Aug. 3, 1965 YUKO FUJII 3,198,177

WATER TUBE BOILER

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Fig. 1

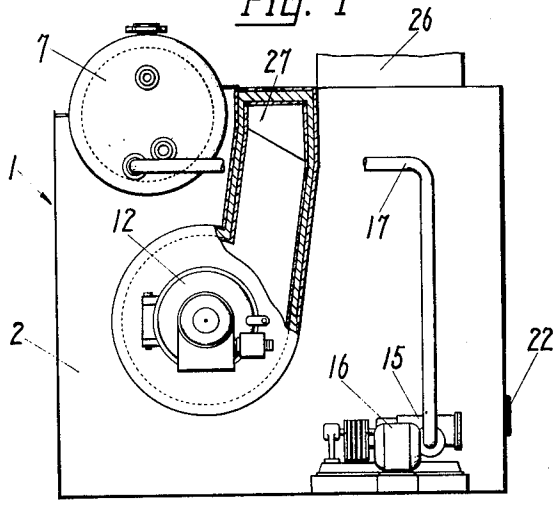
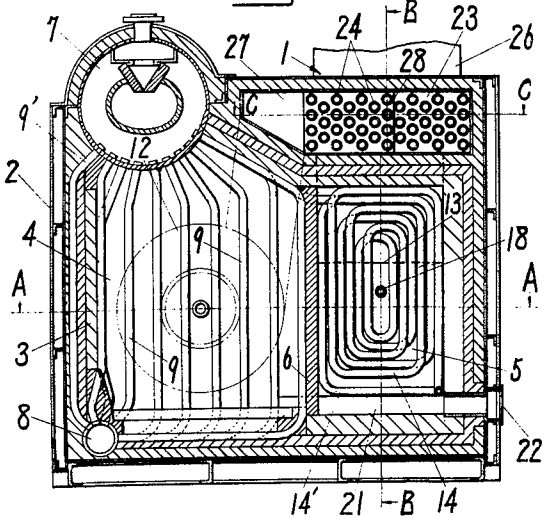


Fig. 2



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Fig. 3

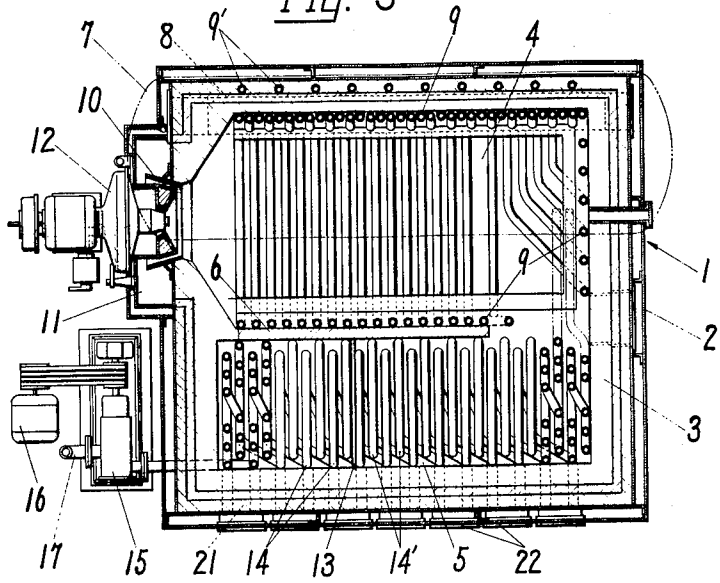
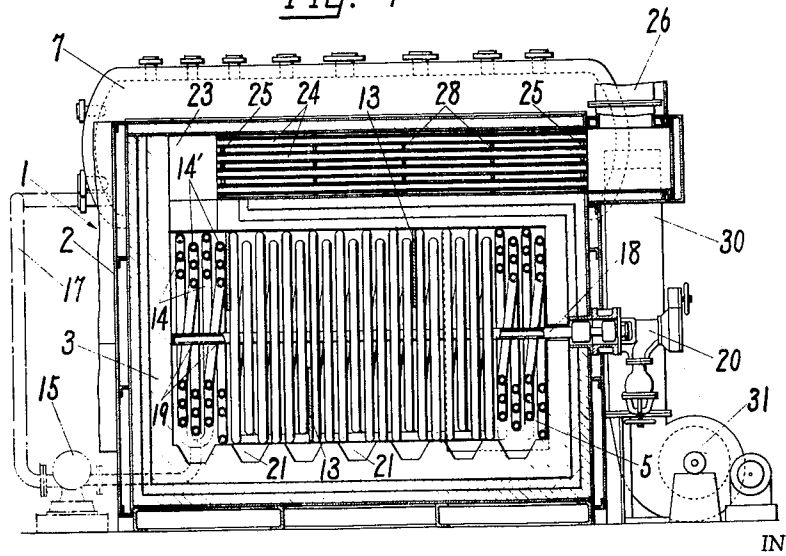


Fig. 4



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Fig. 5

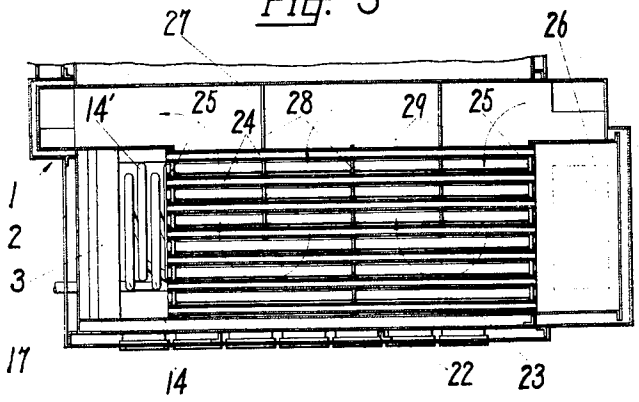
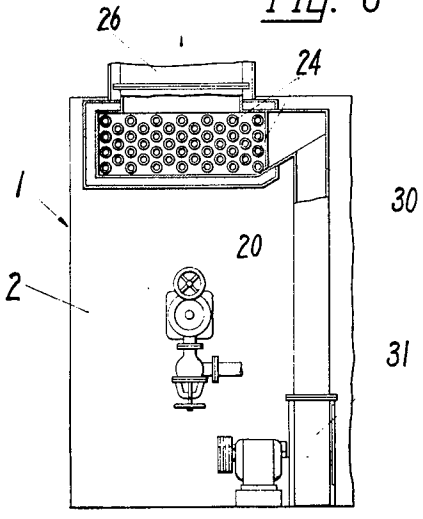


Fig. 6



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WATER TUBE BOILER

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2 Claims. (Cl. 122—236)

The present invention relates to water tube boilers, and particularly those of box shape.

The water tube boiler according to the invention essentially comprises a main body of box shape having a main combustion chamber and a convection chamber, said chambers being formed by partitioning with a vertical wall and communicating with each other at their rear ends, and said convection chamber being partitioned by vertical baffles to form a zigzag combustion gas passage, a steam drum which is mounted on said main body at the top portion of said main combustion chamber, a water drum which is embedded in fire proof lining at the bottom portion of said main cumbustion chamber, said drums being connected by a number of water tubes, a burner port which is installed on the front wall of said main combustion chamber and located in a feed air chamber formed on the front side of said main body, and a number of vertical coiled water tubes which are installed within said convection chamber closely adjacent to each other and alternating with each other, and successively connected to form long pipe lines, each front end of said pipe lines being connected to said steam drum through a circulating pump and each rear end of said pipe lines being directly connected to said steam drum.

The chief features and advantages are as follows:

(1) Said water tube boiler is very compact and efficient, since said boiler involves the main combustion chamber and the convection chamber within the main body of box shape, said chambers being adjacent and communicating with each other at their rear ends, and the combustion gas passing through said chambers is efficiently used to heat the water tubes.

(2) In the main combustion chamber of high temperature of the combustion gas having the steam drum and the water drum, which are connected by a number of the vertical water tubes, a natural circulation of water is carried out and said water is favorably and sufficiently heated.

(3) In the convection chamber the temperature of the combustion gas is lower than in the combustion chamber, and in the long pipe lines composed of a number of the vertical coiled water tubes and in the zigzag combustion gas passage, a forced circulation of water is carried out and said water is effiiciently heated.

The other features and advantages will become apparent from a consideration of the following description.

In the accompanying drawings:

FIG. 1 is a front view partly in section, of a water tube boiler according to the invention;

FIG. 2 is a sectional front view of said boiler;

FIG. 3 is a sectional plan view of said boiler taken along line A—A in FIG. 2;

FIG. 4 is a sectional side view of said boiler taken along line B—B in FIG. 2;

FIG. 5 is a sectional plan view of a part of said boiler taken along line C—C in FIG. 2; and

FIG. 6 is a rear view partly in section of a part of said boiler.

Like characters of reference show corresponding parts throughout the views.

Referring to FIGS. 1–4, 1 denotes a main body of box shape having a casing 2 provided with fire proof lining 3. Within said main body a main combustion chamber 4 and a convection chamber 5 are formed by partitioning with

a vertical wall 6, and said chambers communicate with each other at their rear ends as shown in FIG. 3.

At the top portion of the main combustion chamber 4 a steam drum 7 is mounted on the main body 1, and at the bottom portion of said chamber a water drum 8 is embedded in the lining 3. They are connected by a large number of vertical water tubes 9, which are arranged in parallel along the surrounding walls except the front wall of the chamber 4, and by a number of vertical water tubes 9' which are embedded in the lining 3. Said front wall is conically shaped and provided with a burner port 10, which is located in a feed air chamber 11 formed on the front side of the main body 1. In said burner port the injection nozzle of an oil burner 12 is positioned.

The convection chamber 5 is partitioned by a plurality of baffles 13 which are alternately arranged upward and downward as shown in FIGS. 3 and 4, thereby forming a zigzag combustion gas passage. Installed within said chamber are a large number of vertical rectangularly-coiled water tubes 14 and 14', which are arranged to be closely adjacent and to alternate with each other and successively connected to form two long pipe lines. Each front end of said pipe lines is connected to the outlet of a circulating pump 15 which is located in front of the main body 1 and driven by a motor 16, and each rear end of said pipe lines is directly connected to the steam drum 7, the inlet of said pump being connected to the bottom of said steam drum through a feed pipe 17.

Passing through each central part of the coiled water tubes 14 and 14' a motor-driven horizontal pipe 18 is rotatably mounted in the casing. Said pipe is provided with a number of small holes 19 along its length and is connected to a steam injector 20 which is secured to the back side of the main body 1. At the bottom of the convection chamber 5 a plurality of drains 21, each of which has an end cover 22, are installed.

Formed above the convection chamber 5 is an air preheating chamber 23 which communicates with the former at their front ends and is provided with a large number of horizontal combustion gas pipes 24 supported by partition walls 25, the rear end of said air preheating chamber communicating with a chimney 26. Adjacent to said chamber and above the main combustion chamber 4 a horizontal air duct 27 is formed which communicates with the combustion gas pipes containing part of the chamber 23 between the partition walls 25, a plurality of vertical baffles 28 being mounted in the duct 27 and chamber 23 and forming a zigzag feed air passage as indicated by arrows 29 in FIG. 5.

The front and rear ends of said air duct communicate with the feed air chamber 11 and a vertical air duct 30, respectively, said vertical air duct being set up behind the main body 1 and connected to an air blower 31.

The water tube boiler according to the invention is thus constructed and its operation is as follows:

Water is fed to the steam drum 7, and the vertical water tubes 9 and 9' as well as the water drum 8 are filled with said water. After driving the circulating pump 15 by the motor 16, the oil burner 12 is ignited, thereby heating the main combustion chamber 4 up to high temperature of over 1,300° C. Then said water in the vertical water tubes 9 boils and goes up to the steam drum 7, where steam separates from the hot water, and comparatively cold water in said steam drum goes down to the water drum 8 through the vertical water tubes 9' embedded in the fire proof lining 3, thus a natural circulation of the water being carried out and heating of the water being conducted favorably and sufficiently.

The combustion gas produced in the main combustion chamber 4 flows from its rear end to the convection chamber 5 and flows in a zigzag path through it due to the vertical baffles 13 which are alternately arranged up-

ward and downward, heating the long pipe lines composed of a large number of the coiled water tubes **14** and **14'** efficiently, although the gas temperature falls to about 900–1,000° C. On the other hand, the water in said water tubes boils and is forced to flow to the steam drum **7**, and comparatively cold water in said steam drum is forced to flow to said water tubes by the circulating pump **15**.

The combustion gas of 300–350° C. passing through the front end of the convection chamber 5 goes up to the air preheating chamber **23** and passes through a large number of the combustion gas pipes **24** which are horizontally arranged within said chamber, heating surrounding air which is fed by the air blower **31** through the vertical air duct **30** and flows in a zigzag path through the horizontal air duct **27** as well as the chamber **23** due to the baffles **28**. Then said air preheated economically is fed to the feed air chamber **11**, the exhaust combustion gas, which temperature falls to 200–250° C., escapes to the chimney **26** from the rear end of the air preheating chamber **23**.

When the coiled water tubes **14** and **14'** are coated with soot, the horizontal pipe **18** is revolved and steam is fed to said pipe by the steam injector **20**, then said steam is emitted from a large number of the small holes **19** in all directions, whereby said soot adhered to said water tubes is blown off, and the dirty water is discharged from the drains **21**, thus the efficient heating of the water in said coiled water tubes being steadily maintained.

Without further description it is thought that the features and advantages of the invention will be readily apparent to those skilled in the art, and it will of course be understood that changes in the form, proportion and minor details of construction may be resorted to, without departing from the spirit of the invention or the scope of the appended claims.

What I claim is:

1. A water tube boiler construction, comprising a substantially right rectangular prismatic housing, a vertical partition within and extending along the length of said housing and dividing the housing into a combustion chamber and a convection chamber, a burner directed into one end of said combustion chamber substantially axially of the longitudinal dimension of the chamber, a steam drum along the top of said combustion chamber and extending slightly into said combustion chamber and extending slightly out of the top surface of said housing, said combustion chamber having a fireproof lining, a water drum in said lining and extending along the bottom of said combustion chamber, boiler tubes extending from said water drum to said steam drum through said combustion chamber, further boiler tubes extending from said steam drum to said water drum through the lining in the side of said combustion chamber, a plurality of coiled tubes in said convection chamber, each tube having a plurality of substantially rectangular coils which lie in substantially vertical planes in the convection chamber, the one ends of said coiled tubes being connected to one end of said steam drum and circulating pump means to which the other ends of said coiled tubes are connected, said circulating pump means being connected to the other end of said steam drum, a substantially horizontal partition extending along the length of said housing and covering the top of said convection chamber, means forming an opening between said vertical partition and said housing at the end remote from said burner for admitting combustion gases into said convection chamber, a plurality of transverse horizontally spaced baffles in said convection chamber, alternate baffles extending upwardly from the bottom of the convection chamber and the remainder extending downwardly from the horizontal partition, said horizontal partition defining an air preheating chamber between itself and the top wall of the casing, a plurality of combustion gas pipes extending longitudinally of the casing through said air preheating chamber and having their one ends opening into said convection chamber adjacent the end of said casing with the burner therein and having the other ends opening out of the casing at the other end of the air preheating chamber, passage means between said casing and one end of said air preheating chamber for admitting combustion air into the air preheating chamber, a duct opening out of the other end of said air preheating chamber and extending to said burner, and baffles in said air preheating chamber for causing combustion air to travel a zigzag path across said combustion gas pipes.

2. A water tube boiler construction as claimed in claim **1** further comprising a horizontal pipe rotatably mounted in said casing and extending through said convection chamber and the centers of the coils of tubes therein, said pipe having a plurality of holes therein spaced along the length thereof, steam injector means coupled to said pipe, and pipe rotating means coupled to said pipe for rotating said pipe.

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