

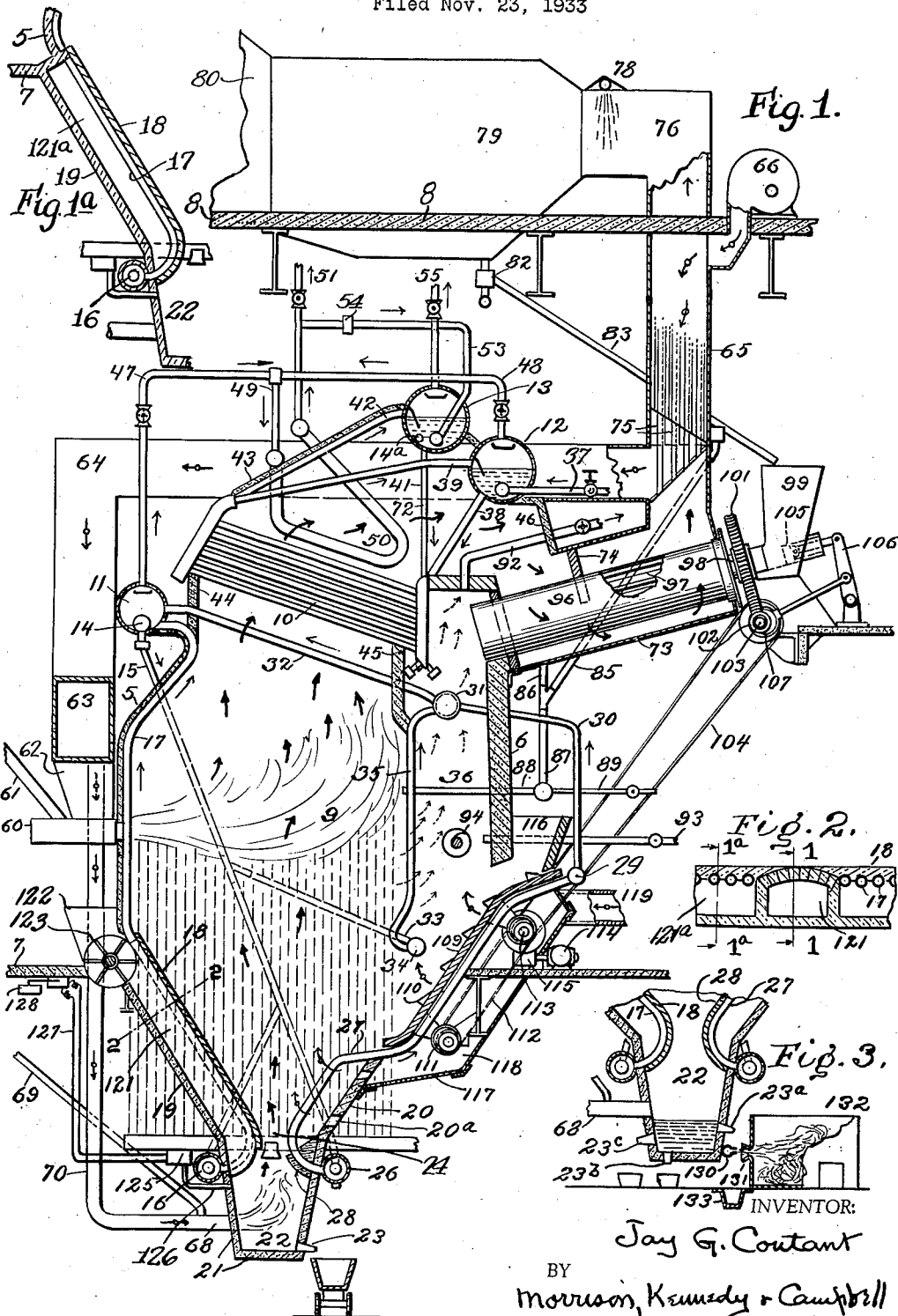
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BOILER FURNACE

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BOILER FURNACE

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This invention relates to boiler furnaces and is in part a continuation of my prior copending application Serial No. 496,870, filed November 20, 1930 for a Steam generating system. The present invention is capable of various commercial uses including the generating of vapor or steam for the development of light, heat or power, also for various other heating purposes including heating of water or melting of snow, also for the destruction or incineration of refuse, also for generation of combustible gases, production of coke and the like.

The general object of the present invention is to afford a boiler furnace adapted to one or more of the uses mentioned and which can be operated with high efficiency and by smokeless combustion. A particular object is to afford a boiler furnace adapted to be fired by a plurality of fuels, namely a primary fuel of smokeless character, preferably pulverized coal, but sometimes oil or gas, and a secondary fuel which may be smoky or require special treatment to reduce it to smokeless fuel before or during combustion. A further object is to afford a multiple fuel furnace adapted to the preliminary treatment or drying of a secondary fuel and thereupon burning it, such as garbage, dust, soot, sewage or other rubbish in a manner to eliminate the issue of noxious substances or bacteria from the stacks, thus rendering the plant adapted to use in congested regions. A further object is to afford a furnace of the character referred to wherein the solid refuse or residue from the several fuels is reduced to molten condition for discharge at the pit of the furnace. A further object is the recovery of commercially valuable by-products from both the volatile and solid products of the combustion.

Other and further objects and advantages of the invention will be explained in the hereinafter following description of a practical embodiment thereof or will be manifest to those conversant with the subject. To the attainment of such objects and advantages the present invention consists in the novel boiler furnace and the novel features of operation, combination, arrangement and construction herein illustrated or described.

In the accompanying drawing Figure 1 is a diagrammatic vertical section through a boiler furnace embodying the present invention; the left bottom wall of the main combustion chamber being shown in section taken on the line 1—1 of Fig. 2, and Fig. 1^a is a detached section taken on the line 1^a—1^a of Fig. 2.

Fig. 2 is a section of such left bottom wall taken on the line 2—2 of Fig. 1.

Fig. 3 is a view similar to Fig. 1 showing a modification of the lower part of the apparatus.

The furnace may be bounded by suitable walls 5 of which there is shown a left wall 5 and a right wall 6 and others to be described. At an appropriate level is shown the floor 7, and high above the boiler the ceiling 8. The main combustion or non-fusion chamber 9 is enclosed between the left and right walls and similar lateral walls at the remaining sides. Above the main chamber is shown the main boiler, a conventional type of tubular boiler 10 comprising inclined tubes extending between sectional headers. The boiler system also comprises a plurality of drums, for example a first or lowest drum 11 shown at the left, near the boiler level, a second drum 12 to the right and above the boiler, and a third drum 13 higher than the others, and cooperating circulation tubes.

The first drum 11 is part of a supplemental boiler, and may be supplied with hot water by a connection 14. From the drum 11 extends a downtake 15 leading to a low header 16 at the left, below the combustion chamber, from which extend upwardly a system of uptakes 17, at first along the steeply inclined chamber bottom, and then vertically, exposed to the radiant heat, in front of the left wall 5.

The lower or inclined parts of the uptakes 17 are covered by high heat conducting material as cast iron or silicon carbide 18 and may be continued around to the header 16, except at certain places as will be described. Below and outside of the bottom 18 is an exterior bottom wall 19, and at the opposite or right side of the furnace is a corresponding inclined bottom wall 20, provided with a poke hole 20^a. The two bottom walls 19 and 20 converge downwardly and are continued as walls 21 to form a pilot or fusion chamber 22 substantially uncooled and arranged to maintain molten the received material and to deliver or drain the slag to a convenient receptacle or disposal point, as by a spout 23. Between the combustion and fusion chambers is a metallic throat 24 cooled by the adjacent water tubes for its protection.

The water downtake 15 from the drum 11 supplies also a right low header 26 opposite to the header 16, and from the header 26 extend uptakes 27 of a particular shape to be subsequently described. The lower ends of the uptakes 27 may have a metallic or refractory cover 28 adjacent to the throat 24. The upper end of the

system of uptakes 27 has a common header 29 from which extend further uptakes 30 leading to a header 31 inside the chamber 36 to be described. From the header 31 extend inclined tubes 32 spaced apart and constituting a water screen between the combustion chamber 9 and the boiler. From the downtake 15 extends a supplemental downtake 33 leading to a transverse header 34 from which extend upwardly a series of uptakes or wall tubes 35 delivering into the header 31. These tubes 35 constitute an open water-cooled wall partially separating the combustion chamber 9 from a lateral or refuse chamber 36 contained between the tube system 35 and the right wall 6. The first drum and described circulation passages, some exposed to the radiant heat, may be considered as a high pressure boiler separate from the main boiler 10.

The second drum 12 is shown as supplied with feed water by a pipe 37. From this drum extend downtakes 38 to a number of the sections of the boiler 10, but not all, and these sections deliver by uptakes 39 back to the drum 12. Similarly, the top drum 13 is supplied with feed water by pipe 14^a and has downtakes 41 leading to the remaining sections of the boiler lower header, while uptakes 42 bring steam and water back from the corresponding upper sections of the boiler to the drum. There are thus in effect three boilers, each having its own drum.

The uptakes 42 to the drum 13 are shown as covered with refractory members or plates 43, closing the furnace at this point; and the furnace may be similarly closed at other points, for example by a wall 44 between the left wall 5 and the boiler, and a wall 45 between the open wall 35 and the boiler, and refractory walls 46 extending below the drum 12.

From the top of the first drum 11 extends a valved outlet pipe 47. A similar outlet pipe 48 extends from the drum 12. These outlet pipes 47 and 48 meet in a common steam pipe 49 which is shown extending to a superheater 50 from which extends upwardly the high pressure final or delivery outlet pipe 51. Each of these several pipes may contain a steam valve. From the high pressure delivery pipe 51 is shown a relief pipe 53 arranged to deliver into the drum 13, this pipe containing a relief valve 54 adapted to discharge when the pressure in outlet 51 becomes excessive. From the drum 13 extends a delivery outlet 55 conveying low pressure steam to the place of consumption.

The described boiler and water and steam circulating passages in general correspond substantially with the arrangement disclosed in my said copending application, to which reference may be made for further details.

For the purpose of burning primary or smokeless fluent fuel in the main chamber 9 there is indicated a burner 60 which for example may be arranged to inject the fuel inwardly in a lateral direction, creating an oxidizing hot zone of combustion, from which the products pass upwardly through the boiler and flues to be described. The burner 60 may be fed by pulverized coal through a fuel supply pipe 61, and by primary air through an air pipe 62 delivering from an air duct 63 extending across the side of the furnace to supply any number of burners. The duct 63 is supplied with air by a duct 64 which may receive air from a preheater 65 through which the air is forced downwardly by a blower 66 or other source of forced draft.

The pilot fusion chamber 22 may be similarly provided with a pilot burner 68 fed by a primary fuel pipe 69 and an air pipe 70 coming from the duct 63. An excessive temperature, e. g. between 1200° and 2000° C., will be maintained in the confined pilot chamber or space 22, so high indeed as to melt ash and other solids received from the combustion chamber, including even metal if desirable. This chamber may take different forms and may be of a rotary type; and it may deliver either to a vehicle as shown, to a sluice or otherwise.

From the fusion chamber the products ascend through the throat 24 into the main combustion or non-fusion chamber 9; any suspended molten matter being cooled and solidified before reaching the main chamber. Here the products combine with the flames from the main burners 60, in the incandescent zone in the main chamber, and the combined products ascend from the combustion chamber through the water screen 32 and thence through and to the boiler 10 and around by the flue 72 to the flue box 73, which contains a baffle 74 and a rotary drier to be described, thence passing upwardly through the flue pipes 75 within the preheater 65, which pipes are surrounded by the downflowing primary air. This preheater may be on the principles of my Patent 1,773,954 of August 24, 1930.

The temperature of the main combustion chamber 9 at or adjacent the walls is to be kept somewhat below the fusion point of ash, when pulverized fuel is burned, so that products settling toward the bottom will be in solid rather than molten condition, and will descend through the throat 24 without tendency to adhere thereon, the throat indeed being cooled to prevent this. The gases from the fusion chamber raise the temperature above the melting point of the settling products during the passage of solids through the throat. The main combustion chamber is partly or wholly surrounded by heat absorbing elements or water tubes such as 17, 27 and 35, restraining undue temperature rise therein, these sets of tubes together with the screen 32 and the drum 11 constituting substantially a complete boiler, at maximum temperatures and pressures, directly exposed to the radiant heat.

While for the boiler systems, throughout this specification, water has been mentioned as a circulating fluid, it is to be understood that mercury, aluminum bromide, or aluminum-chloride or other vaporizable materials may be used.

The gaseous products after traversing the preheater 65 travel through a flue portion 76 above the ceiling 8, at which flue portion is shown an electric sterilizing device 78 adapted to generate and project into the flue X-rays or radium waves or rays or waves of other character, e. g. so-called death rays or waves, such as to kill any living bacteria in the gases. The flue 76 leads to a unit 79 adapted for the purifying of the gases by removing entrained solids, condensable vapors and soluble gases, for example on the principles of my Patent 1,866,193, issued July 5, 1932. The remaining gaseous products finally passing to a stack 80, the base of which is shown. The purifier 79 may have an underneath separating trap 82 for accumulating sludge and this may be conducted by pipe 83 and delivered to the hopper 99 to be described for drying and introduction with refuse into the furnace.

Flue dust may be collected from various points, for example in the preheater 65, from which it

is taken by a descending pipe 85 which joins with a pipe 86 leading from the flue box 73, the two being connected by a dust pipe 87 leading to a syphon or injector pipe 88 which extends into the furnace for injection of the recovered flue dust or fly ash into the main combustion chamber, by means of a steam or air pipe 89 maintaining the injecting action. This part of the apparatus may be operated to supply substantially non-combustible mineral or ash, in accordance with the disclosure of my copending application Serial No. 164,824, filed January 31, 1927, with the result of increasing the combustion radiance in the main chamber, improving the speed and thoroughness of combustion, and assisting and rendering more complete the transfer of generated heat to the water in the boiler system. Other agents may be thrown into the combustion atmosphere by the injector 88, such as neutralizing and fluxing agents; for example, broken or powdered limestone will be partly calcined and entrained with the gases to neutralize sulphurous contents injurious to the boiler system, and this will be extracted at the gas purifier 79 or removed at the preheater 65, which may also be a dust collector as described in said Patent 1,773,954. Such limestone as reaches the fusion chamber aids to flux and neutralize the molten slag therein.

Coming now to the lateral chamber 36, this serves several purposes including the drying or roasting of the refuse, coal or other material before it passes down into the main chamber as smokeless fuel. This chamber may be used for the roasting of soft or other coal, to produce coke, and in that case valuable volatiles will be generated which may be drawn off by the valved pipe 92 and may be utilized as combustible gas. A pipe 93 is shown to inject oil and steam to enrich the outgoing gases. Low temperature distillation may be carried on in the chamber 36.

When coke is produced in said chamber, or a part of it, this may be progressively extracted from the lower part of the chamber as a by-product, and for this purpose there is diagrammatically indicated a rotating screw conveyor device 94, which may be water cooled, for drawing the coke or other material from the chamber 36. Smoky combustibles may be treated in the lateral chamber as the volatile products are not passed to the boiler. The tubes 35 form an apertured wall between the main and lateral chambers, this wall being water cooled, but permitting radiant heat to pass through for action upon the materials. Additional heat is drawn through the wall apertures into the lateral chamber, which may be utilized for example for carbonization of solid fuel at 550°-840° C. and for continuous hydrogenization and furnishing of additional carbon dioxide for purposes of gas generation in the lateral chamber.

The chamber 36 may be fed with material to be degasified, dried, roasted or incinerated through a drying chamber or rotating barrel 96 located in the flue box 73 and contacted above by the baffle 74. The drying barrel delivers directly into the chamber 36 and the flue gases are compelled to pass around the barrel under the baffle 74, maintaining the barrel fairly hot. The barrel may contain ribs or lugs 97 to cause constant tumbling of the contents as they are fed inclinedly down toward the chamber.

The barrel 96 may turn in fixed bearings near its ends and may be driven as follows. At its upper or outer end the barrel has a projecting

hollow hub 98 coupled with the exit of a supply hopper 99 into which coal, refuse or any other desired fuel or material may be supplied. The hub 98 is shown as provided with a worm wheel 101 driven by a worm 102 on a shaft 103 which may take its rotation through a belt 104 from a shaft 113 to be described. The material may be driven from the hopper 99 into the barrel by means of a reciprocating ram 105 operated by a swinging lever 106, this lever being driven by an eccentric 107 on the shaft 102.

Below the chamber 36 is shown a reciprocating grate 109, in the nature of a stoker, through which air may pass into the body of the material descending from the chamber. The grate 109 has stoker bars with inclined feeding lugs 110 and these are driven in a circular manner by underneath eccentrics 111 so that the materials resting on the grate are at each downward shift movement thrust from the chamber 36 into the lower part of the main chamber. The several eccentrics driving the grate 109 are rotated by chain belts 112. The shaft 113 of one of the eccentrics is shown driven from a motor 114 through reducing gears 115. Above the top end of the reciprocating grate 109 is shown a supplemental hopper 116 into which fuel or other materials may be dumped to pass progressively down the grate without traversing the chamber 36. In any case the materials traversing the stoker or grate travel partly through the main combustion chamber, subject to the full radiant heat thereof, and are therein burned or consumed. For supplying air to the grate 109 there is shown an exterior wall 117 forming an air chamber 118 below or behind the grate. This chamber may be supplied with preheated air by an air conduit 119. Also combustible gas coming from chamber 36 by pipe 92 may be delivered to the main combustion chamber for combustion on the bottom or grate.

At the left side of the main chamber the bottom wall may have one or more special chutes 121, indicated in section in Figs. 1 and 2, each being open at its lower end and delivering directly into the fusion chamber 22. These chutes, for example, may be employed as a destructor furnace for hospitals. At the upper end of each chute is a hopper 122 for receiving the material, and each hopper may contain a feed wheel 123 rotated by power to force the material from the hopper into the chute, without permitting reverse flow of vapors or fumes. At each side of the chute 121 are air spaces 121^a between the walls 18 and 19.

There is indicated in Fig. 1 an instrument 125 for detecting the presence in the fusion chamber of metallic poisons. This instrument is connected by a pipe 126 with the chamber and by an electric circuit 127 with a bell or alarm device 128. The instrument 125 for example may comprise a breathing device or bellows operating to suck vapors from and return them to the fusion chamber, through a straining sheet; and within the instrument may be a lamp and a photoelectric cell, spaced apart, and affected by the density of heavy indrawn vapors to control the circuit to operate the alarm, thus giving a warning of dangerous conditions.

Fig. 3 shows the overflow of molten slag from spouts 23^a of the fusion chamber, and a high pressure superheated steam or air pipe 130, with nozzles or jets below the spouts, to impinge upon each slag stream; break it into fine parts or threads and project it through a flanged ap-

erture 131 into a receptacle 132 in the form of rock wool, useful for insulation etc. When the molten slag is dropped directly into a water trough 133 the cooling converts it to granular form. The heaviest ingredients as lead can be tapped by spout 23^b while molten iron can be tapped at spout 23^c, at levels lower than spout 23^a.

There has thus been described a boiler furnace embodying the principles of the present invention; but since many matters of operation, combination, arrangement and construction may be variously modified without departing from the principles it is not intended to limit the invention to such matters except to the extent set forth in the appended claims.

What is claimed is:

1. A boiler furnace comprising a main combustion chamber having a fluent fuel burner and means cooling the chamber to prevent slagging therein, and therebelow a fusion chamber connected by a throat with the main chamber, means for water cooling such throat, a burner comprising fluent fuel and air injecting means for the fusion chamber, said chamber being substantially uncooled to allow temperatures above the melting point of solids present, and adjacent to the main chamber a lateral chamber subject to the heat of the main chamber and adapted to be filled with solid material, and means below said lateral chamber and extending into the lower part of the main chamber for delivering from the lateral chamber into the lower part of the main chamber the residues of such solid material for eventual delivery through said water cooled throat into the fusion chamber.

2. A boiler furnace comprising a main combustion chamber and means cooling the chamber to prevent slagging therein, and therebelow a fusion chamber substantially narrower than the main chamber, a throat substantially narrower than the fusion chamber and connecting it with the main chamber, fuel and air injecting means constituting a burner for said fusion chamber adapted to cause temperatures above the melting point of solids present, an air supplied grate for supporting a bed of solid fuel in the lower part of the main chamber lateral to said throat and arranged to deliver its solid residue to said throat and thence into the fusion chamber, and an infeed entrance for supplying solid fuel to said grate.

3. A boiler furnace comprising a main combustion chamber having a fluent fuel burner and means cooling the chamber to prevent slagging therein, and therebelow a fusion chamber connected by a throat with the main chamber, a burner comprising fluent fuel and air injecting means for the fusion chamber, said chamber being substantially uncooled to allow temperatures above the melting point of solids present, and adjacent to the main chamber a lateral chamber subject to the heat of the main chamber and adapted to be fed with solid material, and means below said lateral chamber and extending toward the lower part of the main chamber for delivering from the lateral chamber into the lower part of the main chamber the residues of

such solid material for eventual delivery through said throat into the fusion chamber; said lateral chamber having a gas outtake means from its upper part for drawing off gases or vapors therefrom without traversing the main chamber or boiler.

4. A boiler furnace comprising a main combustion chamber having a fluent fuel burner and means cooling the chamber to prevent slagging therein, and therebelow a fusion chamber connected by a throat with the main chamber, a burner comprising fluent fuel and air injecting means for the fusion chamber, said chamber being substantially uncooled to allow temperatures above the melting point of solids present, and adjacent to the main chamber a lateral chamber subject to the heat of the main chamber and adapted to be supplied with solid material, and means below said lateral chamber and extending toward the lower part of the main chamber for delivering from the lateral chamber into the lower part of the main chamber the residues of such solid material for eventual delivery through said throat into the fusion chamber; said lateral chamber having means for supplying solid materials into its upper part to be roasted or dried therein before passing into the main and fusion chambers.

5. A boiler furnace comprising a main combustion chamber having a fluent fuel burner and means cooling the chamber to prevent slagging therein, and therebelow a receiving chamber connected by a throat with the main chamber, and adjacent to the main chamber a lateral chamber subject to the heat of the main chamber and adapted to be supplied with solid material, and means below said lateral chamber and extending toward the lower part of the main chamber for delivering from the lateral chamber into the lower part of the main chamber the residues of such solid material for eventual delivery through said throat into the receiving chamber; said lateral chamber having means for supplying solid materials into its upper part to be roasted or dried therein before passing into the main chamber.

6. A boiler furnace comprising a main combustion chamber having a fluent fuel burner and means cooling the chamber to prevent slagging therein, and therebelow a receiving chamber into which the main chamber delivers, and adjacent to the main chamber a lateral chamber subject to the heat of the main chamber and adapted to be supplied with solid material, and means below said lateral chamber and extending to the main chamber for delivering from the lateral chamber into the lower part of the main chamber the residues of such solid material for eventual delivery into the receiving chamber; and the delivery means below said lateral chamber consisting of an air supplied grate receiving material from the lateral chamber and extending into the main chamber.

7. A boiler furnace as in claim 6 and wherein the grate below the lateral chamber has means to reciprocate it to promote feed from the lateral chamber into the main chamber.

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