Jan. 25, 1955 P. L. KNIGHT 2,700,380

RADIANT TUBE HEATER AND COMBUSTION AIR PREHEATER THEREFOR

Filed Dec. 29, 1950

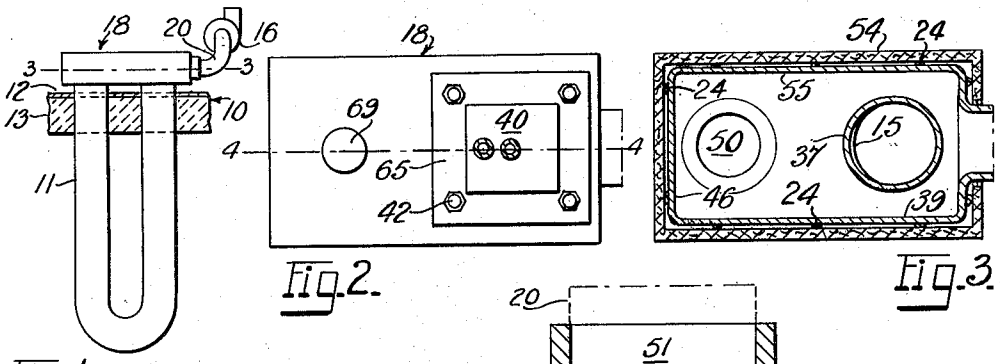


Fig. 2.

Fig. 3.

Fig. 1.

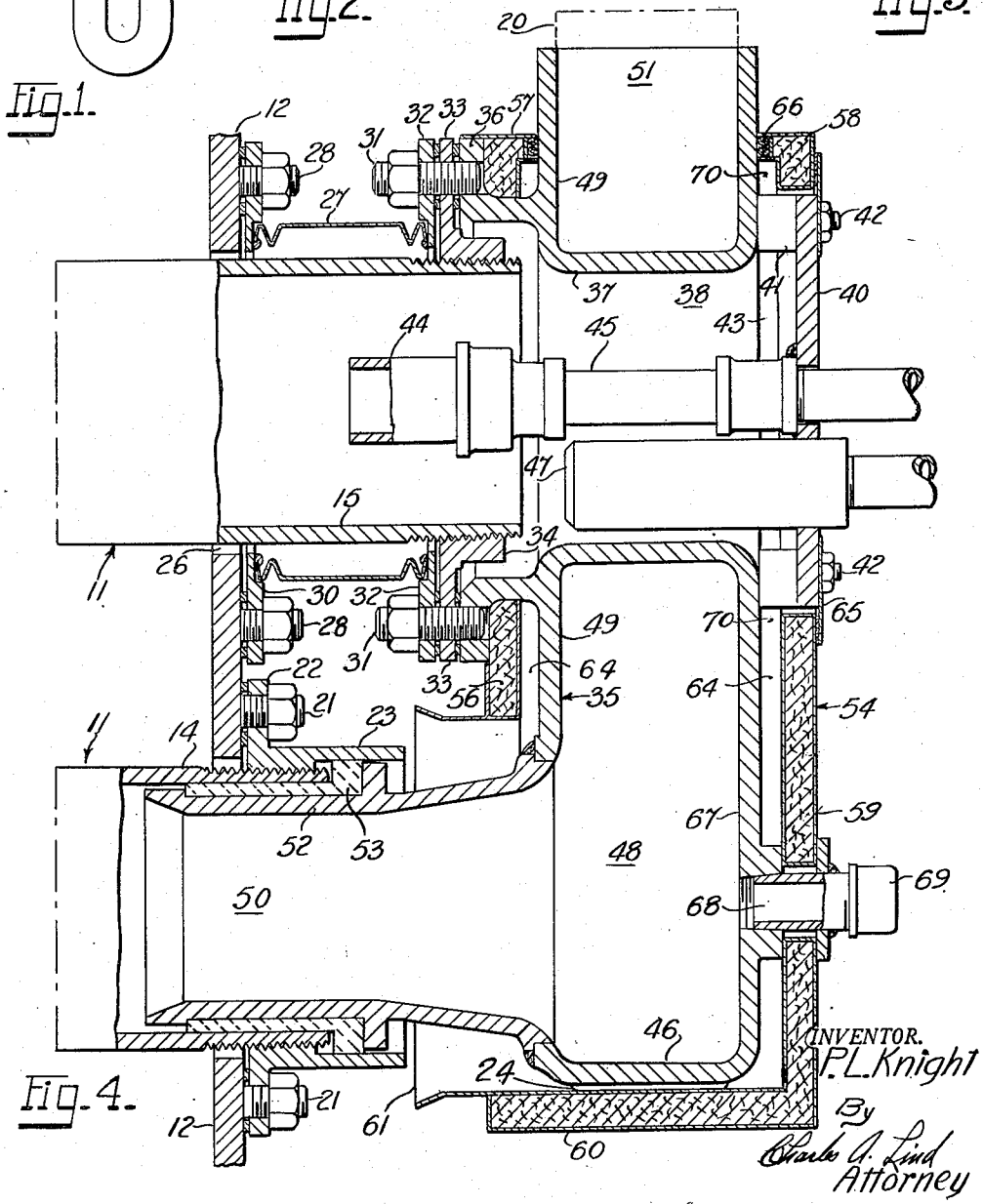


Fig. 4.

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United States Patent Office 2,700,380 Patented Jan. 25, 1955

2,700,380

RADIANT TUBE HEATER AND COMBUSTION AIR PREHEATER THEREFOR

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Application December 29, 1950, Serial No. 203,376

6 Claims. (Cl. 126—91)

The present invention relates to improvements in means for utilizing hot flue gas for preheating air for combustion and the object of the invention is to provide an air preheater which shall be particularly well adapted for use with combustion apparatus where the fuel intake end and the exhaust end thereof are in relatively close proximity to each other as in the case of a radiant tube of the return bend type.

For a consideration of what I consider to be novel and my invention attention is directed to the following specification and the concluding claims thereof.

In the drawing—

Fig. 1 is a schematic view of heating apparatus embodying the present invention.

Fig. 2 is a somewhat enlarged front elevation of the apparatus shown in Fig. 1.

Fig. 3 is a somewhat enlarged section on line 3—3 of Fig. 1 with parts omitted.

Fig. 4 is an enlarged section on line 4—4 of Fig. 2.

In the drawing, 10 indicates a portion of the wall of a substantially gastight chamber wherein articles may be heated in a controlled atmosphere, and 11 indicates an internally fired U-shaped tube for producing radiant heat in said chamber, the wall of said chamber comprising an exterior metal skin 12 and an interior lining of refractory heat insulating material 13 next to said skin. Air at atmospheric pressure flows into the burner end 15 of said tube under the influence of draft applied at the exhaust end of said tube, the draft being produced by a power operated exhauster 16 indicated as a blower whose suction is made effective at the exhaust end 14 of said tube through a flue gas passage in an air preheater 18 which forms the special subject of the present invention. A flue pipe 20 is shown as connecting the exhauster 16 with the discharge end of said flue gas passage.

The exhaust end 14 of the combustion tube 11 is fixedly secured gastight to the exterior metal skin 12 of the furnace chamber wall 10 by means comprising stud bolts 21 mounted on said skin to extend through a rim flange 22 on a collar 23 which is screwed onto the exhaust end 14 of said tube. The burner end 15 of the combustion tube is free to move axially relative to said furnace chamber wall 10 so that when thermal expansion causes relative movement between the two legs of the combustion tube it will be the burner end of the tube which moves axially relative to the exhaust end of the tube. To prevent loss of atmosphere from the furnace chamber by way of the aperture through which the burner end 15 of the combustion tube extends out of the furnace chamber, the burner end of said tube is surrounded by a metal bellows 27 of which the end next to the metal skin 12 of the furnace chamber wall is secured gastight to said skin by means comprising stud bolts 28 carried by said skin to extend through a rim flange 30 on the adjacent end of the bellows for clamping said flange against said skin. The other end of the bellows has a rim flange 32 through which stud bolts 31 extend for securing said flange gastight against the rim flange 33 of a collar 34 screwed onto the burner end 15 of the combustion tube, the screw studs extending from an annular member 36 herein after more fully described.

The air preheater 18 comprises a body 35 mounted on the burner end 15 of the combustion tube 11 for movement therewith, the mounting means comprising the rim flange 33 against which the annular member 36 is adapted to be clamped by said stud bolts 31, the said annular member 36 being a flange at one end of an annular

wall 37 which defines an air tunnel 38 in front of the burner end 15 of the combustion tube. Preheated air enters said air tunnel 38 through a peripheral air gap 43 formed between the outer end of said tunnel and an end plate 40 in front of the outer end of said tunnel and which is spaced from said outer end by spacer elements 41 through which stud bolts 42 carried by the body 35 extend. The burner end 15 of the combustion tube comprises a burner 44 at the end of a supporting tube 45 secured to the aforesaid end plate 40. Fuel issuing from the burner 44 may be ignited in any preferred way as by a flame from a pilot burner 47 shown as extending through an aperture in the said end plate 40.

The said body 35 has a flue gas passage 48 extending therethrough whereby to constitute said body an internally heated radiator. The inlet end 50 of said passage 48 connects with the exhaust end 14 of the combustion tube to receive hot flue gas therefrom and the outlet end 51 of said passage connects with the aforementioned exhauster 16 through the connecting flue 20. Said inlet end 50 is defined by a tubular member 52 projecting from said body 35 and said member is movably positioned within the exhaust end 14 of the combustion tube to permit free axial movement relative thereto. It is not essential that the joint between said tubular member 52 and the said exhaust end 14 shall be gastight but nevertheless it is desirable to prevent objectional infiltration of atmospheric air through said joint with consequent cooling of the flue gas flowing into said tubular member 52, and therefore the latter is desirably surrounded by a ceramic packing sleeve 53 movable with said member 52.

The flue gas passage 48 may be said to comprise a short leg and a long leg, the long leg extending in front of both the exhaust end 14 and the burner end 15 of the combustion tube and the short leg extending at a right angle to the long leg and being defined by the passage 50 in tubular member 52. As may be seen in Figs. 3 and 4, the wall 37 which defines the air tunnel 38 in front of the burner end of the combustion tube extends across the flue gas passage 48 so that the flue gas flows around said wall to reach the outlet end 51 of the flue gas passage 48. As may be seen in Figs. 3 and 4, the long leg of the flue gas passage 48 is rectangular rather than round in section and resembles a box of which the back wall is indicated at 49, the front wall at 67, the bottom wall at 39, the top wall at 55 and one of the end walls at 46, it being understood that the walls of the box will be heated by the flue gas flowing through the flue gas passage 48. That portion of the front wall 67 of the radiator opposite the exhaust end 14 of the combustion tube will be relatively highly heated not only by the flue gas flowing towards said portion and impinging thereagainst but also by radiant heat from such heated parts of the combustion tube as can be "seen" by said wall portion.

The long leg or box portion of the radiator 35 is surrounded in spaced relation by a heat insulated jacket or casing 54 to provide an air chamber 64 for a current of the air to be preheated, the casing having an air inlet 61 about the neck portion of the tubular member 52 of the radiator and having its outlet 70 extending about the air gap 43 about the outer end of the air tunnel 38 in front of the burner end of the combustion tube. It will be understood that air at amospheric pressure enters the air inlet end 61 of said jacket or casing 54 by virtue of the draft or suction prevailing at the burner end of the combustion tube as a result of the draft produced by the exhauster 16 at the exhaust end of the tube. Portions of said radiator jacket 54 are indicated at 56—60. Infiltration of cold air at the joint between the rim of the end plate 40 and the surrounding portion of said jacket may be prevented by a sheet metal wall 65 overlapping said joint, the wall being clamped against the end plate 40 by the nuts on the stud bolts 42. Other joints may be sealed substantially air tight by asbestos rope packing or the like as indicated at 66.

The character of the flame in the interior of the return leg of the combustion tube 11 may be viewed through a peep hole provided by a section of pipe 68 in the front end wall 67 of the radiator coaxial with the

tubular member **52**, the outer end of said pipe section being normally closed by a pipe cap **69**.

For descriptive purposes it has been convenient to describe the invention as applied to a U-shaped combustion tube **11** but it should be understood that the invention is not limited in its application to that type of tube since it is obvious that the two legs of said tube might well be replaced by two independently fired tubes arranged with the exhaust end of one in relatively close proximity to the burner end of the other for connection with the radiator **35** as shown in Fig. 4. Moreover, the air preheater per se is not limited in its application to a combustion tube since the place where combustion of the fuel takes place may be defined by walls other than those of a tube and therefore the air tunnel **38** which extends through the radiator may be considered as delivering to the burner port of a refractory combustion chamber and the tubular member **52** of the radiator as being in connection with an exhaust port of said combustion chamber.

The back wall **56**, **57** of the air chamber defined by the air casing **54** is spaced a substantial distance from the back wall **49** of the heat radiator; hence the air on entering said chamber through the air inlet **61** is free to spread out along the entire area of said back wall **49** of the radiator. To insure that the air thus entering at **61** shall not short circuit to the air outlet **70** and thus not be properly heated, the exterior peripheral portion of the radiator **35** is provided with a series of parallely extending vanes or ribs **24** between which the air must flow in flowing from the back portion to the front portion of said air chamber in front of the front wall **67** of said radiator.

From the foregoing description it may now be seen that the present invention provides an air preheater that is well adapted for its intended purpose.

What I claim is:

1. In combustion apparatus, in combination, a front radiator wall having an aperture, a back radiator wall having an aperture opposite to the aperture in the front wall, a peripheral wall connecting the periphery of the front wall with the periphery of the back wall, said front, back and peripheral walls constituting the external walls of the radiator, an annular wall connecting the aperture in the front wall with the aperture in the back wall and forming a tunnel through the radiator, a flue gas inlet tube connected to and communicating with the interior of the radiator on one side of the tunnel, a flue gas outlet tube connected to and communicating with the interior of the radiator on the opposite side of the tunnel, the radiator being gastight except for the connections with such inlet and outlet tubes, a casing disposed about the radiator in spaced relationship, which encloses an air space surrounding the radiator, and which has an inlet for admitting air to the space between the casing and the front wall of the radiator and is airtight except for such inlet, an extension of the radiator tunnel, projecting from the front wall of the radiator and extending through the casing, the tunnel and extension forming an outlet passage to conduct air from the space between the casing and the back wall of the radiator, and a burner arranged to discharge fuel into the air flowing through such outlet passage.

2. In combustion apparatus according to calim 1, a plate forming a part of the casing, opposite the inlet end of the radiator tunnel, and supporting the burner.

3. In combustion apparatus according to claim 1, a structure wherein the flue gas inlet tube is connected to the front wall of the radiator, and the air inlet of the casing surrounds such flue gas inlet tube.

4. In combustion apparatus according to claim 1, a structure wherein the peripheral wall of the radiator is substantially more closely spaced from the casing than the front and back walls of the radiator.

5. In combustion apparatus according to claim 1, spaced parallel ribs disposed between the peripheral wall of the radiator and the casing, said ribs extending longitudinally between the front wall and the back wall of the radiator.

6. In combustion apparatus according to claim 1, a firing tube connecting the radiator tunnel extension to the flue gas inlet tube.

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