Oct. 18, 1932. H. J. KERR ET AL 1,883,380

BOILER

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Fig. 2.

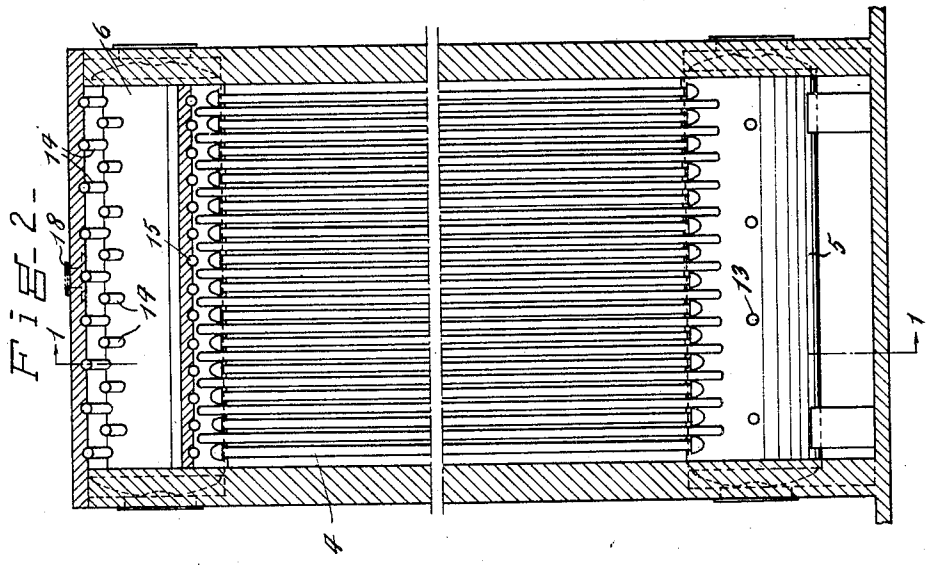
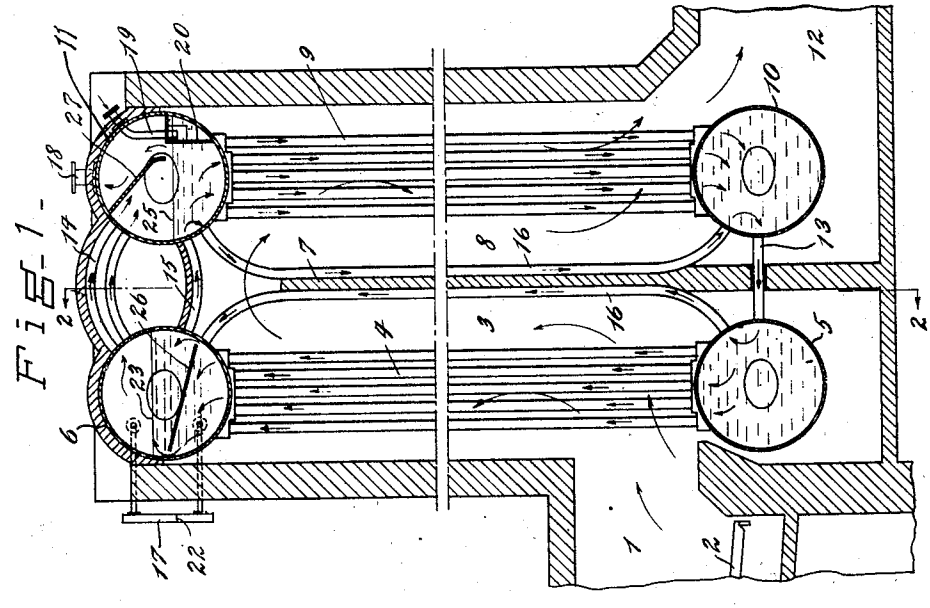


Fig. 1.



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Fig. 4.

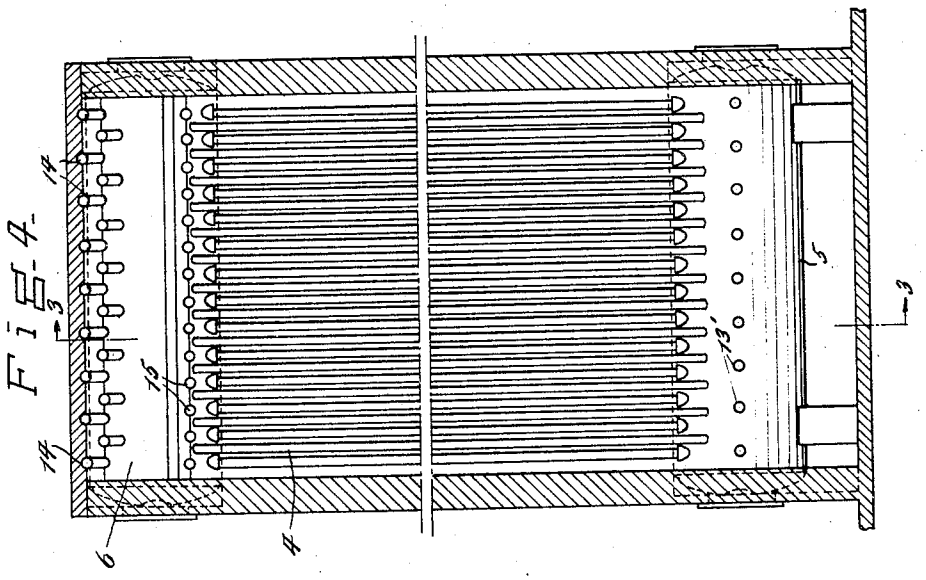
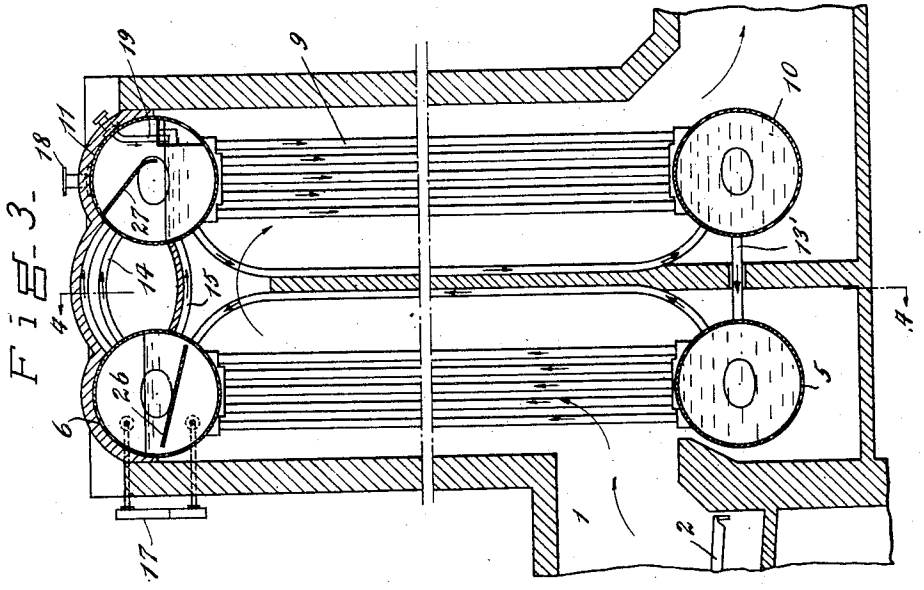


Fig. 3.



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Fig. 6.

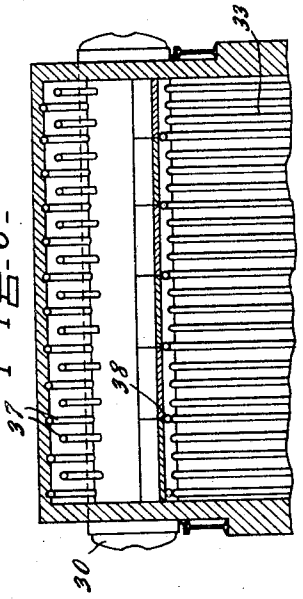


Fig. 7.

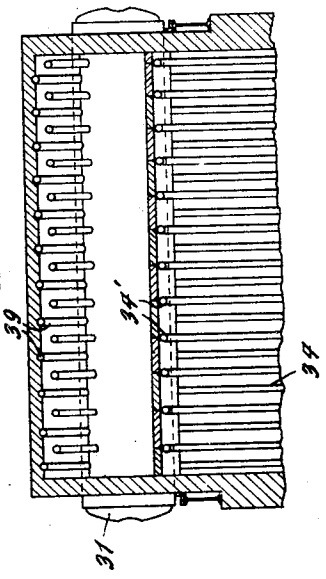
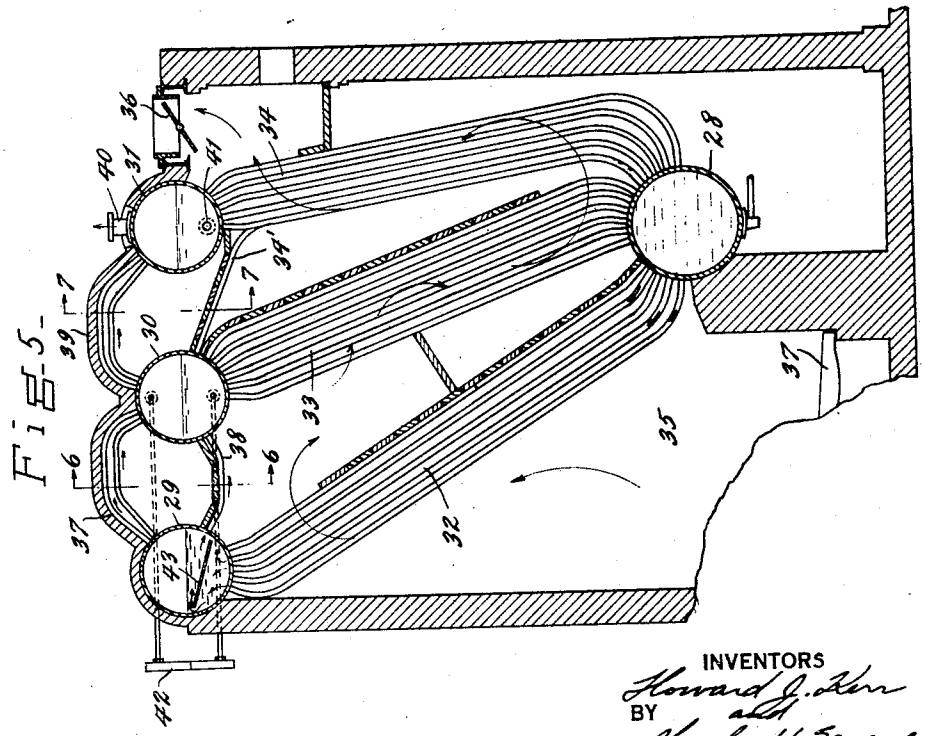


Fig. 5.



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Fig. 9.

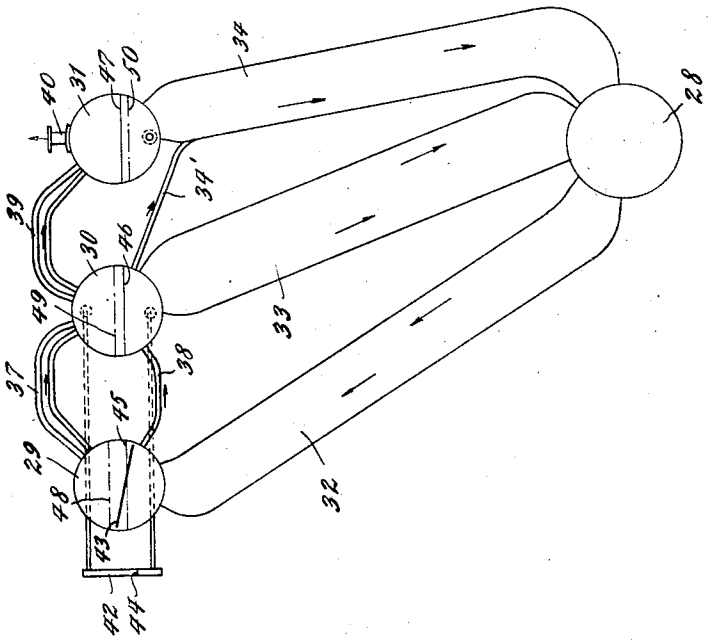
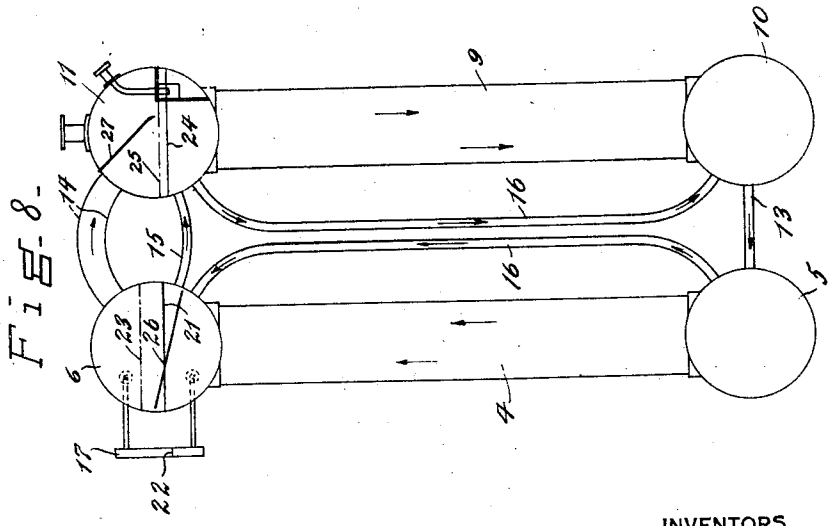


Fig. 8.



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Patented Oct. 18, 1932 1,883,380

UNITED STATES PATENT OFFICE

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BOILER

Application filed November 13, 1928. Serial No. 319,045.

This invention relates to an improved form of boiler, the novel features of which will be best understood from the following description, when read in connection with the annexed drawings. In these drawings, we have shown selected embodiments of the invention, and referring thereto;

Fig. 1 is a vertical sectional view through a boiler of the Rust type having our invention embodied therein, this view being taken on the line 1—1 of Fig. 2.

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

Figs. 3 and 4 are views corresponding to Figs. 1 and 2 respectively, but showing a modification of the invention disclosed in said Figs. 1 and 2.

Fig. 5 is a view corresponding to Fig. 1, but showing the invention as applied to a boiler of the Stirling type.

Fig. 6 is a section on the line 6—6 of Fig. 5.

Fig. 7 is a section on the line 7—7 of Fig. 5.

Fig. 8 is a diagrammatic view corresponding to Figs. 1 and 3.

Fig. 9 is a diagrammatic view corresponding to Fig. 5.

Referring first to Figs. 1 and 2, wherein the invention is shown as applied to a boiler of the Rust type, the numeral 1 designates a combustion chamber of a furnace having a source of heat therein, this source being indicated in this instance by a grate 2. The gases from the combustion chamber flow first upwardly through a first pass 3 in which is a bank of tubes 4 connecting a lower water drum 5 with an upper steam and water drum 6. At the top of the first pass 3 the gases pass over the top of the baffle 7 and downwardly through a second pass 8, in which is a second bank of tubes 9 connecting a lower water drum 10 to an upper steam and water drum 11. The gases then pass outwardly through the flue 12. The water drums 5 and 10 are connected by a plurality of water circulators 13, here shown as four in number, while the steam and water drums are connected by steam circulators 14 and water circulators 15, and baffle wall tubes 16 are also provided in each of the gas passes 3 and 8. A suitable gauge glass 17 is provided and this glass is shown as connected to the front steam and water drum 6. The rear steam and water drum 11 is provided with the usual steam outlet 18, and the water inlet 19 is adapted to discharge the feed water back of the drum baffle 20. When the boiler is not operating the pressure above the water is the same in both drums, and the water levels are also the same.

The hot gases will cause a circulation in the boiler somewhat like that indicated by the arrows in Fig. 1, although it is to be understood that these arrows are merely indicative of the general trend of the flow of the fluid in the boiler, and are not intended to be limiting in any way. The bank of tubes 4 is subjected to the hottest gases and normally this will cause steam to be generated therein, and this in turn causes an upward flow of the fluid in the tubes 4, this fluid being replaced by fluid coming through the circulators 13 from the drum 10 and the tubes 9. Some of this fluid is water from the drum 6 flowing through tubes 15 to the drum 11, and some of it is feed water supplied to the drum 11.

The fluid in the tubes 4 will normally be a mixture of steam and water of less average density than that in the tubes 9, because of a larger ratio of steam to water, and the upward velocity of the steam and water in the tubes 4 may be such as to cause excessive agitation of the water in the drum 6, if no corrective measure were applied. Moreover, the rising water in the tubes 4 contains a large percentage of steam bubbles which, if permitted to rise through the water in the drum 6 and escape from its free surface, would burst in the steam space of the drum 6 and spatter water drops upward. These two conditions together result in there being sufficient water suspended in the steam above the water in the drum 6, so that there is danger of more of it being carried over through the steam circulators 14 to the rear drum 11, than can be separated there and so making the steam leaving exit nozzle 18 too wet. In this connection the fact that the mixture of steam and water in the tubes 4 and drum 6 is of relatively low density, will cause the water level in the drum 6 to be substantially

higher than that indicated on the water glass 17 and the level in the rear drum lower than that in the front drum, even if the steam circulators 14 are large enough to substantially equalize steam pressures in the two drums. When there is no steam mixed with the water in tubes 9, the fluid will be of maximum density and the level in rear drum 11 will be lower than in front drum 6 to a maximum degree and this contributes to discharge of dry steam from the nozzle 18 on the rear drum. If steam bubbles are carried by the water from drum 6 to drum 11 through circulators 15 in a volume greater than can escape in drum 11, then steam bubbles will flow down tubes 9 and decrease the density of the fluid in them with the effect that the water level will rise in drum 11 under the steam nozzle, and may rise enough to result in water being lifted from the surface and discharged with the steam from nozzle 18. This is dangerous and is avoided by the construction of this invention.

The diagrammatic showing in Fig. 8 indicates the normal water level at 21, which is only slightly higher than the level indicated at 22 in the gauge glass 17, whereas the actual water level in the drum 6 may easily reach the level indicated at 23 with the same water glass indication, and at which level, obviously, there is great danger of water being carried over through the circulators 14 into the rear drum and also steam through water circulators 15, unless our invention be applied. The normal water level in the rear drum is indicated at 24, and the actual level when the boiler is in operation is represented by the line 25, indicating a relative level which the water may take.

If a sufficient amount of water is carried over through the steam circulators and steam bubbles with the water through the water circulators, which is most likely when the water is of a high concentration of solids so as to foam easily, the level in the rear drum 11 may be easily raised to such a point as to cause the water to be carried off through the steam outlet 18, this result being termed "priming". Here again the water glass or gauge glass level may give an improper indication of the level in the two drums.

To overcome this priming condition, we have arranged a baffle 26 below the water level in the front drum across the ends of the tubes 4 and preferably inclined upwardly towards the front of the drum, as shown in Fig. 1. The rear or lower end of the baffle is spaced slightly from the rear wall of the drum and is preferably disposed below the water circulators 15. The front or upper edge of the baffle is also spaced from the front wall of the drum. This arrangement forms an interruption of the flow of steam and water coming upwardly into the drum 6 from the tubes 4, and will act as an impact plate and direct the flow upward and forward away from the water and steam circulators. The front edge of the baffle is disposed beneath the water line and the result is to prevent flowing of the water upwardly into the steam space by the velocity of the fluid coming into the drum from the tubes and the high velocity emergence from the free water surface.

The above constitutes one theory according to which we can explain the improved results obtained by this baffle arrangement, but we do not intend to limit ourselves in any way to that particular theory.

In the rear drum we have placed a large baffle 27 with its upper edge adjacent the wall of the drum above the steam circulators 14, and with its lower edge disposed remote from the mouth of the circulators and adjacent the water level in the drum. By this arrangement, water which may still be carried over in the steam circulators is separated from the steam which has to pass around the ends or the lower edge of the baffle 27.

We have found that priming is still further reduced by restricting the area of the water circulators 15 without corresponding restriction of the steam circulators 14. That is, the steam circulators are of sufficient flow area to preserve substantially equal pressures in the drums 6 and 11. In the form shown in Figs. 1 and 2, we have indicated seventeen steam circulators and fourteen water circulators, these circulators being of approximately equal diameters so as to give approximately equal flow area for each circulator. That is, in the embodiment shown, the ratio of flow areas in steam circulators to that of water circulators will be 17:14.

We also found that results were greatly improved by materially reducing the number of connections 13 of a given size between the water drums over the number usually employed. In the form shown in Figs. 1 and 2, we have indicated four of these connections or circulators, these circulators each being of substantially the same flow area as the circulators 14 and 15, so that the ratio between flow areas of the circulators 14, 15 and 13 will be approximately 17:14:4.

In the form shown in Figs. 3 and 4, the construction is substantially identical with that of Figs. 1 and 2, except that here the circulators 13′ are greater in number than in Figs. 1 and 2. In this arrangement the ratio of circulators 14, 15 and 13′ is approximately 17:14:9. The principal parts of the boiler shown in Figs. 3 and 4 have been designated by numerals corresponding to those shown in Figs. 1 and 2, and therefore this form of Figs. 3 and 4 will not be described in more detail.

Referring now to Figs. 5, 6, 7 and 9, we

have shown therein a Stirling type boiler in which there is provided a mud drum 28 and three upper steam and water drums 29, 30 and 31. Each of the upper drums is connected to the mud drum by a bank of tubes indicated at 32, 33 and 34 respectively. Suitable baffling is provided to direct gases from the combustion chamber 35 upwardly over the front bank of tubes 32, downwardly over the middle bank of tubes 33, and upwardly over the rear bank 34 and thus to the outlet flue 36. The combustion chamber is provided with a source of heat indicated as a grate 37. Certain of the tubes in the rear bank 34 are bent forwardly, as indicated at 34′, and connected to the middle drum 30. The front and middle drums are connected by steam circulators 37 and water circulators 38, while the middle and rear drums are connected by steam circulators 39 only. The rear drum is shown as supplied with a steam outlet 40 and a water inlet 41, and the middle drum is supplied with a gauge or water glass 42.

In the front drum 29 we have shown a baffle 43 corresponding to the baffle 26 of the Rust type of boiler, and arranged in substantially the same way with respect to the drum, the tubes in the front bank 32, and the water circulators 38. The flow area of the water circulators 38 is restricted while the flow area of the steam circulators is not so restricted, being sufficient to preserve substantially equal pressures in the drums 29 and 30, and the flow area of the steam circulators 39 is also sufficient for the same purpose, while there is a restriction of the area of the tubes 34′ which connect the rear bank 34 with the water space of the drum 30. We have found that this arrangement is one which results in materially decreasing the priming or carrying of water into the main steam outlet 40 and, at the same time, maintains the level of water in the drums 30 and 31 substantially the same as the level in the glass 42. This has been shown diagrammatically in Fig. 9, wherein the glass 42 is shown as indicating the water level 44 which is approximately the normal levels indicated at 45, 46 and 47 in the drums 29, 30 and 31 respectively.

In operation, the water levels may reach some such lines as those indicated at 48, 49 and 50 respectively, in these three drums, and it will be seen that the level in the rear or outlet drum is not substantially changed from the normal level and may be even lowered, thus greatly diminishing the chances of priming occurring.

We claim:

1. In a boiler having at least two steam and water drums, steam circulators and water circulators connecting said drums, a bank of tubes connected to one of said drums below the normal water level therein and below said water circulators, means to apply heat to said tubes to generate steam therein, and a baffle disposed in the drum above and extending across the ends of said tubes and adapted to interrupt the rise of the fluid discharged from the tubes into the drum, said baffle being inclined upwardly, with its lower edge beneath said water circulators and above said tubes.

2. In a boiler having at least two steam and water drums, steam circulators and water circulators connecting said drums, a bank of tubes connected to one of said drums below the normal water level therein and below said water circulators, means to apply heat to said tubes to generate steam therein, a baffle disposed in the drum above and extending across the ends of said tubes and adapted to interrupt the rise of the fluid discharged from the tubes into the drum, said baffle being inclined upwardly, with its lower edge beneath said water circulators and above said tubes, and having its upper edge spaced from the wall of the drum.

3. A steam boiler comprising front and rear steam and water drums, front and rear water drums, a bank of tubes connecting each water drum to a steam and water drum, means causing hot gases to flow first over the front bank and then over the rear bank of tubes, steam circulators and water circulators connecting said steam and water drums, and connections between said water drums, the flow area of said water drum connections being restricted with respect to that of said steam circulators.

4. A steam boiler comprising front and rear steam and water drums, front and rear water drums, a bank of tubes connecting each water drum to a steam and water drum, means causing hot gases to flow first over the front bank and then over the rear bank of tubes, steam circulators and water circulators connecting said steam and water drums, and connections between said water drums, the flow area of said water drum connections being restricted with respect to that of said water circulators.

5. A steam boiler comprising front and rear steam and water drums, front and rear water drums, a bank of tubes connecting each water drum to a steam and water drum, means causing hot gases to flow first over the front bank and then over the rear bank of tubes, steam circulators and water circulators connecting said steam and water drums, connections between said water drums, the flow area of said water drum connections being restricted with respect to that of said water circulators, and the flow area of the water circulators being restricted with respect to that of the steam circulators.

6. A steam boiler comprising front and rear steam and water drums, front and rear water drums, a bank of tubes connecting each

water drum to a steam and water drum, means causing hot gases to flow first over the front bank and then over the rear bank of tubes, steam circulators and water circulators connecting said steam and water drums, connections between said water drums, the flow area of said water drum connections being restricted with respect to that of said steam circulators, and the flow area of said water circulators also being restricted with respect to that of the steam circulators.

7. In a boiler, a circulation system comprising front and rear steam and water drums, a bank of water tubes connected to each of said drums beneath the normal water level therein, means causing hot gases to flow first over the front bank of tubes and then over the rear bank, steam circulators and water circulators connecting said drums, a steam outlet from said rear drum, and a baffle disposed in said front drum above and extending across the ends of said tubes and adapted to interrupt the rise of fluid discharged from the tubes into the drum, said baffle being disposed between said tubes and the water circulators and adapted to deflect said fluid away from said water circulators.

8. In a water tube steam boiler having two steam and water drums, steam circulators and water circulators connecting said drums, a bank of tubes connected to one of said drums below its normal water level and the circulator connections and acting to discharge steam and water into the drum, means to apply heat to said tubes to generate steam therein, and an inclined and submerged baffle above and extending across the connections of said tubes with the drum for a substantial distance to either side of a vertical plane passing through the longitudinal axis of the drum, the baffle having its lower edge adjacent the water circulators and extending at an upward inclination therefrom substantially entirely across the path of the discharge of said bank of tubes so that the mixture discharged from these tubes into the drum is interrupted and deflected in a direction away from the circulator connections to the drum.

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