May 7, 1946. A. A. OLSON 2,399,690

AIR HEATING FURNACE

Filed Jan. 14, 1943 2 Sheets-Sheet 1

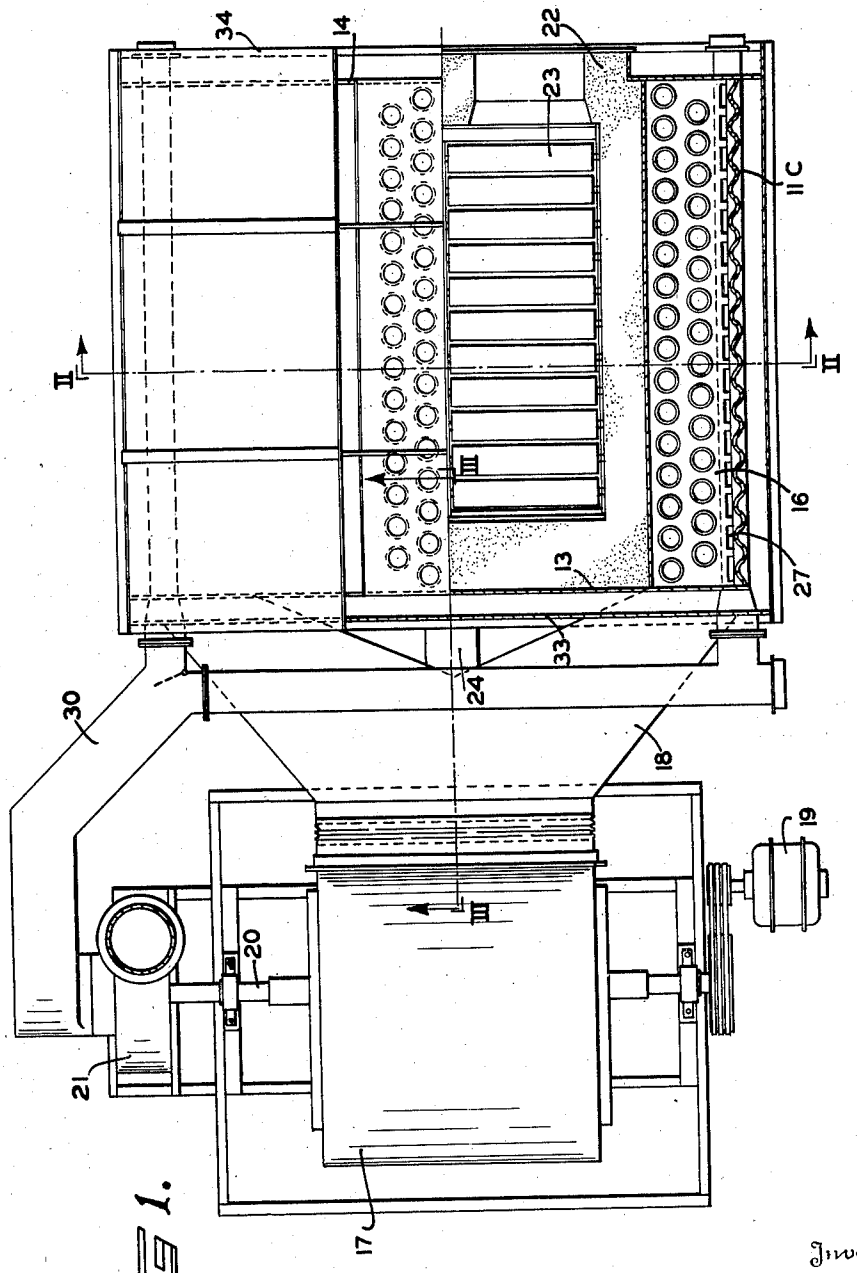


Fig. 1.

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Fig. 2.

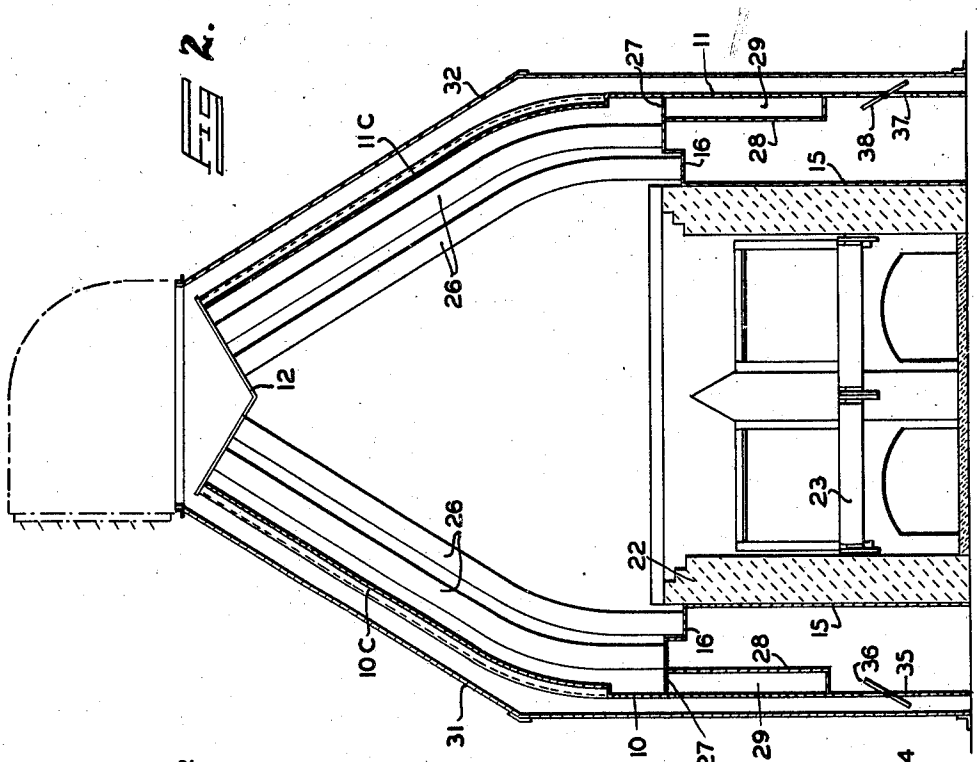
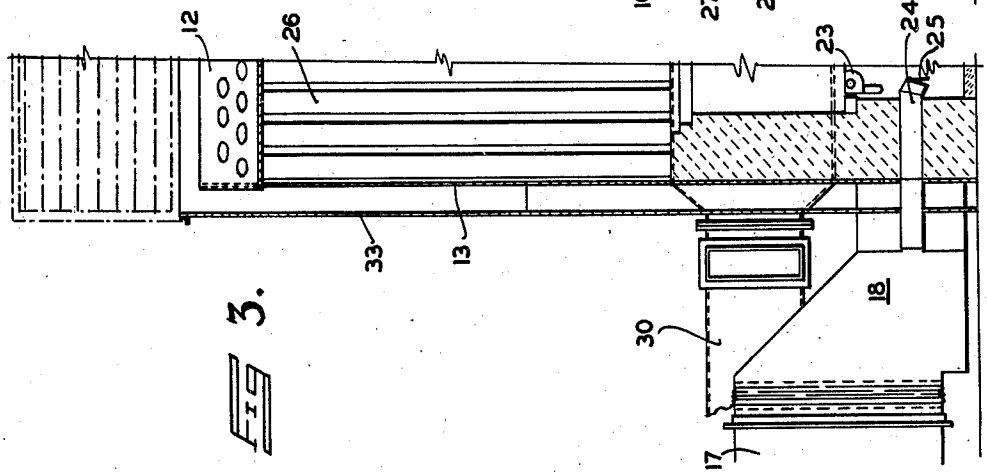


Fig. 3.



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AIR HEATING FURNACE

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7 Claims. (Cl. 126—109)

This invention relates to an air heating furnace of the general type in which the air to be heated is positively circulated in heat exchanging relation to the combustion confining elements of the assembly. To increase the total area of the heat exchanging surfaces thereby increasing the capacity and efficiency of the furnace it has been heretofore proposed to position air conducting tubes directly in the combustion chamber of the furnace and to employ a power-driven air impeller to circulate the air through the tubes with sufficient velocity to restrain localized overheating of the metal of the tubes.

Notwithstanding the air forcing arrangement mentioned above it is difficult, in constructions heretofore proposed, to avoid localized overheating of the tubes principally because of the arrangements employed to direct and remove the hot gaseous products of combustion from the combustion chamber. Consequently the tubes are generally constructed of heavy stock or of alloy steels capable of withstanding the high temperature imposed. It is one of the principal objects of the present invention to provide, in an air heating furnace of simple and economical design employing air tubes in the combustion chamber casing, an efficient arrangement for directing the hot gaseous products of combustion laterally across the tubes whereby a high rate of heat transfer is attained and for distributing the total volume of gases substantially uniform among the respective tubes so that overheating of individual tubes is largely avoided. In this manner, the invention enables an air heating furnace of the general kind mentioned to be constructed and satisfactorily operated while employing air tubes of ordinary steels and of light or medium gauge stock.

Another object of the invention is the provision, in an air heating furnace of the general type described, of an economical but efficient arrangement for incorporating the above mentioned gas distributing means in the general assembly of the furnace. Further, this means which also constitutes the exhausting flue ducts of the assembly is positioned in highly efficient heat exchanging relation to the streams of air to be heated thus enabling the ducts to serve also as economizers to insure a high overall operational efficiency. This object is accomplished, in accordance with the preferred embodiment of the invention, by positioning substantially all of the circumferential wall area of the ducts in direct heat exchanging relation with the moving air to be heated.

Yet another object of the invention is the provision, in an air heating furnace of the air tube type, of an improved arrangement for controlling the amount of heat lost by direct radiation from the body of the furnace.

Other objects and advantages of the invention reside in various features of construction and in various combinations and arrangements of the parts constituting the complete furnace assembly as will become apparent upon a consideration of the following detailed specification and the accompanying drawings wherein there is specifically disclosed the preferred embodiment of the invention.

In the drawings:

Figure 1 is a plan view, partly in section, of an air heating furnace constructed in accordance with the principles of the invention;

Figure 2 is a transverse section through the furnace along the line II—II of Figure 1; and

Figure 3 is a partial longitudinal section through the furnace of Figure 1, the view being taken along the line III—III of Figure 1.

In the drawings, reference numerals 10 and 11 indicate the side walls of a combustion chamber casing which is supported either directly on the floor or on a suitable base, not shown. The upper portions of the walls 10 and 11, which in practice are formed of steel sheets, converge toward each other and are preferably corrugated as shown at 10C and 11C. To the upper ends of these walls is welded or otherwise suitably secured a troughed plate 12. The end walls 13 and 14 complete the combustion chamber enclosure.

Extending along the inner surface of each of the side walls 10 and 11 is a sheet metal member having a vertical wall 15 spaced in parallel relation to the adjacent side wall and a horizontally disposed portion 16 having an outer edge welded or otherwise suitably secured to the contiguous side wall. Thus the lower portions of the side walls 10 and 11 together with the sheet metal members 15—16 provide a longitudinally extending air duct on either side of the furnace. The ducts thus provided are connected to the outlet of a blower 17 through suitable breaching 18. As shown in Figure 1, blower 17 is positioned closely adjacent one end of the furnace structure and is arranged to be driven by motor 19 through the impeller shaft 20. Also mounted on the shaft 20 is the impeller, not shown, of an exhaust fan or blower 21.

Built up against the inner surfaces of the walls 15 and the lower center portions of the end walls 13 and 14 are the refractory walls of the firebox

22. While the invention has been illustrated as a furnace for burning solid fuel for which the grate structure 23 may be provided, it should be understood that the principles of the invention are equally applicable in furnaces constructed for the burning of liquid or gaseous fuels. In any embodiment a primary or secondary supply of air for combustion may be conveniently supplied by a duct 24 extending into the lower part of the firebox from the center of the breaching 18. If desired, the flow of air through the duct 24 may be regulated by a valve 25.

The plates 12 and 16 are suitably apertured to register with the ends of the air tubes 26 which, in practice, are preferably welded to the plates to effect the required gas-tight connections. Preferably two rows of tubes, as shown, are positioned on either side of the furnace and to enable all the tubes to be of the same dimensions the plates 16 are stepped as shown. It will be apparent that air forced into the ducts formed in part of the walls by the blower 17 will be forced upwardly through the tubes 26 and out of the upper end of the furnace.

A multiplicity of closely spaced openings 27 is formed in the outer portions of the plate 16 between the adjacent side walls 10 and 11 and the outer rows of air tubes 26. As indicated in Figure 1, the line of apertures 27 extend throughout the longitudinal extent of the combustion chamber casing and of the rows of air tubes. Positioned immediately below the apertures 27 are the deep L-shaped sheet metal members 28 which have the upper ends of their vertical portions welded to the under surfaces of the plate 16 and the outer ends of their horizontal portions welded to the walls 10 and 11 to provide an exhaust flue 29 on either side of the furnace. At the blower end of the furnace the flues 29 discharge into a breaching 30 which, in turn, is connected to the inlet of the fan or blower 21. It will be apparent that during operation of the furnace suction will be created in the flues 29 drawing the hot gases emitted from the combustion in the firebox 22 laterally across the four rows of air tubes in the casing. Further, by reason of the fact that the apertures 27 are restricted in a lateral direction while extending throughout the longitudinal extent of the casing the gas flow will be distributed longitudinally along the rows of tubes. This distribution effectively prevents a sufficient rate of heat transfer by convection to any of the tubes to cause any localized overheating in the metal of the tubes. Further, this convection heat transfer takes place near the inlet ends of the tubes 26 where the air, tubes and surrounding metal sections are comparatively cool thus providing a substantial gradient for the more rapid transfer of heat. The radiant heat is absorbed largely in the upper inclined portions of the tubes.

An outer casing is provided consisting of side walls 31 and 32 and the end walls 33 and 34 which are spaced from and generally parallel with the adjacent walls of the combustion chamber. The intervening spaces thus provided are utilized for insulation purposes and to this end there is provided one or more longitudinally extending openings 35 in the wall 10 below the flue 29. The effective area of the opening or openings 35 is controlled by a damper 36 which, in practice, has a suitable attached operator readily accessible from the outside of the furnace. Similar openings 37 and dampers 38 are provided in the wall 11 below the adjacent flue 29. It will be understood that by adjusting the dampers 36 and 38 the amount of cold air which is diverted into the spaces between the inner and outer casings of the furnace may be readily controlled to keep the outer casing at any desired temperature thereby controlling the amount of heat emitted by the furnace by direct radiation. The longitudinally extending or spaced nature of the openings 35 and 37 together with the flue action resulting from the corrugations 10C and 11C insure sufficient velocity and longitudinal dispersion of the air flow between the side walls of the inner and outer casings.

By referring to Figure 2 it will be observed that by reason of the shape and relative position of the flues 29 the same are in more efficient heat exchanging relation with the cold air entering the furnace. The substantial areas of both sides of the flues together with the areas of the bottom walls of the flues are subjected to direct wiping contact with the cold air passing through the furnace. Moreover, the flues 29 extend throughout the length of the furnace chamber thus providing heat exchanging surfaces of substantial total area.

The above specifically described embodiment of the invention should be considered as illustrative only as obviously many changes may be made therein without departing from the spirit or scope of the invention. My invention, therefore is not to be limited except insofar as necessitated by the scope of the appended claims.

I claim:

1. An air heating furnace comprising a longitudinally extending casing having spaced upwardly converging side walls, means forming a cold air chamber adjacent the inner side of the lower portion of each of said walls, a fire box positioned between said chambers, air conducting tubes positioned in said casing and extending upwardly from said chambers at points spaced inwardly from said walls, longitudinally extending flue ducts contiguous to said chambers and being in heat exchanging relation with the air contained therein, said flue ducts having substantially greater vertical dimensions than lateral dimensions, and inlets to said ducts whereby products of combustion may be withdrawn from said casing, said inlets being distributed substantially throughout the longitudinal extent of said casing and being positioned laterally intermediate said casing walls and the lower ends of said tubes.

2. An air heating furnace comprising a longitudinally extending casing having spaced side walls with parallel lower portions and upwardly converging upper portions, a fire box in said casing intermediate the parallel portions of said side walls, a horizontally disposed member extending inwardly from each of said side walls at the lower portions thereof, means comprising the lower portions of said side walls and said horizontal members to define cold air chambers on either side of said furnace, a row of longitudinally spaced air conducting tubes supported on each of said horizontal members, said members having apertures therethrough in register with said tubes, said apertures and tubes being spaced inwardly from said side walls, longitudinally extending members L-shaped in section positioned so as to define with portions of said horizontal members and said side walls flue ducts on either side of said furnace, and longitudinally extending openings in said horizontal members above said ducts whereby products of combustion may be withdrawn from said casing.

3. An air heating furnace comprising a longitudinally extending casing having spaced but upwardly converging walls, a fire box in the lower center portion of said casing, a top plate V-shaped in transverse section secured to the upper ends of said side walls, a header extending inwardly from the inner surface of each of said side walls, and a double row of upwardly and inwardly curved air conducting tubes spanning each of said headers and one of the plane surfaces of said top plate, said plate being apertured in register with the openings through said tubes, said headers being stepped whereby each of the tubes in all the rows is identical in size and shape.

4. An air heating furnace comprising a longitudinally extending casing with spaced but upwardly converging side walls, a fire box in the lower center portion of said casing, a flue duct longitudinally co-extensive with said casing positioned on each side of said furnace and adjacent to portions of said side walls, said ducts being substantially greater in vertical dimension than in lateral dimension, means to conduct cold air into contact with the bottom and side walls of said ducts, and apertures in the top walls of said ducts providing communication between said duct and the space within said casing whereby products of combustion may be withdrawn from said casing.

5. An air heating furnace comprising in combination a casing having side walls with spaced parallel lower portions and converging upper portions, an outer casing having side wall portions substantially parallel with said first mentioned side wall portions, a pair of longitudinally extending vertical walls positioned in the lower portion of said first mentioned casing and being spaced from each other and from the lower parallel portions of said first mentioned side walls, a fire box positioned between said vertical walls, plate members spanning the upper ends of said vertical walls and the adjacent parallel portions of said first mentioned side walls to define air inlet chambers on either side of said furnace, a header spanning the upper ends of said first mentioned side walls, air conducting tubes extending between said plate members and said header, longitudinally extending flue ducts positioned in said air inlet chambers, and longitudinally spaced openings in said plate members intermediate said tubes and said first mentioned side walls to provide for the passage of the gaseous products of combustion into said flue ducts.

6. An air heating furnace comprising in combination a casing having side walls with spaced parallel lower portions and converging upper portions, said upper portions being corrugated to provide parallel troughs running from the lower ends to the upper ends of said upper portions, an outer casing having side wall portions substantially parallel with said first mentioned side wall portions, upwardly converging air conducting tubes in the upper portion of the said first mentioned casing, a refractory lined fire box positioned centrally in the lower portion of said first mentioned casing between the parallel lower portions of the side walls thereof, means forming an air chamber on each side of said fire box intermediate the adjacent side wall of said fire box and the adjacent lower portion of the side wall of said first mentioned casing, each said air chamber being positioned immediately below the inlets to said tubes, means to conduct air into said chambers, means forming openings in the lower portions of the side walls of said first mentioned casing to provide passageways between said chambers and the spaces between the side walls of said casings, and means forming an outlet for said tubes and the passages extending upwardly between said casings, said outlet extending longitudinally along the top of said outer casing.

7. Apparatus according to claim 6 further including a longitudinally extending flue duct in each of said chambers, said ducts having heat conductive walls and having inlets extending along the top surfaces thereof and outwardly of the lower portions of said tubes.

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