

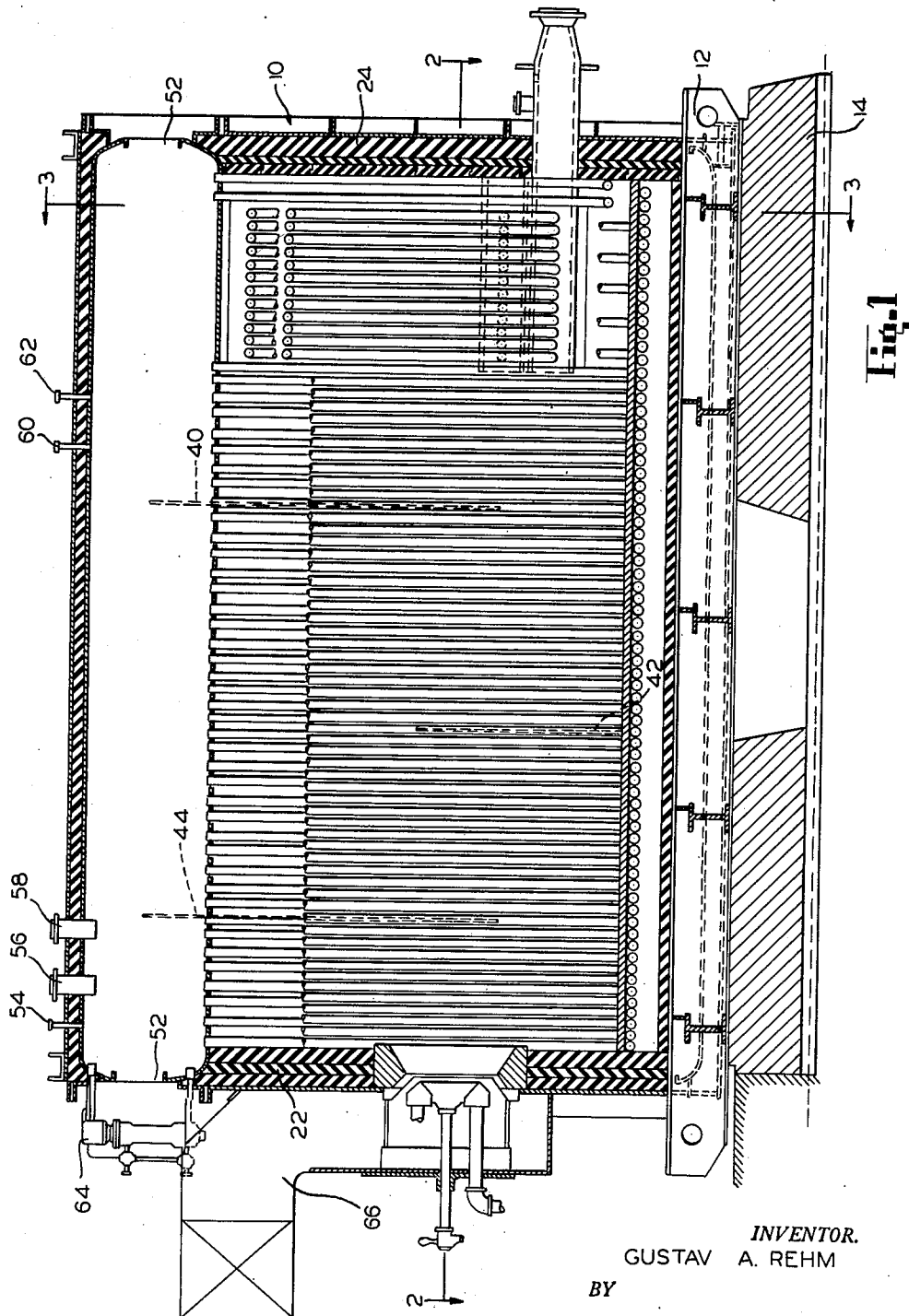
Sept. 24, 1957

G. A. REHM
SUPERHEATER

2,807,243

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5 Sheets-Sheet 1



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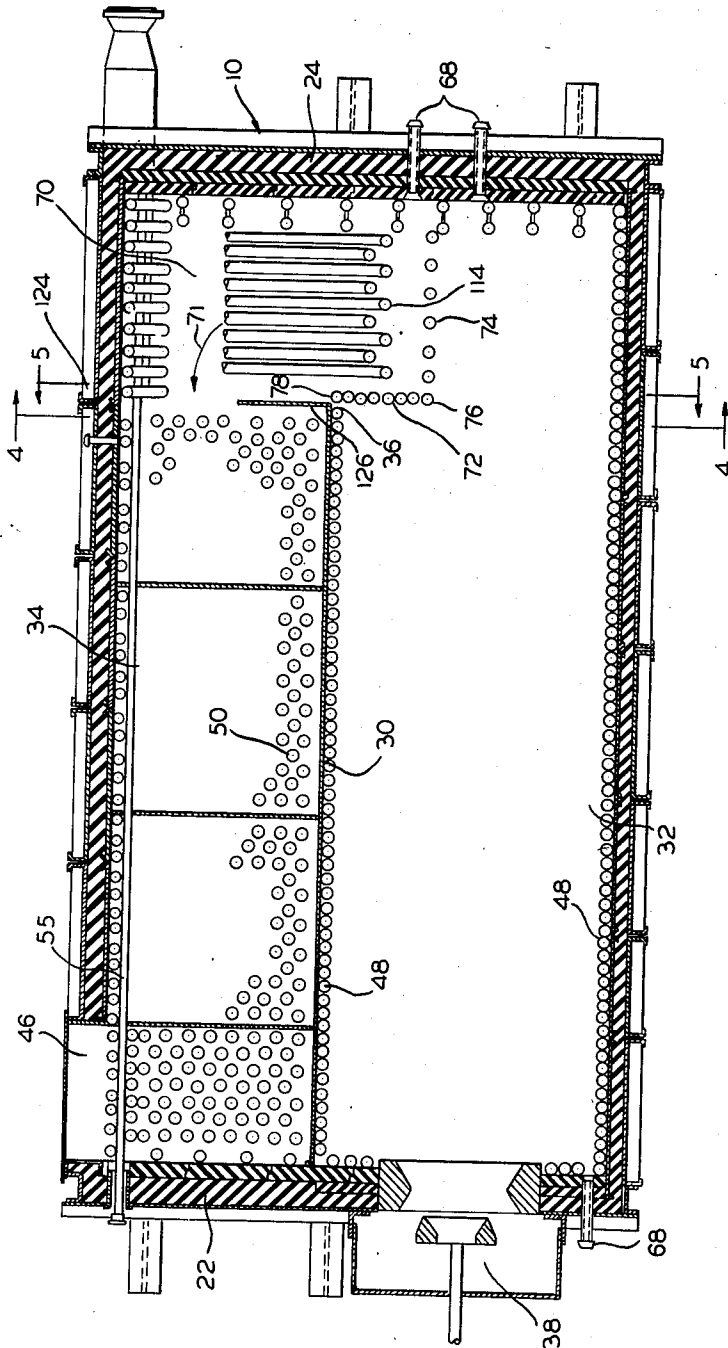


Fig. 2

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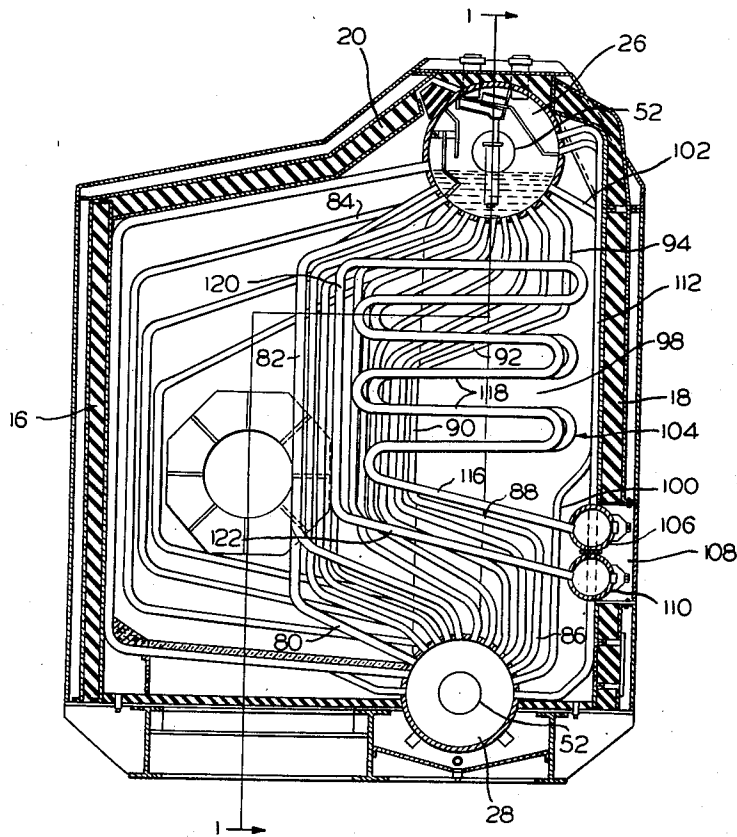


Fig. 3

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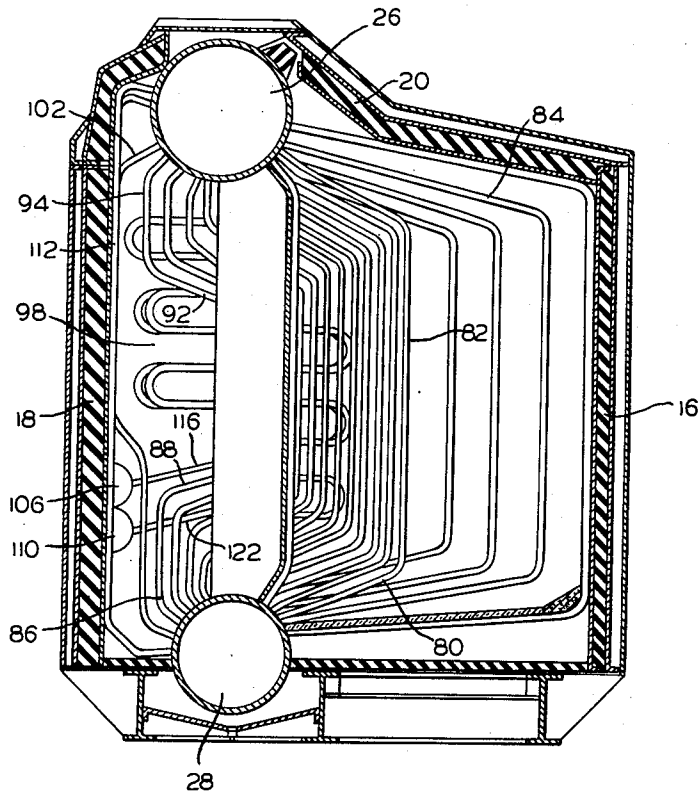


Fig. 4

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5 Sheets-Sheet 5

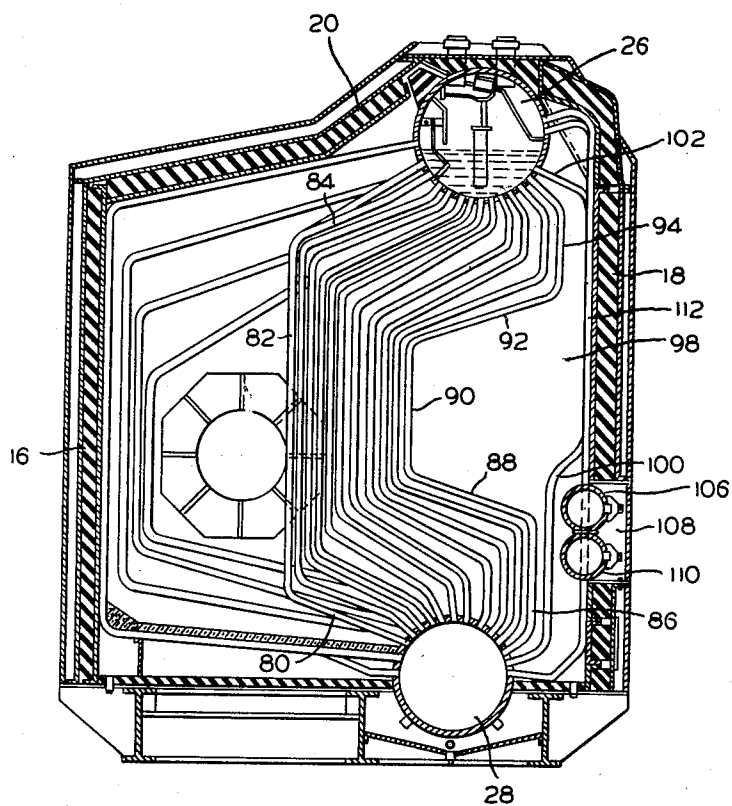


Fig. 5

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1

2,807,243

SUPERHEATER

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6 Claims. (Cl. 122—473)

This invention resides in the field of steam boilers or the like and is an improved type of boiler unit and superheater structure adapted to increase the steaming efficiency of the unit.

A primary object of my invention is a superheater for a package boiler so that the hottest steam will be in direct contact with the hottest gases.

Another object of my invention is a superheater with staggered tubes to get better gas flow between them.

Another object of my invention is a superheater arrangement in the form of a cage, closed on one side by a wall or baffle of circulation tubes.

Another object of my invention is a boiler structure of the above type having a superheater space in the form of a cage closed on one side with screen tubes across its inlet side from the furnace space.

Another object of my invention is a boiler of the above type with a tube baffle wall at one end of the furnace space and at right angles to the gases so that the hot gases are required to turn approximately 90 degrees to enter the superheater space so that all of the superheater tubes will be exposed to approximately the same temperature gas.

Another object of my invention is a superheater of the above type which is drainable.

Other objects will appear from time to time in the ensuing specification and drawings, in which:

Fig. 1 is a vertical section taken along line 1—1 of Fig. 3;

Fig. 2 is a sectional view taken along line 2—2 of Fig. 1;

Fig. 3 is a sectional view taken along line 3—3 of Fig. 1;

Fig. 4 is a sectional view taken along line 4—4 of Fig. 2; and

Fig. 5 is a sectional view taken along line 5—5 of Fig. 2.

In Figs. 1, 2 and 3, the boiler unit has a housing 10 supported by any suitable base 12 mounted on a suitable foundation 14. The housing is composed of two side walls 16 and 18, a roof or top wall 20 and front and rear walls 22 and 24 respectively. The various walls can be made out of any suitable insulation, such as mineral wool felt or the like disposed in any suitable number of layers. The layers can be formed as pads or sheets of insulation disposed between steel plates, however the details are unimportant.

The boiler unit includes an upper drum 26 in the top of the housing and a lower drum 28 disposed generally below it. An intermediate longitudinal wall 30 divides the inside of the housing generally into a furnace space 32 and gas path 34 with the wall terminating as at 36 short of the rear wall so that they are in communication. The front wall of the housing is provided with a suitable burner 38 of the liquid or gaseous type, although of course any suitable source of heat may be used. The gas path is provided with alternating baffles 40, 42 and 44, as shown in Fig. 1, so that the hot gases from the furnace

2

space, after they have rounded the end 36 of the intermediate wall, must flow through a tortuous path to a suitable outlet 46.

The furnace space is enclosed by the usual water wall tubes 48 extending between the upper and lower drums. Natural circulation tubes 50 also extend between the upper and lower drums and pass through the gas path.

The drums have suitable manholes 52 with suitable covers for inspection and repair. The upper drum also has the usual connection 54 for atomizing steam, a soot blower 55, a connection 56 for a soot blower, a connection 58 for safety valves, a connection 60 for a steam lance, and a vent 62, all of which are old, conventional and unimportant for this invention. A suitable water column 64 is provided, and the burner has the usual air inlet 66. The housing can be supplied with the usual observation ports 68.

A superheater space 70 is located at the point of communication between the furnace space and the gas path. As shown in Figure 2 this superheater space occupies the initial part of the 90 degree turn 71 of gas path and projects into the furnace space. Roughly, the superheater space is defined on two sides by the walls of the housing, on the third side by a wall of baffle tubes 72, and on the fourth side by a row of screen tubes 74.

The baffle tubes 72 lie generally in the same lateral plane and are interconnected between the upper and lower drums. The tubes generally rise from the lower drum, project laterally into the furnace space to form a wall or baffle and then return to the gas path to the upper drum. The outermost tube 76 extends approximately one-third to one-half of the distance across the furnace space, while the innermost tube 78 is generally aligned with the water wall tubes 48 along the intermediate longitudinal wall 30, as shown in Fig. 2. Considering these tubes in detail and taking the outermost tube 76 as an example, in Fig. 5, it is provided with a diagonal portion 80 extending from the lower drum into the furnace space. A vertical portion 82 rises through the furnace space and a diagonal portion 84 extends back and connects to the upper drum. Each of the baffle tubes conforms generally to this same pattern, however the inside tubes have a slightly different shape. For example, considering the innermost tube 78, a vertical portion 86 extends upwardly from the lower drum, which turns into a diagonal portion 88 connecting to a vertical piece 90 that is substantially shorter than the vertical portion 82 of the outermost tube. This vertical piece turns into a diagonal piece 92 extending back into the gas path to a vertical section 94 which rises to the upper drum. It should be noted that the outermost tube 76 has the longest vertical section, and these vertical sections gradually diminish from one tube to the next, moving inwardly, until the innermost tube 78 has the shortest vertical piece.

All of the baffle tubes are directly next to each other, and although a slight spacing can be allowed, I prefer to have them directly next to each other. Thus an effective wall of baffle tubes projects into the combustion space and forces the hot gases in a turning movement around the baffle 72 and then into the superheater space. The wall of baffle tubes forces the gases to be flowing in generally a lateral direction when they enter the superheater space.

The entrance to the superheater space is provided with the screen tubes 74 which, in shape or configuration, are generally similar to the outermost tube 76 in the baffle tubes. The screen tubes are spaced substantially from each other to allow free flow of the gases into the superheater space.

After the gases flow through the superheater space and over the superheater elements, to be described more fully

hereinbelow, they flow through an opening 98 formed in the baffle wall as shown in Fig. 5. The baffle tube 100 adjacent the inner edge of the baffle tube wall projects upwardly in Fig. 5 but turns toward the wall 18 and runs along it to the top of the housing where it enters the upper drum, as at 102, so that the opening 98 through the baffle tubes is not blocked.

A superheater, indicated generally at 104, is positioned in the superheater space and includes an inlet header 106 positioned in an opening 108 in the side walls next to an outlet header 110. Both the inlet and outlet headers are accessible through the back wall for service, repair and the like. The inlet header is connected to the upper drum by one or more suitable tubes 112 running along the side wall. A plurality of tubes 114 extend from the inlet header into the superheater space, and after passing through a tortuous configuration, return to the outlet header. The tubes are disposed in generally parallel planes as shown in Figs. 1 and 2, and each includes an outlet portion 116 extending from the inlet header to a zig-zag section 118 which rises to the top of the superheater space. This zig-zag portion merges into a come-down portion 120 which drops along the outer edge of the zig-zag portion and, by a return portion 122, connects to the outlet header 110.

Thus, each superheater tube 114 has a block or rectangular overall appearance. However, the steam passing through the tubes is forced to travel through a maximum distance due to the zig-zag formation 118. The come-down portions along the outside approach but are spaced from tubes and are staggered with relation to each other, as shown in Figure 2, to allow for a free flow of gases between the tube elements. All of the tubes lie in generally parallel planes and project laterally across the superheater space toward the screen tubes from the manifolds in the side walls 18. The inlet and outlet manifolds terminate at 124 in Fig. 2.

A baffle-type plate 126 extends the baffle tubes 72 and only partially directs or impedes the flow of the gases.

The use, operation and function of my invention are as follows:

I have shown and described what I consider a package unit boiler, however, of course, the inventive principle can be included in other types even though it is especially well suited to this type or style of unit.

The unit fundamentally includes any source of heat with a water walled furnace or combustion space to generate high temperature gases which flow from the combustion space to a gas path where the heat from the gases is removed by a network of circulation tubes extending between the upper and lower drum structures. The gases flow out through any suitable outlet. Between the combustion space and the gas path a superheater space is located. In this type of unit the combustion space and gas path are disposed generally parallel and directly adjacent each other so that the gases must make a 180 degree turn from the furnace space to come back through the gas path to the outlet. It is at this point that I locate the superheater space. Basically the initial part of the gas path is appropriated for the superheater space, and it also extends partially into the furnace space. It is very desirable to have the maximum heat-transfer take place between the hot gases flowing from the furnace space and the superheater tubes. To do this I have arranged the superheater space and the superheater elements in a very desirable manner.

To acquire the maximum heat transfer, it is desirable that the hot gases flow with a turning or rotating motion over the superheater elements. The gases must therefore be made to turn 90 degrees, or approximately 90 degrees, before they contact the superheater elements. To make the gases turn 90 degrees before entering the superheater space, I provide a wall of baffle tubes extending laterally from the intermediate wall which, in effect, masks the superheater elements and forces the gases to

turn also in the superheater space after making the 90 degree turn. The entrance to the superheater space is provided with a collection of spaced screen tubes to strain the gas flow.

After flowing over the superheater tubes the gases are allowed to enter the tortuous gas path through a gap in the wall of baffle tubes. It should be noted from the configuration of the baffle tubes in Fig. 5 that the centralized gap 98 will cause a converging action of the gases and will tend to center them.

The superheater bundle positioned in the superheater space is composed of inlet and outlet headers which are each positioned in an opening in the side wall so that they can be easily serviced, withdrawn, or replaced. A collection or manifold of tubes extend from these headers up into the superheater space and each is bent into a zig-zag or tortuous configuration to provide the maximum length of tube in the space and is arranged so that each tube is self draining. The tubes are generally parallel and the forward edges confronting the incoming hot gases are staggered so that the gases can flow between them without interference.

It should be noted that the hottest steam in the superheater will be directly next to the hottest gases, namely the incoming gases, and this is very desirable.

In effect, the superheater is positioned in a cage closed on one side with screen tubes across its open side.

It is important that all of the superheater tubes be subjected to the same temperature gases. Due to the 90 degree turn of the gases caused by the wall of baffle tubes, the gases entering the superheater space through the screen tubes will have approximately the same temperature.

While I have shown and described a preferred form of my invention, it should be understood that numerous modifications, changes, substitutions and alterations can be made without departing from the fundamental theme. For example, the details of the upper drum are old, as shown in Figure 3, however, any suitable upper drum can be used which provides a baffle and steam purifier ahead of the connecting tubes between the upper drum and the inlet header for the superheater. The tubes in the baffle wall 72 can touch each other or be slightly spaced as in Figures 3, 4, and 5 so long as they function as set forth herein above. The details of the drums have been eliminated from Figures 1 and 4 for clarity. Likewise, the soot blowers, safety valves, vents, observation ports, and all the other standard items, are not important but have only been shown to round out the disclosure. While I have shown a conventional burner, it should be understood that gaseous, liquid or solid fuels could be used. I therefore wish that my disclosure be taken as exemplary or diagrammatic and not in a limiting sense except as by the appended claims.

I claim:

1. In a boiler unit, a housing having a floor, roof, front, rear and side walls defining a furnace space and a gas path disposed generally parallel to each other, an intermediate, longitudinal wall extending from the front wall separating the furnace space and gas path and terminating short of the rear wall to provide an approximately 180° turn connecting the gas path and furnace space, means in the housing defining a superheater space against the rear wall generally aligned with the gas path and constructed to receive the flow of hot gases from the furnace space, superheater structure in the superheater space, including generally parallel inlet and outlet headers disposed longitudinally in the side wall so as to be removable and generally adjacent each other, one above the other, the upper header being an inlet header and the lower header being an outlet header, a plurality of superheater tubes connected between the headers in generally parallel planes at right angles to the headers, the path of each tube being tortuous leading away from the inlet header and including a zig-zag section with laterally

5

horizontal, rectilinear lengths and integral, connecting bends providing an over-all, generally rectangular outline, the sides of the outline away from the headers being alternately staggered in relation to each other, the tubes being constructed to receive hot gases from the furnace space in a direction generally parallel to the plane of the tubes, the return line from the outline to the outlet header having a straight, generally vertical section remote from the headers in the path of the incoming gases from the furnace space, and a lateral wall of circulation tubes in the line of flow of the hot gases from the furnace space ahead of the superheater structure, the superheater tubes and wall of circulation tubes being generally perpendicular to the furnace space, the entrance to the superheater space having a longitudinal line of screen tubes across it generally aligned longitudinally with the end of the wall of circulation tubes.

2. The structure of claim 1 further characterized in that the superheater tubes are generally parallel and are staggered in their lateral extent from the headers.

3. The structure of claim 1 in which the superheater tubes are alternately staggered.

4. In a boiler structure, a housing having front, rear and side walls defining a furnace space and gas path generally parallel to each other, a longitudinal wall between them which terminates a substantial distance from the rear wall of the housing, an opening in the side wall, means in the housing defining a superheater space at the end of the longitudinal wall occupying the entire corner at the rear wall and side wall that defines the gas path, a superheater structure in the superheater space including an upper inlet header and a lower outlet header disposed in said opening in the side wall so as to be removable and generally parallel and adjacent each other, one above the other, a plurality of superheater tubes connected generally at right angles between the headers, the path of each tube leading away from the inlet header being tortuous and longitudinally aligned with the gas path but presenting a generally over-all rectangular outline, the return line to the outlet header having a straight, somewhat vertical section remote from the headers in the path of the incoming hot gases, the straight sections of each tube being staggered in relation to the straight sections of adjacent tubes, and means for turning the hot gas approximately 90° as they enter the superheater space.

6

5. The structure of claim 4 further characterized in that the superheater space occupies only the corner at the rear wall and side wall that defines the gas path, and further characterized in that said means for turning the hot gases approximately 90° as they enter the superheater space includes a lateral wall of circulation tubes generally in the line of flow of hot gases from the furnace space ahead of the superheater structure.

6. In a boiler structure, a housing having front, rear and side walls defining a furnace space and gas path generally parallel with each other, a longitudinal wall between them which terminates a substantial distance from the rear wall of the housing, an opening in the side wall, means in the housing defining a superheater space at the end of the longitudinal wall aligned at least with the gas path, a superheater structure in the superheater space including at least an outlet header disposed in said opening in the side wall so as to be removable, a plurality of superheater tubes connected to the header in generally parallel planes and at right angles to the header, the path of each tube being tortuous and including a zig-zag section with laterally horizontal, rectilinear lengths and integral, connecting bends providing an over-all, generally rectangular outline, the rectilinear lengths and integral, connecting bends being aligned generally with the gas path to provide a minimum resistance to the flow of hot gases through the superheater space into the gas path, a lateral wall of circulation tubes generally in the line of flow of hot gases from the furnace space ahead of the superheater structure, the superheater tubes and wall of circulation tubes being generally perpendicular to the furnace space, and a longitudinal line of screen tubes across the entrance to the superheater space.

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