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W. H. ROWAND
SUPERHEATER BOILER

2,563,489

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2 Sheets-Sheet 1

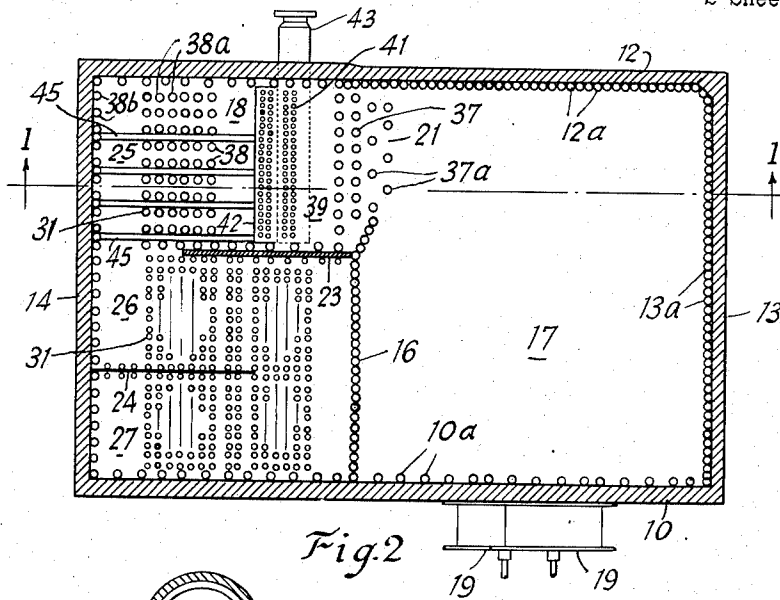


Fig. 2

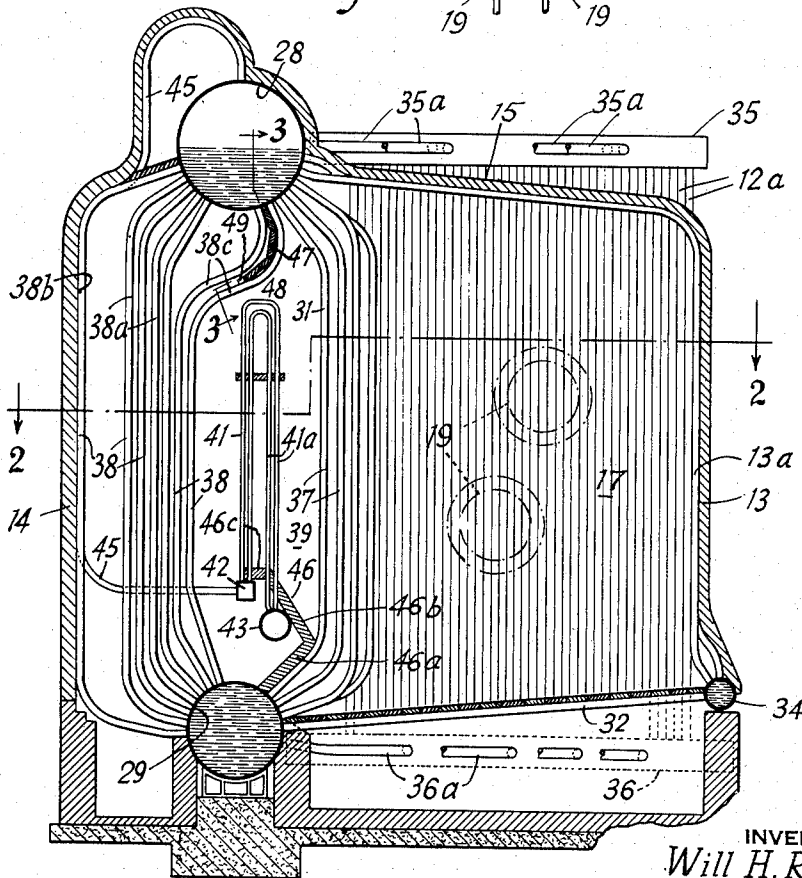


Fig. 1

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2 Sheets-Sheet 2

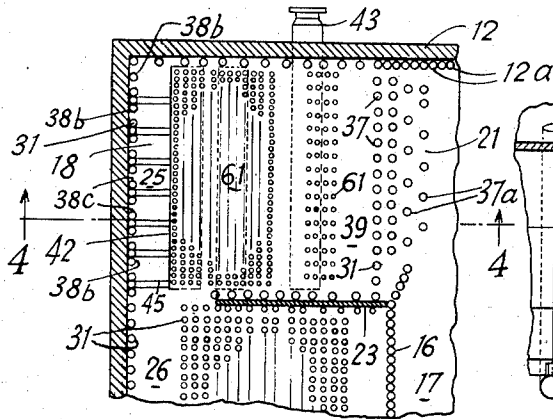


Fig. 5

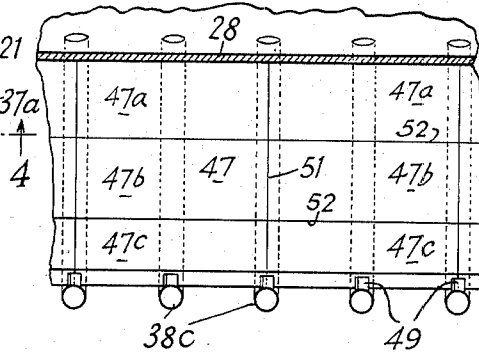


Fig. 3

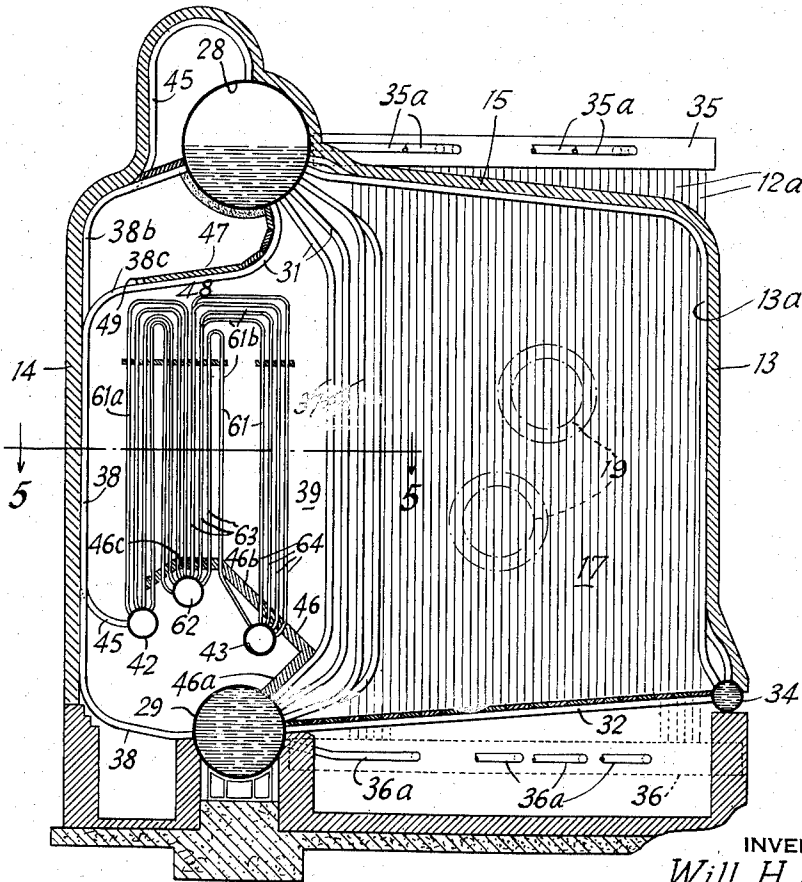


Fig. 4

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SUPERHEATER BOILER

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3 Claims. (Cl. 122-478)

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The present invention relates to the construction of a water tube boiler including a steam superheater, and particularly to a construction affording flexibility in the modification of gas flow characteristics as a means for attaining the desired degree of superheat under predetermined operating conditions.

When boiler operation is affected as the result of a change in fuel, for example, or of other changed conditions, it often becomes necessary to effect a change in heat absorption by the superheater, particularly when the steam-using apparatus imposes limitations with respect to the temperature of superheated steam to be supplied. In an existing installation, the alteration in heat absorption can generally be accomplished by adding or removing superheating tube surface, but each such operation is a troublesome and often an unduly expensive procedure which cannot be reversed without corresponding disadvantages. A second method of attaining modification of the degree of superheating in an existing installation is through provision of means for altering the effectiveness of the superheater heat absorbing surface. Both methods have been utilized in the past, and it is the latter method with which the present invention is more directly concerned in that my invention has for an objective the means whereby the practice of such a method is facilitated.

With respect to certain types of boilers, such as those having upright lengths of tubes extending between and connected to upper and lower drums, my invention further contemplates the use of a gas directing baffle suitably positioned in relation to a superheater located between such drums as a means for attaining adjustment of heat absorption by the superheater without the requirement of a change in the extent of superheater heat absorbing surface.

My invention also contemplates a boiler having selected boiler tube portions arranged to support a baffle in gas directing relationship to adjacent superheater surface.

Another object of my invention is the provision of boiler tubes having portions arranged in gas shielding relationship to an upper boiler drum and adapted to support a baffle in gas directing relationship to adjacent superheater tubes.

An additional object is the provision, in a boiler having horizontally spaced groups of upright tubes, of a novel arrangement of tubes in one of the groups to serve as a support for a baffle disposed in gas directing relationship to a superheater located between the groups.

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A further object of my invention is the provision of a readily modifiable baffle structure positioned in operative relationship to a superheater and defining a portion of the gas flow passage in which the superheater is located.

Still another object is the provision of a baffle arranged in gas directing relationship to a superheater and formed of removable and replaceable sections enabling adjustment of heat absorption by the superheater whose area of exposure to the gases is maintained constant.

Among other objects is the provision of a superheater positioned in a heating gas pass formed between upper and lower boiler drums together with a sectional baffle affording adjustment of the proportion of heating gases directed over the superheater.

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 drawings and descriptive matter in which I have illustrated and described a preferred embodiment of my invention.

Fig. 1 of the drawings is a sectional elevation of an integral furnace type of boiler illustrating an embodiment of my invention;

Fig. 2 is a horizontal plan section of the boiler shown in Fig. 1;

Fig. 3 is an enlarged fragmentary sectional view showing an element of my invention, taken along line 3-3 of Fig. 1;

Fig. 4 is a sectional elevation of a boiler, similar to Fig. 1, illustrating a modification of my invention; and

Fig. 5 is a fragmentary horizontal plan view of Fig. 4, in section along line 5-5.

In detail, and referring first to Figs. 1 and 2, the boiler shown is of the two-drum integral furnace type, having a boiler tube space arranged laterally of the combustion chamber and providing for heating gas flow through the space in a plurality of passes, the boiler having a setting of substantially rectangular horizontal cross section defined by upright front and rear walls 10 and 12 respectively, together with upright side walls 13 and 14, the latter being extended over the top of the setting to form the roof 15. Interiorly of the setting is an upright wall or partition 16 dividing the space within the setting into a combustion chamber 17 and a laterally adjoining boiler space 18. Burners 19 of any suitable type for the kind

of fuel to be burned are installed in association with the front wall 16 to provide a source of heating gases. The dividing wall 16 extends from the front wall 10 to a location spaced from the rear wall 12 whereby a passage 21 is provided as an outlet for heating gases passing from the combustion chamber 17 into the boiler space 18. Transverse baffles 23 and 24 extending partially across the boiler space 18 provide serially connected gas passes 25, 26 and 27 through which a substantially horizontal flow of heating gases is maintained from the combustion chamber 17. The spent gases are discharged from the setting through an outlet, not shown, suitably from the final pass 27 at a location closely adjacent the front wall 10.

The boiler includes upper and lower drums 28 and 29, respectively, having their longitudinal axes in a common vertical plane, the drums being connected by a bank of upright boiler tubes 31 disposed within the boiler space 18 substantially throughout the length thereof between front and rear walls 10 and 12. The boiler bank tubes are suitably arranged in parallel rows extending longitudinally of the boiler drums 28 and 29, preferably with the tubes in the first pass 25 larger in diameter and more widely spaced than the tubes in either of the succeeding passes 26 and 27.

Other tubes connected to the boiler drums 28 and 29 include the floor cooling tubes 32 extending from the lower drum 29 to the side wall header 34, the side wall and roof tubes 33a extending from the header 34 to the upper drum 28, and the front and rear wall tubes 30a and 30a, respectively, suitably connected to the drums through upper and lower headers 35 and 36, and through riser and make-up tubes 35a and 36a, respectively.

In the first pass 25, the tubes of the boiler bank 31 are divided horizontally into front and rear tube groups 37 and 38 defining a superheater space 39 therebetween, the tubes in each of these groups having the major portions of their lengths vertically disposed and having their end portions suitably bent as shown for connection to the drums in circumferentially spaced rows. Certain tubes 37a of the front group 37 may be arranged in staggered relation as shown to form a known pattern of slag screen across the entrance 21 into the first pass 25. The rear group 38 includes several rows of tubes 38a spaced from the side wall 14, and a single row of tubes 38b spaced along the wall 14.

A superheater 41 disposed within the space 39 comprises a series of vertically extending inner and outer tube loops 41a, formed as U-tubes and arranged forwardly of the vertical plane containing the centerlines of drums 28 and 29, the loops 41a having their ends connected to inlet and outlet headers 42 and 43, respectively, arranged in horizontally spaced relation at different elevations, the rearwardly disposed inlet header 42 at the higher elevation being connected to the upper boiler drum 28 through tubes 45 which extend downwardly along the side wall 14 between the spaced boiler tubes 38b. The superheater 41 may be suitably supported by known means not shown, interposed between the headers 42, 43 and the lower bottom-supported boiler drum 29, a baffle 46 extending from the drum 29 and across the superheater tube loops 41a to protect the headers 42 and 43 from the hot gases entering the first pass 25, the baffle 46 also defining the lower boundary of the passage available for gas flow over the superheater tubes 41a.

The baffle 46 includes a lower portion 46a extending upwardly and forwardly along the inner row of boiler tubes 37, and an upper intermediate portion 46b inclined upwardly and rearwardly across superheater tubes above the lower header 43, the baffle terminating in an upper portion 46c extending across superheater tubes above the upper header 42.

On the basis of the construction thus far described, the height of the total available gas flow space through pass 25 at the location of the superheater is measured between the uppermost portion of baffle 46 and the under surface of drum 28. The space between the uppermost loop ends of the superheater and drum 28 is thus available for the bypass of a certain proportion of the gases particularly for minimum superheat temperatures. However, when higher superheat temperatures are required, a baffle 47 is installed within the bypass space, as embodied in the present disclosure, to block off any desired portion of the total available bypass area and thus enable higher predetermined degrees of superheat to be obtained. In the form shown, the baffle 47 extends downwardly from the drum 28 to a predetermined level adjacent the uppermost loop ends where only a relatively small space 48 remains in order that superheat temperatures approaching the maximum may be obtained.

The bypass baffle 47 is preferably supported entirely on tubes of the boiler and for this purpose, in the form shown in Fig. 1, two rows of tubes 38c of the rear group 38 are bent forwardly and upwardly in a reverse curve above the upper end of the superheater to enter the lower forward quadrant of drum 28 adjacent the rows of tubes forming the front group 37, the portion of each tube 38c between bends being horizontally inclined.

The baffle 47 is retained between the two rows of tubes 38c at their upper ends and in this position acts to shield the rearward lower portion of drum 28 from direct impingement by the hot products of combustion flowing rearwardly in the space beneath the drum. The upper ends of tubes 38c may in themselves serve as a shield or screen for the rearward lower portion of drum 28 under conditions when the baffle 47 might be omitted or when the baffle is narrow so as to extend only a short distance downwardly from the drum. The baffle 47 conforms in general to the curvature of the forward row of tubes 38c against which it rests so as to present a surface to the approaching gases which is practically self-cleaning, that is, a surface on which there is little tendency for any solid products of combustion to accumulate, due to its upper end portion being generally vertically disposed and its lower end portion being generally inclined downwardly toward the side wall 14. Moreover, with the baffle 47 positioned rearwardly of at least one row of tubes 38c, the forward sides of the tubes in that row in the zone of the baffle are in contact with hot gases and thus are effective as boiler heating surface.

As indicated in Fig. 3, the baffle 47 is suitably formed of separate rectangular tile sections such as 47a, 47b and 47c installed in horizontally extending rows between the two adjacent rows of boiler tubes 38c, the lowermost row of tile 47c resting against bracket or stop members 49 which are individually welded or otherwise secured to successive tubes 38c in one row. Alternate known forms of stop means 49 may be used if desired, such as C-clamps which may be bolted about tubes 38c. Each tile section 47a, 47b or 47c is preferably made long enough to span two inter-

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tube spaces so that the joints 51 between successive tile sections occur at every alternate tube in the row, whereby the ends of each tile are supported on alternate tubes while the central portion of each tile is supported on an intermediate tube. For example, each tile section would have a length of twelve inches for tubes 38c spaced on six-inch centers, and a length of twenty-four inches for tubes 38c spaced on twelve-inch centers, the edges of adjoining tile sections being beveled or otherwise companionately shaped to provide substantially gas tight joints 52 transversely of the tube lengths 38c.

Should a longer or shorter extension of baffle 47 be desired, in order to alter the extent of the gas bypass area 48, the change may be readily effected by increasing or decreasing the number of tile sections 47a, 47b, etc., or by substituting one or more tile sections of different dimension as measured longitudinally of the supporting tubes 38c. If the baffle 47 is to be made narrower, the change in width may be made from either end, although preferably the upper end will remain in contact with the upper drum 28 and any alteration in width made at the lower end. It will be understood that stops 49 may be relocated as necessary to suit the new dimension of baffle. Due to the formation of the row of baffle supporting tubes 38c, the lowermost tile 47c are supported on a downwardly inclined portion of the row and thus are held in contact with their supporting tubes by gravity.

In a boiler such as described, the boiler tubes in groups 37 and 38 are suitably of three inches outside diameter, and except for tubes 37a are uniformly spaced at six-inch centers in rows extending longitudinally of the drums 28 and 29, the tubes 37a being spaced at twelve-inch centers to provide the staggered arrangement. The tubes 38a and 38b being aligned in rows transversely of the drums 28 and 29 provide the necessary intervening spaces to enable the superheater inlet tubes 45 to be installed between tubes 38b adjacent the side wall 14 and between tubes 38a to enter the inlet header 42. The superheater tubes 41a are suitably of one-and-one-half or two inches outside diameter and arranged at center-to-center spacings of two-and-one-half inches in successive longitudinal rows.

In the modification illustrated in Figs. 4 and 5, the boiler and furnace arrangement is generally the same as that shown in Figs. 1 and 2, and accordingly for convenience and clarity the same reference characters are utilized to identify identical or closely similar parts. In the modified form, a seven-loop superheater 61 is shown of considerably greater capacity and heating surface than the two-loop superheater 41 of the previously described embodiment; in this instance, the superheater having portions of its heating surface at both sides of the common vertical plane containing the longitudinal axes of the upper and lower boiler drums 28 and 29. The loops 61a, formed as U-tubes and arranged in groups of four to provide the superheater inlet section, are connected at their opposite ends to inlet header 42 and intermediate header 62, while the loops or U-tubes 61b, arranged in groups of three to provide the superheater outlet section, are connected at their opposite ends to intermediate header 62 and outlet header 43. Each group of four inlet loops 61a is in a single plane transverse to the drums 28 and 29 and thus successive four-loop groups are in successive parallel planes parallel to the flow of heating gases. The

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groups of outlet loops 61b are arranged with legs 63 extending from the intermediate header 62 in planes common to the inlet loops 61a, and with legs 64 of the majority of the loops extending toward the outlet header 43 in half the number of planes to provide twice the spacing for legs 64 across the width of the setting than for legs 63.

A baffle 47 similar to that provided in the boiler first described is disposed across the bypass space 48 between the upper end of the superheater 61 and the upper drum 28. In the present form of boiler, the boiler tubes constituting the rear group 38 are disposed in a single row along the side wall 14, suitably at uniform six-inch center-to-center spacings, as in Figs. 1 and 2; the rear group 38 including one set of tubes 38b at twelve-inch centers connected to the upper drum 28 rearwardly of the common plane containing the drum axes, and a second set of tubes 38c, also at twelve-inch centers and alternating with tubes 38b, connected to the upper drum 28 forwardly of the common plane adjacent the front group of tubes 37. The tubes 38b and 38c are thus interspersed along the wall 14 and provide intervening spaces in which are disposed the desired number of superheater inlet tubes 45, preferably at six-inch or twelve-inch spacings. The upper end portions of tubes 38c are suitably bent in a reverse curve, substantially as shown, to afford support for the superheater bypass baffle 47 which may be formed and arranged substantially as described in connection with Fig. 3, the lowermost row of tile sections such as 47c resting against stops 49 secured to individual tubes 38c. The major portion of baffle 47 rests on horizontally inclined portions of tubes 38c and thus is held in contact with its supporting tubes by gravity. Any tendency for the uppermost tile sections 47a to tilt away from tubes 38c is opposed by the layer of heat insulating material commonly applied to the upper drum 28 at the location indicated.

I claim:

1. A boiler comprising horizontally disposed upper and lower drums having longitudinal axes in a common plane, upright boiler tubes extending between said drums and having upper and lower ends connected thereto in rows paralleling said plane, said tubes being arranged in horizontally spaced front and rear groups laterally adjacent a heating gas source from which gases are directed horizontally over said tubes in a single pass throughout the major portion of the height of the space between said drums, a superheater having tubes disposed between said front and rear tube groups and positioned in downwardly spaced relation to said upper drum so as to provide a gas bypass space therebetween, said rear tube group including a front set of tubes disposed in at least one row and having upper portions reversely bent over the upper end of said superheater and connected to a lower quadrant of said upper drum forwardly of said plane adjacent the upper portions of tubes of said front group, the remaining tubes of said rear group forming a rear set of tubes having upper portions connected to a lower quadrant of said upper drum rearwardly of said plane, said sets of rear group tubes being circumferentially separated at said upper drum a distance equal at least to the circumferential width of space occupied by the upper end portions of said front group tubes in a plurality of said rows, and a baffle supported on said row of reversely bent tubes for restricting the flow of heating gases through said bypass

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space, said baffle extending downwardly from a position adjacent said upper drum and terminating in a lower end portion adjacent the uppermost portion of said superheater.

2. A boiler as claimed in claim 1 and further characterized by said superheater comprising inlet and outlet headers arranged parallel to and between said upper and lower drums in a lower portion of the space between said front and rear tube groups, the superheater tubes extending upwardly from said headers and having ends connected thereto, said front set of rear group tubes comprising two rows of tubes between which the baffle above the superheater is positioned, and a lower baffle extending upwardly from said lower drum forwardly of the superheater headers to a terminal position above said headers, said baffles combining to direct said gases toward and across said superheater tubes in said single pass while said lower baffle constitutes a means for shielding said headers from the hot gases entering said pass.

3. A boiler comprising horizontally disposed upper and lower drums having longitudinal axes in a common plane, a group of upright boiler tubes connecting said drums in rows paralleling said plane and being arranged forwardly of said plane across the path of heating gases flowing horizontally in a single pass between said drums, means defining a lateral boundary of said gas path comprising an upright setting wall arranged parallel to said drums in rearwardly spaced relation thereto, a second group of boiler tubes rearwardly spaced from said first named group and comprising two sets of tubes having intermediate portions in a substantially common row adjacent said upright wall and having the upper tube ends of the respective sets connected to said upper drum in circumferentially separated rows at opposite sides of said common plane, said sets of

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tubes of said second group being circumferentially separated at said upper drum a distance equal at least to the circumferential width of space occupied by the upper end portions of said forwardly arranged tubes in said rows, a superheater disposed between said groups of boiler tubes and comprising tubular elements confined to elevations below said upper drum, vapor inlet connections from said upper drum to said superheater comprising a row of tubes having portions interspersed with tubes of said second group adjacent said upright wall, one of said sets of tubes of said second group having upper end portions reversely bent over the upper end of said superheater elements and connected to said upper drum adjacent tubes of said first named group, and a baffle supported on said reversely bent tube portions for directing gases across said superheater elements while restricting the flow of gases through the space separating said elements from said upper drum.

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