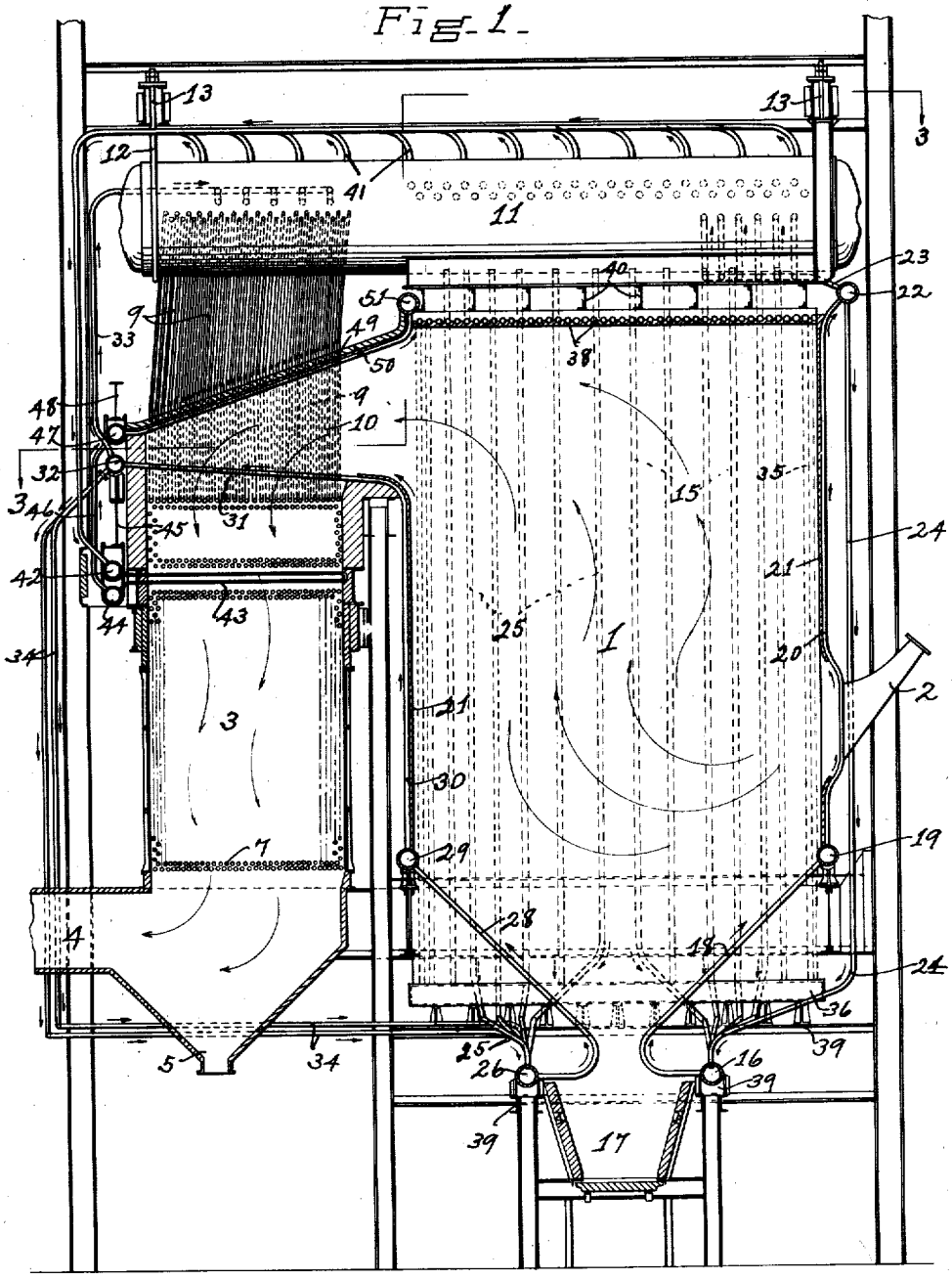
March 5, 1935. H. J. KERR 1,992,953

STEAM BOILER

Filed Feb. 4, 1929 5 Sheets-Sheet 1

Fig. 1.



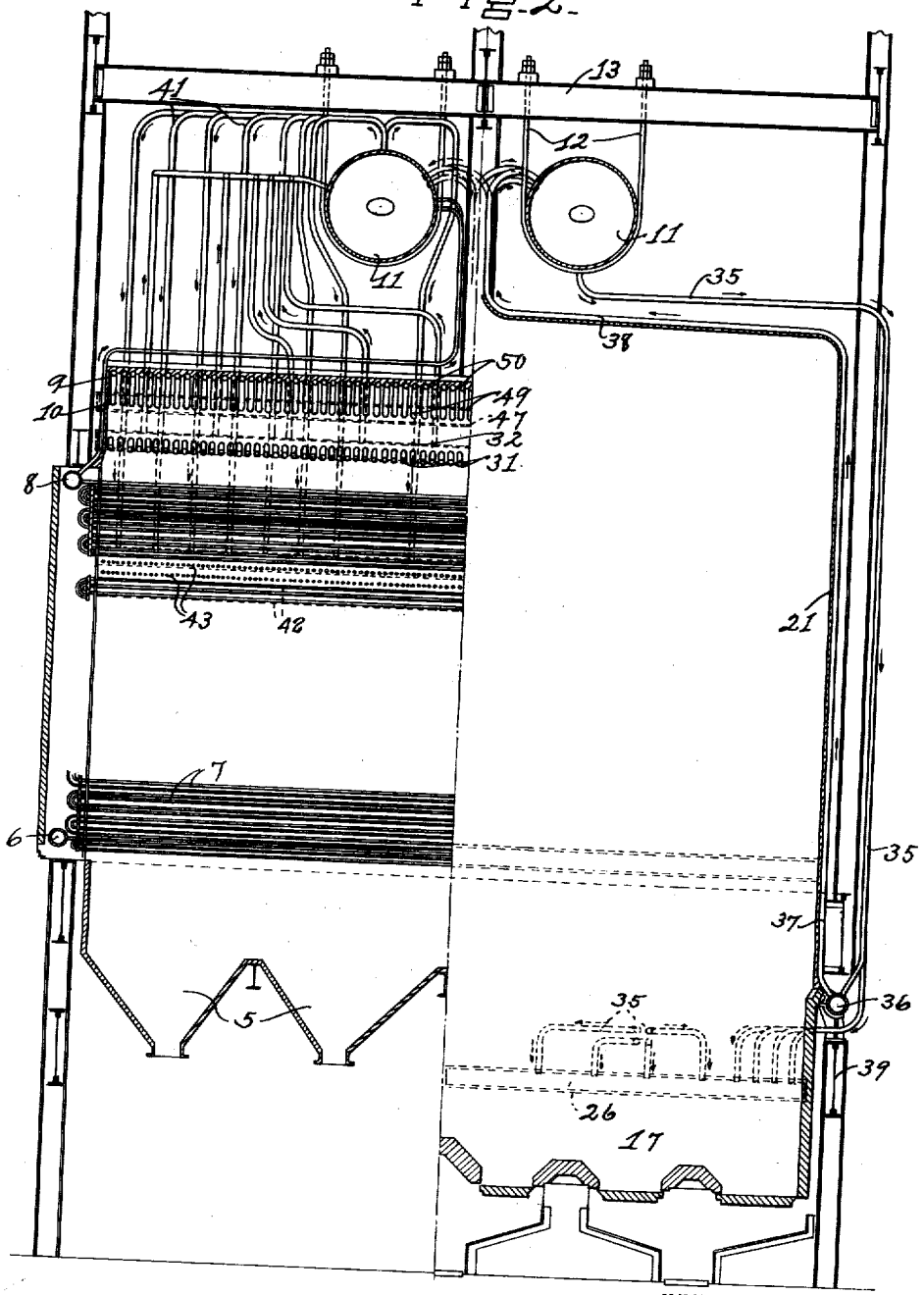
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Filed Feb. 4, 1929 5 Sheets-Sheet 2

Fig. 2.



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March 5, 1935. H. J. KERR 1,992,953

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Filed Feb. 4, 1929 5 Sheets-Sheet 3

Fig. 3.

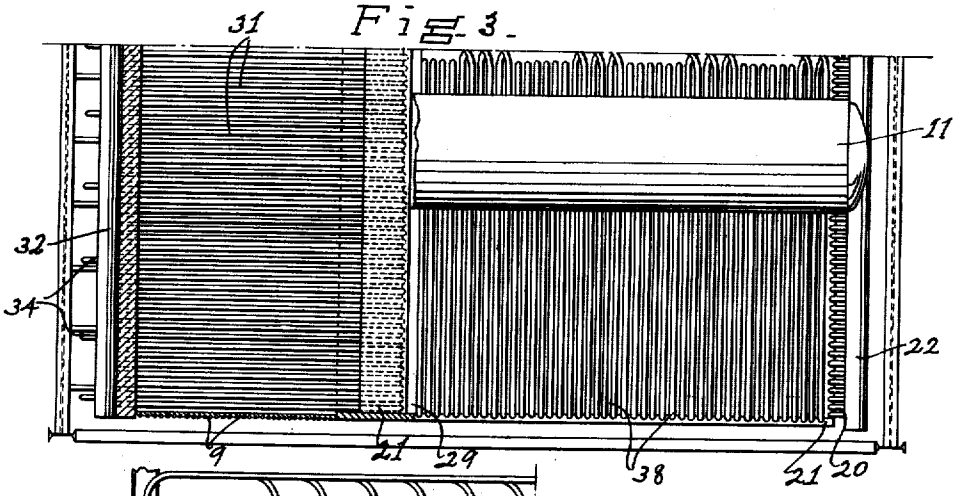
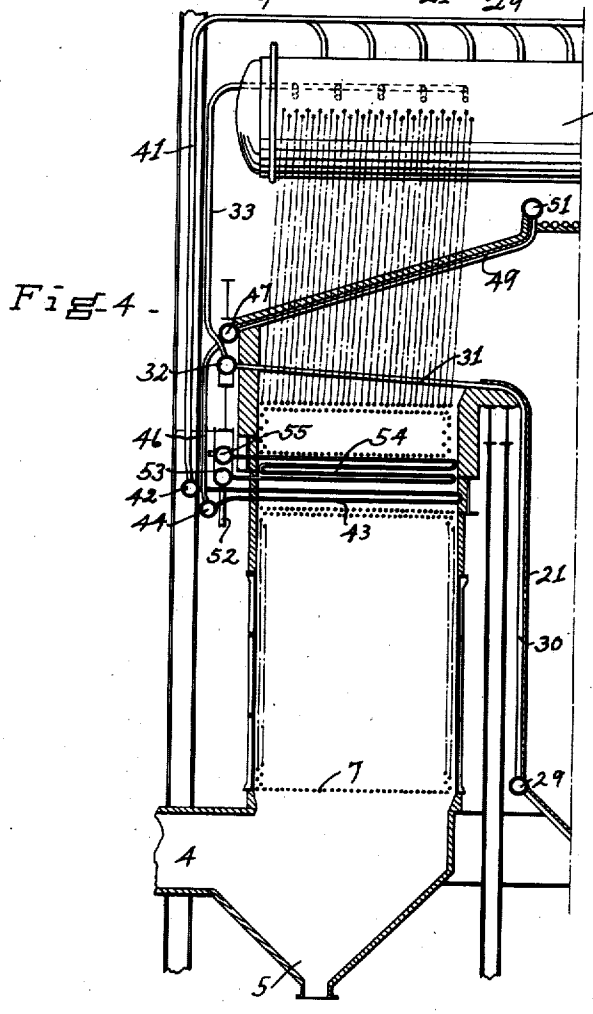


Fig. 4.



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March 5, 1935. H. J. KERR 1,992,953

STEAM BOILER

Filed Feb. 4, 1929 5 Sheets-Sheet 4

Fig. 5.

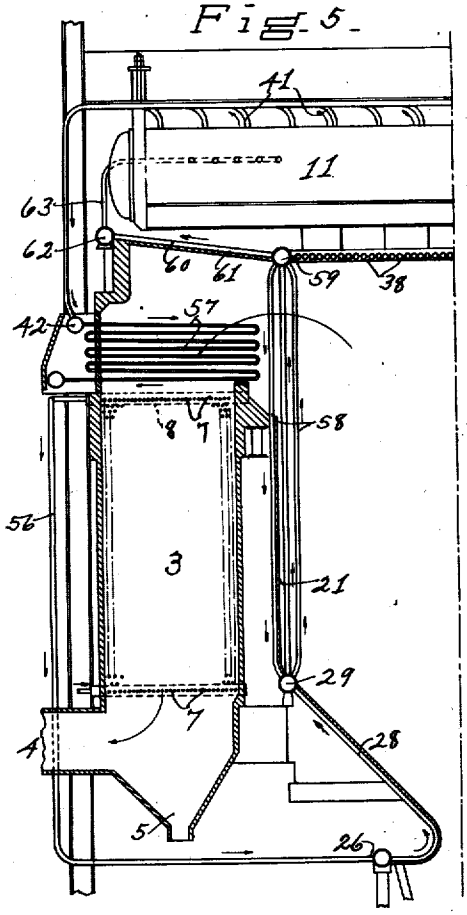


Fig. 6.

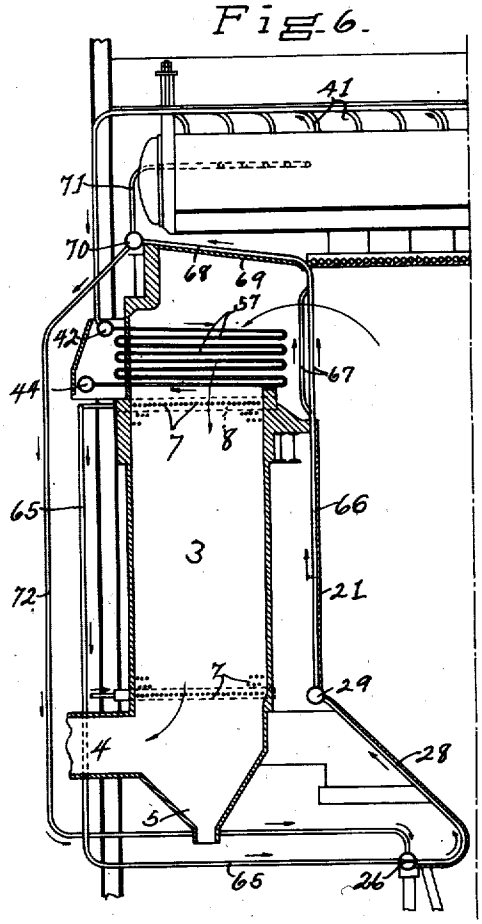


Fig. 9.

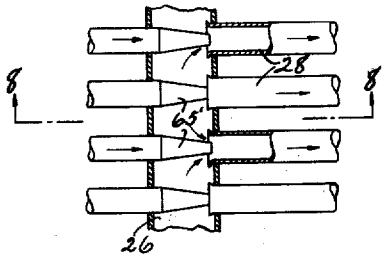


Fig. 7.

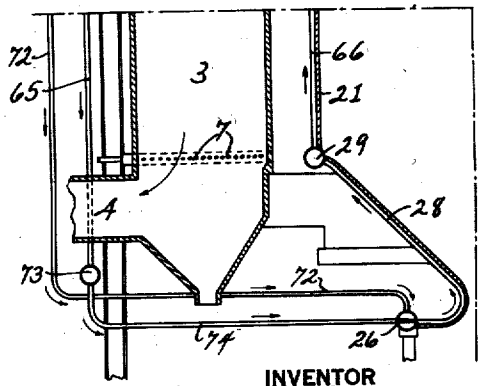
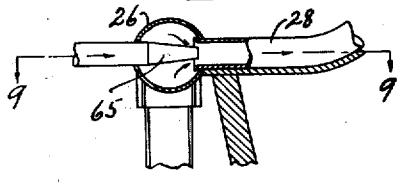


Fig. 8.



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March 5, 1935. H. J. KERR 1,992,953

STEAM BOILER

Filed Feb. 4, 1929 5 Sheets-Sheet 5

Fig. 11.

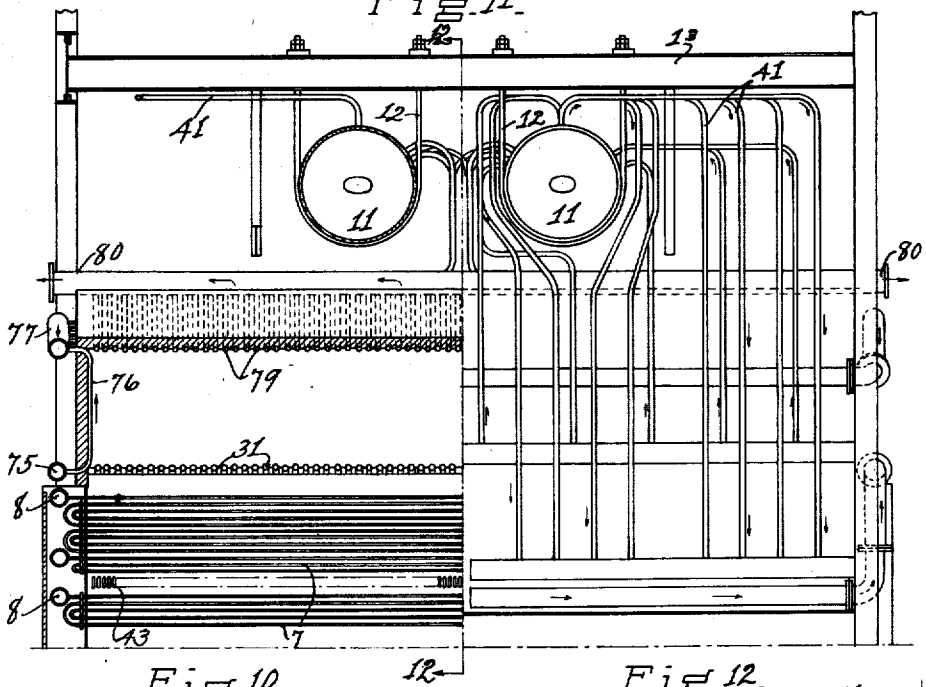


Fig. 10.

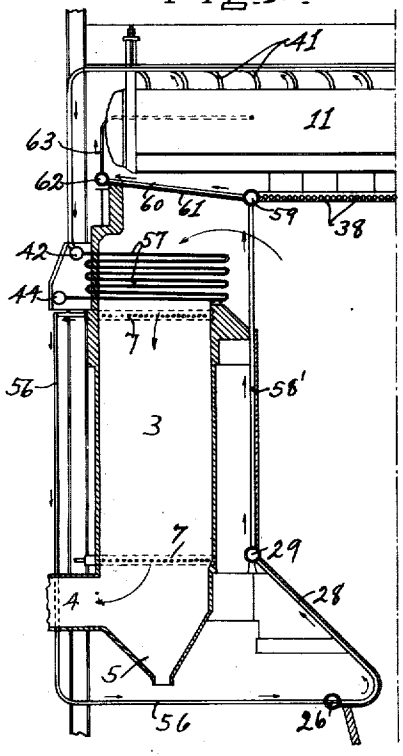
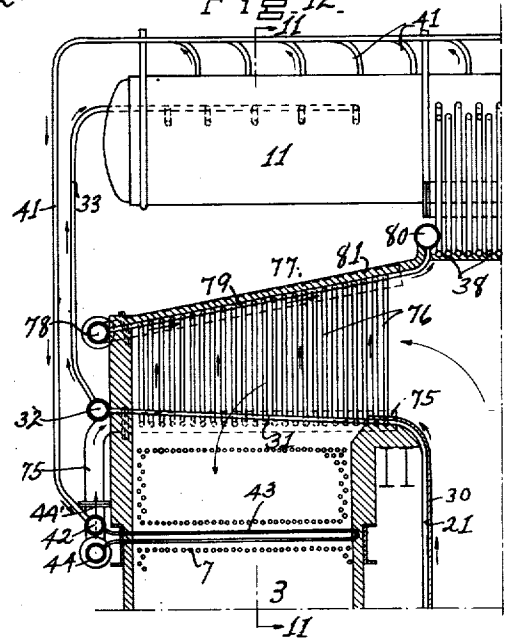


Fig. 12.



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UNITED STATES PATENT OFFICE

1,992,953

STEAM BOILER

Howard J. Kerr, Westfield, N. J., assignor to The Babcock & Wilcox Company, Bayonne, N. J., a corporation of New Jersey

Application February 4, 1929, Serial No. 337,295

26 Claims. (Cl. 122—235)

This invention relates to a steam boiler having a furnace with tubes in the walls thereof and having an economizer and a superheater located in a flue at the rear of the furnace. A pair of longitudinal steam and water drums may extend over the furnace, economizer and superheater.

The invention will be understood from the description in connection with the accompanying drawings, in which Fig. 1 is a vertical section through an illustrative embodiment of the invention; Fig. 2 is a vertical section at right angles to Fig. 1 with the respective halves through different portions of the boiler; Fig. 3 is a section along the line 3—3 of Fig. 1; Figs. 4, 5, 6 and 7 are vertical sections partly broken away showing modifications of certain parts; Fig. 8 is a side view partly in section through one of the headers taken along the line 8—8 of Fig. 9; Fig. 9 is a section taken along the line 9—9 of Fig. 8; Fig. 10 is a vertical section partly broken away showing another modification; Fig. 11 is an elevation partly broken away and partly in section showing a modification taken along the line 11—11 of Fig. 12; and Fig. 12 is a section taken along the line 12—12 of Fig. 11.

In the drawings reference character 1 indicates a furnace that may be provided with burners 2 in the front wall thereof. A downwardly extending flue 3 is located at the rear of the furnace with its upper end communicating with the upper portion of the furnace at the rear. An outlet 4 for waste gases is provided at the lower portion of the flue 3 and a soot and dust hopper 5 is located at the bottom of the flue.

An economizer inlet header 6 is located on each side near the bottom of the flue 3 and these headers are connected by reverse bend tubes 7 extending across the flue to upper economizer outlet headers 8 located on opposite sides of the flue.

The upper headers 8 are connected by rows of tubes 9 which extend upwardly from the headers 8 along the sides of the flue a short distance and then inwardly horizontally inclined upwardly to steam and water drums 11 that are located above the furnace near the middle and extend over the furnace and the economizer. The portion of the tubes 9 along the sides of the furnace are lined with refractory material as indicated at 10. The drums 11 are supported by means of straps 12 from the cross supports 13.

A plurality of tubes 15 extend from the water space of each drum 11 near the front ends thereof to a horizontally disposed header 16 located at the bottom of the furnace on one side of the ash hopper 17. A row of tubes 18 extend upwardly from the header 16 along the sloping bottom of the furnace 1 to a front header 19 from which header a row of furnace wall tubes 20 for the front wall of the furnace extend upwardly to the header 22, this row of tubes being lined with refractory material 21. A plurality of tubes 23 extend from the header 22 to the steam space of each drum 11 near the front end thereof. Recirculating tubes 24 may be provided between the headers 22 and 16 on the outside of the furnace.

A plurality of tubes 25 extends from the water space of each drum 11 near the middle of the drums to the horizontally disposed header 26 at the bottom of the furnace located on the side of the hopper 17 opposite the header 16. A row of tubes 28 corresponding to the row of tubes 18 leads from the header 26 to the header 29 from which a row of rear furnace wall tubes 30 lined with refractory material 21 extends upwardly and thence rearwardly as shown at 31 into the header 32, leaving an outlet for gases at the rear of the furnace near the top thereof. A plurality of tubes 33 leads from the header 32 into the steam space of each steam and water drum 11 near the rear ends of these drums. Recirculating or downcomer tubes 34 may be provided from the header 32 to the header 26, these tubes being located outside of the furnace.

A plurality of tubes 35 leads from the water space of each drum 11 to corresponding horizontally disposed headers 36 located near the lower end of the furnace on opposite sides thereof. A row of side wall furnace tubes 37 leads from each header 36 upwardly to the upper end of the furnace, these tubes being bent inwardly as shown at 38 to extend along the roof of the furnace and thence into the headers 11. The portions 38 of the tubes 37 on opposite sides extend into proximity to each other and some of the tubes 37 in each wall are cross connected in the drum 11 on the other side, as most clearly indicated in Fig. 2. These tubes are also associated with refractory material 21. The headers 16, 26 and 36 may be supported upon supports 39 below the headers, and the furnace roof portions 38 of the tubes 37 may be supported by supports 40 from above.

A plurality of tubes 41 distributed along the steam space of each steam and water drum 11 leads to the superheater inlet header 42, the inlet ends of the tubes being uniformly distributed along this header. Superheater U-tubes 43 connect the inlet header 42 to the outlet header 44. The superheater headers 42 and 44 may be supported by means of the support 45.

The headers 42 and 44 may be divided into two aligned sections each extending approximately half way across the boiler. A plurality of tubes 46 leads from the superheater outlet header 44 to the horizontally disposed header 47 that is supported by means of the support 48. A row of tubes 49 with a layer of refractory material 50 thereon extends in an upwardly sloping direction from the header 47 at the rear of the boiler into an outlet header 51 for superheated steam located at the rear end of the roof portion 38 of the tubes 37. The superheated steam passes from the header 51 to a steam main.

In the modification shown in Fig. 4 the superheater is divided into two sections, one of the sections being similar to that already described. The other section is provided with steam inlet tubes 52 leading to the inlet header 53 that is connected by reverse bend tubes 54 extending across the flue 3 to the outlet header 55. This section may be utilized for reheating steam between stages of a turbine, for example.

In the modification shown in Fig. 5 the outlet header 8 of the economizer in the flue 3 is connected by one or more tubes 56 to the horizontally disposed header 26 instead of being connected to the drums 11, so that the rear wall tubes of the furnace operate as an economizer connected in series with the other economizer. The economizer may be a steaming economizer. In this modification the superheater 57 is indicated as being located above all of the tubes of the economizer in the flue 3 instead of being located between groups of economizer tubes as indicated in Figs. 1 and 4. A plurality of rows of rear furnace wall tubes 58 extend from the header 29 to the header 59, the tubes in the rear row serving as circulating tubes between the headers 29 and 59. A row of tubes 60 extends from the header 59 that is located at the rear side of the roof tubes 38 in an upwardly sloping direction to the header 62, this row of tubes being lined with refractory material 61. A plurality of tubes 63 leads from the header 62 to the steam space of each drum 11.

In the modification shown in Fig. 6 a row of tubes 65 leads from the uppermost economizer header 8 in the flue 3 to the rear furnace wall header 26, the number of the tubes 65 being preferably the same as the number of tubes 28 and the ends of these tubes being reduced and extending through the header 26 into the ends of the tubes 28, as most clearly indicated at 65' in Figs. 8 and 9. Tubes 28 connect the headers 26 and 29. A single row of tubes 66 leads along the rear furnace wall from the header 29 to the rear side of the roof tubes 38, some of these tubes being bent as indicated at 67 to provide gas passes. The tubes 66 then extend toward the rear from the roof 38 as indicated at 68, this portion of the tubes being lined with refractory material 69. The rearwardly extending portions 68 of the tubes 66 extend into the horizontally disposed header 70 from which a plurality of tubes 71 extend into the steam space of each steam and water drum 11. The header 70 is connected by one or more circulating tubes 72 to the header 26.

The modification shown in Fig. 7 differs from that shown in Fig. 6 in that the tubes 65 instead of leading directly to the header 26 lead to a header 73 from which a row of tubes 74 extends to the header 26. The tubes 74 extend through the header 26 in a manner similar to that shown for tubes 65 in Figs. 8 and 9 so their reduced ends enter the ends of the tubes 28. By interposing the header 73 into which the tubes 65 enter, it is not necessary to have the same number of tubes 65 as the number of tubes 28 or 74.

In the modification shown in Fig. 10 the feed water from the economizer is discharged through the tubes 56 directly into the lower header 26 of the rear wall of the furnace. The tubes 28, 58' and 60 are made of sufficiently small cross-sectional area to cause the water and whatever steam may be generated to pass upwardly through these tubes into the drum 11 as in a series flow, thus dispensing with downcomers from the header 62 to the header 26.

In the modification shown in Figs. 11 and 12 the superheater tubes constitute a portion of the walls of a box or enclosure located above the flue 3, and the superheater tubes receive radiant heat from the furnace. In this modification there is no indication of a connection for the feed water after it leaves the topmost economizer header 8. It is obvious, that the feed water after leaving the economizer may pass directly to the drums 11 or it may be passed to the lower header of the rear wall of the furnace, as described above in connection with the other embodiments of the invention. In this modification the outer ends of the superheater outlet headers 44 are connected to elbows 44' that extend upwardly and are connected to the lower downwardly bent ends of headers 75, the main portions of which extend horizontally along opposite sides of the furnace approximately level with the rearwardly extending portions 31 of the tubes 30. Each header 75 is connected by a row of short side wall tubes 76 to headers 77 that lie along the outside walls of the furnace and are inclined upwardly. The lower ends of the headers 77 are bent around the rear corners of the furnace wall, as shown at 78, and a row of tubes 79 extends upwardly from the portions 78 to a superheater outlet header 80 from the outlet ends of which the superheated steam passes to the mains. A layer of tile 81 may be placed above the tubes 79 to complete the roof of the furnace from the roof tubes 38 to the rear wall of the furnace or rear side of the flue 3.

The operation of the embodiment shown in Figs. 1 to 3 is as follows:

Feed water enters the lower headers 6 of the economizer 7 from any convenient source (not shown) and passes upwardly through the economizer into the headers 8 from which the water, or mixture of steam and water, passes through the tubes 9 into the drums 11. Water passes from the drums 11 downwardly through the tubes 15, 25 and 35 into the headers 16, 26 and 36, respectively. The water passes upwardly from the header 16 through the tubes 18 and 20, where steam is generated into the headers 22, thence through the tubes 23 into the steam spaces of the steam and water drums 11. Water passes upwardly from the header 26 through the tubes 28 and 30, where steam is generated, into the header 32 and thence through the tubes 33 into the steam and water spaces of the steam and water drums 11. Water passes upwardly from the headers 36 on opposite sides of the furnace through side wall tubes 37 and roof portions 38 where steam is generated, the mixture of water and steam from each row of side wall cooling tubes 37 passing for the most part into the corresponding drum 11 and the remainder passing through the cross connected tubes into the other drum 11. Steam

from the steam spaces of the steam and water drums passes through the tubes 41 into the superheater 43, thence through the tubes 46 into the superheater tubes 49 and the header 51 from where it passes into the steam mains.

Hot products of combustion from the furnace 1 pass upwardly and rearwardly as indicated by the arrows across the portion 31 of the tubes 30 and thence across the economizer and superheater tubes to the waste gas outlet 4.

In the modification shown in Fig. 4 the operation is similar to that already described, and in addition thereto, the steam between stages of a turbine may be passed through the superheater 54.

In the modification shown in Fig. 5 the water, after passing through the economizer in the flue 3, passes through the tubes 56 into the header 26, thence upwardly through the rear furnace wall tubes where steam may be generated, thence through the tubes 60 and 63 to the steam and water drums 11. In this modification hot gases from the furnace pass across the tubes 58 near their upper ends and thence across the superheater and economizer tubes.

In the modifications shown in Figs. 6 and 7 the water, after passing through the economizer in the flue 3, is forced into the lower ends of the tubes 28 that extend into the header 26, thus increasing the local recirculation through the tubes 72 and 28. In these two modifications hot gases pass between the spaced portions 67 of the tubes 66 from the furnace, thence over the superheater and economizer to the outlet 4.

In the modification shown in Fig. 10, the operation is similar to that shown in Figs. 6 and 7, except that the downcomer tubes between the header 62 and header 26 are dispensed with and the steam and water passes directly from the economizer header through the tubes 56, 28, 58', 60 and 63 to the steam and water drums 11.

In the modifications shown in Figs. 11 and 12 steam passes from the steam and water drums 11 to the superheater 43 located in the flue 3, where it receives some heat and thence passes into the headers 75, thence through tubes 76 into the headers 77, and thence through tubes 79 to the superheater outlet header 80 and thence to the steam main. In this modification the superheater tubes 76 and 79 receive radiant heat from the furnace and the hot products of combustion pass from the furnace between the rows of tubes 76 on opposite sides of the furnace under the row of tubes 79 thence downwardly across the tubes 31 into the flue 3.

I claim:

1. In a boiler, a furnace, an economizer at the rear of said furnace, and a pair of longitudinal drums extending over said furnace and economizer, said furnace having walls and a roof lined with tubes directly connected to said drums, with tubes in each side wall connected to both drums.

2. In a boiler, a furnace, an economizer at the rear of said furnace, a pair of longitudinal drums extending over said furnace and economizer and rows of furnace wall forming tubes extending along the roof of said furnace and directly connected to said drums.

3. In a boiler, a furnace, a downwardly extending flue at the rear of said furnace, an economizer in said flue, a longitudinal drum extending at a higher level than said furnace and said flue, and side wall tubes extending from said economizer to said drum.

4. In a boiler, a furnace, an economizer at the rear of said furnace, a longitudinal drum extending at a higher level than said furnace and economizer and a row of tubes extending along the roof of said furnace and connected to said drum, and a superheater at the rear of said furnace having a row of tubes extending along the roof of said furnace.

5. In a water tube steam boiler, a combustion chamber, steam generating tubes forming the chamber walls, an economizer at the rear of the chamber, a steam and water drum at a higher level and spaced with respect to the chamber, a chamber roof formed by steam generating tubes directly communicating with the drum, and means leading directly from the water space of the drum to the lower ends of tubes to insure tube wetness and equalization of fluid flow in the tubes.

6. In a water tube steam boiler, a furnace having a refractory roof, a steam and water drum, a convection steam superheater receiving steam directly from the drum, and a steam superheater consisting of wall tubes aligned along the refractory roof and exposed directly to radiant heat from burning fuel in the furnace, said second superheater receiving steam directly from the convection superheater.

7. In a water tube steam boiler, a furnace having a combustion chamber, a flue at one side of the chamber in which the furnace gases proceed in a direction opposite to the direction of movement in the furnace, a steam and water drum spaced from said furnace and flue and at a higher level, a convection steam superheater having tubes extending across said flue, a second superheater consisting of tubes constituting a part of the roof of the furnace and exposed directly to radiant heat from the burning fuel in the furnace and connections between said drum and said superheater whereby steam passes from the drum through the convection superheater and thence through the roof superheater.

8. In a water tube steam boiler, a boiler setting, a steam and water drum at the top of the setting, a boiler furnace with its roof spaced downwardly from the steam and water drum, a flue located laterally of the furnace, a flue roof beneath the steam and water drum and adjoining the furnace roof, superheater tubes extending along and forming a part of said flue roof and exposed directly to heat radiantly transmitted from burning fuel in the furnace, an economizer header, upright tubes directly communicating with said header and extending along the inner side of said flue wall and thence directly to the drum, and means for connecting said superheater tubes and the drum.

9. In a water tube steam boiler, a plurality of steam and water drums, a boiler furnace, a set of upright steam generating tubes forming one wall and a roof part of the furnace, an opposite wall and roof part similarly formed, each of said drums being directly connected with some of the tubes of each set to receive the steam discharged therefrom, and other tubes delivering water from the drums to the inlet ends of said sets of tubes.

10. In a water tube steam boiler, a furnace having a tapered lateral extension at its upper part, a furnace gas flue beneath said extension and communicating therewith, a convection steam superheater having tubes extending across the flue, a steam and water drum spaced from said furnace and extension and located above them, means for conducting steam from the drum to the superheater, upright radiant superheater tubes extending along a side wall of the ex-

tension, an inlet header from which said upright superheater tubes lead, means for conducting steam from the convection superheater to said header, a second header connected to the discharge ends of said upright tubes, an angular extension of said second header, and roof superheater tubes leading at an upward inclination from the angular extension, an outlet header connected to the discharge ends of said roof tubes, heat resisting material supported by said roof tubes to form the roof of said extension, and an economizer interposed relative to said convection and radiant superheaters.

11. In a water tube steam boiler, a furnace having wall and roof tubes constituting its only steam generating tubes, a heating chamber for turning the furnace gases as they pass from the furnace, a row of roof tubes exposed to heat from the furnace gases in the chamber, and connected into boiler circulation, a row of tubes cooperating with the last mentioned roof tubes to form a gradually restricted gas passage to uniformly distribute the furnace gases over the chamber and prevent thermal stratification of the gases as they pass from the chamber, and spaced fluid heat exchange tubes contacted by the gases after they pass from the heating chamber.

12. In a water tube steam boiler, a furnace chamber having wall and roof steam generating tubes, a heating chamber into which furnace gases pass from the first chamber, a row of fluid circulating tubes delineating a roof for the second chamber and arranged to present a cooled gas deflecting wall at an angle to the roof of the furnace chamber so as to cause slag to be thrown out from the gases as they change their direction in going from the first roof part to the second, and a bank of tubes in the second chamber extending therethrough so as to be contacted by the furnace gases.

13. In combination, a steam generator having a furnace, chamber walls about a radiant heat zone of the furnace and other walls about a convection zone beyond the radiant zone, parallel flow tubes in the radiant heat zone of said furnace, a steaming economizer in the convection heat zone, a steam and water separator, means connecting the separator and the economizer, means returning the water from said separator only to the radiantly heated tubes, continuations of said walls defining a gas pass connecting said zones, and fluid conducting wall tubes absorbing heat from the gases flowing through the connecting gas pass, the connecting gas pass causing a draft loss which is low as compared to that caused by heat absorbing surface presented by a bank of convection heated natural circulation tubes.

14. In a boiler, a furnace having front and rear walls connected by side walls, tubes in the walls of said furnace, an economizer at the rear of said furnace, walls arranged to form a tapered gas pass between the furnace and the economizer, a pair of longitudinal drums extending over said furnace and economizer, means for connecting the economizer to the drums, and means for connecting the wall tubes to the drums, the upper ends of the rear wall tubes being extended to the rear above the economizer to form a screen through which furnace gases must pass before they contact with the economizer.

15. In a water tube steam boiler, a boiler furnace including furnace walls, an economizer at the rear of said furnace, a steam and water drum extending entirely across the furnace and the economizer and spaced from the furnace walls, upright side wall furnace tubes extending from the economizer to said drum to form a connection therebetween, upright furnace wall tubes arranged along the rear wall of the furnace and having parts extending across the gas space at the economizer entrance, and means connecting the furnace wall tubes with the drum.

16. In a water tube steam boiler, a boiler furnace including furnace walls, a gas outlet for the furnace, a boundary wall for the gas outlet, a steam and water drum extending over the furnace and spaced from the furnace walls, upright side wall furnace tubes forming steam generating surfaces for the boiler, means for connecting the furnace tubes and the drum, a low temperature superheater exposed to heat from the furnace gases after they have proceeded past the upright tubes, a high temperature superheater having radiantly heated tubes arranged along the boundary wall of the gas outlet, and means connecting the drum and the superheaters for the flow of steam from the drum.

17. In a water tube steam boiler, a boiler furnace including furnace walls, an economizer at the rear of said furnace, a steam and water drum extending over the furnace and the economizer and spaced from the furnace walls, the furnace having a gas outlet leading to the economizer, a boundary wall for the outlet upright tubes extending from the economizer to said drum and forming a connection therebetween, a low temperature superheater section exposed to heat from the furnace gases after they have proceeded past the upright tubes, a high temperature superheater section having radiantly heated furnace wall tubes along the boundary wall of a portion of the gas outlet, and connections between the drum and the superheaters to provide for the flow of steam from the drum.

18. In a water tube steam boiler having all of its steam generating tubes radiantly heated, a furnace combustion chamber, parallel steam and water drums at the top of the boiler, rows of spaced steam generating furnace wall tubes with each row forming a side wall and a roof portion of the combustion chamber and having its tubes individually connected to the drums, refractory material carried by the tubes and extending over the furnace sides of the tubes for completing said side wall and roof portion, means for supplying said tubes with water at their lower ends, means forming other walls of the combustion chamber, means for supporting the drums, and means for burning fuel in said chamber, said side wall and roof portion being at a substantial angle to each other and some of the tubes of each of said rows being connected to one of said drums while the remainder are connected to the other drum.

19. In a water tube steam boiler, a steam and water drum at the top of the boiler, a furnace and an economizer located at a lower level than the drum, furnace wall steam generating tubes delineating the walls of the furnace and constituting the main steam generating surfaces of the boiler, fuel burning means so located with reference to a gas outlet at the upper part of the furnace that there is an upflow of gases within the furnace towards the top of the economizer flue, economizer tubes conducting the fluid streams in a generally counter-current direction with reference to the flow of gases through the economizer, means for individually connecting

the furnace wall tubes and the economizer tubes to the steam and water drum, a radiantly heated superheater having wall tubes exposed to heat from the furnace gases after they have passed said outlet, extensions of furnace wall tubes interposed relative to said superheater tubes and the economizer and positioned in radiant heat transmission relationship to the superheater, said extensions acting to temper the heat absorption through the superheater tubes and to protect the economizer tubes against excessive heating, and means for connecting the said superheater tubes with the steam space of said steam and water drum.

20. In a water tube steam boiler, a steam and water drum at the top of the boiler, a furnace and an economizer located at a lower level than the drum, furnace wall steam generating tubes delineating the walls of the furnace and constituting the main steam generating surfaces of the boiler, fuel burning means so located with reference to a gas outlet at the upper part of the furnace that there is an upflow of gases within the furnace towards the top of the economizer flue, tubes conducting the fluid streams through the economizer in a generally counter-current direction with reference to the flow of gases through the economizer, means for individually connecting the furnace wall tubes and the economizer tubes to the steam and water drum, and extensions of furnace wall tubes forming a screen across the gas inlet to the economizer and acting to temper the heat to which the economizer tubes are subjected.

21. In a boiler, a furnace, a once-through convection heated economizer at the rear of said furnace, and a longitudinal drum extending at a higher level than said furnace and economizer, said furnace having wall and roof water tubes directly connected in circulatory connection with the forward part of said drum, the convection heated economizer having tubes discharging directly into the rear part of said drum, all of the water tubes in circulatory connection with the forward part of the drum being radiantly heated.

22. In a water-tube boiler, a furnace having side wall and roof steam generating tubes, a passageway leading from the side and upper part of said furnace over the top of a chamber and containing heat absorbing tubes, and vertically extending additional furnace wall tubes adjacent said chamber, said last mentioned wall tubes being bent so that their upper ends extend over the top of said chamber and being so spaced above the chamber as to form a slag screen and gas mingling tubes across which the furnace gases pass before flowing downwardly through said chamber.

23. In a water-tube boiler, a furnace having side wall and roof steam generating tubes, a passageway leading from the side and upper part of said furnace over the top of a chamber and containing heat absorbing tubes, and vertically extending additional furnace wall tubes adjacent said chamber, said last-mentioned wall tubes being bent so that their upper ends extend over the top of said chamber and being so spaced above the chamber as to form a slag screen and gas mingling tubes across which the furnace gases pass before flowing downwardly through said chamber, the passageway leading from the side and upper part of the furnace having an inclined roof of water tubes to cause the gases to flow through progressively decreasing areas before passing across said slag screen and gas mingling tubes whereby the gases are distributed more uniformly across said tubes.

24. A water tube boiler and furnace having side wall and roof steam generating tubes, a passageway leading from the side and upper part of said furnace over the top of a chamber containing heat absorbing tubes, and vertically extending additional furnace wall tube sections adjacent said chamber, said additional wall tubes having extensions at their upper ends which extend over the top of said chamber to provide a continuous and independent flow of the water and steam through each tube and its extension, the tubes which extend over the top of said chamber being so spaced as to form a slag screen and gas mingling tubes across which the furnace gases pass before flowing downwardly through said chamber.

25. A counter flow economizer comprising, in combination, a chamber through which heating gases are passing in one direction, a series of economizer conduits in horizontal rows arranged to conduct a contained fluid from one side of the chamber back and forth across the chamber and generally in a direction countercurrent to the gas flow, and a second series of economizer conduits similarly arranged but starting from the opposite side of the chamber, both series of conduits having extensions arranged as wall tubes beyond the horizontal rows.

26. In combination, a furnace, a lateral furnace extension communicating with the furnace through an opening, and a radiant superheater of the wall tube type having tubes directly exposed in the extension to radiant heat transmitted from the furnace through the opening, said superheater being disposed at an acute angle to the direction of the extension so that the preponderance of heat absorbed thereby is transmitted along lines oblique to the plane of the superheater.

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