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WATER TUBE BOILER

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Fig. 1.

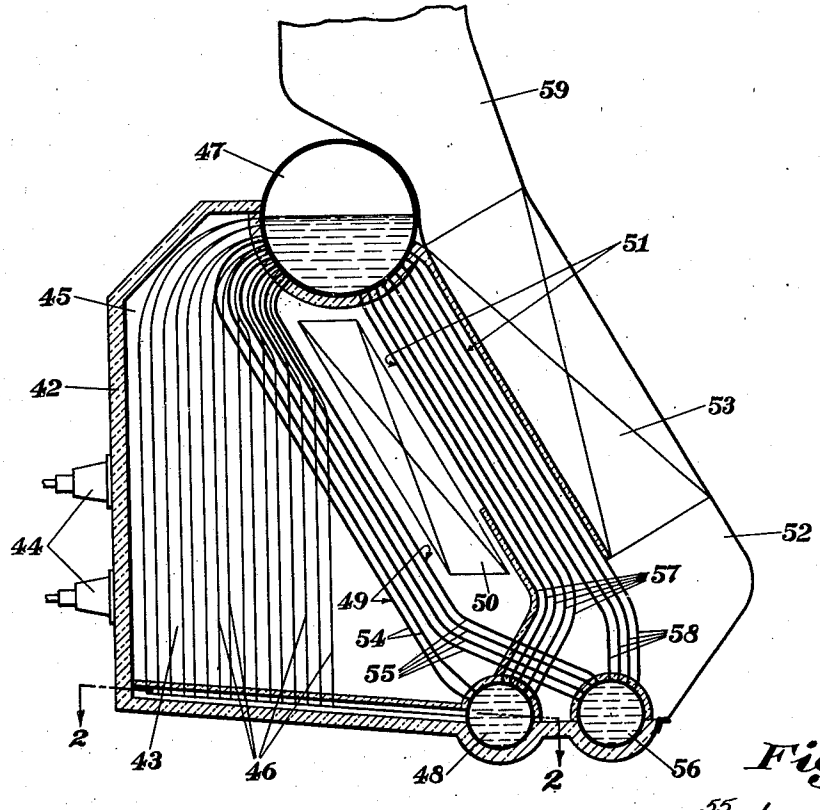


Fig. 3.

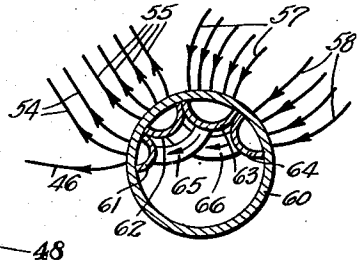
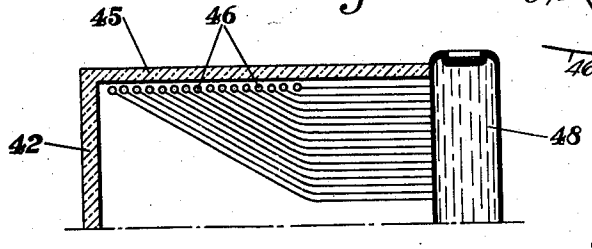


Fig. 2.



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WATER TUBE BOILER

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3 Claims. (Cl. 122—235)

In water tube boilers having risers arranged in rows which are unequally heated, it is old to group risers and downcomers into several groups each having its own water circulation. If, as is frequently the case, risers receiving different amounts of heat belong to one and the same circulation group, there is danger that at certain loads only those rows of tubes which receive the larger amounts of heat will have a sufficient water supply, while in the risers of the group which receive the least amount of heat the circulation of the water may be interrupted, and there may even be a reversal of the circulation, with its objectionable results. It is also old to associate with each single row of risers of a bank a row of downcomers to form a circulation group. In such cases the arrangement is such that the row of risers which is swept by the hottest gases is grouped with the downcomers with which the gases may contact last and which is therefore heated least, while in the next following groups the difference in heating between the risers and the associated downcomers is progressively smaller so that the danger of interruptions in circulation increases correspondingly.

In order to avoid the disadvantages pointed out and to assure an ample water circulation in each of the differently heated riser groups, the risers and downcomers are according to the present invention so grouped that each circulation group consists of groups of risers which are substantially equally heated and have approximately the same resistance to flow through them, and of downcomers which lie in zones of materially lower temperature than the risers of the respective group. Such an arrangement avoids having a circulation group include for example risers which receive their heat by radiation and are therefore very active and also risers which are heated only by convection. It further avoids having risers, which are heated only by convection by gases which are already very materially cooled, and which therefore receive relatively small amounts of heat, grouped with downcomers which are also heated even if they lie behind such risers in the direction of gas flow. The invention utilizes an arrangement that is admissible which is to group downcomers which are slightly heated with risers which receive a large amount of heat to form a circulation group. In such an arrangement the difference in temperature between the risers and downcomers is large enough to ensure a definite circulation.

The grouping of risers and downcomers into circulation groups can be accomplished by means which are old by themselves, for instance by fluid conducting means built into the lower drum and forming return channels from the outlets of the downcomers to the inlets of the risers. The same thing may be accomplished, however, by having the tubes of each circulation group open into its own separate lower drum.

In the drawing, one illustrative example of the invention is shown, together with one variation.

Fig. 1 is a vertical section through a semi-vertical tube boiler embodying the invention; Fig. 2 is a horizontal half-section on line 2—2 of Fig. 1. Fig. 3 is a fragmentary vertical section of a variation.

The boiler shown in Figs. 1 and 2 is a semi-vertical tube boiler arranged for oil firing. The burners 44 are arranged in the front wall 42 of the furnace 43. Each lateral wall 45 of the furnace is provided with a water wall of evaporator tubes 46 connected at their upper ends to the steam and water drum 47 and at their lower ends to a drum 48. These water tubes have vertical portions adjacent and parallel to the water walls and horizontal portions parallel and adjacent to the bottom of the furnace. Their ends lie in single rows but obviously these ends might be arranged in two or more rows. The gases issuing from the furnace 43 flow in sequence through the evaporating bank 49, a superheater 50 (indicated only diagrammatically) and a bank of tubes 51 behind the superheater and pass from the lower end of the bank 51 to the stack 59 through a passage 52 containing an air preheater 53.

The evaporator bank 49 is subdivided into two groups. One of these consists of the two front rows 54 extending between the upper drum 47 and lower drum 48, and the second consists of the rear rows of tubes 55 which at their upper ends are also connected to the upper drum 47 but at their lower ends are connected to a separate lower drum 56. The tubes of bank 51 also are all connected to the upper drum 47, but are divided into two groups, namely, a front one 57 receiving more heat and connected to the lower drum 48, and a rear group 58 receiving less heat and connected to the lower drum 56. In this manner the water screen tubes 46 and the two front rows 54 of the evaporating bank 49 together with the group 57 form the first closed circulation group utilizing the lower drum 48 to close the circuit, and the rear rows 55 of the bank 49 together with the group 58 form a second circulation group through the lower drum 56. In the first circulation group the tubes 46 and 54 are risers and the tubes 57 are downcomers. The

tubes 46 are heated principally by radiation and the two rows 54 likewise receive radiant heat. The tubes 46 and 54 are therefore heated to approximately the same extent. As they also have approximately the same resistance to flow through them they may be connected into a single group. It will be understood that the tubes 46 are present in the form of boiler shown, as this is an oil-fired case. This type of boiler was chosen to illustrate that such tubes as 46 can be gathered into the same group with the portion of the bank nearest the furnace. In many instances there will be no tubes like tubes 46. The downcomers 57 associated with the group comprising tubes 54 are heated by hot gases which have passed through the bank 49 and the superheater 50. The difference in temperature between them and the risers of this circulation group is therefore sufficient to assure a reliable water circulation. These conditions are also present in the second circulation group. The evaporating tubes 55 of this group acting as risers are swept by the hottest combustion gases, whereas in that zone where the downcomers of this group lie, the heating gases have been largely cooled because in addition to the bank 49 and the superheater 50 they have also been in contact with the downcomer bank 57 of the first group.

In the modified example of Fig. 3 the two circulation groups do not utilize separate lower drums, but a common lower drum 60 is used for the two circulation groups, and the grouping of the tubes is effected through appropriate structures inserted in the drum. The two circulation groups are here again made up of risers 46 and 54 and downcomers 57 for one group and risers 55 and downcomers 58 for the other. The openings of the two riser groups are each covered by the boxes 61 and 62 respectively and those of the two downcomer groups by the boxes 63 and 64 respectively. The connection between the boxes 61 and 63 belonging to the first circulation group is effected through the connecting pipes 65 and the connection between the boxes 62 and 64 of the second circulation group through the connecting pipes 66. A suitable number of these connecting pipes is distributed throughout the length of the drum 60. The connecting pipes 65 bridge the box 62 lying between the boxes 61 and 63 and the connecting pipes 66 bridge the box 63 lying between the boxes 62 and 64. The boxes are preferably secured to the wall of the drum by some readily detachable means.

It will be obvious from the above that the invention may be applied to boilers of semi-vertical water tube type other than the specific form shown.

For example, the circulation groups according to Figs. 1 and 3 could be used in a marine boiler of the A-type. By separating the groups of riser tubes which have varying degrees of heating and varying flow resistance into separate circulation groups with downcomers that are heated only slightly as compared with their associated risers, a constant circulation through all the risers without any danger of stoppage or reversal is assured in each case. Furthermore a proper relation between the cross-sectional area of the risers and downcomers of each group can be selected and the number of downcomers can be kept as small as admissible.

What I claim is:

1. In a boiler, the combination of a plurality of groups of upright transversely alined riser tubes, means to cause hot gases to flow in a direction generally across the tubes so that the tubes in each transverse row receive substantially equal amounts of heat and successive groups receive progressively decreasing amounts of heat, all the tubes of any group offering substantially the same resistance to the flow of fluid through them, upper and lower water containing means to which the tubes are connected, and downcomers connected with the risers to establish a plurality of separate circulation systems, each circulation system including downcomers and one group of risers, the downcomers also being exposed to heating conditions but in each case to less intense heating conditions than any of the risers of the boiler, the downcomers of all the systems lying with respect to the gas flow beyond all of the risers, and all the downcomers of one system lying, with respect to the gas flow, behind the downcomers of a second system whose risers receive more intense heat than those of the first system.

2. A boiler in accordance with claim 1, the lower ends of the downcomers of one system crossing the lower ends of the risers of another system.

3. A boiler in accordance with claim 1, the lower water containing means being a single drum, the lower ends of each group of risers and the lower ends of each group of downcomers being separately enclosed in boxes arranged in said lower drum, boxes pertaining to one system being connected by conduits bridging a box pertaining to another system.

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