Dec. 21, 1943. J. H. LANGLEY 2,337,053

FURNACES

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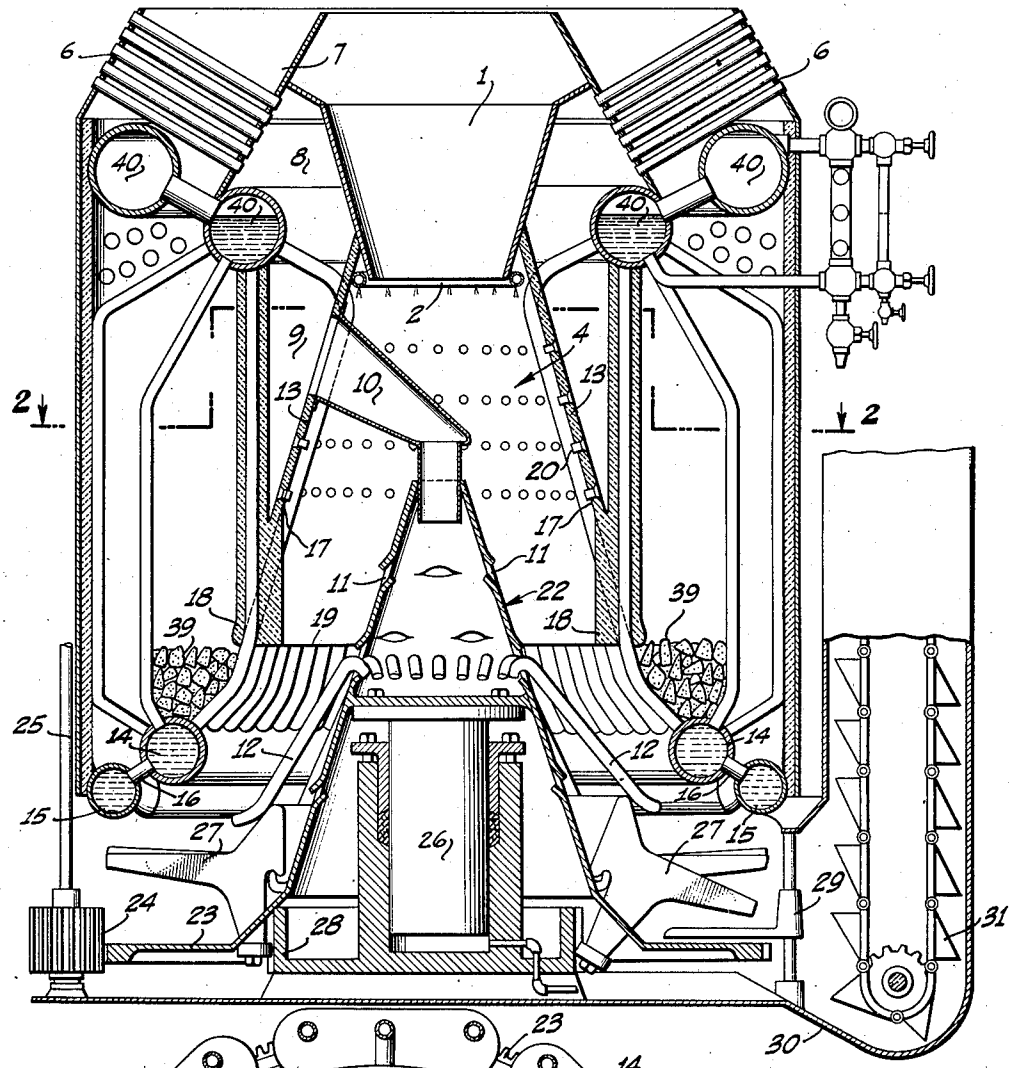


FIG. 1.

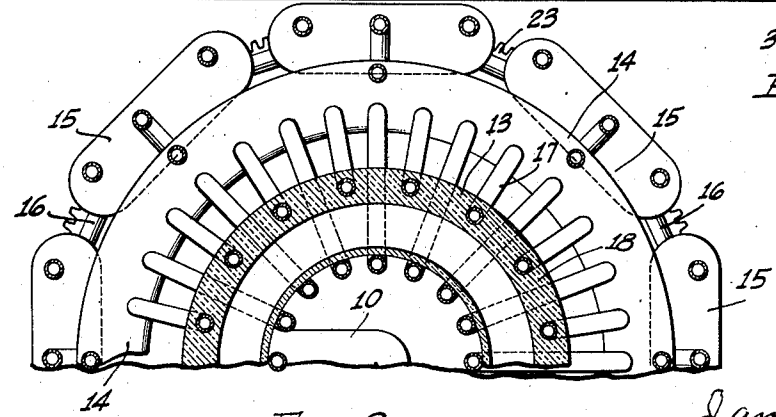


FIG. 2.

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FIG. 3.

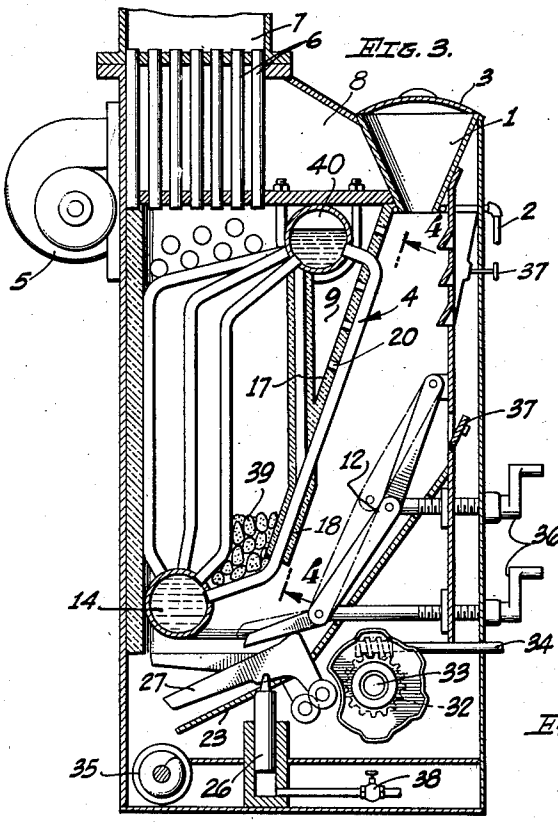


FIG. 4.

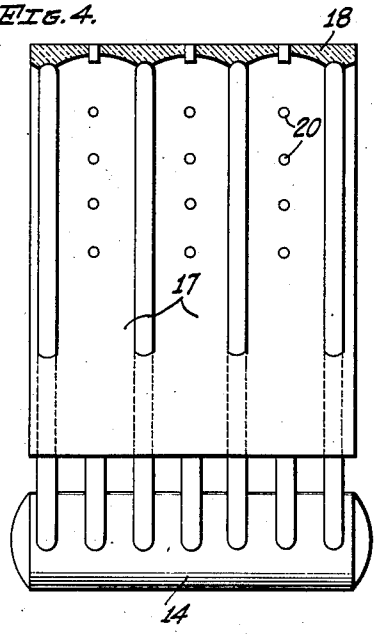


FIG. 5.

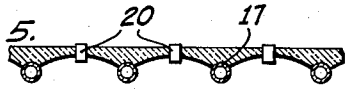


FIG. 6.

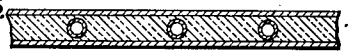


FIG. 7.

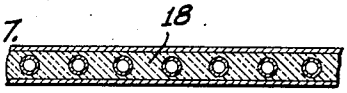


FIG. 8.

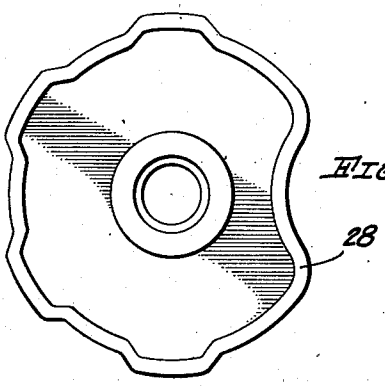


FIG. 9

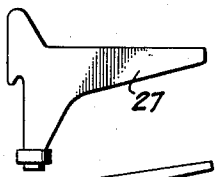


FIG. 8A

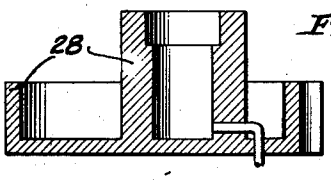
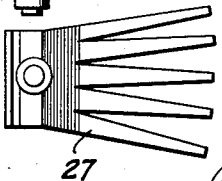


FIG. 9A



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Patented Dec. 21, 1943 2,337,053

UNITED STATES PATENT OFFICE

2,337,053

FURNACE

James H. Langley, Long Beach, Calif.

Application March 6, 1939, Serial No. 259,971

14 Claims. (Cl. 122—339)

This invention relates to the process of burning fuel in a furnace by igniting it as it feeds down into the furnace and passing air and the gases distilled from the burning fuel down through the hotter fuel in the lower part of the furnace, thus raising and equalizing the temperature of the air and gas, enabling them to unite in perfect combustion amidst the hot coals and coke covering the gas outlet openings at the base of the furnace, without flame, smoke, sparks, or fly-ash.

This process is the exact opposite of the usual up draft method in which the air passes up through the grates, the ashes on the grates, the hot coals on the ashes and then through the fresh fuel on the hot coals, which method requires either hand or mechanical stoking and often the loss of much of the heat value in the fuel, due to the difficulty of equalizing the temperature of the air and the gases distilled from the fuel, without which they cannot unite.

In my furnace the ignited fuel is first heated to drive out the volatile gases, and coke the residue. The coke is then burned in the lower part of the furnace as the air and volatile gases from above pass through the bed of hot coke.

The ashes and incombustibles pass out at the base of the furnace by gravity and no stoking is required.

In the larger sizes the furnace may be steeply inclinued and inclined grates may be used to retain the fuel between the grates and the upper wall of the furnace, these grates may be adjusted closer to or farther from this wall and thereby control the thickness of the fuel bed on the grates.

Air may be blown into this ignited fuel through air jets in this upper wall to promote combustion in this fuel between the lower grates and the upper wall to drive out the moisture and the volatile gases.

Since moisture must be evaporated from fuel before it can burn, I prefer to use highly preheated air as it not only dries out the moisture but it raises the temperature of the air just that much nearer to that of the carbon gases, with which it must become equalized before they can unite and form carbon dioxide, or perfect combustion. This is the first object of this invention.

The second object is to eliminate all manual labor and all hand stoking as the fuel feeds down through the furnace by gravity and with the reservoir full of fuel the fire may not even be seen, much less poked or stoked.

The third object is to enable almost any kind of fuel to be used by coking all fuel in the upper part of the furnace and burning the coke in the lower part. Since the process of roasting fuel into coke produces very little ash, the grates in the upper part of this furnace are for the admission of air only so the fine or powdered fuel is coked or consumed instead of dropping through grate bars into the ash pit as it does in the up-draft furnaces. This is the fourth object.

By confining the fuel between the furnace wall and the adjustable grates any class, size, or type of fuel may be burned in this furnace. This is the fifth object.

The sixth object is to provide a boiler consisting of upright water tubes completely encircling this furnace.

This boiler has connected steam drums at the top and connected mud drums at the bottom. The heat entering between the tubes below the water cooled wall which forms the wall of the furnace, passes between the boiler tubes, heating them equally and thus eliminating the violent water circulation so prevalent in many upright water tube boilers.

The seventh object is to provide an automatic stoker which will automatically spread a column of ignited fuel in a conical furnace into the form of a hollow cone between the conical furnace wall and a revolving conical grate in the center of the furnace which grate has flat dumping grates around its base and ash pans under said grates and means for raising or lowering these grates and ash pans so that the grates may be closer to or farther from the wall of the furnace and thereby maintain any desired thickness of fuel in the hollow cone of fuel between the grate and the furnace wall. The rotation of this stoker together with the inclination of the conical grate, distributes the fuel all around the furnace and maintains a constant thickness of the fuel even though some portions of the fuel might burn out faster than other portions. The fuel residue and incombustible material on the dumping grates and the ash pans are automatically dumped at each revolution of the grates.

The eighth object is to provide ignition means for fuel as it enters the top of the furnace. This is quite important, if not absolutely necessary, for the proper functioning of this type of furnace as the down draft draws all heat generated by burning fuel downward and away from the fresh fuel feeding into the furnace at the top.

Other objects will appear from a consideration of the present specification.

Having given the objects of this invention I now give a detailed description.

Detailed description

The invention is shown by way of illustration in the accompanying drawings wherein

Fig. 1 shows a vertical section of a conical furnace encircled by an upright water tube boiler. Also a conical grate and ash pan assembly together with the self dumping grates and cam to operate them and the means for raising and lowering said grates and the means for disposal of the residue.

Fig. 2 shows a plan view of the boiler tubes below a line from 2—2 in Fig. 1 and the baffles forming the wall of the conical furnace. It also shows one plan of connected mud drums.

Fig. 3 shows a section of a rectangular furnace below an inclined water tube boiler with the inclined adjustable grates and flat adjustable dumping grates and ash pans and the means for operating them, it also shows the inclined water cooled wall of the furnace and the air inlet openings and gas outlet openings through said wall, the air blower, the air pre-heater, the air distributing chamber and the pilot burner.

Fig. 4 shows an elevation of the upper wall of Fig. 3 the air inlet openings through the baffles between the tubes forming the wall and the gas outlet openings between the tubes below the baffles.

Fig. 5 is a sectional view taken through an upper portion of the wall shown in Fig. 4.

Fig. 6 is a sectional view of a wall that projects upwardly from a mid portion of the inclined wall shown in Fig. 4.

Fig. 7 is a sectional view taken through a lower portion of the wall as shown in Fig. 4.

Fig. 8 is a plan view of a cam used in operating a plurality of rocking and dumping grates.

Fig. 8*a* is a sectional view of the cam shown in Fig. 8.

Fig. 9 is a side view of a dumping grate.

Fig. 9*a* is a plan view of the dumping grate shown in Fig. 9.

It is presumed that these furnaces are kept full of ignited fuel and that a down draft has been created in the furnace.

This may be done by forced or induced draft fans or by creating heat in the stack which will then draw air down in the furnace chamber as down draft works on the principle of an inverted syphon. Having created a down draft in the furnace the furnace operates in the following manner.

The same reference numerals are used for the same elements on Figs. 1 and 3 and in some parts of the description the two figures are described simultaneously.

In Figs. 1 and 3 the fuel feeding down in the fuel hopper 1 is ignited by pilot burners 2 as it enters the furnace chamber 4 and if a blower is used the cover 3 (see Fig. 3) may be put on to prevent air from blowing up through the fuel inlet. The blower 5 (see Fig. 3) may force air through the air heater 6 located in the stack 7 and through the passage 8 to the chamber 9 encircling the furnace chamber 4. A part of the air entering this chamber is blown into the ignited fuel in the furnace through small air openings through the upper side wall of the furnace to promote combustion of the fuel on the outside of the column of fuel feeding down into the furnace.

All fuel contains more or less moisture which must be evaporated before it can burn and as the fuel falls through the inlet opening it is less compacted than at any other point so these jets of air (preferably highly pre-heated) and the heat from the pilot burners drive the moisture out and the heat into the fuel at this point and promote combustion of the fuel on the upper side of the fuel in the conical furnace.

As there is no way out for the air in the direction of these air jets the air penetrates the fuel as far as it can and then it must return to the wall 13 and pass down together with the gases distilled from the fuel, between the fuel and the wall to the gas outlet openings 19 at the base of the furnace wall. Element No. 17 consists of the furnace wall encircled (in Fig. 1) by the air distributing chamber 9, which wall consists of an inner row of boiler tubes, together with baffles. As shown in Fig. 5, the baffles have air inlet jets 20 therein that distribute the air equally to all the upper part of the furnace chamber. The air is forced through the jets into the outside of the ignited fuel filling the chamber, thus promoting combustion by blowing air into the fuel with some force. The curvature of the baffles, form, between the tubes, a part of a passage for the air and gas distilled from the fuel, so they can pass downwardly.

The air and gases passing down outside of the fuel may not be of equal temperature or of equal specific gravity and therefore not united in perfect combustion so the channels terminate some distance above the gas exits 19 and the spaces between the tubes is filled with refractory material 18, which forces said air and gases to pass down through a bed of hot coals and coke before reaching the gas exits.

In passing through these coals these primary gases become equalized in temperature and unite amidst these coals and all smoke, sparks, odors and carbon monoxide are converted into carbon dioxide gas. This conversion creates an incandescent heat at this point and is one of the reasons for the waterwalls.

The remainder of the air in the distribution chamber 9 (Fig. 1) may pass through the pipe 10 to the conical chamber 22 and out through the louvers 11 and through the coke and coals between said louvers and the gas exits 19. This chamber 22 is the top of the conical grate assembly which revolves on the hydraulic ram 26 and which may be raised or lowered by said ram to adjust the distance between the conical grates and the conical furnace wall and thereby controls the depth of fuel on said grates.

This grate assembly also carries the rocking grates 12 and the dumping grates 27 and the ash pan 23 the outer edge of which engages the gear 24 which is driven by the shaft 25 and controls the speed of the rotation of the assembly.

As can be seen from Fig. 1, each dumping grate 27 is so hung on the lower part of conical chamber 22 that it can be rocked in a vertical direction. Each grate 27 has an arm extending downwardly through the plate that connects conical chamber 22 and ash pan 23. At the lower end of this depending arm is a roller that rolls around the edge of a stationary cam 28 when the grate assembly is rotated. As is seen from Fig. 8 the cam 28 is so shaped that it will cause each grate 27 to rock as the end of its depending arm rolls around the outer edge of the cam. At the right side of the cam 27 (Fig. 8) is a deep indentation. When the roller end of grate 27 reaches this deep indentation, the other end will dip suf-

ficiently to cause ashes on said grate to slide off.

The fuel in the column entering the furnace is spread by the conical grate into the form of a hollow cone of any desired thickness between the conical grates and the conical wall and is blasted by air from within and from the outside.

The roasting of fuel leaves very little ash residue so the louvers are used instead of grate bars in the upper part of the grate so even finely divided fuel is not lost between the grate bars but all sand, rocks and incombustibles slide down on the outside of chamber 22 and either slide down over or drop through the rocking 12 and dumping grates 27 to the ash hopper 30. The ashes are raked off the pan by the finger 29 and they may be elevated by the hoist 31.

The numbers used in Fig. 3 are the same as in Fig. 1 where they dseignate parts performing the same function up to and including 31. The cam 32 is driven by the worm gear 33 and the shaft 34. The ashes may be removed by the screw 35. The inclined grates may be adjusted closer to or farther from the wall 18 by the screw jacks 36 and the dampers 37 control the air to the various parts of the furnace. The valve 38 controls the rams.

Refractory material 39 may be placed above the outlets 19, and in Fig. 1 the connected steam drums 40 encircle the furnace.

As the gases pass through between the boiler tubes after leaving the furnace they heat them equally and therefore create no violent circulation of water within the tubes and all steam drums will show a true water level at any load.

Numeral 40 indicates the upper drums whether they are steam separating drums or header drums and may consist of any number of connected drums. Numeral 16 represents nipples connecting lower header drum 14, and the mud drums 15 to drain the mud from the header drum.

Having described the furnace, the automatic stoker and the boiler, all of which I claim are new and useful, and desire to secure by Letters Patent is:

1. In a conical water walled furnace, ignition means in a fuel opening in the top of said furnace, connected steam drums surrounding said fuel opening, mud drums forming the base of said cone, boiler tubes connecting these upper and lower drums, an inner bank of said tubes together with baffles forming the wall of the furnace, air openings in said baffles to support combustion of fuel within said wall and, gas outlets through said wall at the bottom.

2. In a conical furnace, a fuel opening, ignition means therein, a steam drum encircling said opening, water tubes connecting said steam drum with connected mud drums below, an inner bank of tubes, together with baffles between said tubes, forming the outer wall of said conical furnace, said baffles and tubes forming combustion channels between said tubes, air openings through said baffles connected with an air pre-heater, gas outlets through the lower part of said wall.

3. In a furnace, a fuel opening, a pilot burner therein, an inclined furnace below said opening, combustion channels in the upper wall, air openings in the upper part of said furnace through said wall gas outlet openings through said wall below said air inlet openings, inclined grates and ash pan below said wall that may be adjusted closer to or farther from said upper wall to regulate the amount of fuel, said air, together with gases distilled from said fuel, shall have to pass through to reach said gas outlet openings.

4. In a furnace, ignition means in a fuel opening, an inclined fuel passage below said opening means for blowing air into ignited fuel in said passage, through openings in the upper wall of said inclined passage, inclined, self cleaning grates and an inclined self cleaning ash pan below said grates forming the lower wall of said passage, means of adjusting said grates to be closer to or farther from the upper wall of said passage, and to gas outlets through the lower outer wall to regulate the amount of fuel, said air and gases distilled from said fuel must pass through to reach said gas outlets.

5. In a conical furnace, a fuel opening in the upper part of said furnace, gas outlet openings through the lower, outer walls of said furnace, conical, revolving self cleaning automatic, rocking, self dumping grates, and a revolving, self cleaning, conical ash pan below said grates, said gas outlets being above the outer edge of said grates, and means of raising and lowering said grates to compel the gases to pass through more or less radiant fuel in order to reach said outlets.

6. In an inclined furnace, a fuel opening, inclined grates below said opening, means for moving said grates closer to or farther from the upper wall of said furnace, means for burning fuel between said grates and said upper wall by blowing air into said fuel through said upper wall gas outlet openings through said upper wall below said air inlet openings.

7. In a furnace, means for burning fuel between an inclined upper wall and inclined rocking, self cleaning grates, by blowing air into said fuel through small openings in said wall, means for adjusting said grates closer to or farther from said wall and to outlet openings below said inlet openings in said wall so that said outlets may be obstructed more or less, with hot coals through which the air and gases from the burning fuel above would be forced to pass.

8. In a furnace, means for burning fuel between an inclined upper wall and inclined self cleaning grates below said upper wall, by blowing air into said fuel through small openings in said upper wall and forcing all gases to pass through radiant fuel to reach gas outlet openings in said upper wall below said air inlet openings, and below said fuel.

9. In a furnace, ignition means in a fuel opening, an inclined fuel passage below said opening, baffle means between water tubes comprising an upper wall of said fuel passage, small air inlet openings in said baffle means, said openings being connected with an air preheater and being for the purpose of blowing air through said openings into fuel to support combustion of the fuel in said passage, gas outlet openings in said upper inclined wall located below said air inlets, and inclined grates and an ash pan forming a lower inclined wall for said fuel passage and being adjustable closer to or farther from said upper inclined wall and said gas outlet openings.

10. In a furnace, ignition means in a fuel opening, an inclined passage below said opening, an air inlet opening in the upper end of said passage, a gas exit opening at the lower end of said passage, means for blowing air into ignited fuel in said passage through air jets in the upper wall of said chamber to promote combustion and distillation of gases from said fuel said air and gases becoming equalized in temperature as they

pass down through the hotter fuel below to reach the exit opening below said fuel in said passage, means for controlling the amount of fuel through which said gases must pass and means for discharging the residue from the furnace.

11. In a furnace, a top fuel opening, ignition means in said opening, inclined grates below said opening, means for regulating the distance said grates are from an upper inclined wall, means for blowing air into ignited fuel between said grates and said wall through openings in said grates and through said wall, said air being forced to pass down through said fuel to outlets at the base of said furnace.

12. In a circular furnace, a top fuel opening, a conical grate below said opening, flat dumping grates at the base of said conical grates, means for burning ignited fuel in said furnace between said grates and the wall of said furnace first by a down draft between said fuel and said wall to gas outlets near the base of said wall, second by a cross draft through the fuel between the conical grate and said outlet openings and third by an up draft through the fuel on the flat grates to said outlets.

13. A furnace chamber, ignition means in a fuel opening in the top of said chamber, a gas outlet opening at the base of said chamber, a column of ignited fuel in said chamber, means for consuming said fuel by blowing air into said fuel through air inlet openings in the side wall of said chamber above said outlet opening, and through air inlet openings in inclined grates under said fuel.

14. An inclined furnace chamber, ignition means in a top fuel opening, inclined grates below said opening, means for adjusting said grates closer to or farther from the upper wall of said chamber, and means for blowing air into ignited fuel on said grates through air inlet openings through said wall and down through said fuel to gas outlet openings below said air inlet openings in said wall.

JAMES H. LANGLEY.