117, as the temperature of the room increases the contacts of switch 124 will first be opened to disconnect element 113. Thereafter a lesser amount of heat will be imparted to the air of the room thus tending to maintain the temperature substantially constant. In the event that the temperature does tend to continue to increase to a somewhat higher temperature value, switch 121 will open its contacts to discontinue supply of current to elements 114 and 115. As the temperature of the room falls, contacts of switch 121 will first be established, to again supply current to elements 114 and 115. If the temperature continues to fall, the contact to switch 124 will be closed to also supply current to element 113. It is obvious that this mode of operation will tend to maintain a more constant temperature of the air within a room. The same mode of operation will take place for medium position of switch 117. For low position of switch 117, fan 112 is disconnected, and only element 113 is supplied with current, but the supply of current is under the control of switch 124.

I claim:

1. In an electrical air heater, a housing, walls within said housing serving to divide the interior thereof into primary and secondary upwardly extending air passages, electrical heating means disposed within the housing and adapted to heat air in said primary passage, and a fan or blower disposed within the housing and adapted to effect a rapid flow of air into the housing, thru said primary passage, and out of the housing after being heated by said electrical means, said secondary passage being open to the exterior of the housing at its lower and upper ends thereby forming a flue for upwardly circulating convection currents of air.

2. In an electrical air heater, a housing, walls disposed within said housing and serving to divide the interior thereof into primary and secondary air flow passages, said housing having a back wall and said secondary passages being interposed between said back wall and said primary passage, an electrical fan disposed within the housing and serving to cause a rapid flow of air into the housing, thru said primary passage, and out of the housing, and electrical means serving to heat the air flowing thru said primary passage, said housing having spaced upper and lower openings serving to permit flow of convection currents of air into the housing, thru said secondary passage, and out of the housing.

3. In an electrical air heater, a housing, an electrical fan disposed within the housing, an air flow casing surrounding the impeller of the fan, said casing having air inflow openings communicating with the exterior of the housing and having a discharge portion spaced upwardly from said inflow opening and adapted to discharge air laterally of the housing, and electrical heating means disposed within said casing, said casing being so disposed within the housing as to form a secondary flue for flow of convection currents of air thru the housing.

4. In an electrical air heater, a housing, an electrical motor disposed within the housing, a rotatable air impeller driven by the motor, an air flow casing surrounding said impeller, said casing having a relatively wide discharge portion opening thru one side wall of the housing above said impeller, said casing also having inflow openings communicating with the exterior of the housing at points spaced below said discharge portion.

5. In an electrical air heater, a housing, an electrical motor disposed within the housing, a rotatable impeller mounted upon the shaft of the motor, an upright air flow casing disposed within the housing and surrounding said impeller, and electrical heating means disposed within said casing, said casing having a relatively wide discharge portion opening thru one side wall of the housing, and having inflow openings communicating with the exterior of the housing at points spaced below said discharge portion.

6. In an electrical air heater, a housing having upright front and back walls, an electrical motor disposed within the housing, a rotatable air impeller mounted upon the shaft of the motor, a casing disposed within the housing and surrounding said impeller, said casing being immediately behind said front wall and spaced from said back wall, electrical heating means disposed within said casing, said casing having a discharge portion communicating thru said front walls and having inflow openings communicating through said front wall below said discharge portion, said housing also having upper and lower openings serving to permit flow of convection currents of air thru the space between said casing and said back wall.

7. In an electrical air heater, a housing having relatively upright front and back walls, the back wall being substantially imperforate, a motor disposed within said housing, a rotatable air impeller mounted upon the shaft of the motor, a casing surrounding said impeller and diposed immediately behind said front wall, said casing being spaced forwardly from said back wall, and electrical heating means disposed within said casing, the upper part of said casing serving to form a discharge portion to direct heated air laterally thru said front wall, said casing also having inflow openings communicating thru said front wall in an area spaced below such discharge portion.

8. In an electrical air heater, a housing having relatively upright front and back walls, a motor mounted within the housing, an air impeller mounted upon the shaft to the motor, an air flow casing surrounding said impeller, said casing having an upper discharge portion and an opening below said discharge portion for the inflow of air to the impeller, said front wall having openings adapted to communicate with said discharge portion and other openings at a substantial distance below serving to communicate with the inflow openings in the casing, electrical heating means within the casing and means disposed within the housing, embracing the lower portion of said casing, and forming an inflow conduit, said conduit communicating with the inflow openings in said casing and also communicating with the exterior of the atmosphere thru openings in said front wall.

9. In an electrical air heater adapted to be positioned within a wall recess, a housing having a relatively upright back wall, and having a grille forming a front wall for the same, an electrical

motor disposed within the housing with its shaft horizontal, a rotatable air impeller mounted upon the horizontal shaft of the motor, an upright air flow casing surrounding said impeller and mounted immediately behind said grille, said casing being spaced with respect to the back, top, bottom and side walls of the housing, and electrical heating means disposed in said casing, said casing having a discharge portion communicating thru an upper portion of the grille and an inflow portion communicating through a lower portion of the grille, said space between said casing and the back, top and bottom and side walls of said housing forming an upwardly extending flue for convection currents of air and communicating with the exterior of the housing thru the upper and lower edges of said grille.

10. In an electrical air heater, a housing adapted to be fitted into a wall recess and comprising relatively upright back and side walls, a bottom wall and a top wall, and a grille extending over the front of the housing, a motor mounted within the housing with its shaft horizontal, a rotatable air impeller mounted upon the shaft to the motor, an air flow casing surrounding said impeller and having a diverging discharge portion adapted to discharge air laterally thru an upper portion of the grille, said casing also having inflow openings, an inflow conduit formed immediately below said casing and having one portion thereof communicating with the exterior of the housing thru said grille and another portion thereof communicating with said inflow openings of said casing, and electrical heating means associated with said casing, both said casing and said conduit being spaced from the back, sides, bottom and top walls of said housing thereby forming a relatively upright flue for convection currents of air, said flue being in communication at its upper and lower ends with the exterior of the housing thru said grille.

11. In an electrical air heater, a housing, an electrical motor disposed within the housing, a rotatable air impeller driven by the motor, an upright air flow casing within the housing and surrounding said impeller, said casing having a relatively wide discharge portion opening through one side wall of the housing, said casing also having inflow openings communicating with the exterior of the housing at points spaced from said discharge portion and adjacent the axis of rotation of said air impeller, and an electric heating element surrounding the periphery of said air impeller, whereby a forced draft of air is caused to pass into and out of said housing past said heating element.

12. In an electrical air heater, a housing, an electrical motor disposed within the housing, a rotatable air impeller driven by the motor, an air flow casing surrounding said impeller, said casing having a relatively wide discharge portion opening through one side wall of the housing, said casing also having inflow openings communicating with the exterior of the housing at points spaced from said discharge portion and adjacent the axis of rotation of said air impeller, an electric heating element surrounding the periphery of said air impeller, whereby a forced draft of air is caused to pass into and out of said housing past said heating element, and a second air flow casing spaced from and surrounding said first air flow casing to provide a path for convection currents of heated air.

13. In an electrical heater, an upright housing having an upright back wall and also a grille forming an upright front wall for the same, an electrical motor disposed within the housing with its shaft arranged horizontally, a rotatable impeller mounted upon said shaft, an upright air flow casing having its lower portion surrounding the impeller and mounted immediately behind said grille, said casing being spaced with respect to the back, top and bottom walls of the housing, the rear wall of the casing being upright and having its upper portion sloped forwardly, the lower portion of the casing having communication through the grille for inflow of air to the impeller and the upper portion of the casing having communication thru the grille for the forward discharge of heated air, the contour of the casing as viewed from the front of the housing being of reduced width for the lower portion surrounding the impeller and of enlarged width for the upper portion of the casing from which heated air is discharged, and heating elements disposed within said casing.

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