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STEAM BOILER

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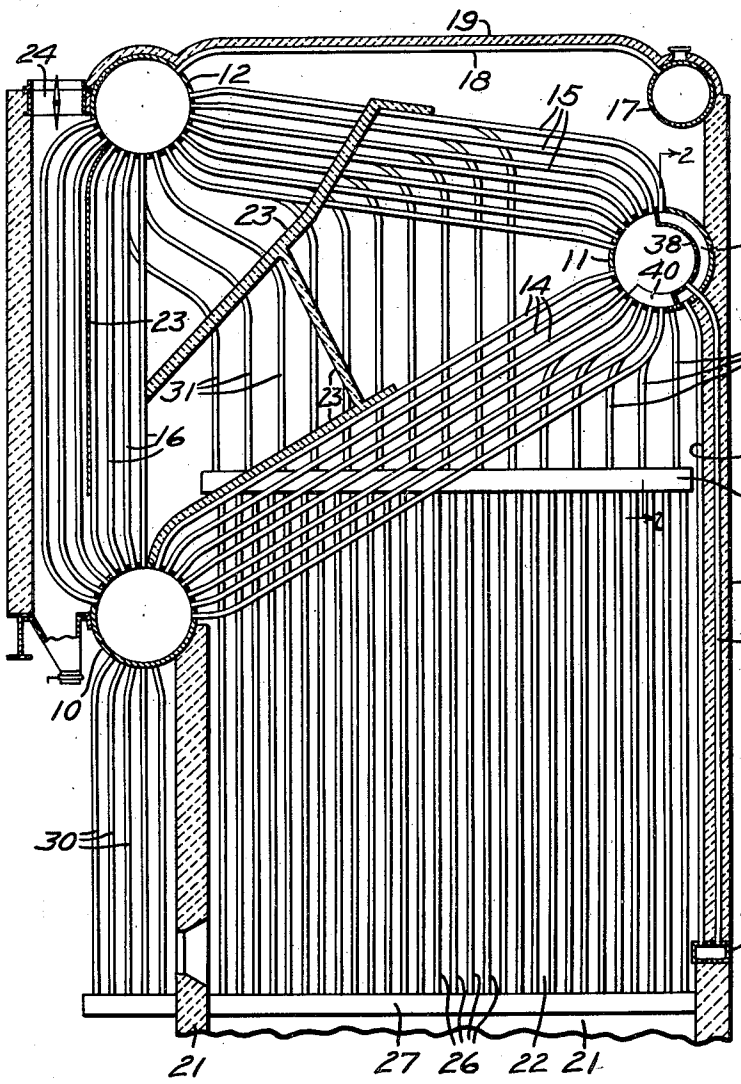


Fig. 1

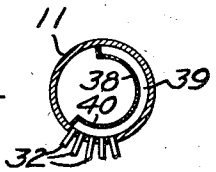


Fig. 3

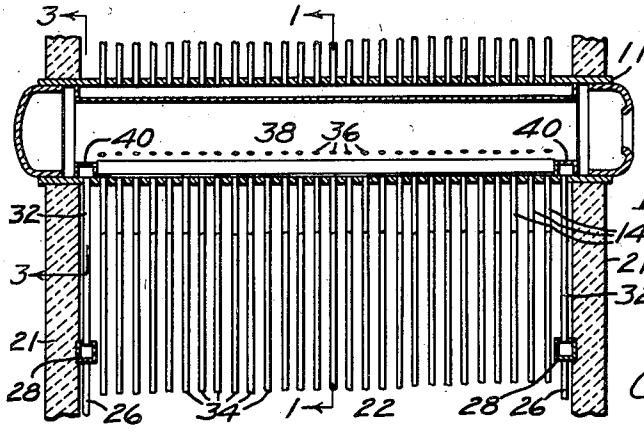


Fig. 2

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STEAM BOILER

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5 Claims. (Cl. 122—235)

This invention relates to steam boilers, and more particularly to water-tube boilers having a transverse horizontal water drum which serves to connect a lower bank of tubes to an upper bank.

When boilers of this type are operated at high ratings, and particularly when water walls are provided which discharge into the drum, there is a tendency for steam to accumulate in the upper portion of the drum and prevent water from entering the tubes in the upper part of the upper tube bank. This condition is aggravated when side water walls are provided, since they cause a concentration of steam in the end portions of the drum. As a result, the tubes located in the upper part of the upper tube bank and near the side walls may receive insufficient water to protect them from overheating.

It is accordingly one object of the present invention to overcome these difficulties and to provide a construction which will decrease the concentration of steam in the upper portion of the drum and thus allow more water to enter the tubes of the upper bank.

It is a further object of the invention to provide means for distributing the steam more uniformly lengthwise of the drum when side water walls are connected to the ends of the drum.

With these and other objects in view, as will be apparent to those skilled in the art, the invention resides in the combination of parts set forth in the specification and covered by the claims appended hereto.

Referring to the drawing illustrating one embodiment of the invention, and in which like reference numerals indicate like parts,

Fig. 1 is a vertical longitudinal section through a steam boiler and furnace, the section being taken on the line 1—1 of Fig. 2;

Fig. 2 is a section on the line 2—2 of Fig. 1; and

Fig. 3 is a section on the line 3—3 of Fig. 2.

In the drawing I have illustrated a steam boiler comprising a rear lower water drum 10, a front upper water drum 11, and a steam and water drum 12 located above the drum 10. These drums are arranged with their axes parallel and horizontal. The drum 10 is connected to the drum 11 by a bank of upwardly and forwardly sloping water tubes 14, and the drum 11 is connected to the drum 12 by a bank of upwardly and rearwardly sloping water tubes 15. The drums 10 and 12 are connected by a bank of substantially vertical water tubes 16. A steam drum 17 is mounted above the front water drum 11, and the drums 12 and 17 are connected by a row of steam tubes 18 which support refractory material 19 arranged to form a roof for the boiler. Walls 21 are arranged to provide a furnace chamber 22 beneath the lower tube bank 14, and baffles 23 direct hot gases from the furnace successively across the tube banks 14, 15 and 16 to a gas outlet 24.

In order to protect the furnace walls and at the same time generate steam by the absorption of radiant heat and thus prevent excessive furnace temperatures, I preferably provide a row of vertical water wall tubes 26 at each side of the furnace. These tubes extend between lower headers 27 and upper headers 28. The lower headers 27 are supplied with water from the drum 10 by means of down-comer tubes 30 leading from the drum to the rear portions of the headers. The rear portions of the upper headers 28 are connected to the steam and water drum 12 by up-comer tubes 31, and the front portions of the headers 28 are connected to the front water drum 11 by up-comer tubes 32. At the front of the furnace I provide a row of vertical water wall tubes 34 which extend between the drum 11 and a horizontal header 35. This header is supplied with water from the drum 11 by means of a row of down-comer tubes 36 leading from the drum to the header and located outside of the tubes 34. The down-comer tubes 36 are protected from the heat by the refractory material of the furnace wall.

With the construction as so far described, there will be a large amount of steam discharged into the drum 11, and this steam will tend to accumulate in the upper portion of the drum and prevent the entrance of water into the tubes of the bank 15. Moreover, this steam concentration will be more pronounced near the ends of the drum, since the up-comer tubes 32 deliver a large amount of steam from the side water walls.

In order to overcome this difficulty, I provide means for conducting a portion of the steam, which would normally be released in the drum 11, directly to the tubes in the upper portion of the tube bank 15. For this purpose I have shown a partition plate 38 mounted inside the drum 11 and cooperating with the front portion of the drum wall to form a passage 39 leading from the front water wall tubes 34 to the upper row of tubes in the tube bank 15. This construction greatly reduces the quantity of steam released in the drum, since the tubes 34 are exposed to the radiant heat of the furnace and hence generate steam at a very high rate. In order that

the circulation through the tubes 34 may be maintained, means is provided to deliver water into the upper ends of the down-comer tubes 36 from the main portion of the drum. In the preferred construction the tubes 36 are extended inwardly through the partition 38 so that water may enter these tubes freely.

Near each end of the drum 11 the partition plate 38 is preferably extended rearwardly, as indicated at 40, to enclose the upper ends of the up-comer tubes 32 and thus compel the steam delivered by these tubes to flow through the passage 39. Not only does this still further decrease the amount of steam liberation in the drum, but it also results in a substantially uniform distribution of the steam throughout the length of the drum.

The operation of the invention will now be apparent from the above disclosure. The furnace 22 is fired in any suitable manner, and the hot gases flow across the tube banks 14, 15 and 16 to the gas outlet 24. Water circulates downwardly in the tube bank 16 and upwardly in the tube banks 14 and 15. Steam which is generated in the various tubes is finally released in the drum 12 and flows through the tubes 18 to the drum 17, from which it is withdrawn for use. Water flows from the drum 10 downwardly through the tubes 30 to the header 27 and thence upwardly through the side water wall tubes 26, the headers 28, and the up-comer tubes 31 and 32. Water flows from the main portion of the drum 11 downwardly through the tubes 36 to the header 35 and thence upwardly through the front water wall tubes 34. The steam and water mixture discharged from the up-comer tubes 32 and the water wall tubes 34 flows through the passage 39 and thence through the upper row of tubes in the tube bank 15 to the drum 12. An adequate circulation is thus maintained in this tube row. At the same time entrance of sufficient water into the remaining tubes of the bank 15 is assured, because of the greatly reduced steam liberation in the drum 11 and the equalization of the steam liberation longitudinally of the drum. As a result, all the tubes are protected against the possibility of overheating, and the boiler can be operated at very high steaming rates without danger.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A steam boiler comprising a transverse horizontal water drum, a lower bank of tubes connected to the drum and extending rearwardly and downwardly therefrom, an upper bank of tubes connected to the drum and extending rearwardly and upwardly therefrom, a furnace wall at the front of the drum, water wall tubes associated with the wall and connected to the drum, a partition mounted within the drum and cooperating with the front wall of the drum to form a passage leading from the water wall tubes to tubes in the upper portion of the upper tube bank, and downcomer tubes arranged to supply water from the main portion of the drum to the water wall tubes.

2. A steam boiler comprising a transverse horizontal water drum, a lower bank of tubes connected to the drum and extending rearwardly and downwardly therefrom, an upper bank of tubes connected to the drum and extending rearwardly and upwardly therefrom, a furnace wall at the front of the drum, a row of substantially vertical water wall tubes associated with the wall and connected at their upper ends to the drum, a partition mounted within the drum and cooperating with the front wall of the drum to form a passage leading from the water wall tubes to tubes in the upper portion of the upper tube bank, a header at the lower ends of the water wall tubes, and a row of substantially vertical downcomer tubes located in front of the water wall tubes and connecting the drum with the header, the upper ends of the downcomer tubes extending through the partition into communication with the main portion of the drum.

3. A steam boiler comprising a transverse horizontal water drum, a lower bank of tubes connected to the drum, an upper bank of tubes connected to the drum, walls forming a furnace chamber beneath the lower tube bank, water wall tubes associated with the side walls of the furnace chamber and arranged to discharge steam and water into the end portions of the drum, and means to conduct said steam and water into certain of the tubes of the upper tube bank without first mingling the steam with steam discharged into the drums by the tubes of the lower tube bank.

4. A steam boiler comprising a transverse horizontal water drum, a lower bank of tubes connected to the drum, an upper bank of tubes connected to the drum, walls forming a furnace chamber beneath the lower tube bank, water wall tubes associated with the side walls of the furnace chamber and arranged to discharge steam and water into the end portions of the drum, and a partition mounted within the drum and cooperating with the wall of the drum to form a passage which serves to conduct said steam and water to tubes in the upper portion of the upper tube bank without first mingling the steam with steam discharged into the drum by the tubes of the lower tube bank.

5. A steam boiler comprising a transverse horizontal water drum, a lower bank of tubes connected to the drum and extending rearwardly and downwardly therefrom, an upper bank of tubes connected to the drum and extending rearwardly and upwardly therefrom, walls forming a furnace chamber beneath the lower tube bank, water wall tubes associated with the side walls of the furnace and arranged to discharge steam and water into the end portions of the drum, water wall tubes associated with the front wall of the furnace and connected at their upper ends to the drum, and a partition mounted within the drum and cooperating with the wall thereof to form a passage which serves to conduct steam and water from the side water wall tubes and the front water wall tubes to tubes in the upper portion of the upper tube bank without first mingling the steam with steam discharged into the drum by the tubes of the lower tube bank.

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