April 15, 1952 W. B. VAN WERT 2,592,980

VERTICAL FLUE BOILER WITH INTERNAL HEATER

Filed July 13, 1949

Fig. 1.

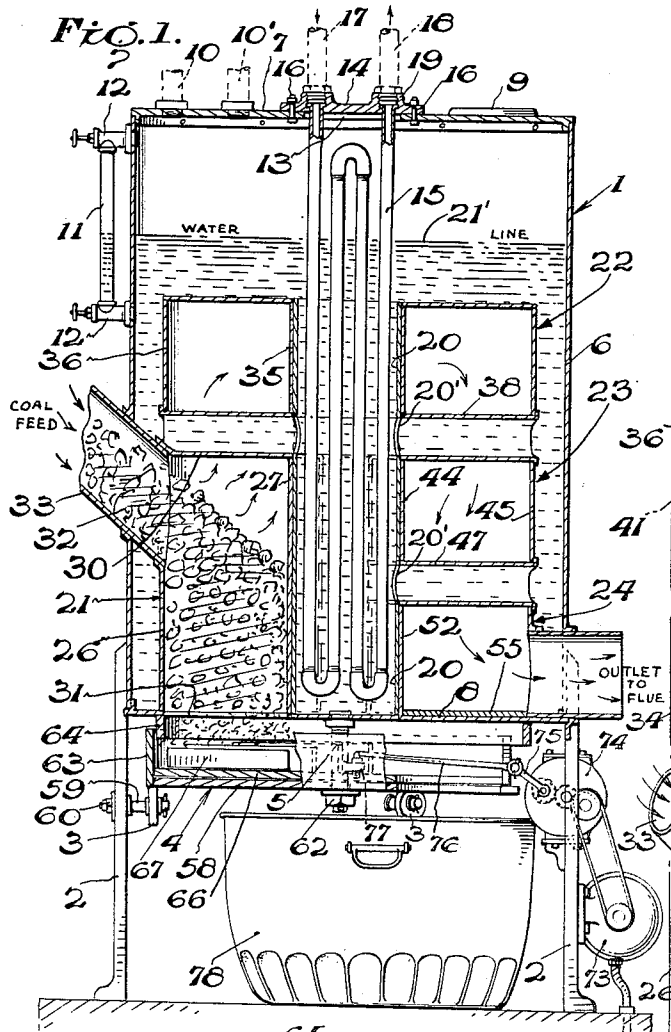


Fig. 3.

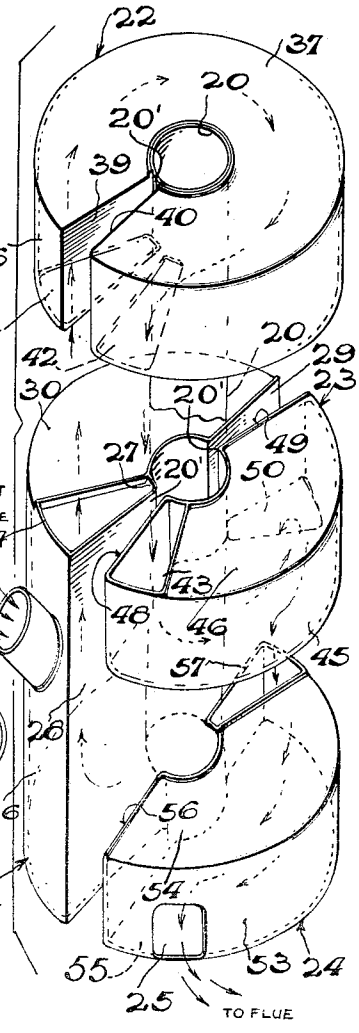
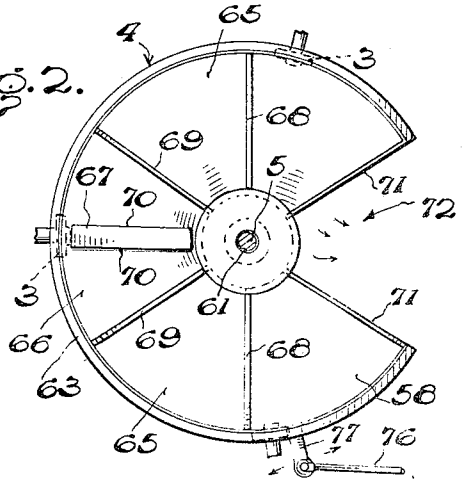


Fig. 2.



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Patented Apr. 15, 1952

2,592,980

UNITED STATES PATENT OFFICE

2,592,980

VERTICAL FLUE BOILER WITH INTERNAL HEATER

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Application July 13, 1949, Serial No. 104,438

5 Claims. (Cl. 122—33)

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My invention relates to boilers and more particularly to a boiler of the type used with steam or hot water heating systems for dwellings or other buildings.

Heretofore, it has been suggested to provide boilers for domestic heating or other purposes, designed for use with solid fuel, wherein the fuel is fed by means of a mechanical stoker device. In accordance with conventional systems, the so-called hand fired boiler or furnace is converted to automatic feed by modifying the boiler to accommodate the stoker. With conversion systems of the above mentioned type the coal is usually fed upwardly from below the grate, and means are provided for removing ashes comprising breaker arms or the like, associated with the grate.

While the prior suggested arrangements are satisfactory to the extent that they function for their intended purposes, they are open to certain objections which are inherent in their construction and design. Boilers or furnaces of the hand fired type, even when equipped with thermostatic controls, require considerable attention and care on the part of an attendant to supply fuel and to remove ashes. If the boiler is converted to automatic type by the addition of a mechanical stoker, the manual labor normally required with the hand fired boiler is reduced to a minimum, but is obtained at the cost of over-all efficiency of the unit. The reduced efficiency generally arises from the fact that the boiler was originally designed and constructed for hand firing and the modifications thereto, incident to the installation of the stoker unit, results in a much lower over-all efficiency.

I have found, after considerable research and experimentation, that desired efficient and substantially carefree operation of boilers of the automatic type, that is to say, those wherein mechanical means are used to feed coal or other solid fuel and to remove the ashes, is best obtained by providing a unitary structure, specifically designed for automatic operation.

More particularly, I have found that boilers of conventional design do not permit of economical adaptation or conversion to automatic operation, and accordingly, among the features of novelty and advantage of the present invention, in addition to automatic operation, is the provision of a combination steam boiler and hot water heater for domestic purposes, particularly adapted for use with anthracite coal or other solid fuel.

An object of my invention is to provide an improved boiler.

Another object of my invention is to provide

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an improved boiler wherein the combustion chamber and associated combustion gas chambers are substantially completely immersed in the water of the boiler.

Yet another object of my invention is to provide an improved boiler wherein the combustion chamber and associated gas chambers are circumferentially arranged in spaced relationship about a central tubular support member, the chambers being constructed and arranged to provide for free flow of the gases of combustion upwardly from the combustion chamber, around and through the gas chambers in zig-zag fashion.

Still another object of my invention is to provide an improved boiler construction having a domestic hot water heating unit incorporated therein.

A further object of my invention is to provide a boiler, adapted for use with solid fuels, having improved ash removing means which also functions as automatic fire-bed level control means.

Yet a further object of my invention is to provide an improved grate structure constructed and arranged for automatic oscillatory movement, whereby ashes are periodically removed from beneath the fire box.

A still further object of my invention is to provide an improved boiler having conveyor means associated therewith, adapted to convey coal from a bin or other source of supply, to the boiler.

Yet a still further object of my invention is to provide an improved boiler construction, designed to operate under induced draft, whereby the coal is caused to burn under partial vacuum.

With these and other objects in view, which may be incident to my improvements, the invention consists in the parts and combinations to be hereinafter set forth and claimed, with the understanding that the several necessary elements, comprising my invention, may be varied in construction, proportions and arrangement, without departing from the spirit and scope of the appended claims.

In order to make my invention more clearly understood, I have shown in the accompanying drawings means for carrying the same into practical effect, without limiting the improvements in their useful applications to the particular constructions, which for the purpose of explanation, have been made the subject of illustration.

In the drawings:

Figure 1 is a vertical sectional view of the boiler of the present invention;

Fig. 2 is a top plan view of the grate arrangement; and

Fig. 3 is an expanded view of the interior elements of boiler, showing the arrangement of the combustion chamber and associated combustion gas chambers.

The improved boiler of the present invention consists essentially of a vertical cylindrical shaped outer wall or casing, closed with a top sheet and a bottom sheet, a central tube extending upwardly from the bottom sheet, forming a support for a plurality of units comprising a combustion chamber and gas flues or chambers, circumferentially arranged in spaced relation on the tube, and a domestic hot water heating coil supported from the top sheet and extending into the boiler within the tube. The chambers and central tube, after assembly, constitute a unitary structure substantially completely immersed in the water of the boiler, the chambers being constructed and arranged whereby the gases of combustion flow upwardly from the combustion chamber, around and downwardly of the other chambers or flues, in zig-zag fashion. Underlying the boiler, adjacent its bottom portion is a circular grate having a sweep bar thereon underlying the open end of the combustion chamber, whereby when the grate is oscillated, ashes are swept from beneath the combustion chamber. Means are also provided to convey coal or other solid fuel from a source of supply to a hopper or chute, communicating with the top of the combustion chamber.

Referring to the drawings, and more particularly to Figs. 1 and 2, there is shown a vertical boiler 1, of generally cylindrical shape, mounted upon legs 2, to which are secured roller bearings 3, adapted to support a circular grate, designated generally by numeral 4, the grate being mounted for oscillation on a pin 5, as will be described more fully hereinafter.

The boiler 1, which may be covered with insulating material, and provided with a suitable outside casing or cover, not shown, comprises a shell or body 6, a top sheet 7, and a bottom sheet 8. The top sheet has the usual steam outlet 9 and taps 10 and 10', for a pressure limit control device and a safety valve, respectively, not shown, which of course may be readily modified for use with a hot water heating system. The boiler is further provided with a water level gauge 11, having customary connections or fittings 12, and a water return line, not shown, connected to the boiler in the vicinity of the bottom thereof. It will be noted, that the top sheet 7 is formed with a central opening 13, covered by a plate 14, mounting a tankless coil 15 of the hot water heater, which will be described more in detail hereinafter. Plate 14 is secured to the crown sheet 7 by means of stud bolts 16, and a suitable gasket, not shown, may be interposed between the plate and the crown sheet.

The ends of coil 15 may be secured to the plate in any suitable manner, for example, by swaging or welding, the water inlet and outlet 17 and 18 being threaded into shoulder portions 19, formed integral with the plate. The domestic hot water heating coil normally depends into the boiler within a tube 20, to a plane just above the bottom plate 8, and is formed with return bends, as illustrated. It will thus be seen, that the coil 15 is immersed in the water contained in tube 20, and that it extends above the top of the tube, the water level of the boiler being indicated generally by numeral 21'. By arranging the coil in this fashion, that is to say, wholly out of contact with combustion gases, the water within the coil is uniformly heated at a temperature not exceeding the boiling point of water, under the conditions of operation, and the coil is protected from corrosion and/or erosion due to noxious constituents of the gases of combustion.

The boiler of the present invention is especially adapted for the insertion of a domestic hot water heating unit, without detracting from the normal function of the boiler for heating purposes. Furthermore, by reason of the fact that the domestic hot water heating unit is immersed in the water contained in the boiler, the unit is exposed to uniform heating conditions, which would not obtain if conventional practice was followed, namely, exposing the unit to corrosive combustion gases. In normal operation of the boiler, there is little, if any, temperature differential in the water to which the unit is exposed, and accordingly, corrosion of the material of the coil, due to electrolytic action, engendered by temperature differentials, is reduced to a minimum. It will also be appreciated that the design of the coil is such that any expansion thereof, due to contact with the water of the boiler or with the steam generated in the steam chest portion above the water line, is readily taken up.

Referring to Figs. 1 and 3, the central tube 20 is secured to the bottom plate 8, and extends upwardly to a point above the lowermost water gauge connection, as shown. The central tube 20, serves not only as a casing or housing for the coil 15, but also as the central structural supporting member of the heater elements of the system, now to be described. The heater system comprises a semi-cylindrical combustion chamber 21, discharging upwardly into and clockwise through a first annular heat exchanger 22, thence downwardly, counter-clockwise, through a second heat exchanger 23, which is approximately semi-cylindrical in shape, and then downwardly to a similarly shaped semi-cylindrical chamber 24, from which the gases are drawn clockwise through an outlet 25 to the exhaust stack, by means of a blower or suction fan, not shown. As indicated heretofore, the heater elements of the system are secured to and supported by the central tube 20, thus forming a unitary structure positioned within the shell 6 of the boiler, and centrally thereof.

Details of the individual elements and the connecting ducts therebetween will now be described. The first element of the combination disclosed herein, comprises the novel combustion chamber 21, which is of generally semi-cylindrical shape, having an outer wall 26 and an inner wall 27, both of which walls are concentric with the central tube, and are joined in spaced relation by radial walls 28 and 29. A crown sheet 30 forms the top of the combustion chamber, the bottom of the chamber being open as at 31. Coal or other solid fuel, designated generally by numeral 32, is fed into the combustion chamber through a chute 33, positioned in wall 26 in the vicinity of the crown sheet 30. The coal feeding chute 33 may be connected to a suitable coal hopper, adapted to be supplied with coal by means of a screw conveyor, or the chute may be directly connected with the conveyor conduit or in some other suitable manner, not shown, since the details of the coal supply means form no part of the present invention.

The combustion gases from the combustion chamber 21 discharge through duct 34 (Fig. 3) into one end of top chamber 22, having concentric curvilinear inner and outer walls 35 and 36, respectively, a top plate 37, a bottom plate 38, and radial end walls 39 and 40. The duct 34 discharges into chamber 22 through a conformed opening 41, formed in the bottom plate 38, adjacent the end wall 39. A second opening 42 in the bottom plate, adjacent the end wall 40, connects through a duct 43, to the second, subjacent, substantially semi-cylindrical heat exchanger 23. The second heat exchanger is comprised of concentric inner and outer walls 44 and 45, a top plate 46, a bottom plate 47, and radial end walls 48 and 49. A discharge duct opening 50, formed in the bottom plate discharges downwardly through duct 57, into the third, semi-cylindrical heat exchanger 24. This chamber is comprised of concentric inner and outer walls 52 and 53, a top plate 54, bottom plate 55, and radial end walls 56 and 57.

It will be noted that the outer and inner walls of the chambers, as above described, are concentric with respect to the central tube and that the inlets and outlets of the several chambers comprising the heat exchangers are positioned at opposite ends of the individual chambers, whereby to provide a circuitous path for the free flow of combustion gases through the unit.

One of the important features of the present invention is the design and mounting arrangement of the combustion chamber and associated heat exchangers. These units are constructed and arranged to form an integral part of the exhaust line of the combustion chamber, and provide heating surfaces of comparatively large contact area, whereby the relatively thin films or layers of water, which come into contact with certain of these areas, are quickly heated to vaporizing temperature. This is accomplished by reason of the rather close spacing between the bottom plates of the chambers and the top plates of the subjacent chambers.

By directing the gases in the manner heretofore described, that is, from the combustion chamber 21, upwardly into and completely around chamber 22, downwardly into and through chamber 23, then downwardly into and through chamber 24, the hottest gases are in heat exchanging relation with the water of the boiler at the topmost part of the system. The down streaming cooled combustion gases are in heat exchanging relation with the water of the boiler on the opposite side of the combustion chamber, however, the cooler gases are utilized in an area where maximum heat transfer occurs between the combustion chamber and water and, therefore, a balance is maintained. Also by directing the gases upwardly, and then downwardly and out at the bottom of the boiler, stack losses are reduced to a minimum.

As previously stated, the bottom of the combustion chamber is open as at 31 (Fig. 1), and associated therewith is a grate member 4, comprising a circular body portion 58, supported upon a plurality of rollers 3, rotatably mounted upon stub shafts 59, secured to legs 2 of the boiler, as at 60. To maintain the grate centered, with respect to the bottom of the boiler, the body portion thereof is provided with a central opening 61, adapted to receive the pin 5, attached to the bottom plate 8 of the boiler, the free end of pin 5, being threaded to receive

a nut 62. The grate is spaced a sufficient distance below the bottom plate 8 to permit maintenance of a proper ash bed, the ash bed being retained or held thereon by means of a vertical peripheral flange 63, which overlaps a flange 64, depending from the bottom plate (Fig. 1).

As best seen in Figs. 1 and 2, the body portion of the grate underlying the combustion chamber 21, is built up with a first overlying plate 65, a second plate 66 overlying the first plate, and a sweep bar 67 positioned centrally of the plate 66. Considering the sweep bar 67 as a center, plate 66 extends approximately 45° to each side thereof, and plate 65 extends about 90° to each side of the bar. By means of this arrangement, the edges 68 and 69 of plates 65 and 66, respectively, and edges 70 of the sweep bar 67, constitute radial steps, designed to move the ashes from beneath the combustion chamber and force them along the upper surface of the grate when the grate is oscillated, the resulting ash stream flowing over edges 71, of a cut-out portion 72, formed in the body portion 58 of the grate.

Oscillation of the grate may be accomplished by means of a motor 73, operatively connected through a suitable speed reducing mechanism 74, having a crank arm 75, connected through a link member 76, to an arm 77, attached to and extending radially of the grate. The degree of oscillation of the grate is relatively small, being of the nature of approximately two and one half inches. Upon oscillation of the grate, the sweep bar alternately sweeps the ashes from beneath the central portion of the combustion chamber, and forces them outwardly over the radial stepped portions of plates 65 and 66, the ashes flowing in stream like fashion from opposite sides of the bar, until they reach and fall through the opening 72, formed by removal of a segment of the body portion of the grate of desired size. As shown in Fig. 1, a suitable basket or other receptacle 78, is provided to receive the ashes which fall through the opening 72.

As hereinbefore noted, the above described oscillatory grate arrangement performs a double function, namely, it serves as an efficient ash removal device and also as an automatic firebed level control means. Since the sweep bar 67 is relatively high, compared with the plates 65 and 66, it will be seen that upon each oscillation, the bar will clear a space beneath the center of the fire-bed causing the latter to fall, and thus maintain a continuous lowering of the same to compensate for the top feeding.

By reason of the design of the combustion chamber, and arrangement of the coal feeding chute at one side of the boiler, whereby the coal is fed into the combustion chamber from a point in the vicinity of the top thereof, it has been found that the angle of repose of the fire-bed, including the coal extending upwardly therefrom to the inlet end of the chute, is such that the coal falls gently and uniformly over the bed, when the bed is lowered by removal of the ashes.

As mentioned in connection with the flow of gases through the various chambers forming the heat exchange units, the outlet 25 of the bottom chamber 24, is connected to a flue, not shown, having an exhaust fan or blower positioned therein. The induced draft created by the fan removes the gases and fresh air is supplied to the combustion chamber through the breaching formed between the rims 63 and 64, attached to

the grate and to the bottom of the boiler, respectively.

In connection with the arrangement of central tube **20** and associated chambers, it will be appreciated that free circulation of water therebetween, that is to say, between adjacent surfaces of the chambers and into or out of the tube, is obtained during normal operation of the boiler. As indicated hereinbefore, the chambers are attached to the tube by welding; thereafterwards slots **20'** are cut in the tube wall, whereby to permit the water in the boiler to freely circulate internally and externally of the tube, and around and between the chambers.

With reference to the grate arrangement described herein, it will be understood that the specific details thereof can be modified without changing the functional operation of the device. For example, the body portion may be provided with a plurality of graduated steps starting from one side of the ash discharging opening and designed to discharge ashes over the other side of the opening. In other words, the ashes would then be discharged in stream-like fashion over one side only, the coal being fed slightly off center towards the highest step of the grate.

Although automatic controls have not been shown, it will be appreciated the present invention comprehends the use of controls, as desired. For example, the operation of the grate may be thermostatically controlled and a similar control may be used for the draft or exhaust gas blower. It will also be understood that fuel conveying device will be provided with a control means responsive to actuation of the grate, so that coal will normally only be fed during the periods of oscillation of the grate.

While I have shown and described the preferred embodiment of my invention, I wish it to be understood that I do not confine myself to the precise details of construction herein set forth, by way of illustration, as it is apparent that many changes and variations may be made therein, by those skilled in the art, without departing from the spirit of the invention or exceeding the scope of the appended claims.

I claim:

1. A boiler of the character described comprising an outer cylindrical casing, an inner tubular member concentric with the outer casing, said tubular member forming a central support, a vertical combustion chamber, a top annular gas chamber, and a plurality of subjacent, axially displaced lateral gas chambers, all of said chambers being supported by said tubular member, the spaces between the combustion chamber and the adjacent gas chambers and between successive adjacent gas chambers constituting water passages of substantial contact area, and flue connections between the chambers whereby the gases of combustion flow upwardly from the combustion chamber into the top gas chamber and thence downwardly in ziz-zag fashion through the subjacent gas chambers.

2. A boiler of the character described comprising an outer cylindrical casing, an inner tubular member concentric with the outer casing, said tubular member forming a central support, a semi-cylindrical combustion chamber, a top annular gas chamber, and a plurality of subjacent, semi-cylindrical, axially displaced lateral gas chambers, all of said chambers being supported by said tubular member, the spaces between the combustion chamber and the adjacent gas chambers and between successive adjacent gas chambers constituting water passages of substantial contact area, the tubular member being in fluid communication with each of said water passages, a domestic hot water heating coil positioned within the central tubular support, and flue connections between the chambers whereby the gases of combustion flow upwardly from the combustion chamber into the top gas chamber and thence downwardly in ziz-zag fashion through the subjacent gas chambers.

3. A boiler of the character described, comprising an outer cylindrical casing closed at one end by a top sheet and at the other end by a bottom sheet, an inner tubular member concentric with the outer casing, said tubular member forming a central support, a semi-cylindrical shaped combustion chamber, a superjacent annular gas chamber, and a pair of semi-cylindrical shaped subjacent gas chambers concentrically arranged about the central tubular support, and axially displaced with respect to each other, all of said chambers being supported by said tubular member, the spaces between the combustion chamber and the adjacent gas chambers and between successive adjacent gas chambers constituting water passages of substantial contact area, and flue connections between the chambers whereby the gases of combustion flow upwardly from the combustion chamber into the top gas chamber and thence downwardly in ziz-zag fashion through the subjacent semi-cylindrical gas chambers.

4. A boiler of the character described, comprising an outer cylindrical casing closed at one end by a top sheet and at the other end by a bottom sheet, an inner tubular member concentric with the outer casing, said tubular member forming a central support, a semi-cylindrical, vertical combustion chamber, an annular top gas chamber, and a plurality of subjacent gas chambers, concentrically arranged about the central tubular support, and axially displaced with respect to each other, all of said chambers being supported by said tubular member, the spaces between the combustion chamber and the adjacent gas chambers and between successive adjacent gas chambers constituting water passages of substantial contact area, and severally in fluid communication with said tubular member, a domestic hot water heating coil depending from the top sheet into the central tubular support, and flue connections between the chambers whereby the gases of combustion flow upwardly from the combustion chamber into the top gas chamber and thence downwardly in zig-zag fashion through the subjacent gas chambers.

5. A boiler of the character described, comprising an outer tubular member closed at one end by a top sheet and at the other end by a bottom sheet, an inner tubular member concentric with said outer tubular member, a semi-cylindrical shaped combustion chamber attached to the outer surface of said inner tubular member and extending lengthwise thereof, a pair of semi-cylindrical gas chambers attached to said inner tubular member, one above the other, and opposite the combustion chamber, a hollow cylindrical shaped gas chamber attached to the inner tubular member above the combustion chamber, the water level of the boiler extending above the top of said cylindrical gas chamber, and flue connections between said gas chambers whereby the combustion gases flow upwardly from the combustion chamber, completely around the cylindrical shaped gas chamber,

thence downwardly zig-zag through the other gas chambers.

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