Sept. 6, 1949. B. A. LANDRY 2,481,165

DOWN AND CROSS DRAFT HEATER, INCLUDING AIRTIGHT ASH PIT

Filed Feb. 2, 1949 3 Sheets-Sheet 1

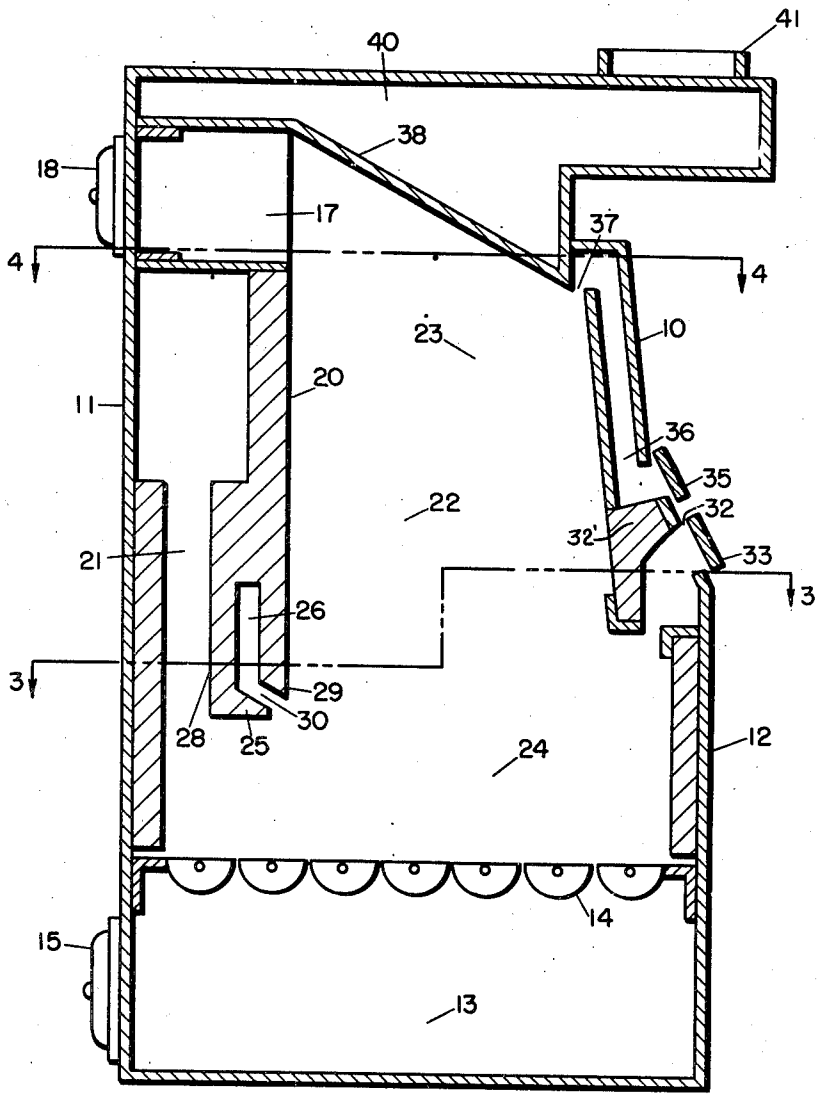


FIGURE 1

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DOWN AND CROSS DRAFT HEATER, INCLUDING AIRTIGHT ASH PIT

Filed Feb. 2, 1949 3 Sheets-Sheet 2

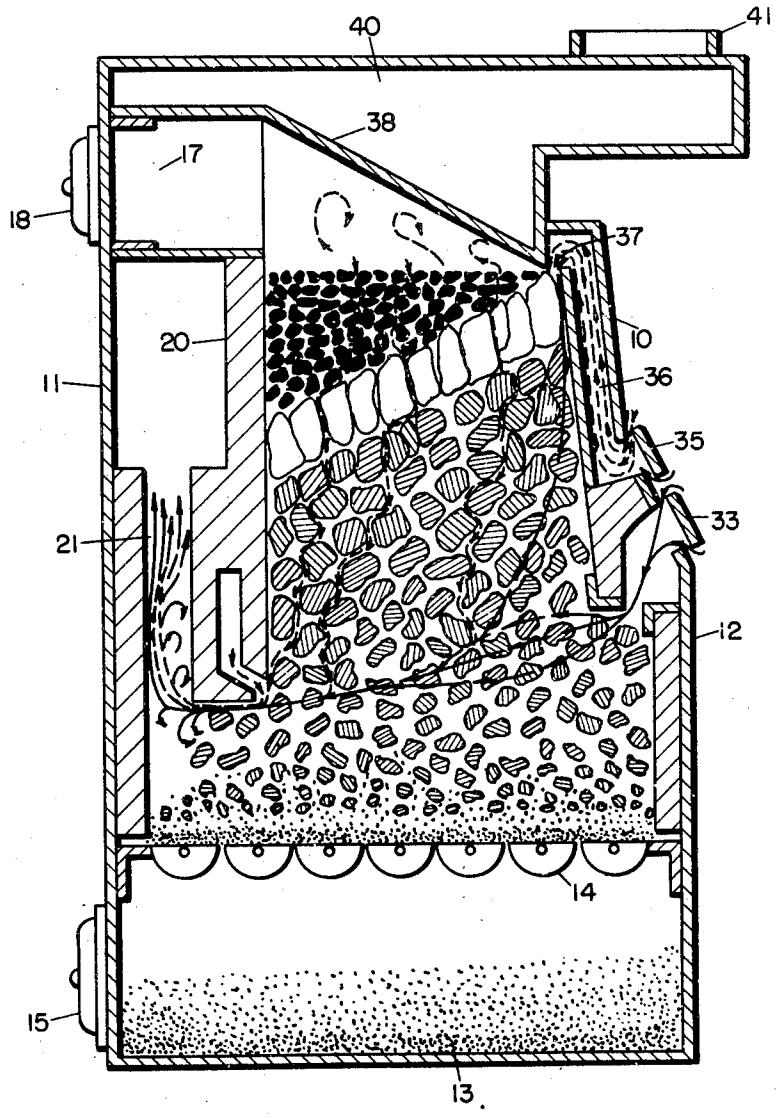


FIGURE 2

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DOWN AND CROSS DRAFT HEATER, INCLUDING AIRTIGHT ASH PIT

Filed Feb. 2, 1949 3 Sheets-Sheet 3

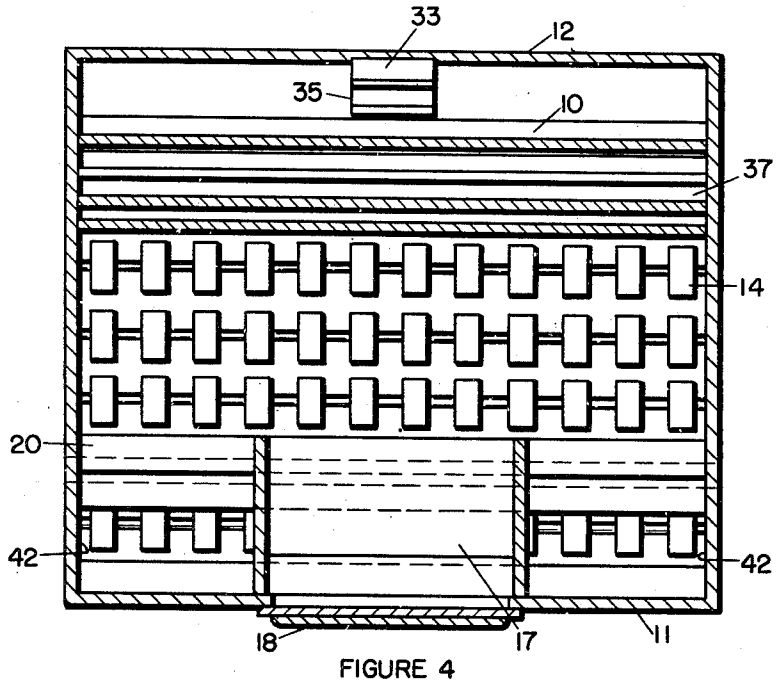


FIGURE 4

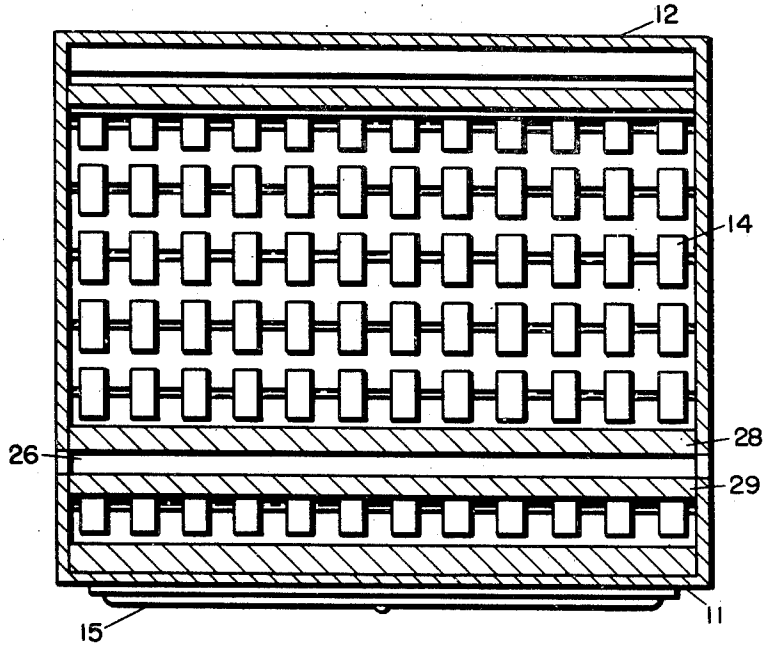


FIGURE 3

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Patented Sept. 6, 1949

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UNITED STATES PATENT OFFICE

2,481,165

DOWN AND CROSS DRAFT HEATER, INCLUDING AIRTIGHT ASH PIT

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Application February 2, 1949, Serial No. 74,083

12 Claims. (Cl. 126—76)

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This invention relates generally to apparatus for burning solid fuel and more particularly to a down and cross draft heater including an air tight ash pit and wherein substantially smokeless combustion is achieved simultaneously with continuous feed, and the present application is a continuation-in-part of my application, Serial No. 781,544, filed October 23, 1947.

A solid fuel heater of the magazine-feed, cross-draft type has been heretofore devised which is capable of achieving smokeless combustion. This heater comprises, in general, a main chamber divided into an upper fuel space and a lower combustion space, and a cross-feed primary air supply and a secondary air supply on opposite sides of the combustion space, with outlet means disposed on the same side of the combustion space as the secondary air supply. In practice it has been found that such a heater is satisfactory from the standpoint that it burns without appreciable smoke, but is unsatisfactory in that it requires poking due to the fact that a suspensory arch or layer of caked or agglomerated fuel is formed in the central portion of the main chamber. The arch or layer is directly attributable to the incomplete devolatilization and/or oxidation of the distillation products of the fresh fuel in the chamber and can be destroyed or eliminated only by periodic poking operations.

One of the principal objects of the invention is to provide a solid fuel smokeless burning heater which is an improvement upon previously designed heaters, including that of the aforementioned application, and is characterized by the fact that poking is eliminated.

Another object of this invention is to provide an apparatus for effecting essentially smokeless combustion of normally smoky fuels, in which poking is eliminated by introducing air into the fuel space in such a manner as to remove and/or oxidize the volatiles from the fuel, as well as to produce an ignition rate that is higher than the rate of burning.

A further object of the invention is to provide a smokeless solid fuel burning heater which is characterized by essentially smokeless combustion, freedom from the necessity of poking, and freedom from "puffing."

Other objects of the invention and the various advantages and characteristics of the present heater will be apparent from the following detailed description when read in conjunction with the accompanying drawings wherein:

Figure 1 is a vertical section through a heater embodying the invention, showing the essential parts thereof,

Figure 2 is a similar section, showing the various air passages or ducts together with the path followed by the fuel charge; and

Figures 3 and 4 are horizontal sections taken, respectively, on the lines 3—3 and 4—4 of Figure 1.

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It is known that when a coking coal is heated in the relative absence of air, a hard, continuous structure is formed after devolatilization is complete or nearly complete. On the other hand, it has been observed that when a coking coal is heated while air is passing around the individual pieces, enough oxidation of the exuded tarry constituents occurs to prevent agglomeration of the individual pieces, so that the final mass consists essentially of separate or distinct non-packing or non-uniting coke pieces. This latter principle has been applied in the production of the instant heater or apparatus for burning solid fuel, wherein means are provided for preventing caking or agglomeration of the fuel.

In the embodiment shown in the accompanying drawings, the apparatus comprises an improved heater including an outer casing which is shown as a whole at 10 and may be cast or formed from sheet metal, or in any desired manner, and may comprise any suitable number of parts or sections and be of any desired shape. However, the particular casing shown is box-like and has a front wall 11 and a back wall 12. It also has a pair of side walls spaced from one another, a horizontal bottom wall and a horizontal top wall. The lower portion of the casing 10 is provided with a perforate, horizontally extending grate 14 and this defines with the bottom wall and the lower portions of the front, back and side walls an airtight ash-pit 13. Access to the latter is provided by way of an opening which is formed in the lower portion of the front wall and is normally closed by an imperforate door 15. In the upper portion of the casing is a chute 17 through which fresh solid fuel may be loaded into the apparatus. Such chute is normally closed by an imperforate firing door 18.

Depending from the fuel-firing chute 17 and extending between and connected to the casing side walls is a wall 20 which divides the central portion of the interior of the casing into a vertical heat-transfer space or outlet duct 21 in the area between the wall 20 and the front wall 11 and a vertical chamber 22 between the wall 20 and the back wall 12. The upper portion of the chamber 22 is a fuel space or magazine 23 and the lower portion is a combustion space 24 directly over the grate.

The lower portion of wall 20 is in the form of an inverted arch 25 and this is disposed at a substantial distance above the grate 14 in order to effect communication between the combustion space and the lower end of the outlet duct 21. A passageway 26 passing transversely through the lower portion of the wall 20 divides the lower portion of said wall 20 into two vertical wall portions 28 and 29. Such passageway is open to

the atmosphere at both of its ends, thus providing a channel for secondary air which passes into the combustion space 24 at the lower portion of the chamber 22 through a single longitudinal full length slot 30 in the arch portion 25 of the wall 20. As shown in Figures 1 and 2, the slot 30 is downwardly inclined in the direction of the back wall 12, so that a portion of the secondary air flows into the combustion space and mixes with the hereinafter described primary air.

In the back wall 12 of the casing is a horizontal full width port 32 for the admission of primary or cross-feed air to the combustion chamber 24. An adjustable cover or damper 33 controls the amount of air that is admitted through this port 32. As shown in the drawings, the port 32 is located at a point above the level of the lower end of the arch 25, communicates with outside atmosphere, and is so angled or positioned that the primary air sweeps or bows substantially horizontally over the grate 14 and through the combustion space 24. Also in the back wall 12, which is inclined inwardly toward its top, and positioned above the port 32, is a second adjustable cover or damper 35 for controlling the inflow of pre-oxidizing and ignition air to a vertically extending full width duct 36 the upper end of which opens into the fuel space or magazine 23 through a full width slot 37. A barrier wall 32' separates the inlets provided by the port 32 and the duct 36. The slot 37 is located at or near the level of the bottom of the firing door 18, which is at approximately the same level, but opposite the lower, rear edge of an inclined imperforate roof 38 which is disposed above and defines the upper portion of the fuel space or magazine 23. The roof 38 is forwardly and upwardly inclined and is spaced beneath the top wall of the casing. The upper end of the vertical heat-transfer space or outlet duct 21 communicates with an upper horizontally disposed heat-transfer space or outlet duct extension 40 by way of passageways 42—42 (see Fig. 4) on either side of the fuel firing chute 17. The outlet duct extension 40 is disposed between the roof 38 and the top wall of the casing. A smoke type collar 41 is mounted upon the rear portion of the casing top wall and communicates with the duct extension 40. A smoke pipe or outlet stack (not shown) may be mounted upon the collar 41 and this may, in turn, be provided with a damper or valve for controlling the draft through the heater.

The vertical wall 20, the arch 25, the wall portions 28 and 29, the portions of the back wall 12, and the front wall 11 near the combustion space as well as the inner face of the vertical heat-transfer portion or outlet duct 21, are all preferably lined with refractory or other heat resisting material, in view of the extremely high temperatures to which they are subjected.

In Figure 2, the separate paths followed by the primary, secondary, and pre-oxidizing and ignition air streams are indicated by arrows. It will be seen that the primary, or cross-feed, air is admitted to the combustion space at a point above the grate and passes across the fuel bed in a direction substantially at right angles to the direction of the downward movement of the fuel through the vertical chamber 22. The secondary air, is admitted to the combustion space through the transverse continuous slot 30, as shown. This air penetrates into the fuel bed to some extent as indicated in Figure 2. It is also illustrated how the pre-oxidizing and ignition air enters the chamber 22 at a point approximately level with the bottom of the firing door and passes downward through the fuel bed toward the entrance to the outlet duct 21. It will be seen that the three air streams converge at a point near the arch 25 and pass into the outlet duct together. It will be further noted that all three air streams have a planar action, that is, each stream extends substantially the entire width of the heater.

The action of this improved heating apparatus under normal operating conditions will now be described. For purposes of this description, it will be assumed that the fuel being burned is bituminous coal, although it will be understood that the mode of operation would not vary appreciably for other types of solid fuel. Assuming that the appaartus has been in operation, fresh fuel is supplied on top of the residual fuel bed in the fuel space or magazine 23 so as to fill the chamber 22. Combustion of the coal in the combustion space 24 is supported by the primary or cross-feed air entering through the port 32, the flow of such air being induced by natural draft. The rate of burning may be controlled by adjustment of the damper 33 or by control of the draft by means of the damper or valve in the smoke pipe. A part of the heat that is released by the combustion of the fuel is conducted or radiated upwards to the fresh fuel in the fuel magazine or space 23, another part is transmitted through the walls surrounding the hearth to the outside and the remainder is carried by the gases to the heat exchange space or outlet duct 21. The combustion-supporting, or primary air passes through the fuel bed in a direction which is essentially at right angles to the movement of the fuel bed and towards the wall 20, as shown in Figure 2.

The effect of the heat from the burning bed below on the fresh fuel above is to raise the temperature of the fresh fuel to a temperature sufficiently high that by reason of the combined effects of heat and air the distillation products from the coal will oxidize, with solid fuel residue remaining. The air which passes through the duct 36 enters the top of the chamber through the slot 37 and passes downwardly through the green fuel and the partially burned fuel to the entrance to the outlet duct 21. While the direction of movement of this air is, in the main, diagonally from the slot 37 to the entrance to the outlet duct 21, the tendency of flowing air to follow the path of least resistance causes air entering through the slot 37 to pass in contact with substantially all of the green fuel and partially burned fuel in the chamber 22. Such air flowing downwardly through the green fuel serves to oxidize the tarry matter distilled from the fuel, to prevent caking of the fuels, and thus, to permit the ignition plane gradually to approach the top of the charge with the result that the fresh fuel is gradually converted to a non-caking or non-agglomerating fuel.

The secondary air that is admitted through the slot 30 maintains a hot zone near the point of exit of the gases and further assures intimate mixing of air and the volatile gases. This results in complete combustion of all unburned gases since all the essential factors for smokeless combustion have been provided. The presence of sufficient air is assured because the devolatilization described above in gradual and sufficient secondary air may be readily provided; the streams of secondary air and of gases passing under the arch 25 are copenetrating and thus become intimately mixed; furthermore, the high

temperature resulting from the various forms of combustion occurring near the arch are communicated to the arch material which serves as a temperature catalyst for combustion.

Experience in using the apparatus with a horizontal roof has shown that occasionally a mixture of air and volatiles collects in the space above the fuel bed and a "puffing" of varying degrees of severity results whenever such mixture becomes ignited. It has been found that this undesirable feature can be effectively eliminated by inclining the roof **38**, as shown in the drawings. By inclining the roof the volume of the air space above the fuel bed is reduced, and thus the air-gas mixture which may collect above the fuel bed is limited to an amount too small to cause an explosive or "puffing" action upon ignition. Such action may also be reduced or curtailed as the result of the normal down flow of pre-oxidizing and ignition air through the main vertical chamber **22**. The roof **38** is normally inclined downwardly away from the firing door **18** to minimize the amount of gas that can collect above the fuel space but there is no correlation between the direction of inclination of the roof and the slot **37**.

It should be especially noted that neither the firing door **18** nor the door on the ash pit **15** are provided with any sort of opening, so that there is no oportunity for air to be admitted to the combustion space through these doors when they are closed as they normally are during operation of the heater. The only manner in which air can be admitted to the combustion chamber is in the regular fashion already described for passing the primary, secondary and pre-oxidizing and ignition air streams. This eliminates any possibility of air streams passing vertically upwards through the fuel bed as in the previous heater apparatus.

It will be obvious that the apparatus herein described for the burning of bituminous coal is applicable to the combustion of other types of solid fuels, such as anthracite coke, charcoal, lignite, and wood. The present invention is also applicable to different types of heaters, such as stoves, furnaces, and the like. Other changes in the herein described apparatus may be made without departing from the scope of the present invention as will be apparent to those skilled in the art.

The word "heater" as used in the specification and the following claims, is meant to include all types of apparatus for burning solid fuel, such as furnaces, stoves, boilers, ranges, etc.

What is claimed is:

1. A down-feed cross-draft heater including a casing forming a combustion space and a fuel magazine in vertical sequence, with the combustion space at the lower portion of the casing, a supporting grate spaced from the bottom of the casing and forming with the bottom of the casing a sealed ash pit below the grate, primary air supply means in one wall of the casing and above the level of the grate, an outlet duct extending substantially entirely across the opposite wall of the casing and opening adjacent to but above said grate, whereby primary air flowing from the supply means moves substantially transversely across the combustion area to the outlet duct and wholly above the grate, and an air supply duct leading from a point below the top of said first named wall and terminating in a port extending horizontally substantially the entire width of the said first-named wall and

adjacent the top to introduce pre-oxidizing and ignition air into the fuel magazine, said fuel magazine being sealed at its upper end except for the said inlet port and said combustion space having exit gas communication solely at the entrance to said outlet duct adjacent to but above the grate, whereby the pre-oxidizing and ignition air moves in a generally diagonal direction from the port at the top of the fuel magazine through the fuel to the outlet duct on the opposite side thereof and adjacent to said grate.

2. A down-feed cross-draft heater including a casing forming a combustion space and a fuel magazine in vertical sequence, with the combustion space at the lower portion of the casing, a supporting grate spaced from the bottom of the casing and forming with the bottom of the casing a sealed ash pit below the grate, primary air supply means in one wall of the casing and above the level of the grate, an outlet duct extending substantially entirely across the opposite wall of such casing and opening adjacent to but above said grate, whereby primary air flowing from the supply means to the outlet duct moves substantially transversely across the combustion area and wholly above the grate, and an air supply duct leading from a point below the top of said first named wall and terminating in a port extending horizontally substantially the entire width of the said first-named wall and adjacent the top to introduce pre-oxidizing and ignition air into the fuel magazine, said fuel magazine being sealed at its upper end except for the said inlet port and said combustion space having exit gas communication solely at the entrance to said outlet duct adjacent to but above the grate, whereby the pre-oxidizing and ignition air moves in a generally diagonal direction from the port at the top of the fuel magazine through the fuel to the outlet duct on the opposite side thereof and adjacent to said grate, means for controlling the supply of primary air, and means for controlling the admission of air to said pre-oxidizing and ignition air supply duct.

3. A down-feed cross-draft heater including a casing forming a combustion space and a fuel magazine in vertical sequence, with the combustion space at the lower portion of the casing, a supporting grate spaced from the bottom of the casing and forming with the bottom of the casing a sealed ash pit below the grate, primary air supply means in one wall of the casing and above the level of the grate, an outlet duct extending substantially entirely across the opposite wall of such casing and opening adjacent to but above said grate, whereby primary air flowing from the supply means to the outlet duct moves substantially transversely across the combustion area and wholly above the grate, and an air supply duct leading from a point below the top of said first-named wall upwardly and terminating at a port extending horizontally substantially the entire width of the said first-named wall and adjacent the top to introduce pre-oxidizing and ignition air into the fuel magazine, said fuel magazine being sealed at its upper end except for the said inlet port and said combustion space having exit gas communication solely at the entrance to said outlet duct adjacent to but above the grate, whereby the pre-oxidizing and ignition air moves in a generally diagonal direction from the port at the top of the fuel magazine through the fuel to the outlet duct on the opposite side thereof and adjacent to said grate, a normally closed fuel inlet at the top of the casing, the top of said cas-

ing being inclined downwardly from the fuel inlet to the port at the top of the fuel magazine to minimize the space above the fuel in the casing and thereby prevent puffing.

4. A down-feed cross-draft heater including a casing forming a combustion space and a fuel magazine in vertical sequence, with the combustion space at the lower portion of the casing, a supporting grate spaced from the bottom of the casing and forming with the bottom of the casing a sealed ash pit below the grate, primary air supply means in one wall of the casing and above the level of the grate, an outlet duct extending substantially entirely across the opposite wall of such casing and opening adjacent to but above said grate, whereby primary air flowing from the supply means to the outlet duct moves substantially transversely across the combustion area and wholly above the grate, and an air supply duct leading from a point below the top of said first-named wall upwardly and terminating in a port extending horizontally substantially the entire width of the said first-named wall and adjacent the top to introduce pre-oxidizing and ignition air into the fuel magazine, said fuel magazine being sealed at its upper end except for the said inlet port and said combustion space having exit gas communication solely at the entrance to said outlet duct adjacent to but above the grate, whereby the pre-oxidizing and ignition air moves in a generally diagonal direction from the port at the top of the fuel magazine through the fuel to the outlet duct on the opposite side thereof and adjacent to said grate, the casing being of less height on the pre-oxidizing and ignition air inlet side than on the opposite side.

5. A down-feed cross-draft heater including a casing forming a combustion space and a fuel magazine in vertical sequence, with the combustion space at the lower portion of the casing, a supporting grate for the fuel spaced from the bottom of the casing and forming with the bottom of the casing a sealed ash pit below the grate, a primary air supply opening in one wall of the casing and above the level of the grate, a hollow wall structure positioned within the casing in closely spaced substantially parallel relation with the opposite wall of said casing to define with such wall an upwardly extending outlet duct for the products of combustion, said hollow wall being of such length that the entrance to the outlet duct opens adjacent to but above said grate, whereby primary air from the supply means moves substantially transversely across the combustion area to the entrance to the outlet duct and wholly above the grate, means for introducing air to said combustion area at the lower end of said hollow wall structure adjacent the entrance to the outlet duct, and an air inlet passageway leading from a point below the top of said first-named wall to terminate in a port extending horizontally substantially the entire width of the said first-named wall and adjacent the top thereof to introduce pre-oxidizing and ignition air into the fuel magazine, said fuel magazine being sealed at its upper end except for the said inlet port and said combustion space having exit gas communication solely at the entrance to said outlet duct adjacent to but above the grate, whereby the pre-oxidizing and ignition air moves in a generally diagonal direction from the port at the top of the fuel magazine through the fuel to the outlet duct on the opposite side thereof and adjacent to said grate.

6. A down-feed cross-draft heater including a

casing forming a combustion space and a fuel magazine in vertical sequence, with the combustion space at the lower portion of the casing, a supporting grate for the fuel spaced from the bottom of the casing and forming with the bottom of the casing a sealed ash pit below the grate, a primary air supply opening in one wall of the casing and above the level of the grate, a hollow wall structure positioned within the casing in closely spaced substantially parallel relation with the opposite wall of said casing to define with such wall an upwardly extending outlet duct for the products of combustion, said hollow wall being of such length that the entrance to the outlet is adjacent to but above said grate, whereby primary air from the supply means moves substantially transversely across the combustion area to the entrance to the outlet duct and wholly above the grate, means for introducing air to said combustion area at the lower end of said hollow wall structure adjacent the entrance to the outlet duct, and an air supply duct leading from a point below the top of said first-named wall to terminate in a port extending horizontally substantially the entire width of the said first-named wall and adjacent the top thereof to introduce pre-oxidizing and ignition air into the fuel magazine, said fuel magazine being sealed at its upper end except for the said inlet port and said combustion space having exit gas communication solely at the entrance to said outlet duct adjacent to but above the grate, whereby the pre-oxidizing and ignition air moves in a generally diagonal direction from the port at the top of the fuel magazine through the fuel to the outlet duct on the opposite side thereof and adjacent to said grate, the casing being of less height on the pre-oxidizing and ignition air inlet side than on the opposite side to minimize the space above the fuel in the casing and thereby prevent puffing.

7. A down-feed cross-draft heater including a casing forming a combustion space and a fuel magazine in vertical sequence, with the combustion space at the lower portion of the casing, a supporting grate for the fuel spaced from the bottom of the casing and forming with the bottom of the casing a sealed ash pit below the grate, a primary air supply opening in one wall of the casing and above the level of the grate, a hollow wall structure positioned within the casing in closely spaced substantially parallel relation with the opposite wall of said casing to define with such wall an upwardly extending outlet duct for the products of combustion, said hollow wall being of such length that the entrance to the outlet is adjacent to but above said grate, whereby primary air from the supply means moves substantially transversely across the combustion area to the entrance to the outlet duct and wholly above the grate, means for introducing air to said combustion area at the lower end of said hollow wall structure adjacent the entrance to the outlet duct, and an air supply duct leading from a point below the top of said first-named wall upwardly to terminate in a port extending horizontally substantially the entire width of the said first-named wall and adjacent the top to introduce pre-oxidizing and ignition air into the fuel magazine, said fuel magazine being sealed at its upper end except for the said inlet port and said combustion space having exit gas communication solely at the entrance to said outlet duct adjacent to but above the grate, whereby the pre-oxidizing and ignition air moves in a generally diagonal direction from the port at the top of the

fuel magazine through the fuel to the outlet duct on the opposite side thereof and adjacent to said grate, means for controlling the supply of primary air, and means for controlling the admission of air to said pre-oxidizing and ignition air supply duct.

8. A down-feed cross-draft heater including a casing forming a combustion space and a fuel magazine in vertical sequence, with the combustion space at the lower portion of the casing, a supporting grate spaced from the bottom of the casing and forming with the bottom of the casing a sealed ash pit below the grate, primary air supply means in one wall of the confined space and above the level of the grate, an outlet duct extending substantially entirely across the opposite wall of the casing and opening adjacent to but above said grate, whereby primary air flowing from the supply means moves substantially transversely across the combustion area to the outlet duct and wholly above the grate, and an air supply duct leading from a point below the top of said first named wall upwardly and terminating in a port extending horizontally substantially the entire width of the said first-named wall and adjacent the top to introduce pre-oxidizing and ignition air into the fuel magazine, a dividing wall between said primary air supply means and said air supply duct, said fuel magazine being sealed at its upper end except for the said inlet port and said combustion space having exit gas communication solely at the entrance to said outlet duct adjacent to but above the grate, whereby the pre-oxidizing and ignition air moves in a generally diagonal direction from the port at the top of the fuel magazine through the fuel to the outlet duct on the opposite side thereof and adjacent to said grate.

9. A down-feed cross-draft heater including a casing forming a combustion space and a fuel magazine in vertical sequence, with the combustion space at the lower portion of the casing, a supporting grate for the fuel spaced from the bottom of the casing and forming with the bottom of the casing a sealed ash pit below the grate, a primary air supply opening in one wall of the casing and above the level of the grate, a hollow wall structure positioned within the casing in closely spaced substantially parallel relation with the opposite wall of said casing to define with such wall an upwardly extending outlet duct for the products of combustion, said hollow wall being of such length that the entrance to the outlet is adjacent to but above said grate, whereby primary air from the supply means moves substantially transversely across the combustion area to the entrance to the outlet duct and wholly above the grate, means for introducing air to said combustion area at the lower end of said hollow wall structure adjacent the entrance to the outlet duct, and an air supply duct leading from a point below the top of said first-named wall upwardly to terminate in a port extending horizontally substantially the entire width of the said first-named wall and adjacent the top to introduce pre-oxidizing and ignition air into the fuel magazine, a dividing wall between said primary air supply means and said supply duct, said fuel magazine being sealed at its upper end except for the said inlet port and said combustion space having exit gas communication solely at the entrance to said outlet duct adjacent to but above the grate, whereby the pre-oxidizing and ignition air moves in a generally diagonal direction from the port at the top of the fuel magazine through

the fuel to the outlet duct on the opposite side thereof and adjacent to said grate, means for controlling the supply of primary air, and means for controlling the admission of air to said pre-oxidizing and ignition air supply duct.

10. A heater adapted to burn solid fuel without appreciable smoke and comprising a box-like casing formed of a first pair of opposed vertical walls, a second pair of opposed vertical walls between the first pair, a top wall and a bottom wall, a perforate grate disposed in the casing directly above the bottom wall and defining with said bottom wall and the lower portions of the vertical walls a normally closed and air tight ash pit, a substantially vertical hollow wall structure positioned in the casing in closely spaced and substantially parallel relation with one of the vertical walls of the first pair, extending between and connected to the second pair of vertical walls, defining between said hollow wall and said one vertical wall of the first pair an upwardly extending outlet duct for the products of combustion and between said hollow wall and the other vertical wall of the first pair a vertical chamber consisting of an upper fuel space and a lower combustion space directly above the grate, said hollow wall having the lower portion thereof terminating above the grate in order that the combustion space is in communication with the lower end of the outlet duct, means in the upper portion of the casing for sealing the upper end of the fuel space from the upper end of the outlet duct, normally sealed means for introducing solid fuel into the fuel space, horizontally elongated primary air supply means disposed above the grate, associated with, and extending transversely across, said other vertical wall of the first pair, connected to receive outside air as primary air, and having a single horizontal full length opening arranged so that all of the primary air flows substantially horizontally over the grate, through the fuel in the lower portion of the combustion space and towards the lower end of the outlet duct, and means within the casing and directly above the primary air supply means forming a substantially vertical duct having its lower end open to receive outside air as pre-oxidizing and ignition air and its upper end communicating with the upper portion of the fuel space and arranged so that it introduces the pre-oxidizing and ignition air into said upper portion of the fuel space for flow downwards past the pieces of fuel in the vertical chamber, the hollow wall structure being connected to receive outside air as secondary air and having in the lower portion thereof a single horizontal full width discharge slot facing inwards and downwards and serving to discharge the secondary air so that it flows part way through the fuel in the lower portion of the combustion space, said upper portion of the fuel space, when the heater is charged with fuel and in operation and the fuel introducing means is sealed, being completely closed except for the upper end of said vertical duct and the interstices between the pieces of fuel in said vertical chamber.

11. A heater adapted to burn solid fuel without appreciable smoke and comprising box-like casing formed of a first pair of opposed vertical walls, a second pair of opposed vertical walls between the first pair, a top wall and a bottom wall, a perforate grate disposed in the casing directly above the bottom wall and defining with said bottom wall and the lower portions of the vertical walls a normally closed and air-tight

ash pit, a substantially vertical hollow wall structure positioned in the casing in closely spaced and substantially parallel relation with one of the vertical walls of the first pair, extending between and connected to the second pair of vertical walls, defining between said hollow wall and said one vertical wall of the first pair an upwardly extending outlet duct for the products of combustion and between said hollow wall and the other vertical wall of the first pair a vertical chamber consisting of an upper fuel space and a lower combustion space directly above the grate, said hollow wall having the lower portion thereof terminating above the grate in order that the combustion space is in communication with the lower end of the outlet duct, means in the upper portion of the casing for sealing the upper end of the fuel space from the upper end of the outlet duct, normally sealed means for introducing solid fuel into the fuel space, horizontally elongated primary air supply means disposed above the grate, associated with, and extending transversely across, said other vertical wall of the first pair, connected to receive outside air as primary air and having an opening arranged so that all of the primary air flows substantially horizontally over the grate, through the fuel in the lower portion of the combustion space and towards the lower end of the outlet duct and means within the casing and directly above the primary air supply means forming a substantially vertical duct having its lower end open to outside air as pre-oxidizing and ignition air, and its upper end provided with a horizontal substantially full width port communicating with the upper portion of the fuel space and facing inwards and downwards so as to cause the pre-oxidizing and ignition air to flow in a generally diagonally downward path past the pieces of fuel in the fuel space and in the direction of the lower portion of the hollow wall, said hollow wall structure being connected to receive outside air as secondary air and having in the lower portion thereof a downwardly and inwardly facing substantially full width slot for discharging the secondary air so that it flows part way through the fuel in the lower portion of the combustion space, said upper portion of the fuel space when the heater is charged with fuel and in operation and the fuel introducing means is sealed, being completely closed except for the upper end of the vertical duct and the interstices between the pieces of fuel in said vertical chamber.

12. A heater adapted to burn solid fuel without appreciable smoke and comprising box-like casing formed of a first pair of opposed vertical walls, a second pair of opposed vertical walls between the first pair, a top wall and a bottom wall, a perforate grate disposed in the casing directly above the bottom wall and defining with said bottom wall and the lower portions of the vertical walls a normally closed and airtight ash pit, a substantially vertical hollow wall structure positioned in the casing in closely spaced and substantially parallel relation with one of the vertical walls of the first pair, extending between and connected to the second pair of vertical walls, defining between said hollow wall and said one vertical wall of the first pair an upwardly extending outlet duct for the products of combustion and between said hollow wall and the other vertical wall of the first pair a vertical chamber consisting of an upper fuel space and a lower combustion space directly above the grate, said hollow wall having the lower portion thereof terminating above the grate in order that the combustion space is in communication with the lower end of the outlet duct, means in the upper portion of the casing for sealing the upper end of the fuel space from the upper end of the outlet duct, normally sealed means for introducing solid fuel into the fuel space, horizontally elongated primary air supply means disposed above the grate, associated with, and extending transversely across, said other vertical wall of the first pair, connected to receive outside air as primary air and having an opening arranged so that all of the primary air flows substantially horizontally over the grate, through the fuel in the lower portion of the combustion space and towards the lower end of the outlet duct, and means within the casing and directly above the primary air supply means forming a substantially vertical duct having its lower end open to outside air as pre-oxidizing and ignition air, and its upper end provided with a horizontal substantially full width port communicating with the upper portion of the fuel space and facing inwards and downwards so as to cause the pre-oxidizing and ignition air to flow in a generally diagonally downward path past the pieces of fuel in the fuel space and in the direction of the lower portion of the hollow wall, said hollow wall structure being connected to receive outside air as secondary air and having in the lower portion thereof a downwardly and inwardly facing substantially full width slot for discharging the secondary air so that it flows part way through the fuel in the lower portion of the combustion space, said upper portion of the fuel space when the heater is charged with fuel and in operation and the fuel introducing means is sealed, being completely closed except for the upper end of the vertical duct and the interstices between the pieces of fuel in said vertical chamber, and the top wall of the casing being inclined downwardly from the normally sealed means for introducing fuel into the fuel space and said port to minimize the space above the fuel and thereby prevent puffing.

BERTRAND A. LANDRY.

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Certificate of Correction

Patent No. 2,481,165 September 6, 1949

BERTRAND A. LANDRY

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 3, line 21, for the word "bows" read *flows*;

and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 10th day of January, A. D. 1950.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.