Nov. 14, 1950 F. L. KALLAM 2,529,611

WATER-TUBE BOILER

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FIG. 1

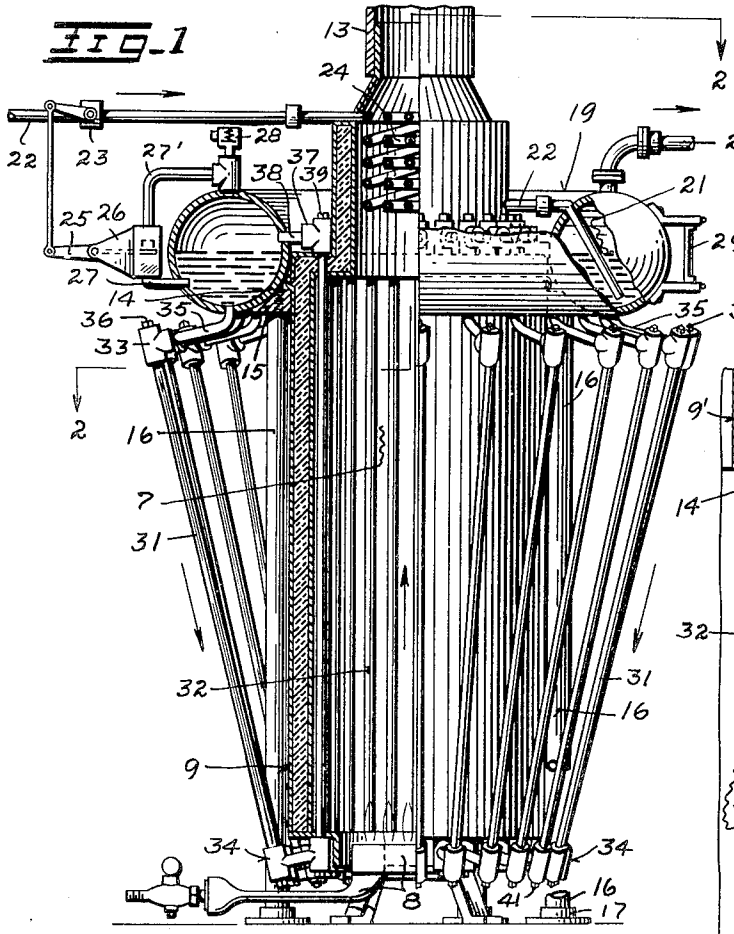


FIG. 3

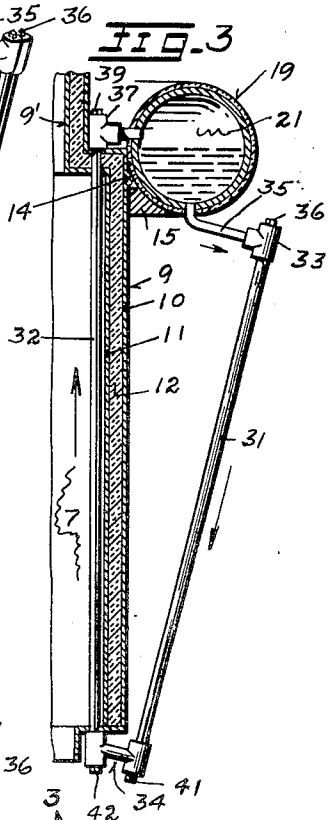
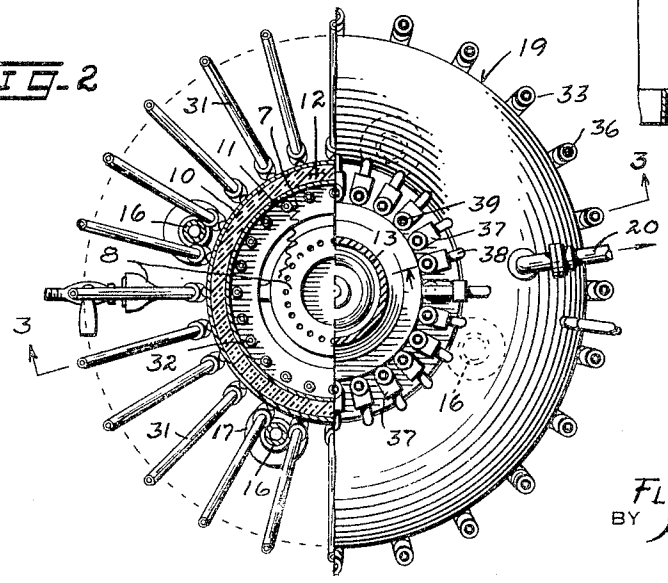


FIG. 2



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FIG. 4

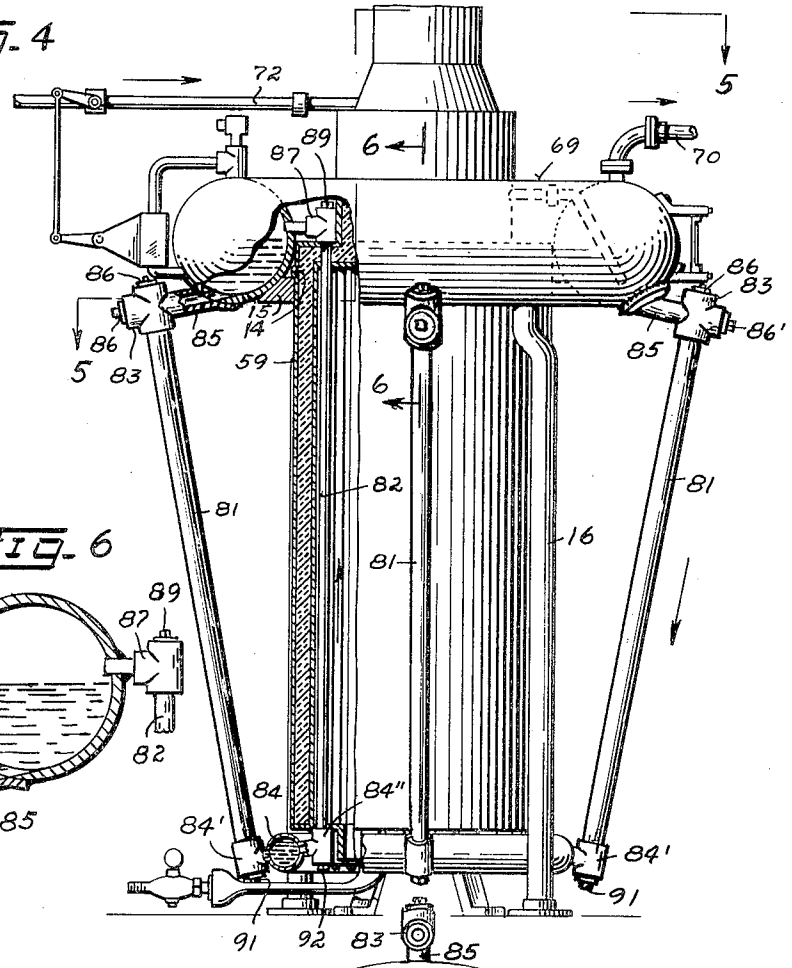
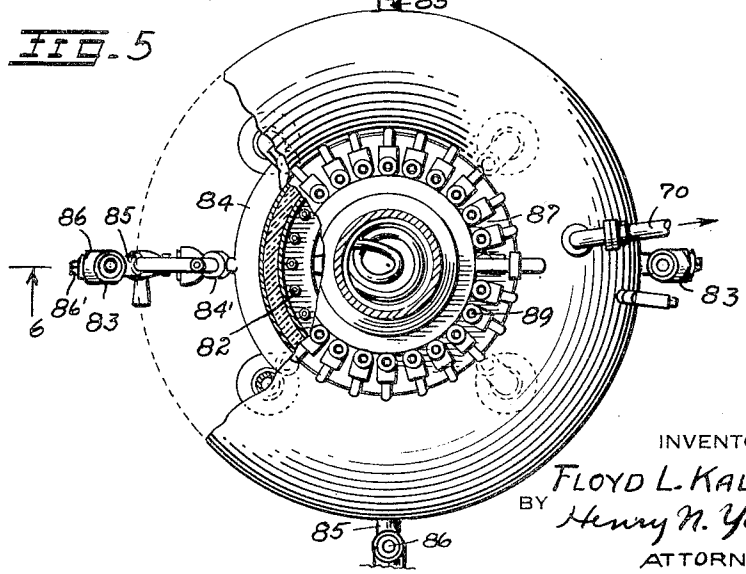


FIG. 6

FIG. 5



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WATER-TUBE BOILER

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14 Claims. (Cl. 122—333)

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The invention relates to a water tube boiler of the upright type.

A general purpose is to provide an upright boiler which is so constructed that a truly free convection circulation is assured therein.

Another object is to provide an improved boiler having both the head chamber and down flow tubes therefrom outside of the heat exchanging zone.

A further object is to provide a boiler having its tube elements arranged for ready cleaning in place, and their ready replacement.

An added object is to provide a boiler structure in which major expansion effects are arranged to take place without strain or distortion of the structure, and generally downwardly.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth or be apparent in the following description of typical embodiments thereof, and in the accompanying drawings, in which,

Figure 1 is a partly sectional elevation of a boiler structure embodying the features of present invention.

Figure 2 is a sectional plan view taken on the broken line 2—2 in Figure 1.

Figure 3 is a fragmentary section taken on an upright plane at the line 3—3 in Figure 2.

Figure 4 is a partially sectional elevation of another embodiment of the boiler.

Figure 5 is a plan view taken at the broken line 5—5 in Figure 4.

Figure 6 is an enlarged fragmentary section at 6—6 in Figure 4.

In the embodiments of Figures 1 to 3 inclusive, the water and steam carrying elements of the boiler are provided in symmetrical relation to a cylindrical combustion and heat-exchange chamber 7 which is provided above a gas burner 8. The chamber 7 is provided within a tubular insulated wall 9 comprising an outer shell 10, an inner shell 11, and suitable insulation 12 filling the space between the shells, said shells being coaxial, and the axis thereof comprising the axis of symmetry of the boiler. An upper wall portion 9' is stepped inwardly, and is connected at its top with a flue pipe 13.

At a level thereof below the step of the combustion chamber wall 9, the shell 10 is provided with a circumferential bead or flange 14 which is permanently fixed to it, and the bead 14 is arranged to rest upon the top of a support ring 15 encircling the shell below it. The ring 15 is mounted at the top of a plurality of posts 16 having feet 17 at their bottoms for engaging a supporting floor for

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the boiler structure, said structure, except for the burner 8, being suspended from the support ring 15 in spaced relation to said supporting floor. The gas burner 8 is shown as independently supported on feet 18.

A continuous tubular member 19 providing a chamber 21 is carried upon the top of the support ring 15 outwardly of and encircling the outer shell 10 of the wall 9, said member preferably being of torical outline as shown. Opposed face portions of the ring and member are complementarily formed to provide for a centered seating of the member on the ring and to extend about the wall of the combustion chamber 7. The member 19 comprises a head element of the boiler from the top of which generated steam is taken through a delivery pipe 20, and in which a predetermined water level is arranged to be automatically maintained.

As particularly illustrated in Figure 1, water under suitable pressure is arranged to be delivered to the chamber 21 of the member 19 through a pipe 22 having a float-controlled valve 23 interposed therein, and said pipe preferably has also interposed therein a pre-heating coil 24 disposed within the reduced upper portion 9' of the combustion chamber wall. The pipe 22 enters the head member 19 at a top point thereof and extends downwardly in the chamber to a point well below the desired water level in the chamber. The control of the water input valve 23 may be effected by an appropriate link-and-lever connection with a float-operated arm 25 extending from a float housing 26 mounted at the side of the member 19. The float chamber of the housing 26 is connected with the water in the chamber 21 at a bottom point thereof by means of a pipe 27, and is connected at its top to the steam space of the chamber by means of a pipe 27'.

If desired, a pressure-released safety valve 28 may be provided in the pipe 27', or at some other upper point of the head member. Also, the level of water in the chamber 21 may be directly ascertained by observing a conventional water glass 29 provided at the side of the member 19 and connected to the chamber at points above and below the normal water level for the chamber. The indicated float-controlled supply valve 23 and safety valve 28 and water glass 29, being old and well-known devices in the art, will not be further described herein.

It will now be particularly noted that the circulation of water for the generation of steam with the present boiler is arranged to be effected through downcomer and upcomer tubes or pipes 31 and 32 respectively, with corresponding said

tubes connected at their bottoms to provide U-bends comprising individual closed connections between bottom and upper points of the chamber 8, as shown. Also, the connection of the tubes 31 and 32 to provide a U-tube connection between the water and steam portions of the boiler head is preferably such that the tubes proper may be straight, are disposed for their ready cleaning in place, and may be individually replaced without requiring a dismantling of the boiler, assembly.

As particularly shown, the tubes 31 are each connected between an arm of a T-connection fitting 33 at its top and an arm of a double-T connection fitting 34 at its bottom. Short tubes 35 connected to the bottom of the head 19 extends to a connection with the stem portion of each fitting 33, and the upwardly directed arm of the latter fitting is sealedly closed by a removable plug 36. Each tube 32 extends between a lower arm of a T-connection fitting 37 and an upwardly-directed arm of the double-T fitting 34. The stem portion of the T fitting 37 is connected with the chamber 21 of the head 19 by means of a nipple 38 extending through the head wall to discharge at a point above the normal water level in the chamber.

It will be noted that each T 37 is disposed above the radial shoulder provided in the wall 9 at the base of the reduced wall portion 9', the arrangement being such that the tube 31 extends through the shoulder and along the inner face of the wall 9 to its connection with the T member 34 which is disposed below the bottom edge of the wall. The upwardly directed arm of each fitting 37 is normally closed by a removable plug 39, and the downwardly directed arms of each double T 34 are normally closed by removable plugs 41 and 42 in line with the tubes 31 and 32 respectively. The plugs 36 and 39 and 41 and 42 may be threadedly or otherwise removably retained in sealing engagement with the fitting arms which mount them.

It is to be noted that a removal of the plugs 39 and 42 of an upcomer tube 32 provides a straight passage in the line of the tube whereby an appropriate cleaning tool may be applied through the tube. Each connecting pipe 35 at the top of a downcomer tube 31 extends generally radially from its point of connection to the head for such a distance that the line of the tube 31 passes laterally beyond the head, and thereby facilitates a cleaning of this tube when the plugs 36 and 42 are removed from their fittings. The tubes 31 and 32 and the connecting pipe 35 and the nipple 38 may have threaded or expanded connections in the members which they engage, as may be preferred. Also, since the tubes 31 and 32 are straight, and are independently accessible, these tubes may be individually replaced as may be required in the service of the boiler.

By reference to the disclosure of Figures 4 to 6, it will be noted that this embodiment differs primarily from the first in that upcomer or riser tubes 82 and downcomer tubes 81 are connected at their bottoms with a torical manifold ring 84, and that the tubes 81 are fewer in number than the tubes 82; the present ratio is one to six. The present arrangement lacks the individual U-tube device of the first embodiment and is operatively less desirable, but has the advantage that less tubing surface is exposed for possible heat losses outside of the combustion chamber wall 59. The connections to the ring 84 at the bottom ends of the tubes 81 and 82 comprise T fittings 84' and 84'' having their downwardly directed arms respectively closed by removable plugs 91 and 92 for tube-cleaning purposes. Because the tubes 81 are fewer in number than the tubes 82, the effective cross-section of the flow passage jointly provided by the tubes 81 must at least equal that provided by the tubes 82.

At the top ends thereof, the tubes 81 and 82 are respectively connected to the present head 69 through cross fittings 83 and T fittings 87, the fittings 83 being provided with top cleanout plugs 86 and with side cleanout plugs 86' in line with the bores of connecting tubes 85 comprising straight arms of the fittings extending to connections with the head 69, and the fittings 87 having cleanout plugs 89 at their tops. Except for the provision of the manifold ring 84 at the bottoms of the tubes 81 and 82, the present arrangement corresponds to that of the first embodiment in structure and operation and is therefore not further described.

With reference to the present device of supporting a boiler having its tubes upright, it is to be noted that the plane of the line of support provided by the support ring 15 preferably lies above the center of gravity of the supported structure which is therefore suspended in place, and that the line support of the suspended assembly permits its free thermal expansion axially thereof without distortion and generally downwardly with, rather than upwardly against, gravity. Also, the present boiler structures providing for a free flow of fluid to and through upright riser tubes which extend through a combustion chamber or other heated zone from which steam-generating heat may be derived comprises a particularly efficient and inexpensive and durable structure for the duty to be performed. While such is not specifically shown, it will be understood that the fluid-carrying elements external to the heat exchanging chamber would, in practice, be provided with heat insulating jackets for conserving the heat stored in the fluid therein.

From the foregoing description taken in connection with the accompanying drawings, the advantages of the construction and operation of the present device will be readily understood by those skilled in the art to which this invention appertains. While I have described the features and principles of operation of assemblies which I now consider to comprise preferred embodiments of my invention, I desire to have it understood that the showings are primarily illustrative, and that such changes and developments may be made, when desired, as fall within the scope of the following claims.

1. In a water-tube boiler, an upright tubular shell stepped inwardly near its top and defining a heat-exchanging chamber arranged for the upward flow of a heated fluid therethrough, a boiler head encircling the shell at approximately the shell step level and providing the steam chamber of the boiler, downcomer tubes extending downwardly from the bottom of the boiler head externally of the shell, upcomer tubes connecting the bottoms of the downcomer tubes with the steam chamber and arranged in a circle coaxial with the axis of the heat-exchanging chamber and adjacent the inside wall surface of the shell, a support ring encircling the larger shell portion at an upper level thereof and engaging the shell and boiler head for the support thereof therefrom, and support legs extending from the ring to a level below that of the bottom of the boiler assembly.

2. A structure in accordance with claim 2 having the upcomer tubes extending through the step of the shell and connected with the steam chamber at a level above the water level therein.

3. In a water-tube boiler, an upright tubular heat-insulated shell stepped radially inwardly near its top and providing a heat-exchanging chamber within it arranged for the upward flow of heated gases therethrough, a boiler head encircling the shell at approximately the shell step level and providing the steam chamber space of the boiler, downcomer tubes extending downwardly from the bottom of the boiler head externally of the shell, upcomer tubes extending through the heat-exchanging chamber of the shell and transversely through the step of the shell and connected with the steam chamber at its inner side, and connections for the downcomer and upcomer tubes below the bottom of the shell.

4. In a water-tube boiler, an upright tubular heat-insulated shell stepped radially inwardly near its top and providing a heat-exchanging chamber within it arranged for the upward flow of a heated fluid therethrough, a boiler head encircling the shell at approximately the shell step level and providing the steam chamber space of the boiler, downcomer tubes extending downwardly from the bottom of the boiler head externally of the shell, and straight upcomer tubes connecting the bottoms of the downcomer tubes with the steam chamber and extending through the heat-exchanging chamber and transversely through the step of the shell to a connection with the steam chamber at the inner side, the connections for the upcomer tubes providing openable and normally closed openings in axial alignment with the bores of their tubes to facilitate the cleaning of the tubes in the boiler assembly.

5. In a water-tube boiler, an upright tubular heat-insulated shell stepped radially inwardly near its top and providing a heat-exchanging chamber within it arranged for the upward flow of heated gases therethrough, a boiler head encircling the shell at approximately the shell step level and providing the steam chamber space of the boiler, downcomer tubes extending downwardly from the bottom of the boiler head externally of the shell, and upcomer tubes connecting the bottom of the downcomer tubes with the steam chamber and extending through the heat-exchanging chamber of the shell and transversely through the step of the shell to a connection with the steam chamber at its inner side, the downcomer tubes being straight and extending from their connections with the upcomer tubes in lines lying outwardly of the boiler head and the connections for said tubes providing openable and normally closed openings in axial alignment with the bores of the tubes to facilitate the cleaning of the tubes in the boiler assembly.

6. In a continuously operating water-tube boiler, an upright tubular wall which is heat-insulated and provides a heat-exchanging chamber within it arranged for the upward flow of a heated fluid therethrough, a boiler head encircling the wall at an upper level thereof and thermally removed from the heat-exchanging chamber and providing the steam chamber of the boiler, means automatically operative to maintain a fixed water level in the steam chamber, downcomer tubes extending downwardly from the bottom of the boiler head externally of the shell, and individual upcomer tubes independently connecting the bottoms of the different downcomer tubes with the head chamber at a level above the water level

in the head chamber and extending through the heat exchanging chamber along the inside wall surface of the shell whereby the connected pairs of downcomer and upcomer tubes provide mutually independent U-tube assemblies for the convection circulation of water from the bottom of the boiler head to the top thereof.

7. In a continuously operating water-tube boiler, an upright tubular wall which is heat-insulated and provides a heat-exchanging chamber within it arranged for the upward flow of a heated fluid therethrough, a boiler head encircling the wall at an upper level thereof and thermally removed from the heat-exchanging chamber and providing the steam chamber of the boiler, means automatically operative to maintain a fixed water level in the steam chamber, a manifold ring at the bottom of the wall, downcomer tubes extending downwardly from the bottom of the boiler head to the manifold externally of the shell, and upcomer tubes connecting the manifold with the head chamber at a level above the water level in the steam chamber and extending through the heat-exchanging chamber.

8. In a continuously operating water-tube boiler, an upright tubular shell providing a heat-exchanging chamber within it, a boiler head encircling the shell at an upper level thereof and providing the steam chamber of the boiler, means automatically operative to maintain a fixed water level in the steam chamber, downcomer tubes extending downwardly from the bottom of the boiler head externally of the shell, and upcomer tubes connecting the bottoms of the downcomer tubes with the head chamber at a level above the water level in the steam chamber and disposed in the heat-exchanging chamber.

9. A structure in accordance with claim 8 provided with a support for the boiler assembly engaging the shell in a single encircling line at a level above the center of gravity of the assembly.

10. In a liquid-tube boiler, an upright tubular shell providing a heat-exchanging chamber within it arranged for the solely upward flow of heated gases therethrough, a torical boiler head adjacent the top of the shell coaxial therewith and providing the vapor chamber space of the boiler, downcomer tubes extending downwardly from the boiler head solely externally of the shell, upcomer tubes extending downwardly from the boiler head solely internally of the shell, and means connecting the downcomer and upcomer tubes at their bottoms.

11. A structure in accordance with claim 10 having the upcomer tubes connected with the header at the vapor chamber space thereof.

12. A structure in accordance with claim 8 having the upcomer and downcomer tubes provided and connected solely in pairs.

13. A structure in accordance with claim 8 wherein the connection of the upcomer tubes with the downcomer tubes at their bottoms comprises a common manifold for the tubes.

14. A structure in accordance with claim 10 whereof the boiler head encircles the shell.

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REFERENCES CITED

The following references are of record in the file of this patent:

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