Dec. 22, 1931. W. A. REMBER 1,837,485

HEATING APPARATUS

Filed Feb. 24, 1930 3 Sheets-Sheet 1

Fig. 1.

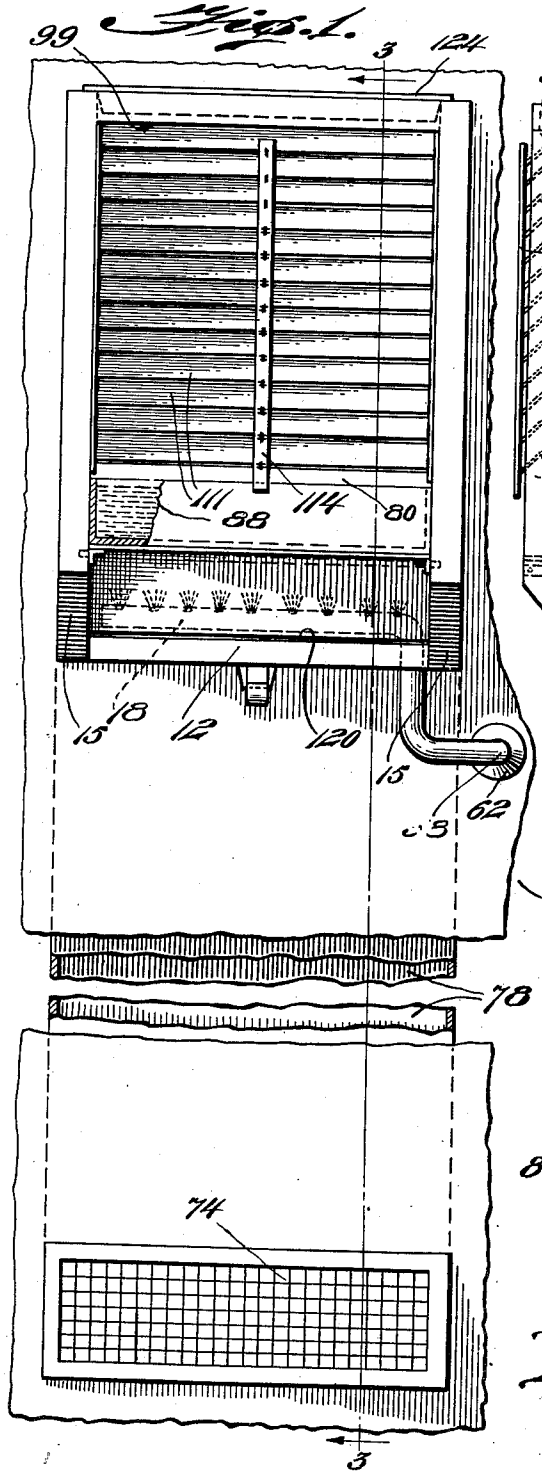


Fig. 2.

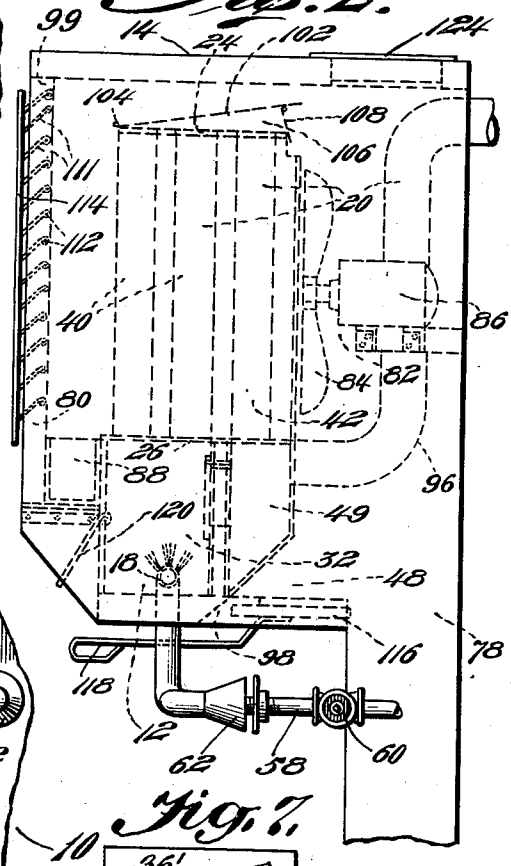
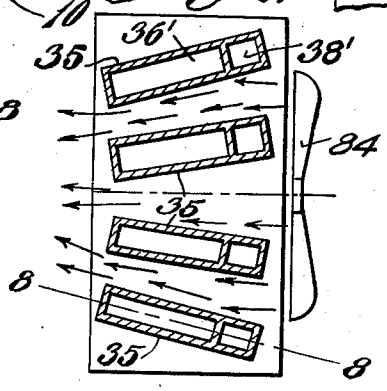


Fig. 7.



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Fig. 3.

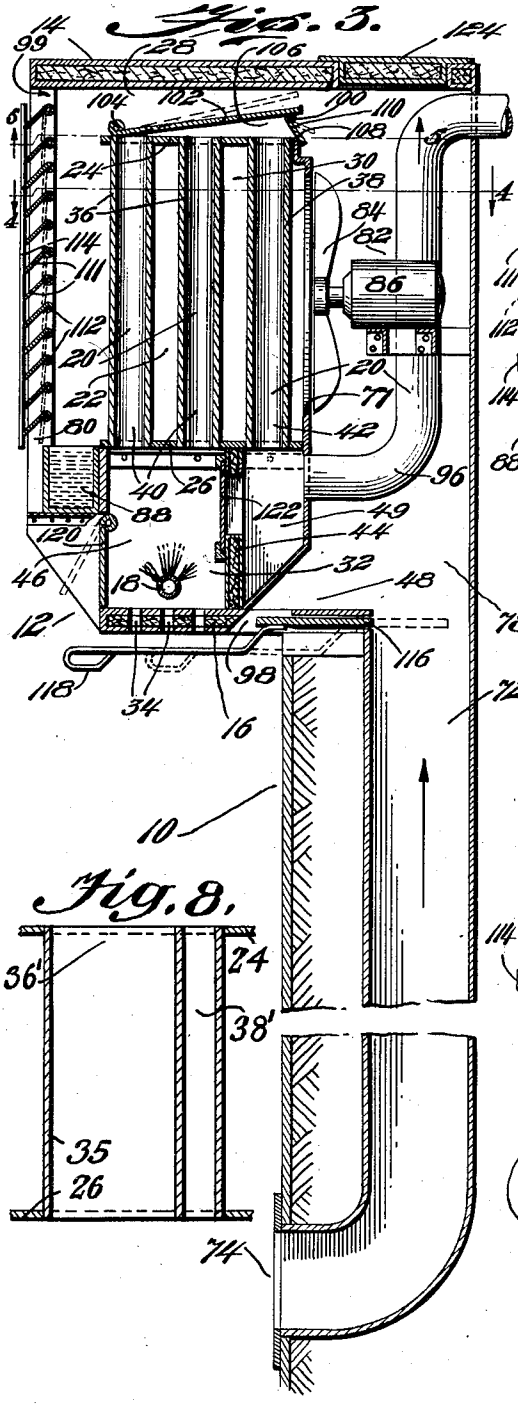


Fig. 4.

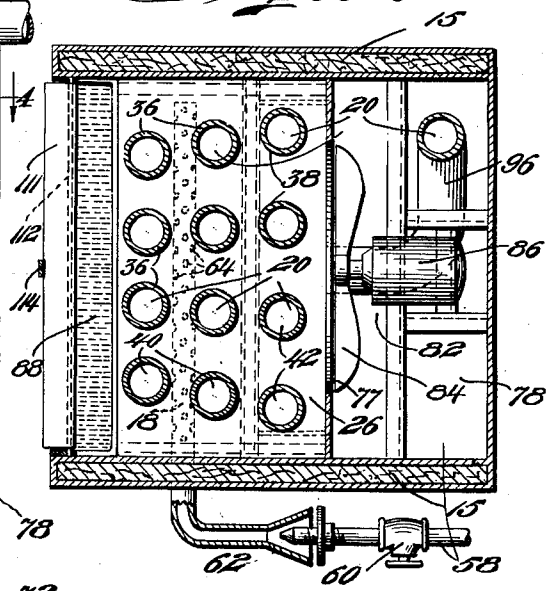
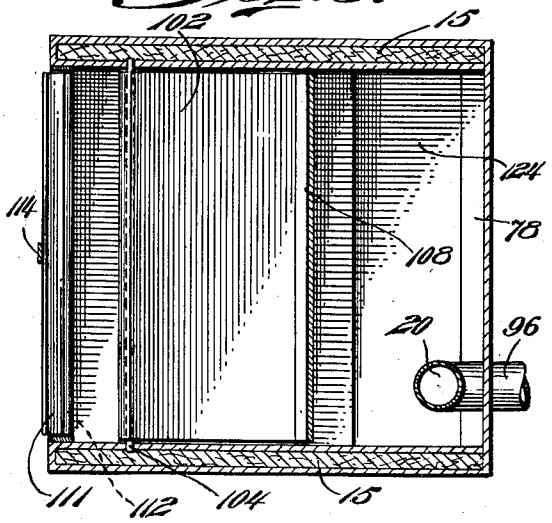


Fig. 8.

Fig. 5.



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HEATING APPARATUS

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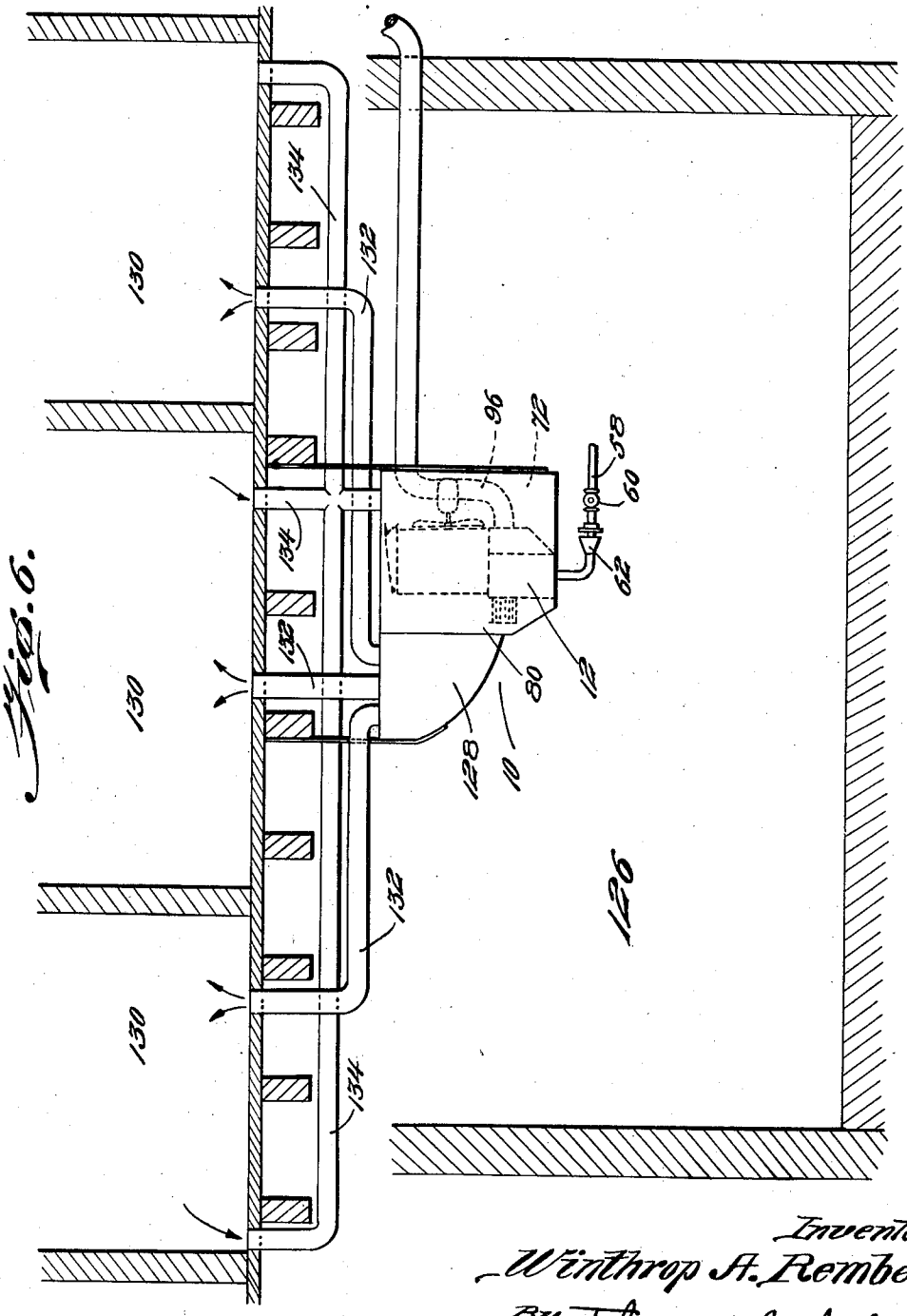


Fig. 6.

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1,837,485

UNITED STATES PATENT OFFICE

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HEATING APPARATUS

Application filed February 24, 1930. Serial No. 430,826.

My invention relates to a heating apparatus particularly of the type adapted to burn gas and specifically of the type having a heating means, preferably a gas burner and having a circuitous passage for the products of combustion therefrom adapted to heat a circulating stream of air indirectly by passing it across and around the circuitous passage with the stream of air to be heated and the circuitous passage being in counter-current heat interchange relationship and preferably of the type employing power means to circulate the air through the furnace preferably a blower located immediately in front of said circuitous passage. The circuitous passage preferably consists of one or more rows of upwardly extending tubes between two headers and one or more rows of downwardly extending tubes, the upwardly extending tubes forming the up-pass of the circuitous passage and the downwardly extending tubes forming the downpass of the circuitous passage.

To take advantage of all the heat radiating surfaces, in addition to having the main air duct preferably blown across the circuitous passage, I preferably provide supplemental air ducts circulating around the top and bottom of the heating unit tubes which supplemental air ducts lead into the main air duct and thus absorb additional heat by radiation from the top and bottom of said unit.

A further object of my invention relates to the spacing of the up-pass tubes and the down-pass tubes where employed. To lessen the amount of eddy currents I preferably diverge said tubes towards said inlet and preferably space them to allow for air expansion.

These and such other objects of my invention as may hereinafter appear will be best understood from a description of the accompanying drawings which illustrate an embodiment thereof.

In the drawings, Fig. 1 is a front elevation of the side of a room having my invention attached thereto.

Fig. 2 is a side elevation of the upper portion of the heater, parts thereof being shown in dotted lines.

Fig. 3 is a vertical sectional view of the heater taken along the line 3—3 of Fig. 1 showing it in this installation protruding from a wall of a room.

Fig. 4 is a horizontal sectional view taken along the line 4—4 of Fig. 3.

Fig. 5 is a horizontal sectional view taken along the line 5—5 of Fig. 3.

Fig. 6 is a sectional view through a house showing a single unit of my invention installed in the cellar thereof in elevation and showing pipe connections to the various rooms thereof.

Fig. 7 is a diagrammatic view of a modification with the tubes of my invention constructed of oblong shape diverging in similar fashion towards the inlet for the substantial elimination of eddy currents.

Fig. 8 is a sectional view taken along the line 8—8 of Fig. 7.

In the drawings, wherein like characters of reference generally indicate like parts throughout, 10 generally indicates an apparatus constructed in accordance with my invention. 12 indicates the furnace or heater proper thereof which as shown in Figs. 2 and 3 is generally rectangular in shape. Said furnace 12 is preferably provided with the heat insulated top and bottom walls 14 and 16 respectively, and heat insulated side walls 15 preferably constructed of metal layers provided with a suitable intermediate heat insulating lining. While the furnace proper may be located in any desired position, as shown in my preferred embodiment is is preferably located near the top of a room. I provide a suitable heating means 18′ and a suitable circuitous passage 20 for the products of combustion located in said furnace. While the heating means 18 and circuitous passage 20 may be located in any desired manner within the said furnace, in my preferred embodiment I preferably construct them as follows: I provide in the front portion 22 of said furnace the spaced top and bottom header plates 24 and 26 respectively dividing the front portion 22 of said furnace into an upper compartment 28, an intermediate compartment 30 and a lower compartment 32. The bottom wall of the furnace underneath

said lower compartment is preferably perforated as at 34 to provide suitable secondary air for said burner. To provide the circuitous passage I preferably vertically mount series of tubes 36 and 38 between said spaced top and bottom header plates 24 and 26 respectively. Said tubes 36 and 38 preferably comprise parallel lines of spaced tubes extending transversely across the furnace as shown in Fig. 4.

As shown in Figs. 4 and 7, I preferably converge the series of preferably parallel tubes in straight lines towards the outlet to lessen the amount of eddy currents produced thereby, to permit the device to function with much less power to cause the desired air circulation therethrough. In Fig. 7 I have shown both the up-pass and down-pass tubes constructed of a single oblong rectangular tube, the up-pass tube portion 36′ thereof comprising the enlarged front portion thereof and the down-pass portion 38′ thereof comprising the smaller rear portion thereof, said composite tubes 35 similarly converging towards the outlet as the up-pass and down-pass tubes 36 and 38 respectively shown in Fig. 4.

As shown in Figs. 3 and 4 the two front lines of tubes preferably comprise the up-pass 40 of said circuitous passage 20 and the rear layer of tubes 38 mounted in rear of said up-pass tubes 36 preferably forms the down-pass 42 of said circuitous passage. I preferably provide the insulated partition 44 to divide the lower compartment 32 into a front section 46 and a rear section 48. To complete said circuitous passage 20, I provide an outlet passage 49 extending transversely across the rear section 48 to receive the lower ends of said down-pass tubes 38, and to function as a condensation drier to catch the condensed water and other detritus from the products of combustion.

The heating means for my improved furnace in the embodiment shown comprises a gas burner 18 provided with the usual gas inlet pipe 58 controlled by the valve 60 and the usual primary air mixing chamber and valve 62. Said gas burner 18 preferably extends transversely across the furnace as shown in Fig. 4 in the front section 46 thereof underneath said up-pass tubes 36 and is provided with a plurality of burning orifices 64 therein.

As stated hitherto, my improved heating apparatus is adapted to circulate and heat a stream of air by a system of indirect heating including counter-current heat interchange with the products of combustion from the heating means. To this end I provide an air duct 72 which preferably has an inlet opening 74 normally located near the floor of the room to be heated and passes upwards into the rear portion 78 of said furnace communicating with the upper compartment 28 thereof and then forwardly through the air hole 77 across the up-pass and down-pass tubes 36 and 38 respectively of the circuitous passage 20 and having the outlet opening 80 discharging into the room or to whatever points desired.

As stated, I provide power means to circulate the air through the air duct 72 which in my preferred embodiment comprises the blower 82 consisting of the fan 84 suitably propelled by the electric motor 86 and preferably located in the cool incoming air duct 72 in the rear portion 78 of said furnace 12 immediately in rear of said up-pass and down-pass tubes.

As stated, I preferably provide humidifying means to suitably moisten the air before discharge into the room. In my prefered embodiment said means comprises a humidifying water holding tank 88, preferably located in front of said lower compartment 32 immediately underneath said air duct just prior to the outlet 80 thereof, although if desired said humidifying tank may be located in any desired position. Said humidifying tank 88 is thus not only heated by radiation from the burner 18 but also by the hot air draft in the main air duct.

To complete the circuitous passage 20 for the products of combustion, I preferably provide an exhaust duct 96 leading from said exhaust passage 49 and discharging upwardly through a suitable hole in the rear wall of said furnace 12. Said exhaust duct 96 preferably extends across the air duct 72 to utilize the waste heat from the products of combustion by heat interchange with the cold incoming air. Said exhaust duct 97 as it is cooled by the incoming air in the air duct 72 also condenses a further amount of liquids and other detritus from the waste gases of combustion which are thus led downwards into the condensation drier chamber 49.

A lower supplemental air duct 98 is preferably provided in the lower wall 16 of the furnace underneath said outlet passage 49 extending obliquely upwardly into the main air duct 72, and preheated by radiation convection and conduction from the heating means 18 and the wall of said outlet passage 49.

As stated, I provide a safety valve or exhaust port in the circuitous passage 20 preferably between the up-pass 40 and the down-pass 42 thereof having a closure or a plurality of closures therefor preferably pivoted thereto normally biased by gravity in closed position and adapted to open on excess pressure within said passage, such as is often caused by explosions in gas heating apparatus of this type. While said safety valve may be constructed in any suitable manner, in my preferred embodiment it is preferably constructed as follows: I provide the bar 100 mounted transversely of said upper compartment 28 preferably above the rear end of

said top plate 24. I provide a safety heat radiating door 102 having the front end thereof pivotally mounted as at 104 above the front edge of said top header plate 24 and adapted to rest on said bar 100 in an oblique position to provide a communicating passage 106 between said up-pass 40 and down-pass 42 of said circuitous passage. As the bar 100 is vertically offset from the pivot point 104 of said safety door 102, it is obvious that when in closed position said safety door 102 will be biased by gravity in closed position, but that on any excess pressure within the circuitous passage 20, said safety door 102 will be free to pivot upwards to discharge the products of combustion into the upper compartment 28 and from there into the communicating air passage 72. In my preferred embodiment I provide the supplemental safety door 108 having its upper edge 110 suitably pivotally mounted on said bar 100 and normally resting in offset relationship on the rear edge of said top header plate 24. It is thus obvious that said supplemental door 108 is also normally biased by gravity in a closed position to form a closure for the rear end of the communicating passage 106 but that on excessive pressure within said circuitous passage 20 said supplemental door 108 may also be free to pivot outwards to discharge directly into the communicating air passage 72.

As stated I circulate air in so far as possible all around the intermediate and lower compartments 30 and 32 of my device. I thus not only circulate air around the lower compartment 32 through the medium of the lower supplemental air duct 98, but I also provide an upper supplemental air duct 99 located just underneath the top wall 14 of my device discharging through the upper portion of said upper compartment when the heat radiating safety door 102 is in closed position and into the upper portion of the main air duct 72. The incoming air through said upper supplemental air duct is preferably thus preheated by radiation from said door 102 before it is discharged into the main air duct.

In order to not only regulate the amount of draft admitted through the main air duct 72, but in order to deflect the heated air discharging through the outlet 80, I preferably provide in the front of said furnace and in said outlet 80 a plurality of adjustable louvre plates 111 each suitably mounted on pivot bars 112 extending horizontally across said outlet and each having the outer ends thereof attached to the adjusting bar 114 to simultaneously open or close said series of louvre plates 111 for the above purposes.

In order to additionally regulate the amount of draft either admitted through the lower supplemental air duct 98 or admitted upwards through the main air duct 72 I horizontally mount in the lower wall 16 of said furnace in rear of said supplemental air duct 98 a damper 116 provided with the operating handle 118 slidable from a position closing said supplemental lower air duct 98 into a position partially closing said main air duct 72 as shown in dotted lines in Fig. 3.

It is desirable particularly in cool weather to cut down on the cold air draft admitted from the floor of the room and thus in cold weather substantially lessen this large amount of cold air to be preheated by recirculating a larger amount of air at a higher level by sliding over the damper 116 to partially close the main air duct 72.

I also preferably construct my improved furnace so that it may be readily accessible for cleaning purposes and to this end I pivotally mount the door 120 in the front wall of the front section 46 of said lower compartment 32. For purposes of additionally cleaning the exhaust passage or condensation drier 49 I slidably mount the door 122 in the partition 44 splitting said lower compartment 32 into the front section 46 and the rear section 48 including the exhaust passage 49. I also provide the door 124 near the rear portion of the top wall of said furnace.

My improved heating apparatus may also be used in the cellar of a house to heat a plurality of rooms. In Fig. 6 I have shown a cross section of a house having my improved apparatus inserted in the cellar 126 thereof. With this construction I provide in front of the outlet 80 of said furnace a hot air reservoir 128 and I connect said hot air reservoir to each respective room 130 of the house by the medium of the hot air pipes 132. To complete the circulation of air through the house I additionally connect each room 130 with the main air duct 72 of said chamber by the return ducts 134, the rest of my improved apparatus being constructed on a larger scale than where employed to heat a single room or an apartment.

The operation of my invention is obvious from the above description. To start, the motor 86 is merely turned on to revolve the fan 84 the desired amount to attain the desired circulation throughout the air duct 72 and the valve 60 is turned to provide the desired amount of gas to the gas burner 18. The products of combustion therefrom pass through the circuitous passage 20 and discharge out of the furnace therefrom in counter-current heat interchange with (thus indirectly heating) the hot air forced through the air duct 72. It is obvious that due to the location of the humidifier tank 88 it will be heated sufficiently to suitably humidify the air. It is also obvious that when any explosion occurs within said circuitous passage 20, that the safety doors 102, 108 and 120 will immediately pivot outwards to discharge into the air duct 72 without any disastrous

explosive consequence. The louvre plates 111, the valves 60 and 62 and the damper 116 are preferably adjusted and the speed of the blower 82 regulated to not only supply the desired circulation to thoroughly heat the room, but also to supply it at a speed which will completely use up in so far as possible the waste heat from the products of combustion. It is also obvious that the device functions to supply to the heated air the desired amount of moisture through the humidifying tank 88 and if desired my device may be employed as a drier with the elimination of said humidifying tank. It is also obvious that if desired in hot weather my improved device may be employed either as a circulating, or circulating and humidifying device, with elimination of the use of the heating means 18 and also, if desired, the humidifying tank 88, if humidification is not desired.

While I have shown various details connected with my improved apparatus, it is obvious that various ones may be dispensed with, if desired; namely, that the humidifier tank 88 may be omitted, that the safety valve may be omitted, and if desired the passage 20 may merely consist of the up-pass 40 of the vertical tubes 36. It is obvious that I have provided a neat and simple heating apparatus with the advantages portrayed above.

It is also obvious that, if desired, the entire heater plates and tubes may be readily removed for cleaning and repair purposes through the outlet 80 after prior removal of the louvre plate 111. It is understood that my invention is not limited to the specific embodiments shown and that various deviations may be made therefrom without departing from the spirit and scope of the appended claims.

What I claim is:

1. In an apparatus of the class described, a closure having spaced top and bottom header plates dividing the front portion of said closure into an upper, an intermediate and a lower compartment, a series of tubes vertically mounted between said header plates extending upwards through said intermediate compartment to form and up-pass of a circuitous passage, a smaller series of tubes vertically mounted between said header plates extending downwards through said intermediate compartment to form a down-pass of said circuitous passage in rear of said up-pass tubes, passage means connecting said up-pass and down-pass tubes in said upper compartment, a partition dividing said lower compartment into a front section, and a rear section, an outlet passage extending transversely across the said rear section to receive the lower ends of said down-pass tubes, an air duct for said closure having an inlet opening passing into the rear end of said closure and communicating with said upper compartment and passing forwardly across said up-pass and down-pass tubes and having an outlet opening, a blower located in said air duct in rear of said tubes, an exhaust duct leading upwardly from said outlet passage across said air duct and discharging outside of said closure, a lower supplemental air duct passing through said lower compartment and discharging into said main air duct in front of said tubes, and an upper supplemental air duct extending through the front of said closure above said tube connecting means and into said upper compartment and discharging into said main air duct in front of said tubes.

2. In an apparatus of the class described, a closure having spaced top and bottom header plates dividing the front portion of said closure into an upper, an intermediate and a lower compartment provided with a perforated lower wall, a series of rows of tubes vertically mounted between said header plates extending upwards through said intermediate compartment to form an up-pass of a circuitous passage, a smaller series of tubes vertically mounted between said header plates extending downwards through said intermediate compartment to form a down-pass of said circuitous passage in rear of said up-pass tubes, passage means connecting said up-pass and down-pass tubes of said upper compartment, the rows of inlet and outlet tubes diverging longitudinally towards the rear of said intermediate compartment to lessen the eddy currents, a partition dividing said lower compartment into a front section and a rear section, an outlet passage extending transversely across the said rear section to receive the lower ends of said down-pass tubes, an air duct for said closure having an inlet opening passing into the rear end of said closure and passing forwardly across said up-pass and down-pass tubes and having an outlet opening, a blower located in said air duct in rear of said tubes, an exhaust duct leading from said outlet passage across said air duct and discharging outside of said closure.

3. In a furnace, a partition dividing said furnace into a front portion and a rear portion having a hole therein, spaced top and bottom header plates dividing the front portion of said furnace into an upper, an intermediate and a lower compartment provided with a perforated lower wall, tubes vertically mounted between said header plates in said intermediate compartment to form an up-pass and a down-pass of a circuitous passage for the products of combustion and passage means connecting the upper end of said tubes in said upper compartment, an exhaust passage for the products of combustion leading from said lower compartment, a gas burner having a plurality of burning orifices extending transversely across the lower com-

partment, an air duct for said furnace entering the rear portion thereof, passing through said partition hole forwardly across said tubes and having an outlet opening discharging in front of said tubes, a blower located in said air duct in rear of said tubes, and supplemental air ducts passing around said intermediate compartment below and over said tubes and discharging into said main air duct in front of said up-pass tubes.

4. In a furnace, a partition dividing said furnace into a front portion and a rear portion having a hole therein, spaced top and bottom header plates dividing the front portion of said furnace into an upper, an intermediate and a lower compartment provided with a perforated lower wall, rows of tubes vertically mounted between said header plates in said intermediate compartment to form an up-pass and a down-pass of a circuitous passage for the products of combustion and passage means connecting the upper end of said tubes in said upper compartment, diverging longitudinally toward the rear thereof to lessen eddy currents, an exhaust passage for the products of combustion leading from said lower compartment, a gas burner having a plurality of burning orifices extending transversely across the lower compartment, an air duct for said furnace entering the rear portion thereof, passing through said partition hole forwardly across said tubes and having an outlet opening discharging in front of said tubes, and a blower located in said air duct in rear of said tubes.

5. In a heating apparatus, in combination, a closure having a circuitous passage including an up-pass and a down-pass for the products of combustion, an air duct for said closure having an inlet opening passing across the up-pass and down-pass of said circuitous passage in heat interchange therewith and having an outlet opening, means to cause an air draft through said air duct and supplemental ducts in said closure to admit air below and above said circuitous passage in heat interchange therewith and discharge it into said main air duct in front of said passage.

6. In a heating apparatus, in combination, a closure having a circuitous passage for the products of combustion, an air duct for said closure having an inlet opening passing across the circuitous passage a plurality of times in heat interchange therewith and having an outlet opening, means to cause an air draft through said air duct and supplemental ducts in said closure to admit air below and above said circuitous passage in heat interchange therewith and discharge it into said main air duct in front of said passage.

7. In a heating apparatus, in combination, a closure having a circuitous passage including an up-pass and a down-pass for the products of combustion, a main air duct for said closure having an inlet opening passing across the up-pass and down-pass of said circuitous passage in heat interchange therewith and having an outlet opening, means to cause an air draft through said main air duct, and a supplemental duct in said closure to admit air around said circuitous passage in heat interchange therewith discharging into said main air duct so as to pass therethrough.

8. In an apparatus of the class described, two spaced header plates, tubes interposed between said plates having the ends thereof projecting through said header plates arranged in substantially parallel transverse rows transversely of said header plates and in spaced longitudinal rows longitudinally of said header plates, said longitudinal rows diverging towards one end of said header plates and means to circulate a current of gas longitudinally between said tubes from the diverging end thereof.

9. In an apparatus of the class described, two spaced header plates, tubes interposed between said plates having the ends thereof projecting through said header plates arranged in transverse rows transversely of said header plates, said longitudinal rows diverging towards one end of said header plates and means to circulate a current of gas longitudinally between said tubes from the diverging end thereof.

10. In an apparatus of the class described, two spaced header plates, tubes interposed between said plates having the ends thereof projecting through said header plates arranged in substantially parallel transverse rows transversely of said header plates and in spaced longitudinal rows longitudinally of said header plates, said longitudinal rows diverging towards one end of said header plates and means to circulate a current of gas longitudinally between said tubes.

11. In an apparatus of the class described, two spaced header plates, tubes interposed between said plates having the ends thereof projecting through said header plates arranged in transverse rows transversely of said header plates and in spaced longitudinal rows longitudinally of said header plates, said longitudinal rows diverging towards one end of said header plates and means to circulate a current of gas longitudinally between said tubes.

12. In a heating unit, a lower heating chamber, an upper chamber, tubes vertically connecting said chambers arranged in spaced substantially parallel transverse rows transversely of said chambers and in spaced longitudinal rows longitudinally of said chambers, said longitudinal rows diverging towards one end of said chambers, at least the front transverse row of said tubes forming an up-pass of a circuitous passage for the products of combustion and at least the rear transverse row of said tubes forming a down-

pass for the products of combustion and means to circulate a current of gas to be heated between said tubes from the diverging ends thereof.

13. In a heating unit, a lower heating chamber, an upper chamber, tubes vertically connecting said chambers arranged in spaced transverse rows transversely of said chambers and in spaced longitudinal rows longitudinally of said chambers, said longitudinal rows diverging towards one end of said chamber, at least the front transverse row of said tube forming an up-pass of a circuitous passage for the products of combustion and at least the rear transverse row of said tubes forming a down-pass for the products of combustion and means to circulate a current of gas to be heated between said tubes from the diverging end thereof.

14. In a heating unit, a lower heating chamber, an upper chamber, tubes vertically connecting said chambers arranged in spaced substantially parallel transverse rows transversely of said chambers and in spaced longitudinal rows longitudinally of said chambers, said longitudinal rows diverging towards one end of said chamber, at least the front transverse row of said tubes forming an up-pass of a circuitous passage for the products of combustion and at least the rear transverse row of said tubes forming a down-pass for the products of combustion and means to circulate a current of gas to be heated between said tubes.

15. In a heating unit, a lower heating chamber, an upper chamber, tubes vertically connecting said chambers arranged in spaced transverse rows transversely of said chambers and in spaced longitudinal rows longitudinally of said chambers, said longitudinal rows diverging towards one end of said chamber, at least the front transverse row of said tubes forming an up-pass of a circuitous passage for the products of combustion and at least the rear transverse row of said tubes forming a down-pass for the products of combustion and means to circulate a current of gas to be heated between said tubes.

In testimony whereof I affix my signature.

WINTHROP A. REMBER.