

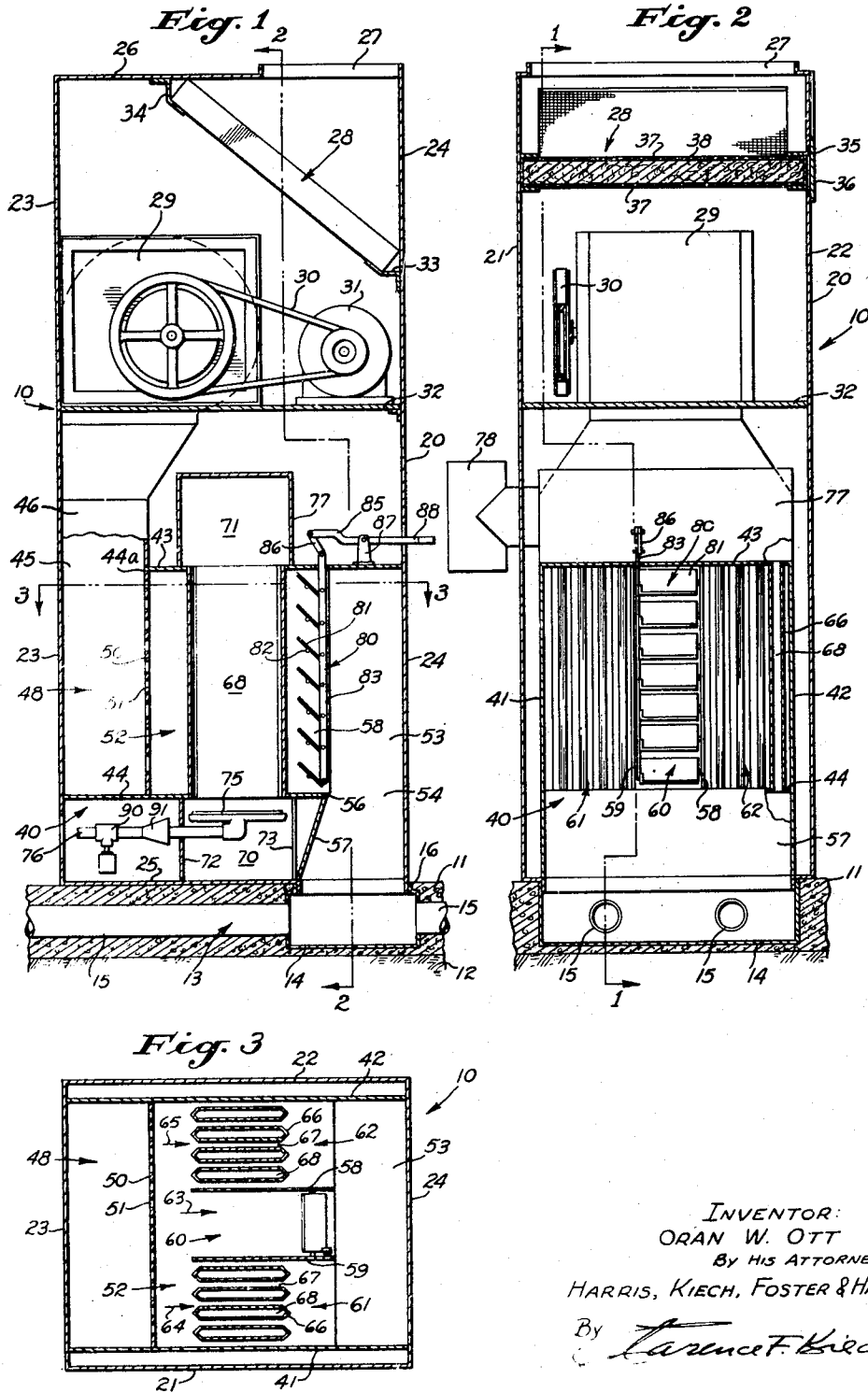
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FUEL BURNING FORCED AIR HEATING UNIT

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FUEL BURNING FORCED AIR
HEATING UNIT

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My invention relates to a forced air heating unit and particularly to a heating unit for delivering warmed air to an under-floor heating system.

It has been demonstrated that one of the most satisfactory ways of heating a room is by circulating a heating medium through floor ducts whereby the air in the room is heated by radiation and conduction from the floor. Heretofore, this method of heating has been employed, to a limited extent, in concrete-floor structures by imbedding a network of pipes in the concrete and circulating hot water therethrough. Any precipitation of minerals from the water tends to clog such a system and cleaning thereof is very difficult. In addition, any leaks in the pipes are almost impossible to repair.

I have found that these difficulties can be overcome and that a much more satisfactory and long-lived heating arrangement can be produced by circulating warmed air through an appropriate network of ducts imbedded in or associated with a floor formed of concrete or other material. The present invention is concerned particularly with a heating unit for supplying warmed air to the inlet of such an under-floor duct system.

It is an object of the present invention to provide a compact forced air heating unit for delivering warmed air to the inlet of an under-floor heating system and to provide a heating unit of this type which is of relatively small size so as to occupy a minimum of floor space. The invention will be illustrated as incorporated in a vertical-type heating unit which can be placed in a closet or relatively small heating room of a residence or small industrial building.

It is an object of the invention to provide a forced air heating unit in which the warmed air is delivered from the lower portion of the unit and in which the air to be heated enters an upper portion of the unit, whether this air is drawn from the atmosphere or recirculated from the under-floor heating system.

Another object of the invention is to provide such a heating unit in which a blower is mounted in the upper portion thereof, also to provide such a unit in which an air filter is disposed in novel position in such an upper portion of the heating unit.

The invention incorporates a novel heating structure and it is an object to provide horizontally-spaced entrance and outlet chambers with a substantially horizontal space therebetween in which the air is heated.

A further object of the invention is to heat the

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air in such a space by heat transfer from products of combustion rising through internally-passaged heating elements in this space.

If the temperature of the products of combustion is reduced below the dew point, there will be a tendency for moisture to condense from the products of combustion and corrode the heating elements. Because of the presence of carbon dioxide in the products of combustion, the condensate may be a weakly acidic solution of hydrocarbonic gas which is highly corrosive to the walls of the heating elements. These walls are desirably relatively thin to facilitate heat transfer from the products of combustion to the air flowing around the heating elements and it has been found that such heating elements are relatively rapidly corroded and must be replaced after being in use for a period of one to three years.

This deficiency can be eliminated if the products of combustion are not cooled to a temperature below the dew point. It is an object of the present invention to provide a novel control for preventing such cooling of the products of combustion to a temperature below the dew point.

Another object is to divide the air into portions flowing respectively through heating and by-pass chambers, these portions mixing or blending therebeyond. Another object is to control the relative volumes of these portions of air so that the products of combustion are not cooled below the dew point.

Further objects and advantages of the invention will be evident to those skilled in the art from the following description of an exemplary embodiment:

Referring to the drawing.

Fig. 1 is a vertical sectional view of a heating unit of the invention taken on the line 1-1 of Fig. 2.

Fig. 2 is a vertical sectional view taken on the line 2-2 of Fig. 1, and

Fig. 3 is a horizontal sectional view taken on the line 3-3 of Fig. 1.

Referring particularly to Figs. 1 and 2, the heating unit of the invention, indicated generally by the numeral 10, is adapted to be mounted directly on a floor 11 which may be a slab of concrete cast directly on the ground, indicated at 12. Incorporated in the floor 11 is a suitable under-floor heating system 13 which may be of any suitable type but which is shown diagrammatically as including a header 14 from which various conduits 15 extend to conduct heated air to heat the floor and any room area thereabove. The header 14 provides an upwardly extending collar

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16 comprising an inlet for the under-floor heating system, this collar being shown as terminating flush with the upper surface of the floor 11.

The heating unit 10 includes a vertically disposed housing 20 providing side walls 21 and 22, end walls 23 and 24, a bottom wall 25 and an upper wall 26. The upper wall 26 provides an air inlet opening 27 which may communicate with the surrounding atmosphere or which may be connected to a return from the under-floor heating system 13 to conduct cooled air to the air inlet opening 27. Air is drawn into the air inlet opening 27 and through a filter 28 by a fan or blower 29 connected by a belt 30 to an electric motor 31, the fan and motor being mounted on a horizontal wall 32 secured to the side and end walls of the housing 20.

The filter 28 is mounted in the upper portion of the housing 20 in an inclined position to extend diagonally between the end wall 24 and the upper wall 26, being retained by brackets 33 and 34 respectively secured to these walls. The inclined filter 28 thus divides the upper portion of the housing 20 into an essentially triangular air inlet chamber above the filter and a lower chamber below the filter. Preferably the side wall 22 provides an opening 35 through which the filter 28 may be slid into place, this opening being closed by a hinged cover 36, best shown in Fig. 2. The filter 28 may be of any suitable type, for example, a pair of perforated members 37 with a pad of fibrous material 38 therebetween.

In the lower portion of the housing 20 is a heating structure, indicated generally by the numeral 40. This heating structure includes side walls 41 and 42 extending between the end walls 23 and 24, also an upper wall 43 and a lower wall 44. The upper wall 43 extends between and is secured to the side walls 41 and 42. It also extends from the end wall 24 toward the end wall 23 but provides an end 44a terminating short thereof to provide an entrance opening 45. A duct 46 conducts air from the blower to this entrance opening and to an entrance chamber 48.

The inner portion of this entrance chamber 48 is bounded by a distribution plate 50 extending downwardly between the end 44 of the upper wall 43 and the lower wall 44. The distribution plate 50 includes openings 51 which are smaller in size or number near the upper end of the plate than near the lower end so that these openings are of greater combined area toward the lower end of the distribution plate 50. The arrangement of the openings 51 is such that air moving downwardly into the entrance chamber 48 is distributed to flow substantially horizontally and at substantially equal velocity through all portions of a horizontal space 52 bounded at its upper and lower ends by the walls 43 and 44 and at its sides by the side walls 41 and 42. This air enters an outlet chamber 53 from whence it flows downwardly through an exit opening 54 to the air inlet of the under-floor heating system 13. The lower wall 44 extends between and is secured to the side walls 41 and 42. It extends from the end wall 23 toward the end wall 24 but terminates short thereof to provide an end 56, being bent downwardly therefrom to form a sloping member 57 which aids in guiding the air from the outlet chamber to the under-floor heating system.

It is desirable that the air moving through the horizontal space 52 be divided into portions moving respectively through one or more heating chambers and one or more by-pass chambers. In the construction shown, two partitions 58

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and 59 extend vertically across the horizontal space 52 to define a by-pass chamber 60 between the partitions and heating chambers 61 and 62 between the partitions and the side walls 41 and 42. One portion of the air thus flows substantially horizontally through the by-pass chamber 60 as indicated by the arrow 63. Another portion of the air flows as indicated by arrow 64 through the heating chamber 61 and another portion flows as indicated by the arrow 65 through heating chamber 62. All of these portions mix or blend in the outlet chamber 53.

To heat the air flowing through the heating chamber 61 and 62, I provide a plurality of tubular heating elements 66 in each of these chambers, the heating elements being separated from each other to define heating passages 67 therebetween. Each tubular heating element extends between the upper and lower walls 43 and 44 and provides a passage 68 opening at its lower end to a burner chamber 70 and at its upper end to a suitable vent space 71. The burner chamber 70 is bounded by transverse walls 72 and 73 extending between the side walls 41 and 42, and contains a burner 75 fed with fuel through a supply pipe 76. The products of combustion rise through the passages 68, heating the walls thereof and the surrounding air while at the same time being cooled during the upward movement. These products discharge into the vent space 71 formed by a hood 77 and are conducted from the housing 20 to a vent connection 78 adapted to be connected to a vent pipe not shown.

It is desirable that the products of combustion should not be cooled below the dew point while in the passages 68 or the vent space 71. To accomplish this, a somewhat restricted amount of air is permitted to flow through the heating chambers 61 and 62, the heating passages 67 being restricted in cross sectional area for this purpose. However, the temperature of the air moving from the heating chambers 61 and 62 into the outlet chamber 53 will then be substantially higher than desired for the under-floor heating system 13. Desirably the temperature of the air entering this system should be in the neighborhood of 120-180° F., depending upon the heating requirements. At the same time the products of combustion should not be cooled below the dew point and, in this connection, should preferably not be cooled below a temperature in the range of 180-250° F. to insure this result. Correspondingly, the portions of heated air issuing from the heating chambers 61 and 62 should be cooled before entering the under-floor heating system. This function is performed by the by-passed portion of air which flows through the by-pass chamber 60 and mixes with the heated portions in the outlet chamber 53.

Usually it is desirable to design the heating unit so that a relatively large volume of air will move through the by-pass chamber 60. At the same time it is desirable to be able to adjust the relative volumes of by-passed and heated air. To serve this purpose a suitable damper means 80 is provided, preferably near the point where the by-pass chamber 60 opens on the outlet chamber 53. The preferred damper means 80 includes a plurality of damper members 81 each mounted on its individual shaft 82 journaled in the partitions 58, 59. The damper members 81 are respectively pivoted to an arm 83 which is vertically movable to correlate the positions of these members. In the illustrated embodiment the arm 83 is connected to a lever 85 by a link 86, the lever

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85 being pivoted on a standard 87 and extending to the exterior of the housing 20 to form a handle 88. By moving this handle vertically, the positions of the damper members can be simultaneously changed to restrict the by-passed portion of the air and thus control the amount of air forced through the heating chambers 61 and 62. The setting of the damper means can be adjusted when the heating unit is first installed, the selected setting being such that the products of combustion are never cooled below the dew point during normal operation of the heating unit.

Any suitable controls can be used to vary the amount of fuel supplied to the burner 75 and thus vary the temperature of the room heated by the under-floor heating system 13. As illustrated, a magnetic valve 90 is interposed in the supply pipe 76 ahead of an air mixer 91. This magnetic valve may be operated by any suitable switch or by a thermostat located in the room being heated.

It will be apparent that the space between the walls 26 and 32 forms an upper compartment with which the air inlet opening 27 communicates; also that the space between the walls 32 and 43 comprises an intermediate compartment in which the vent means is positioned. Likewise, the space between the upper wall 43 and the bottom wall 25 comprises a lower compartment in which is positioned the outlet chamber 53 and its warm air outlet. This super-imposition of compartments is very desirable from the standpoint of compactness and efficiency. The arrangement illustrated is also advantageous in providing an air path which is downward in the entrance chamber 48, substantially horizontal in the space 52 and substantially downward in the outlet chamber 53.

It will be apparent also that the invention includes a simple yet very efficient arrangement for preventing condensation in the passages 68 of the heating elements 66. This results from the relationship between the by-passed and heated air streams. While the by-pass arrangement can be eliminated if long life of the heating unit is to be sacrificed, it is distinctly preferable to employ this feature. This is particularly true in a heating unit for supplying warmed air to an under-floor heating system because the discharged air should not be at too high a temperature as the floor temperature should not be excessively above the desired room temperature. It should be apparent, however, that other arrangements of the by-pass chamber 60 and the heating chambers 61, 62 can be employed without departing from the spirit of the invention. It is distinctly desirable, however, to dispose the by-pass chamber between heating chambers. On the other hand, the invention is not limited to the use of a single by-pass chamber with two heating chambers. In some instances a plurality of by-pass chambers may be employed, preferably spaced so that a heating chamber is disposed therebetween.

Various changes and modifications can be made without departing from the spirit of the invention as defined in the appended claims.

I claim as my invention:

1. In a forced air heating unit for delivering warmed air to an inlet of an under-floor heating system, the combination of: a housing providing vertically-extending, horizontally-spaced entrance and outlet chambers, said outlet chamber including a warm air outlet for connection to said inlet of said under-floor heating system; an upright perforated distribution plate bounding said entrance chamber on the side thereof toward

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said outlet chamber; walls defining a substantially horizontal space communicating with and extending between said entrance and outlet chambers; a heating means comprising a plurality of internally-passaged tubular heating elements extending upwardly through said space, a burner means for supplying hot products of combustion to the passages of said heating elements to flow upwardly therethrough, and a vent means communicating with the upper ends of said passages of said heating elements, said heating elements being spaced from each other to define heating passages therebetween in said horizontal space through which air may flow from said entrance chamber to said outlet chamber, said upright perforated distribution plate being spaced upstream from said heating passages and providing a plurality of openings for distributing the air into said substantially horizontal space from said entrance chamber; and means for forcing air downwardly in said entrance chamber to flow substantially horizontally through said heating passages to said outlet chamber and thence downward to said warm air outlet.

2. A heating unit as defined in claim 1, in which said openings are of a greater combined area toward the lower end of said substantially horizontal space.

3. A heating unit as defined in claim 1, in which said heating means is in a lower portion of said housing and in which said air-forcing means is disposed above said heating means in an upper portion of said housing.

4. A heating unit as defined in claim 1, in which said heating means is in a lower portion of said housing and in which said air-forcing means is disposed above said heating means in an upper portion of said housing, said housing providing an upper wall including an air inlet opening, said air-forcing means comprising a blower for drawing air through said air inlet opening and compressing same for delivery to said entrance chamber.

5. In a forced air heating unit for delivering warmed air to an inlet of an under-floor heating system, the combination of: a heating structure comprising two side walls, two end walls, an upper wall extending between said side walls and extending from one end wall toward the other but terminating in an end spaced from said other end wall to define an entrance opening bounded by said end and said other end wall and extending substantially the complete distance between said side walls, and a lower wall extending between said side walls and providing an exit opening; a distribution plate extended downwardly from said end of said upper wall to said lower wall and spaced from said other end wall to define an entrance chamber therebetween adapted to receive air from said entrance opening, said distribution plate providing openings through which air may move from said entrance chamber to a space between said side walls and said upper and lower walls, said space communicating with said exit opening; a plurality of internally-passaged heating elements extending upwardly through said space, the passages of said heating elements providing lower ends opening below said lower wall and upper ends opening above said upper wall; and a burner means below said lower wall for supplying hot products of combustion to the lower ends of the passages of said heating elements to flow upwardly therethrough and from said upper ends thereof, said heating elements being spaced from each other to define heating

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passages therebetween in said space and through which air may flow from said entrance chamber to said exit opening.

6. In a forced air heating unit for delivering warmed air to an inlet of an under-floor heating system, the combination of: a housing providing vertically - extending, horizontally - spaced entrance and outlet chambers, said outlet chamber including a warm air outlet for connection to said inlet of said under-floor heating system; walls defining a substantially horizontal space communicating with and extending between said entrance and outlet chambers; means for forcing air downwardly in said entrance chamber to flow substantially horizontally through said substantially horizontal space to said outlet chamber and thence downwardly to said warm air outlet; a partition means extending across said substantially horizontal space to divide same into a heating chamber and a by-pass chamber whereby a portion of said substantially-horizontally flowing air moves from said entrance chamber to said outlet chamber through said by-pass chamber and another portion of this air moves through said heating chamber, said portions of air mixing in said outlet chamber; a plurality of internally-passaged tubular heating elements extending through said heating chamber, said tubular heating elements being spaced from each other to define heating passages therebetween through which air may flow in moving from said entrance chamber to said outlet chamber through said heating chamber; and burner means for supplying hot products of combustion to the internal passages of said tubular heating elements to heat the air flowing through said heating passages.

7. In a forced air heating unit for delivering warmed air to an inlet of an under-floor heating system, the combination of: a housing providing vertically - extending, horizontally - spaced entrance and outlet chambers, said outlet chamber including a warm air outlet for connection to said inlet of said under-floor heating system; walls defining a substantially horizontal space communicating with and extending between said entrance and outlet chambers; means for forcing air downwardly in said entrance chamber to flow substantially horizontally through said substantially horizontal space to said outlet chamber and thence downwardly to said warm air outlet; two partitions extending across said substantially

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horizontal space to divide same into two heating chambers and a by-pass chamber therebetween, a portion of said substantially-horizontally flowing air moving from said entrance chamber to said outlet chamber through said by-pass chamber and another portion of this air moving through said heating chambers, said portions of air mixing in said outlet chamber; a plurality of internally passaged tubular heating elements extending through said heating chambers, the tubular heating elements in each heating chamber being spaced from each other to define heating passages therebetween through which air may flow in moving from said entrance chamber to said outlet chamber through said heating chambers; and burner means for supplying hot products of combustion to the internal passages of said tubular heating elements to heat the air flowing through said heating passages.

8. A heating unit as defined in claim 6 including a damper means for controlling the relative volumes of air moving through said by-pass chamber and said heating chamber.

9. A heating unit as defined in claim 7 including a damper means for controlling the relative volumes of air moving through said by-pass chamber and said heating chambers to prevent cooling of said products of combustion in said tubular heating elements to a temperature below the dew point.

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