

Sept. 24, 1946.

J. C. MILES

2,408,087

HOT AIR FURNACE

Filed July 24, 1943

4 Sheets-Sheet 1

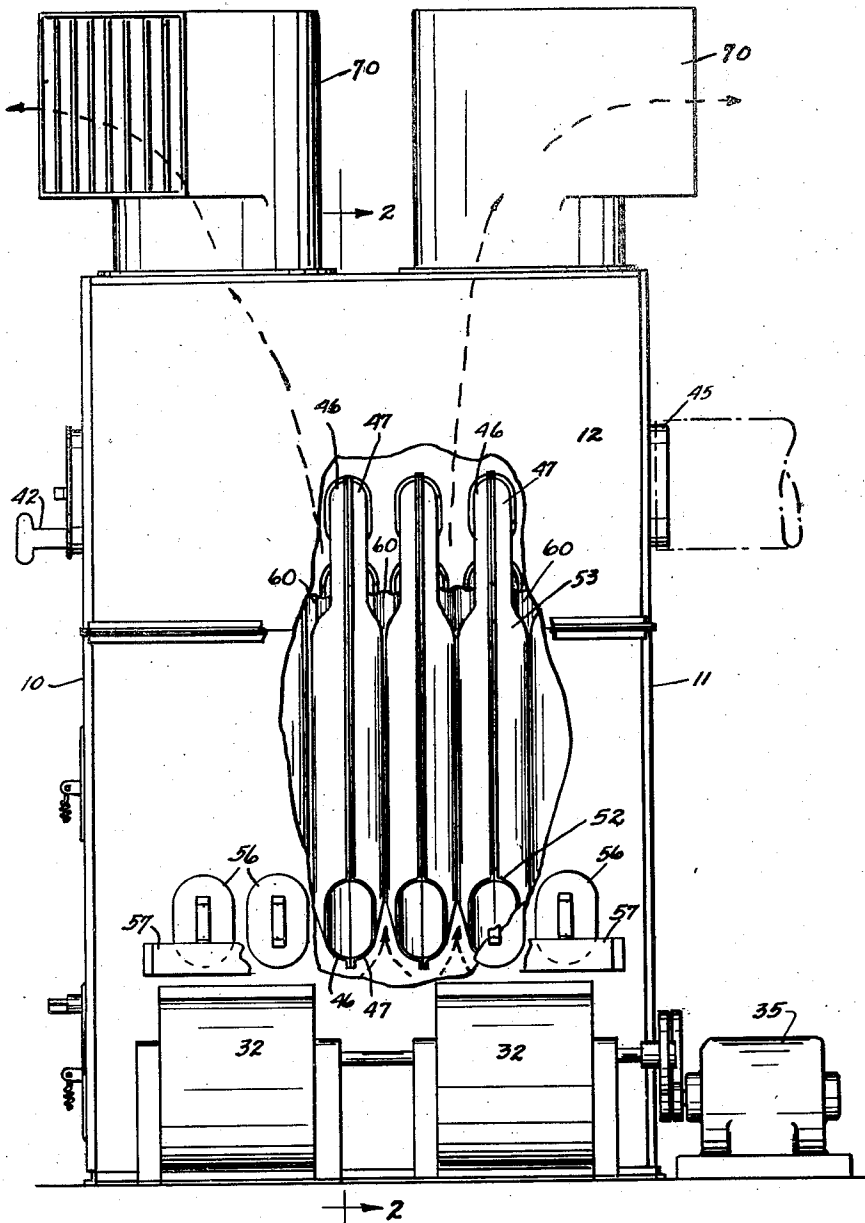


FIG. 1

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4 Sheets-Sheet 2

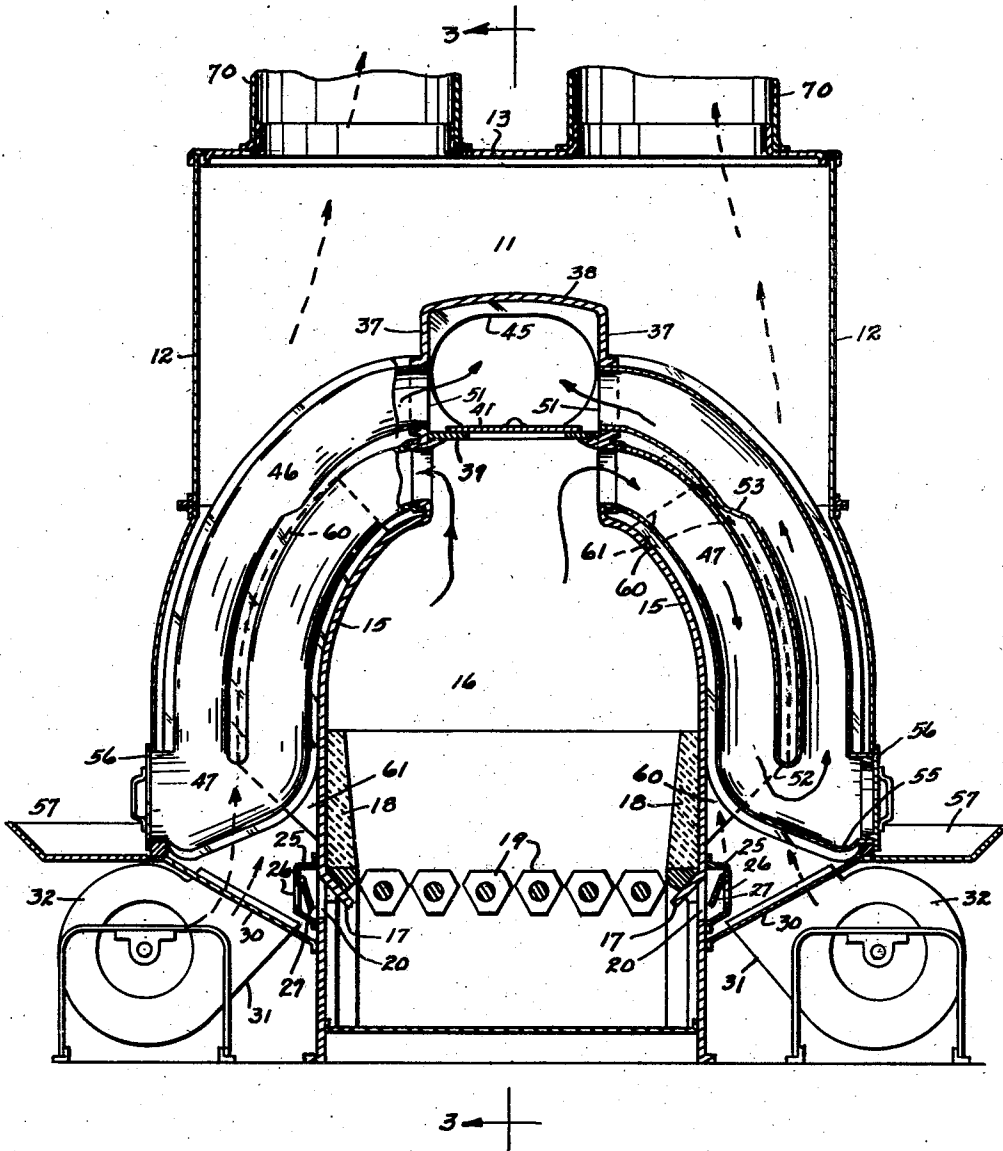


Fig. 2

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4 Sheets-Sheet 3

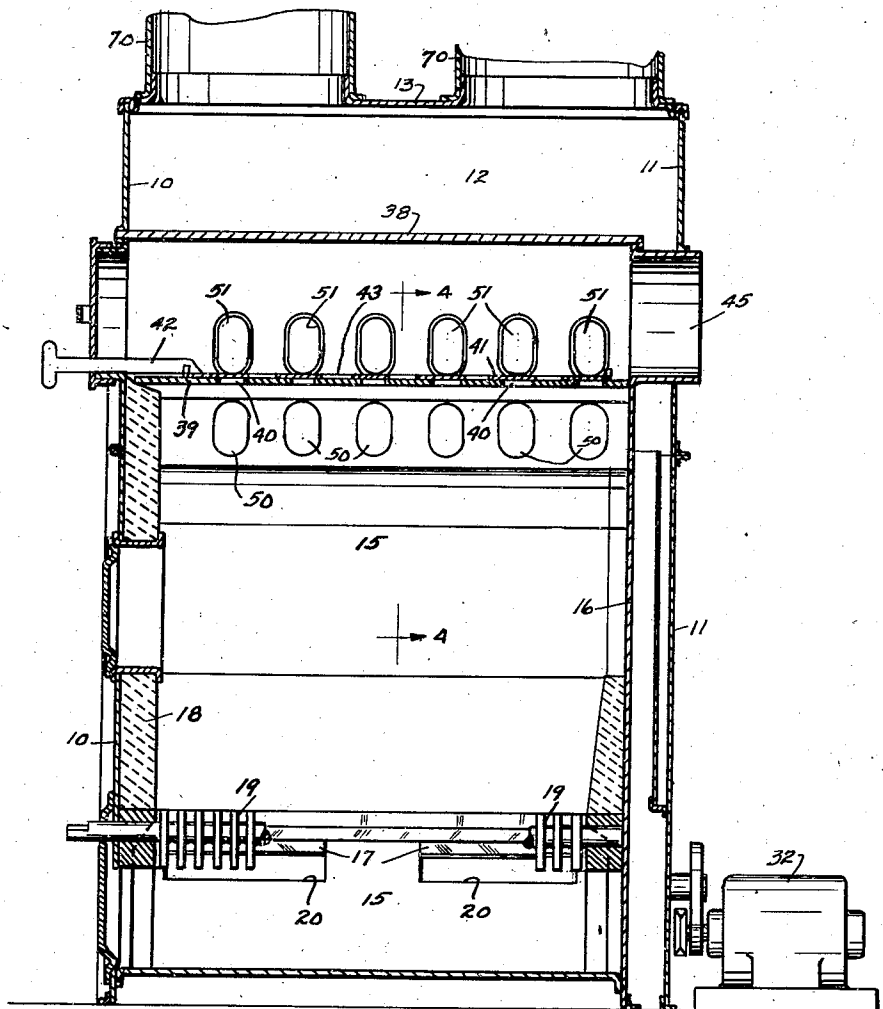


FIG. 3

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4 Sheets-Sheet 4

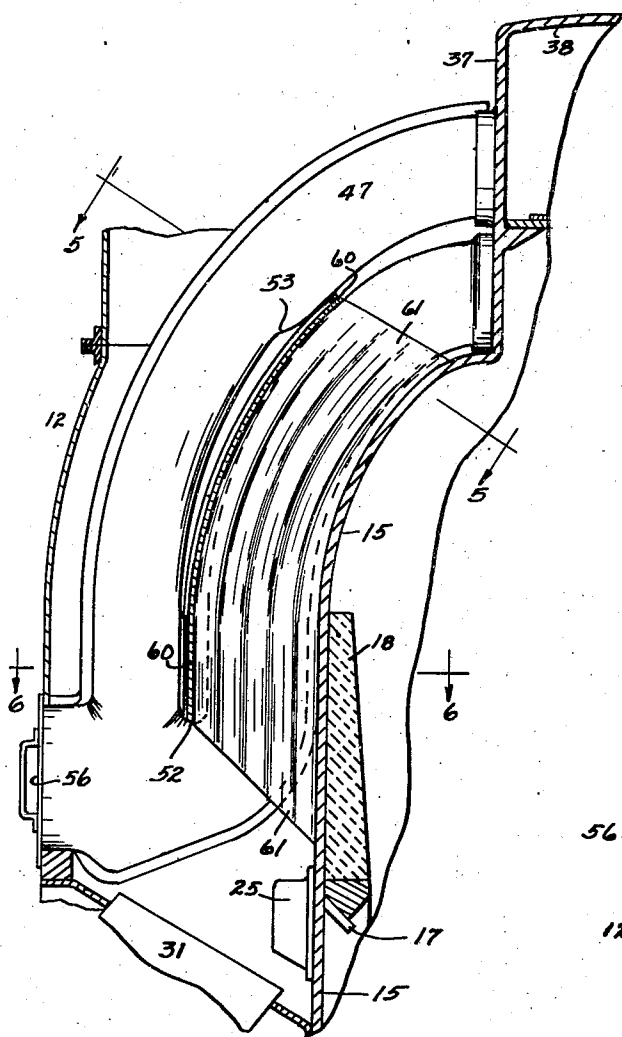


FIG. 4

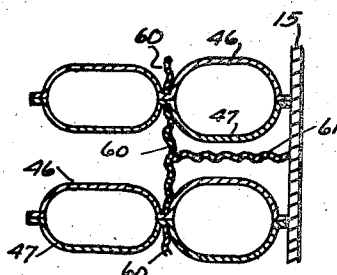


FIG. 5

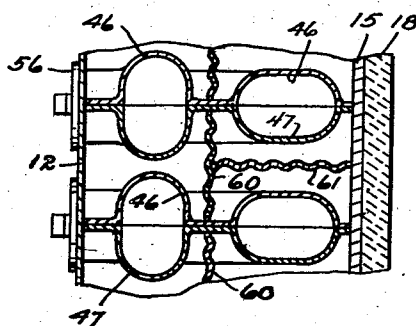


FIG. 6

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HOT-AIR FURNACE

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Application July 24, 1943, Serial No. 496,015

5 Claims. (Cl. 126—104)

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This invention relates to heating devices and more particularly to a coal or oil burning warm air furnace of a type suitable for use in large private dwellings, apartment houses, or in garages or factories, airplane hangers, and the like.

There is a great demand for an efficient hot air furnace that may operate on either coal, gas, or oil as fuel, and that is suitable for heating large installations, such as factories, and airplane hangers, where the ceiling is comparatively high, and where the presence of machinery or equipment makes it difficult to utilize steam or hot water radiators or pipes to advantage. As an attempted method of solving the problem of heating such installations, the practice has been to employ hot air heating furnaces with outlet funnels that are swivelly mounted at the top of the furnace and are adapted to direct the heated air into any predetermined direction. By mounting such units at spaced intervals along the wall of a large building, quick response to a heating demand may be obtained and heat may be supplied to any localized part of the building or to the entire building as desired. Thus, for example, heat may be directed immediately against the engines of an airplane to warm them prior to a take-off under low temperature conditions.

An object of the present invention is to construct a furnace suitable as aforesaid, and which will possess a maximum amount of heating surface and fire travel with a minimum amount of floor space, and which will have a high degree of operating efficiency, as measured by the ratio of heat output to heat input, which is comparatively small and compact, and which can be made principally of stampings. The invention further contemplates a construction which may readily be furnished in various sizes in an expeditious manner. Other features of the invention will become apparent in the following description and in the accompanying drawings.

In the drawings, Fig. 1 is a side view of a furnace embodying the present invention; Fig. 2 is a section taken on the plane indicated by the line 2—2 in Fig. 1; Fig. 3 is a section taken on the plane indicated by the line 3—3 in Fig. 2; Fig. 4 is a section taken on the line 4—4 in Fig. 3, and Figs. 5 and 6 are sections taken on the correspondingly numbered lines in Fig. 4.

The present invention constitutes a furnace heating chamber and a blower constructed as a unitary structure. To this end, the unit has a housing which forms a box-like structure having a front wall 10, a rear wall 11, side walls 12 and a top wall 13. The furnace or combustion cham-

ber 16 extend from the front to the back wall, but is spaced inwardly from the side walls of the housing and is provided with its own side walls 15, which preferably are curved plates that extend from the front to the rear wall of the housing and that cooperate to provide an arch shaped roof for the furnace chamber. Portions of the plates 15 may be bent inwardly as at 17, to provide supports for a furnace lining 18, at about the level of the grate bars 19. The openings 20 left in the side walls by the deformation thereof provide apertures for air to enter the furnace chamber beneath the grate bars for the purpose of supporting combustion within the furnace. A cage 25 may extend along the outer side of each wall 15 for covering each aperture 20, and each cage has an opening 26 therein that is adapted to be closed by a damper 27, that is pivoted for swinging movement inside of each cage.

The heating chamber for the unit is the space disposed between the housing walls and the furnace chamber walls 15. Preferably the housing side walls 12 terminate short of the floor upon which the unit rests, while plates 30 extend from the lower edges thereof to the plates 15 to form the bottom of the heating chamber. Suitable apertures in the plates 30 may receive the discharge spouts 31 of blowers, indicated in general at 32, that are mounted on opposite sides of the unit and beneath the bottom plates 30. Two blowers are illustrated on each side of the unit, and each is adapted to be operated by a motor 35 that is disposed at the rear of the unit.

As shown in Fig. 2, the side walls 15 are spaced apart at their upper edges, wherefore the top of the furnace chamber merges with a smoke chamber that extends from the front to the rear walls 10 and 11, and that has side walls 37 and a top wall 38. A partition 39 divides the smoke chamber into upper and lower compartments and has spaced apertures 40 therein which are adapted to be selectively opened or closed by a damper, preferably in the form of a slidable plate 41, that may be controlled by an operating arm 42 as shown in Fig. 3. The damper has apertures 43 which are adapted to register with the partition apertures 40, whenever the damper is moved to the necessary extent. In Fig. 3 the openings are out of registration, wherefore, the heated products of combustion cannot flow directly into the upper compartment of the smoke chamber and thence out the flue 45, but are forced to flow in a tortuous path through banks of fire tubes that

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are disposed within the heating chamber and between the side walls 12 and 15, respectively.

The fire tubes shown in Figs. 1 and 2 are disposed in close proximity to each other, and each comprises two metal stampings 46 and 47 that are welded together at their peripheral edges, and are so formed as to provide a tubular passageway that is preferably oval in cross section. Each tube thus formed comprises a long curving U, the legs of which are shaped substantially complementary to the side walls 15 of the furnace chamber, while the two open upper ends thereof are shown in communication with the smoke chamber at points above and below the partition 39, respectively. Communication between the tubes and smoke chamber is provided by suitable openings in the side wall 37 for accommodating the ends of the tubes. Each tube extends downwardly for substantially the entire length of the combustion chamber, thus permitting the maximum amount of heat to be transferred from the burning fuel to the circulating air which is introduced through the bottom walls of the heating chamber, by means of the blowers 32. Part of the air forced into the heating chamber may also be forced into the furnace ash pit for supporting combustion, through the apertures 26 and 20; it being understood that the pressure of the air is sufficient to swing the dampers 27 to open position whenever the blowers are in operation.

A furnace made according to the present invention has resulted in a ratio of heating surface to the grate area of 30 to 1, and the same ratio can be maintained notwithstanding the number of tubes which may be utilized in the furnace. The space required to add more tubes automatically increases the area of the grate in an amount to maintain the same ratio of 30 to 1.

As will be observed in Fig. 3, the opening 50 for the entrance of products of combustion into each fire box tube is larger than the discharge opening 51, wherefore the velocity of the gas is undiminished as it cools during its passage through the tubes. Additionally, the cross sectional shape of each fire tube is altered intermediate the points of inlet and outlet, and preferably in the outer leg, so as to deflect the air from the blowers toward the hottest regions of the tubes and furnace walls. This may best be observed in Fig. 2, wherein the region of the outer leg of each tube is narrower from the point 52 to the point 53 than it is between the point 53 and the outlet 51. As shown in Fig. 3, the outlet opening 51 is elliptical in shape and the major axis extends vertically. That condition prevails between the points 51 and 53, but between the points 52 and 53 the major axis and minor axis are transposed, thus imparting greater width to the tube as may be observed in Fig. 1. The outer legs of the tubes, therefore, cooperate to provide, in effect, a curved baffle which tends to confine the major portion of air against the hottest portions of the tubes and furnace walls.

To obtain a better degree of contact between the air to be heated and the hottest portions of the furnace, I may utilize baffles 60 which preferably comprise corrugated curved plates that lie between the curved portions of each tube and extend from the point 52 to the region of the point 53. Each baffle may extend from one bank of tubes to the other, as shown in Figs. 5 and 6, and each may have a fin 61 that is preferably corrugated and extends from the mid-portion of the baffle to the wall of the combustion chamber. The fins preferably abut the combus-

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tion chamber wall so as to conduct heat, by radiation, therefrom, and to transmit it to the air that flows upwardly through the heating chamber.

For convenience of cleaning, each tube is provided with an enlarged portion 55 at the base of the U for trapping non-combustible particles, and such enlarged portion is provided with a clean-out door 56 that is accessible from the exterior wall of the housing and is detachably mounted thereon. A suitable cleanout tray 57 extends along each side of the housing for receiving the material that is removed from the tubes.

If desired, the air which is heated by the furnace may be led directly into conduits which convey it to various parts of the building, or, as illustrated in Fig. 1, the air may enter funnels 70 that are swivelly mounted on the top wall 13 of the housing. Thus, the funnels may be turned in any desired direction for the purpose of obtaining intense heat in a localized zone, or may be turned in diverse directions to effect a heating of a general zone.

The furnace unit made in accordance with the present invention possesses a high degree of economy of manufacture in that most of the parts may be made from stampings, and in that a high degree of output may be obtained from a furnace that occupies a comparatively small space. The utilization of curved fire tubes which are shaped to correspond to the slope of the furnace walls, and the provision of such tubes in banks aid in attaining compactness, and likewise aids in procuring a high degree of output for a given input. An additional feature of the present invention is the fact that the furnace may be made of any desired length merely by increasing the number of tubes, without in any way altering the method of operation or changing the features which account for the high degree of operating efficiency.

I claim:

1. A hot air heating furnace having a body forming a combustion chamber, and having a smoke chamber superimposed thereon, a housing forming a heating chamber on both sides of the combustion chamber, the heating chamber having an air inlet at the bottom and an air outlet at the top thereof, a plurality of fire tubes disposed within the heating chamber and being shaped substantially complementary to the sides of the combustion chamber, each fire tube having one end thereof in communication with the combustion chamber and having the other end thereof in communication with the smoke chamber and extending downwardly into the chamber for substantially the depth of the combustion chamber and thence upwardly to communicate with the smoke chamber, and each of said tubes having a cross section comprising a long and a short axis, the tubes being so positioned that at the upper ends thereof the long axis extends transversely of the furnace and adjacent the bottoms thereof the long axis extends longitudinally of the furnace.

2. A hot air heating furnace having a body forming a combustion chamber, a housing enclosing the same and forming a heating chamber, the heating chamber having an air inlet at the bottom and an air outlet at the top thereof, said body having a smoke chamber disposed above the combustion chamber, fire tubes disposed in the heating chamber on both sides of the combustion chamber, each tube having one end there-

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of in communication with the combustion chamber at a point adjacent the top central portion of the combustion chamber and having the other end thereof in communication with the smoke chamber, said fire tubes extending down into the heating chamber for substantially the depth of the combustion chamber and thence upwardly to communicate with the smoke chamber so as to provide an inner and an outer leg on each tube, and each tube having a cross-section comprising a long and a short axis, the end portions of each tube having the long axis extending transversely of the furnace and an intermediate portion of each tube having the long axis extending longitudinally of the furnace.

3. A hot air heating furnace having a body forming a combustion chamber, a housing enclosing the same and forming a heating chamber, the heating chamber having an air inlet at the bottom and an air outlet at the top thereof, the combustion chamber having side walls that converge in the upper portion of the chamber, a smoke chamber disposed above the combustion chamber and extending longitudinally of the central region thereof, fire tubes of generally U-shape, disposed in side-by-side relationship within the heating chamber and on each side of the combustion chamber and in close proximity thereto, the fire tubes extending down into the heating chamber for substantially the depth of the combustion chamber, and each tube having one end thereof in communication with the combustion chamber adjacent the top central portion thereof, and having the other end thereof in communication with the smoke chamber directly above the point of communication with the combustion chamber, and each tube having a cross section comprising a long and a short axis, the major portion of each tube having the long axis extending transversely of the furnace and a minor portion having the long axis extending longitudinally of the furnace.

4. A hot air heating furnace having a body forming a combustion chamber, and a smoke chamber superimposed thereon, a housing forming a heating chamber on opposite sides of the combustion chamber, the heating chamber having an air inlet at the bottom thereof and an

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air outlet at the top thereof, a plurality of fire tubes disposed within the heating chamber on opposite sides of the combustion chamber and extending downwardly within the heating chamber for substantially the depth of the combustion chamber but not below the level of the grate therein, each tube being formed to provide an outer and an inner leg and having one end thereof in communication with the combustion chamber and the other end thereof in communication with the smoke chamber, and each tube having a cross-section comprising a long and a short axis and being so positioned that the inner leg has the long axis extending transversely of the furnace while the outer leg has the long axis extending transversely of the furnace on its upper portion, but has the long axis extending longitudinally of the furnace on the lower portion thereof.

5. A hot air heating furnace having a body forming a combustion chamber and a smoke chamber superimposed thereon, a casing forming a heating chamber outside the combustion chamber, the heating chamber having an air inlet at the bottom and an air outlet at the top thereof, fire tubes disposed within the heating chamber on both sides of the combustion chamber and each having one end thereof in communication with the combustion chamber and the other end in communication with the smoke chamber, the tubes being generally U-shaped and each having one leg of the U in close proximity to the wall of the combustion chamber, and having the other leg of the U in close proximity to the inner leg, and each of said tubes having a cross-section comprising a long and a short axis, the inner legs having the long axis extending transversely of the furnace, and the outer legs having a major portion thereof with the long axis extending longitudinally of the furnace, baffles interposed within the heating chamber so as to direct the flow of air through the heating chamber into close proximity with the walls of the fire tubes for substantially the depth of the combustion chamber, the baffles cooperating with the tubes to define cellular passageways for the air in the heating chamber.

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