April 8, 1930. G. Y. BONUS 1,753,687

BOILER

Filed June 15, 1925

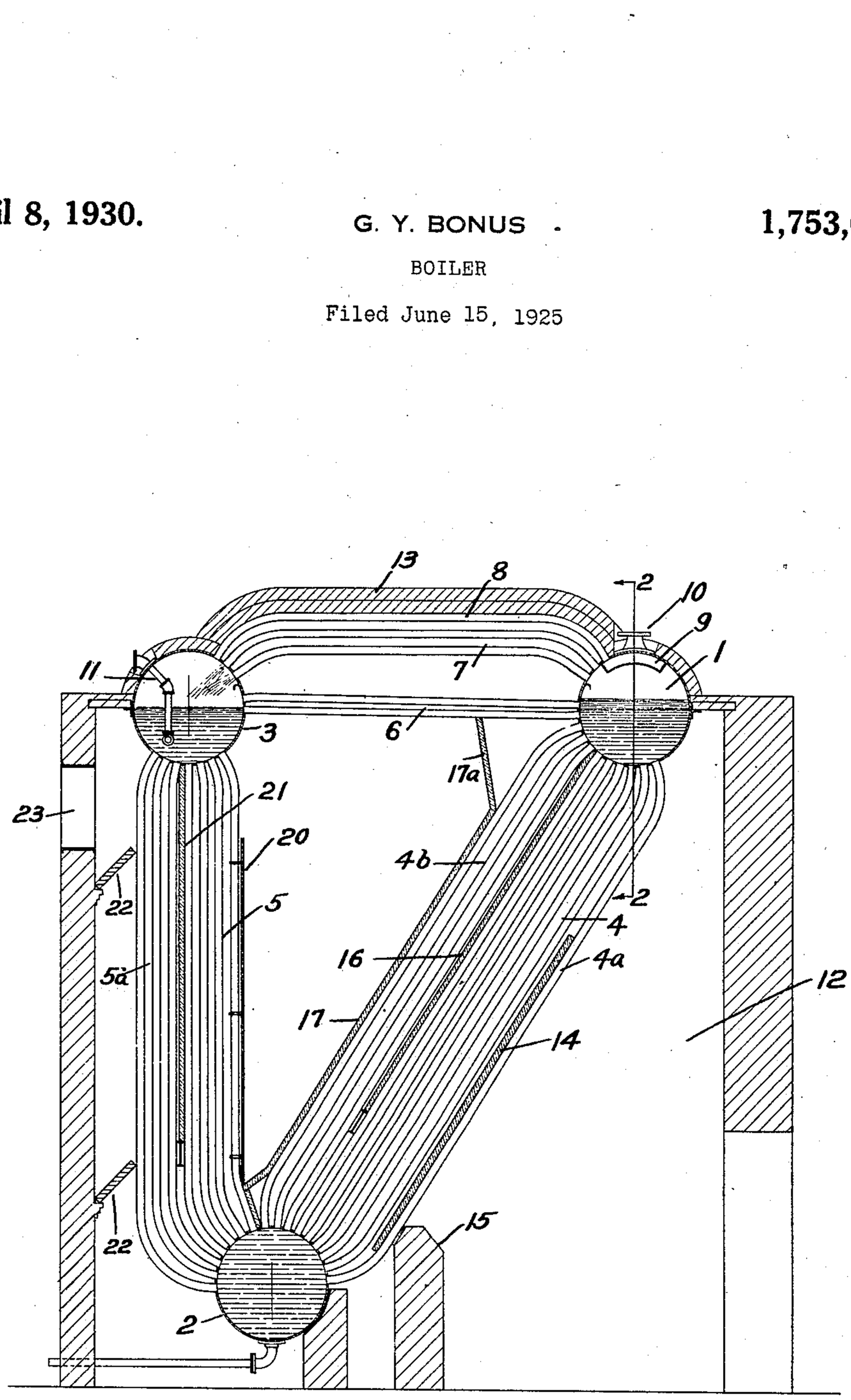


FIG. 1.

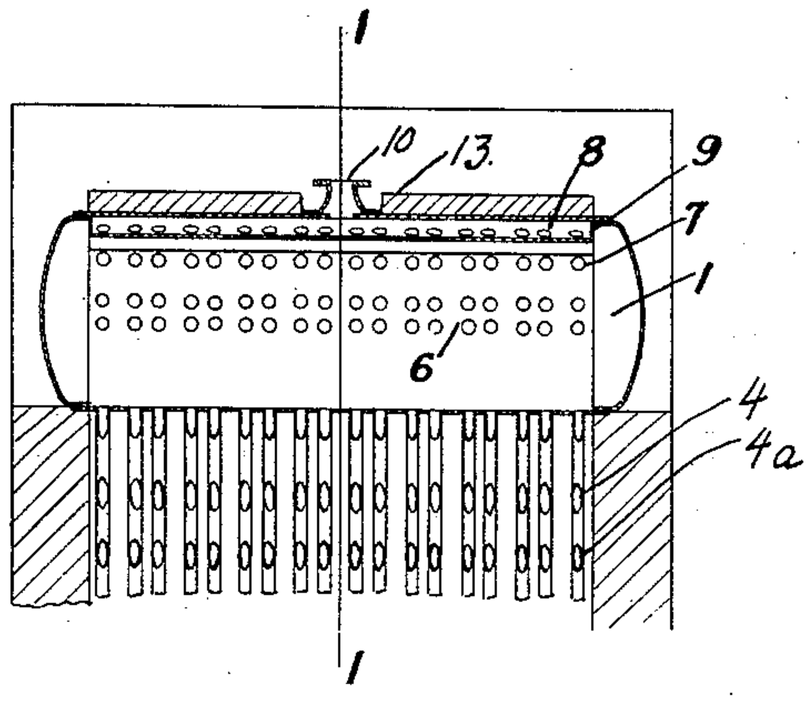


FIG. 2.

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UNITED STATES PATENT OFFICE

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BOILER

Application filed June 15, 1925. Serial No. 37,126.

This invention relates particularly to steam boilers having at least two upper drums in the plane of the water level and connected in circuit with each other and at least one lower drum, the invention being exemplified in what is known as a three drum boiler. The present invention is designed to improve the performance of a boiler of this type by so controlling the application of heat to the various tubes as to provide a one-way flow through the circuit, that is to say, an up-flow in the tubes leading to the front upper drum, a rearward flow from the front drum to the rear drum, and a downward flow from the rear drum, this result being furthered by carrying the feed water into said rear drum. Other features and details of the invention will appear more fully from the specification and claims.

The invention is illustrated in the accompanying drawings as follows:—

Fig. 1 shows a central section through the boiler on the line 1—1 in Fig. 2.

Fig. 2 a section on the line 2—2 in Fig. 1.

1 marks the front drum, 2 the lower drum and 3 the rear drum. As indicated the upper drums are in the plane of the water level, each having a steam space and a water space. The front drum is connected with the lower drum by a bank of tubes 4, 4^a and 4^b. The rear drum is connected with the lower drum by a bank of tubes 5 and 5^a. The upper drums are connected by water tubes 6. Steam tubes 7 also connect the drums 1 and 2. Steam tubes 8 extend from the rear drum 3 to a chamber 9, this chamber being preferably formed in the upper part of the drum 1 and a steam discharge pipe 10 leads from the boiler.

Feed water is delivered preferably to the rear drum 3 by way of a pipe 11.

A furnace chamber 12 has surrounding walls enclosing the entire boiler and a top wall 13. A baffle plate 14 is arranged between the tubes 4^a and 4 of the front bank of tubes and a bridge wall 15 extends directly below the baffle plate 14. The baffle 14 and bridge wall, the front and side walls of the furnace, form the combustion chamber and the products of combustion pass out from the combustion chamber, over the baffle 14 and are deflected downwardly along the tubes 4 by a baffle 16 which extends from the drum 1 between the tubes 4 and 4^b. A baffle 17 arranged over the tubes 4^b deflect the gases upwardly along the tubes 4^b so that the gases pass from the combustion chamber, across the tubes 4^a and 4, and downwardly along the tubes 4, around the baffle 16 upwardly along the tubes 4^b between the baffles 16 and 17. The gases are then carried upwardly by an extension 17^a of the baffle 17, across the tubes 6 and are turned by the upper wall 13 thus sweeping the steam tubes. The gases then pass over the upper end of a baffle 20 arranged at the front side of the tubes 5, this baffle extending from the lower ends of these tubes, or the baffle 17, to a point near the upper ends of the tubes. A baffle 21 extends downwardly from the drum 3 between the tubes 5 and 5^b. Thus the gases are directed downwardly along the tubes 5 between the baffles 20 and 21 and make a turn at the bottom of the rear bank of tubes passing upwardly to the rear of the baffle 21 and between this baffle and the rear wall. Deflecting baffles 22 extend inwardly from the rear wall and force a flow of gases along or through the tubes. The gases are discharged from the furnace to the stack through an opening 23. This movement of gases and the transfer of heat cause a very rapid upflow of water through the front bank of tubes, a very rapid cross flow of water through the water tubes 6, and a down flow of water through the rear bank of tubes, making a complete uninterrupted circuit. The feed water in the rear drum chilling this water to a certain extent adds its influence preventing adverse currents in the rear bank of tubes.

The level of the water tube 6 relatively to the front and rear drums also tends to accelerate or add to this result in that when the boiler is steaming the water level in the front drum through the rapid evolution of steam and upflow of water from the tubes is raised quite materially above the level of the water in the rear drum and the water is ordinarily delivered to the rear drum above the water level so that there may be a free sepa-

ration of steam from the water. This manner of delivering water to the rear drum is of significance in that there is no tendency to cause the throwing upwardly of any masses of water into the steam flow as is common where the delivery of water is upwardly and from below the water level. Steam carried from the front to the rear drum is also delivered to the rear drum in a direction to impinge upon the water of the drum so that any moisture there may be in the steam is separated by this impact. In consequence there is a very complete steam separation in the rear drum. This is made more marked by leading the steam from the rear drum in a direction at an angle to the direction in which the water and steam are delivered to the drum, preferably in a direction the reverse of that from which the water and steam are delivered. This is accomplished in the specific construction shown by the pipes 8 which lead from the rear drum back into the front drum in substantially a reverse direction from the delivery of water and steam by way of the pipes 6 and 7, in other words, there is a complete reversal of direction of flow, all the steam leaving the rear drum in a direction the reverse of that from which the steam and water lead to this drum.

This construction utilizes three of the best known principles for separating solids and liquids from gases, namely, change in velocity, impingement and reversal of flow. The change of velocity spreads the discharge from the tubes delivering the moisture or vapor ladened steam into the rear drum and affords the first opportunity for the steam to lose its entrained moisture and solids. The velocity of this discharge into the rear drum will, under all circumstances, be great enough to effect an impingement or impact of the moisture or vapor ladened steam upon the stabilized surface of the water in the rear drum with such force that the solids will be driven into the water, and the small particles of water in the moisture or vapor will be attracted by cohesion to the water in the rear drum. Having freed itself of the entrained moisture or vapor and solids by the change of velocity and impingement the steam is forced to reverse its flow in order to find its way back through the upper bank of tubes in the heated zone to the steam-tight chamber, or compartment in the front upper drum from which it leaves the boiler through the steam nozzle. This reversal of flow or third principle has a decided tendency to throw out any of the fine particles of water or solids that may have escaped the action of the change of velocity and impingement heretofore described.

What I claim as new is:—

1. In a boiler, the combination of a front drum; a rear drum, said drums being in the plane of the water level; a lower drum; a front bank of tubes connecting the lower and front drum; a rear bank of tubes leading to the rear drum in circuit between the lower drum and the rear drum; an upper bank of water tubes between the front and rear drums, said drums and banks of tubes forming an unobstructed ring path from the lower drum to the front drum, from the front drum to the rear drum and from the rear drum to the lower drum forming the main circuit for the water; a furnace; and baffles comprising a plurality of baffles operating on the front bank of tubes controlling the application of heat to the tubes compelling an upflow of water in and throughout the front bank of tubes, a rearward flow of water in and throughout the upper bank of water tubes, and a downward flow of water in and throughout the rear bank of tubes.

2. In a boiler, the combination of a front drum; a rear drum, said drums being in the plane of the water level; a lower drum; a front bank of tubes connecting the lower and front drum; a rear bank of tubes leading to the rear drum in circuit between the lower drum and the rear drum; an upper bank of water tubes between the front and rear drums, said drums and banks of tubes forming an unobstructed ring path from the lower drum to the front drum, from the front drum to the rear drum and from the rear drum to the lower drum forming the main circuit for the water; means for delivering feed water to the rear drum; a furnace; and baffles comprising a plurality of baffles operating on the front bank of tubes controlling the application of heat to the tubes compelling an upflow of water in and throughout the front bank of tubes, a rearward flow of water in and throughout the upper bank of water tubes, and a downward flow of water in and throughout the rear bank of tubes.

3. In a boiler, the combination of a front drum; a rear drum, said drums being in the plane of the water level; a lower drum; a front bank of tubes connecting the lower and front drum; a rear bank of tubes leading to the rear drum in circuit between the lower drum and the rear drum; an upper bank of water tubes between the front and rear drums, said drums and banks of tubes forming an unobstructed ring path from the lower drum to the front drum, from the front drum to the rear drum and from the rear drum to the lower drum forming the main circuit for the water; a furnace; and baffles comprising a plurality of baffles operating on the front bank of tubes controlling the application of heat to the tubes compelling an upflow of water in and throughout the front bank of tubes, a rearward flow of water in and throughout the upper bank of water tubes, and a downward flow of water in and throughout the rear bank of tubes, the upper

bank of tubes being arranged in the path of the gases.

4. In a boiler, the combination of a front drum; a rear drum, said drums being in the plane of the water level; a lower drum; a front bank of tubes connecting the lower and front drum; a rear bank of tubes leading to the rear drum in circuit between the lower drum and the rear drum; an upper bank of water tubes between the front and rear drums, said drums and banks of tubes forming an unobstructed ring path from the lower drum to the front drum, from the front drum to the rear drum and from the rear drum to the lower drum forming the main circuit for the water; a bank of steam tubes leading from the front drum to the rear drum; a steam discharge connection leading from the rear drum; a furnace; and baffles comprising a plurality of baffles operating on the front bank of tubes controlling the application of heat to the tubes compelling an upflow of water in and throughout the front bank of tubes, a rearward flow of water in and throughout the upper bank of water tubes, and a downward flow of water in and throughout the rear bank of tubes.

5. In a boiler, the combination of a front drum; a rear drum, said drums being in the plane of the water level; a lower drum; a front bank of tubes connecting the lower and front drum; a rear bank of tubes leading to the rear drum in circuit between the lower drum and the rear drum; an upper bank of water tubes between the front and rear drums, said drums and banks of tubes forming an unobstructed ring path from the lower drum to the front drum, from the front drum to the rear drum and from the rear drum to the lower drum forming the main circuit for the water; a furnace; and baffles controlling the application of heat to the tubes compelling an upflow of water in and throughout the front bank of tubes, a rearward flow of water in and throughout the upper bank of water tubes, and a downward flow of water in and throughout the rear bank of tubes, said baffles comprising an upward baffle forming the rear of the combustion chamber and terminating below the front drum, a baffle extending downwardly from the front drum in the front bank of tubes and terminating above the lower drum, and a baffle extending upwardly from the lower drum and reflecting the gases through the upper bank of tubes.

6. In a boiler, the combination of a front drum; a rear drum, said drums being in the plane of the water level; a lower drum; a front bank of tubes connecting the lower and front drum; a rear bank of tubes leading to the rear drum in circuit between the lower drum and the rear drum; an upper bank of water tubes between the front and rear drums, said drums and banks of tubes forming an unobstructed ring path from the lower drum to the front drum, from the front drum to the rear drum and from the rear drum to the lower drum forming the main circuit for the water; a furnace; and baffles controlling the application of heat to the tubes compelling an upflow of water in and throughout the front bank of tubes, a rearward flow of water in and throughout the upper bank of water tubes, and a downward flow of water in and throughout the rear bank of tubes, said baffles comprising an upward baffle forming the rear of the combustion chamber and terminating below the front drum, a baffle extending downwardly from the front drum in the front bank of tubes and terminating above the lower drum, a baffle extending upwardly from the lower drum and deflecting the gases through the upper bank of tubes, and a baffle extending downwardly from the rear drum in the rear bank of tubes.

In testimony whereof I have hereunto set my hand.

GEORGE Y. BONUS.