

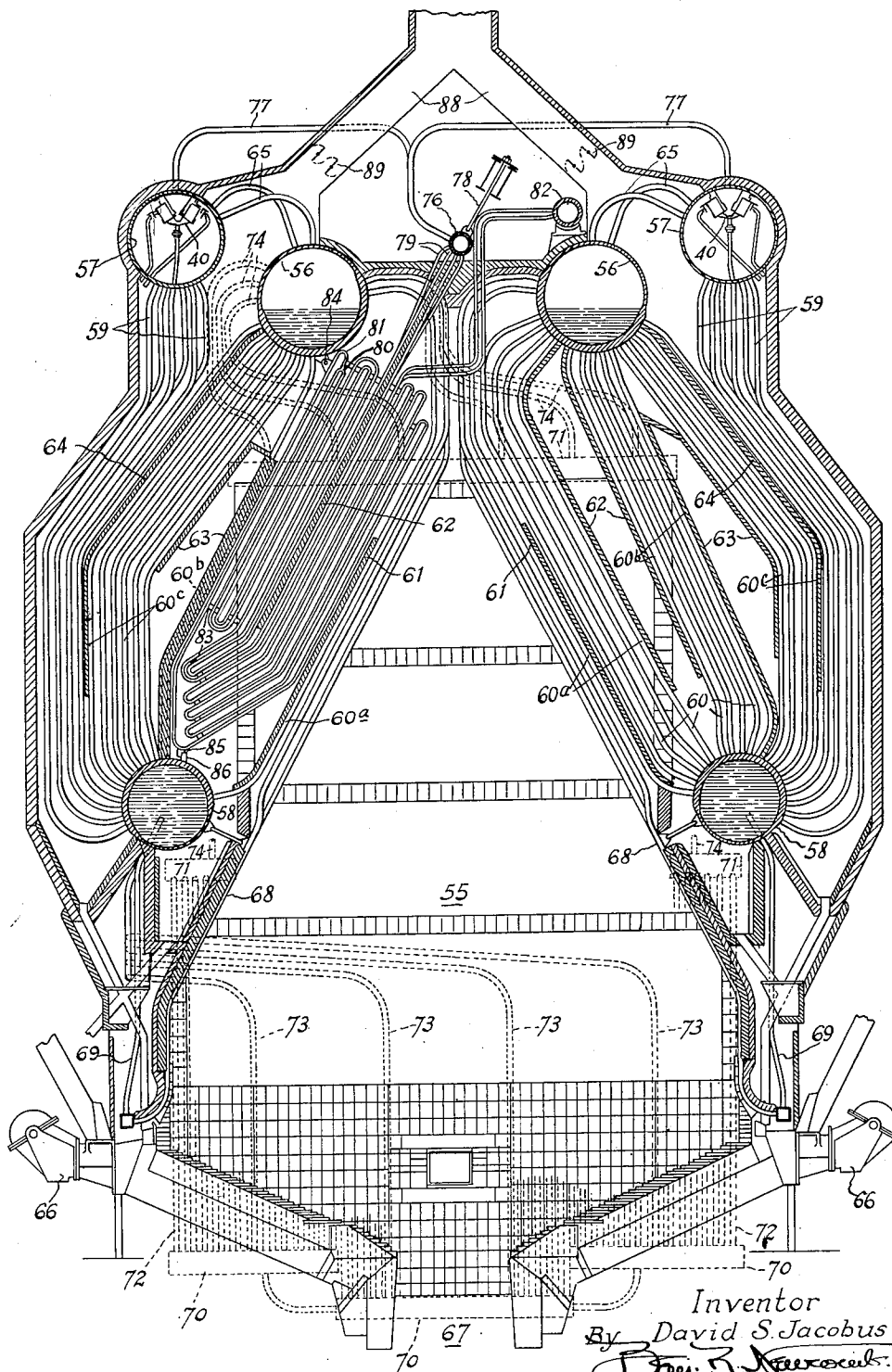
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D. S. JACOBUS

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STEAM BOILER

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Inventor
By *David S. Jacobus*
David S. Jacobus
Attorney

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STEAM BOILER

David S. Jacobus, Montclair, N. J., assignor to
The Babcock & Wilcox Company, Newark,
N. J., a corporation of New Jersey

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My present invention relates in general to the construction and operation of high capacity steam generating units, and more particularly to generating units having one or more water tube steam boilers of the bent tube type including steam heating surface and steam and water separating provisions.

One object of my invention is the provision of improved steam heating provisions characterized by an effective arrangement of the superheater tubes relative to gas flow, low pressure drop in the superheater, and an improved supporting arrangement in a boiler of the character described.

A further object is an improved arrangement of the circulators for furnace wall heating surface in a steam generator having two or more steam boilers receiving heating gases from a common furnace, one of the boilers including steam heating surface.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawing and descriptive matter in which I have illustrated and described a preferred embodiment of my invention.

The figure shown is a partly diagrammatic sectional elevation illustrating one embodiment of my invention.

The steam generating unit illustrated comprises a pair of water tube boiler units above and at opposite sides of a common furnace 55. Each of the boiler units comprises a pair of upper steam drums 56 and 57 and a lower or mud drum 58. The drums 57 and 58 are connected by a substantially vertical bank of tubes 59, while the drums 56 and 58 are connected by a divided bank of tubes 60 arranged in three sections 60^a, 60^b, and 60^c. Most of the rows of tubes 60^a and 60^b are eliminated in the left hand boiler unit and the space occupied by a return bend superheater hereinafter described. Vertical baffles 61, 62, 63 and 64 are arranged along the tube banks to provide a plurality of serially connected passes for heating gases from the furnace 55. The drums 56 and 57 are connected by only steam circulators 65, and each drum 57 is elevated above the corresponding drum 56.

The elevated position of the rear drums 57 provides an adequate space for washing and drying the steam generated in the boilers and pro-

visions for this purpose are incorporated in the upper part of each drum 57. A steam and water separator 40 consisting of a twin arrangement of inclined corrugated plate separator sections extends longitudinally of the drum 57 at opposite sides of the vertical axial plane thereof and between the discharge of the circulators 65 and one or more steam outlets 77. The steam and water separator illustrated is similar to that disclosed in a patent of James Fletcher No. 2,007,966, granted July 16, 1935. Steam washing nozzles are arranged in front of each separator section along the length thereof to provide a sheet of feed water across the inlets of the separator sections.

The furnace 55 is heated by a pair of oppositely arranged underfeed stokers 66 at opposite sides of a central ash pit 67. The furnace is desirably completely water cooled, rows of vertical tubes 68 extending along its sides directly below the boiler units with the tube row at each side supported from the corresponding drum 58 and connected into the corresponding boiler circulation by having its upper ends connected to the corresponding drum 56 above the normal water level therein and its lower ends connecting to the corresponding drum 58 through pipes 69. The portions of the tubes 68 in front of the tubes 60^a are bent and spaced to provide a slag screen.

The two remaining sides of the furnace are also provided with water wall sections consisting of interconnected bottom headers 70 and top headers 71 connected by block-covered tubes 72. In accordance with my invention the headers 70 are connected only to the left hand boiler through downcomers 73 from the mud drum 58 and the headers 71 by riser tubes 74 to the steam drum 56 above the normal water level therein.

The superheater included in the left hand boiler occupies the space between the baffles 61 and 63 and will be protected to a large extent from the radiant heat of the furnace by the baffle 61 and intervening tubes. The superheater comprises an external inlet header 76 receiving steam from the drum 57 through conduits 77. The header 76 is supported as shown by tension members 78 from the setting and aids in supporting the superheater. The superheater tubes 79 extend downwardly from the header 76 in two longitudinal rows at opposite sides of and supporting the baffle 62. At their lower ends adjacent the baffle 63 the tubes 79 are bent rearwardly and extend upwardly into the space between the baffles 62 and 63 in a return bend nested formation providing a double flow path through

each coil in the rear section of the superheater. Each pair of nested tubes is connected adjacent the drum 56 by a Y-fitting 80 into a single tube 81 which extends downwardly along the baffle 63 to a point adjacent the mud drum 58 and thence upwardly along the baffle 61 in successive rearward bends in the space between the baffles 61 and 62, terminating in an external outlet header 82 mounted on the right hand drum 56.

The tubes in each section of the superheater are thus arranged in a series of parallel flat coils with a double flow through each coil in the rear section and a single flow through each coil in the front section. The superheating surface is thus divided into two groups, with the total steam flow area in the group nearer the furnace with respect to heating gas flow less than in the other group. With the described steam flow through the superheater, the pressure drop will be substantially lower than if a single flow throughout each coil were employed, and yet a high velocity steam flow will be maintained through the superheater tubes adjacent the furnace.

The tube legs in each coil and corresponding coils in the front and rear sections are united in a unitary self-supporting formation by lugs 83 connecting the otherwise unconnected ends of adjoining tube legs. The unitary coil structures so formed are supported at their upper ends by the header 76 and connections 84 between brackets on the first upper looped portion of the tube 81 and the underside of the drum 56 and at their lower ends by lugs 85 laterally supported by lugs 86 mounted on the upper side of the mud drum 58. With this arrangement the superheater coils will be free to expand downwardly relative to the mud drum.

Each of the boiler units is provided with a top heating gas outlet flue 88 controlled by dampers 89, the position of which may be varied to regulate the heating gas flow through the corresponding boiler unit and thereby control the degree of steam superheat. In this construction the boiler, superheater and furnace wall heating surface is arranged and proportioned in such a way that by regulating the flow of heating gases through the two boilers a uniform temperature of superheated steam may be obtained over a wide range of load conditions, with substantially the same draft losses at full load through the boilers and the same heating gas exit temperatures at approximately half-load.

In the type of steam generator shown the dampers for the boiler which includes the superheater are normally moved to their closed position in starting up to avoid overheating of the superheater tubes. With the present construction however, there is little danger of overheating of the superheater tubes, as the connection of most of the furnace wall heating surface into the superheater boiler circulation will accelerate the circulation in that boiler and cause it to heat up rapidly.

This application is a division of my prior application, Serial No. 121, filed Jan. 2, 1935.

While in accordance with the provisions of the statutes I have illustrated and described herein the best form of my invention now known to me, those skilled in the art will understand that changes may be made in the form of the apparatus disclosed without departing from the spirit of the invention covered by my claims, and that certain features of my invention may sometimes be used to advantage without a corresponding use of other features.

I claim:

1. A steam generator comprising a furnace, a plurality of steam generating units having separate water circulation systems and arranged at opposite sides of and receiving heating gases from said furnace, one of said generating units including only water heating surface and another generating unit including both water heating and steam heating surface, water heating surface lining the walls of said furnace, and conduits arranged to connect a major portion of said furnace wall water heating surface into the circulation system of said generating unit including steam heating surface.

2. A steam generator comprising a furnace, a pair of steam generating units having separate water circulation systems and arranged at opposite sides of and receiving heating gases from said furnace, one of said generating units including only water heating surface and the other generating unit including both water heating and steam heating surface, a plurality of water wall sections lining the walls of said furnace, and conduits arranged to connect the majority of said water wall sections into the circulation system of said generating unit including steam heating surface.

3. A steam generator including a steam superheater comprising a series of vertically extending return bend tubes divided into front and rear sections with respect to the heating gas flow path, the return bend tubes in said rear section being arranged in parallel nested rows and the return bend tubes in said front section being of the same flow area as the tubes in said rear section and arranged in a single row and each directly connected to a plurality of tubes in said rear section by a Y-fitting, and means for passing steam to be superheated first through said rear section.

4. A steam generator including a steam superheater comprising a series of vertically extending return bend tubes divided into front and rear sections, the return bend tubes in said rear section being arranged in parallel nested rows and the return bend tubes in said front section being arranged in a single row and each connected to a plurality of tubes in said rear section, and a baffle extending substantially between said front and rear superheater sections and locating said front section in a downflow gas pass and said rear section in an upflow gas pass serially connected to said downflow gas pass.

5. A steam generator including a pair of vertically spaced drums, a bank of steam generating tubes connecting said drums and bent to provide a substantial space between adjacent rows thereof, and a steam superheater comprising a series of return bend tubes positioned in said space and divided into front and rear sections; the return bend tubes in said rear section being arranged in parallel nested rows and the return bend tubes in said front section being arranged in a single row and each connected to a plurality of tubes in said rear section.

6. A steam generator including a pair of vertically spaced drums, a bank of steam generating tubes connecting said drums and bent to provide a substantial space between adjacent rows thereof, a baffle dividing said space into front and rear vertical gas passes, and a steam superheater comprising a series of return bend tubes positioned in said front and rear gas passes, the return bend tubes in said rear gas pass being arranged in parallel nested rows and the return

bend tubes in said front gas pass being arranged in a single row and each connected to a plurality of tubes in said rear gas pass.

7. A steam generator including a pair of vertically spaced drums, a bank of steam generating tubes connecting said drums and bent to provide a substantial space between adjacent rows thereof, a steam superheater comprising a series of return bend tubes positioned in said space, means 5 connecting said return bend tubes into a self-supporting unitary structure, and means for pendently supporting said unitary structure from the under side of the upper drum.

8. A steam generator including upper and 15 lower drums, a bank of steam generating tubes connecting said drums and bent to provide a substantial space between adjacent rows thereof, a steam superheater comprising a series of return bend tubes positioned in said space and arranged in parallel flat coils, means connecting the tube 20 legs in each coil into a self-supporting unitary structure, and means for supporting the unitary structures so formed from said upper and lower drums.

9. A steam generator including upper and lower drums, a bank of steam generating tubes connecting said drums and bent to provide a substantial space between adjacent rows thereof, a steam superheater comprising a series of return bend tubes positioned in said space and arranged in parallel flat coils, means connecting the tube 30 legs in each coil into a self-supporting unitary structure, and means for supporting each unitary structure comprising a pivotal supporting connection between said structure and the upper drum and a supporting connection between said structure and the lower drum constructed to permit downward expansion of said structure relative to said lower drum.

10. A steam generator including upper and 40 lower drums, a bank of steam generating tubes connecting said drums and bent to provide a substantial space between adjacent rows thereof, a steam superheater comprising a series of return bend tubes positioned in said space and divided into front and rear sections, the return bend tubes in said rear section being arranged in parallel flat coils with nested tubes in each coil and the return bend tubes in said front section being 50 arranged in parallel flat coils with a single tube in each coil and each connected to a plurality of tubes in a corresponding coil in said rear section, means connecting corresponding front and rear coils into a self-supporting unitary structure, and 55 means for supporting the unitary structures so formed from said upper and lower drums.

11. A steam generator including upper and lower drums, a bank of steam generating tubes connecting said drums and bent to provide a substantial space between adjacent rows thereof, a steam superheater comprising a series of return bend tubes positioned in said space and divided into front and rear sections, the return bend tubes in said rear section being arranged 60 in parallel flat coils with nested tubes in each coil and the return bend tubes in said front section being arranged in parallel flat coils with a single tube in each coil and each connected to a plurality of tubes in a corresponding coil in 70 said rear section, a header positioned above and connected to said coil sections, a tension support for said header, means connecting corresponding

front and rear coils into a self-supporting unitary structure, and means for supporting each unitary structure comprising a pivotal supporting connection between said structure and the upper drum 5 and a supporting connection between said structure and the lower drum constructed to permit downward expansion of said structure relative to said lower drum.

12. In a steam boiler receiving heating gases from a furnace, a steam superheater comprising 10 a plurality of return bend coils in the flow path of said heating gases, each of said coils having a plurality of tube portions, the portion nearest the furnace being formed of a single tube having a bifurcation at one end and a portion farther 15 from said furnace being serially connected to said first portion and formed of a pair of tubes joined to the bifurcated end of the first mentioned tube, and means for passing steam to be superheated first through the tube portion farther from said 20 furnace.

13. In a steam boiler receiving heating gases from a furnace, a steam superheater comprising a plurality of flat return bend coils in the flow 25 path of said heating gases, each of said coils having a plurality of tube portions, the portion nearest the furnace being formed of a single tube having a bifurcation at one end and a portion farther from said furnace being serially connected to said first portion and formed of a pair 30 of nested tubes, each of the same flow area as said single tube, joined to the bifurcated end of and in the same plane as the first mentioned tube, and means for passing steam to be superheated first through the tube portion farther 35 from said furnace.

14. In a steam boiler receiving heating gases from a furnace, a steam superheater comprising a plurality of return bend coils in the flow path 40 of said heating gases, each of said coils having a plurality of tube portions, the portion nearest the furnace being formed of a single tube having a bifurcation at one end and a portion farther from said furnace being serially connected to said first portion and formed of a pair of tubes joined 45 to the bifurcated end of the first mentioned tube, and a baffle extending between said tube portions and locating said portions in different passes of the heating gas flow path.

15. A steam generator including a pair of vertically spaced drums, a bank of generating tubes connecting said drums, a steam superheater including a group of return bend superheating tubes extending adjacent said tube bank and having portions adjacent said upper and lower 55 drums, and means for supporting said steam superheating tubes from said upper and lower drums.

16. A steam generator including a pair of vertically spaced drums, a bank of generating tubes connecting said drums, a steam superheater including a group of vertically disposed return bend superheating tubes extending adjacent said tube bank, means for supporting said superheater tubes at their upper ends, and means for supporting the lower ends of said superheater tubes 65 from said lower drum, said last named means being constructed to permit thermal expansion and contraction of said superheater tubes relative to said lower drum.

DAVID S. JACOBUS.