

March 10, 1953

C. W. MILLER
STEAM GENERATOR

2,630,790

Filed July 20, 1950

6 Sheets-Sheet 1

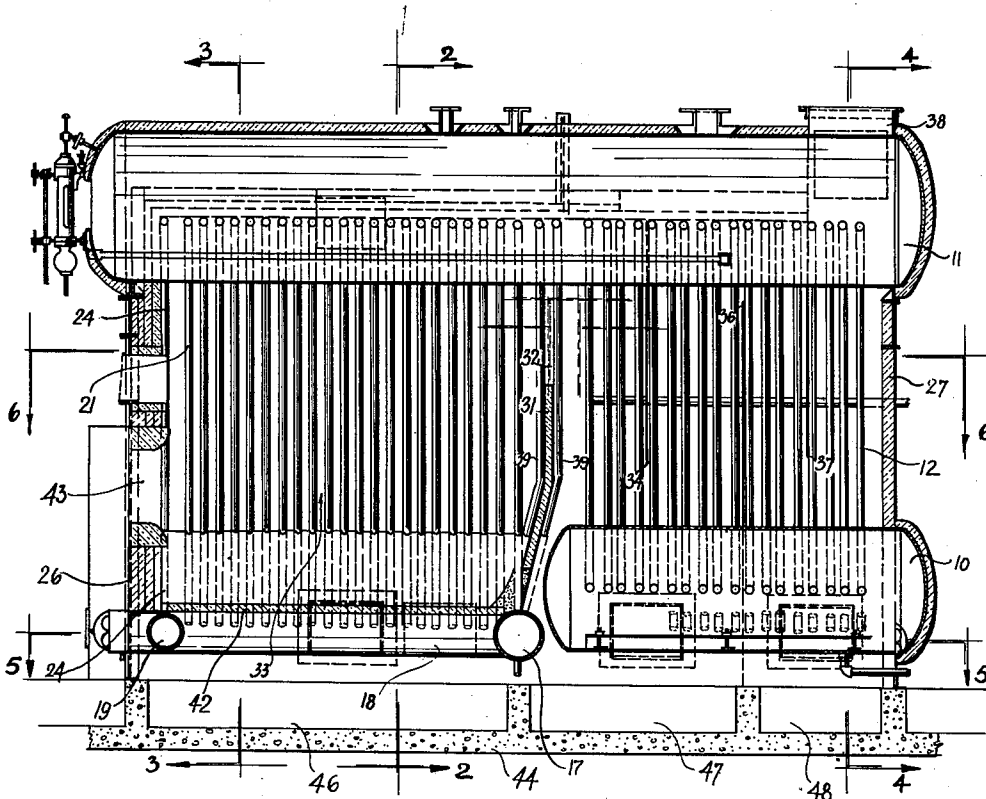


FIG. 1

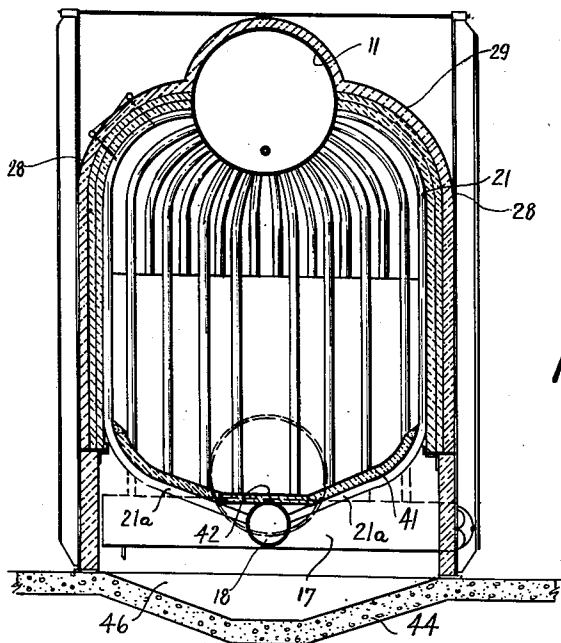


FIG. 2

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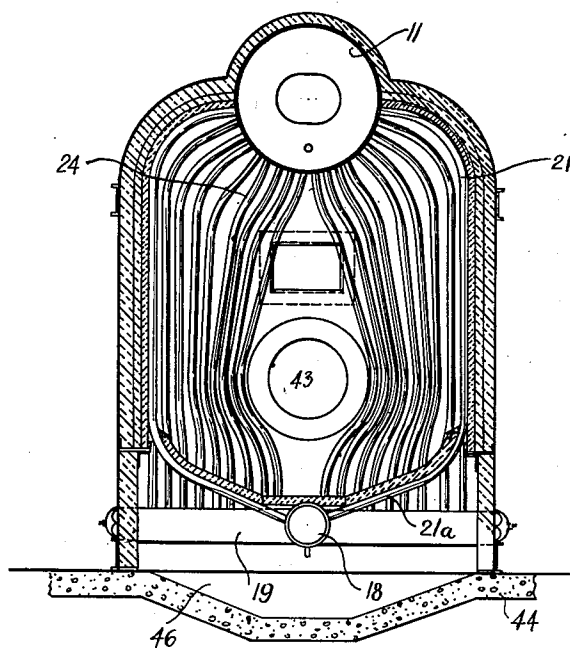


FIG. 3

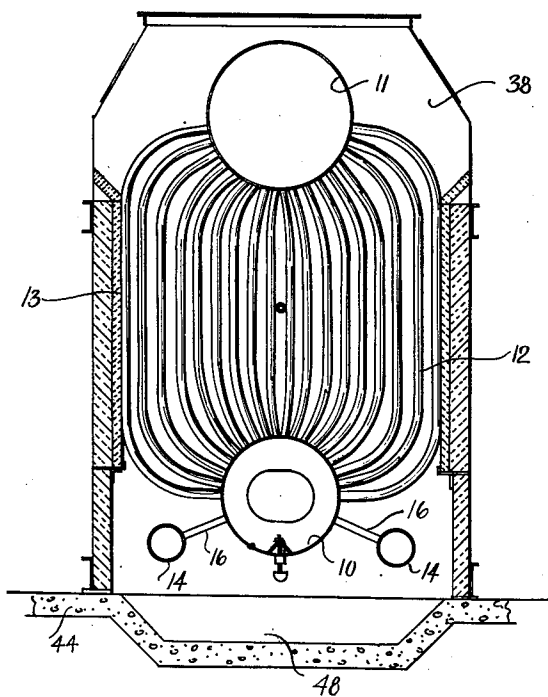


FIG. 4

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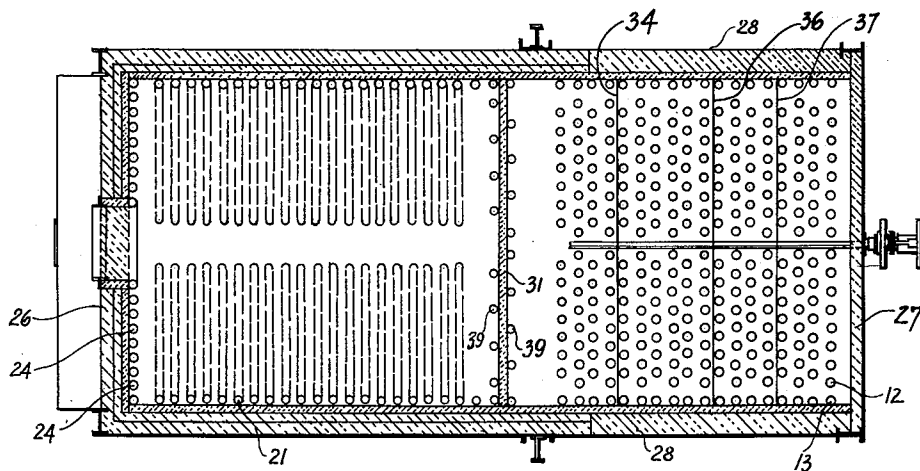


FIG. 6

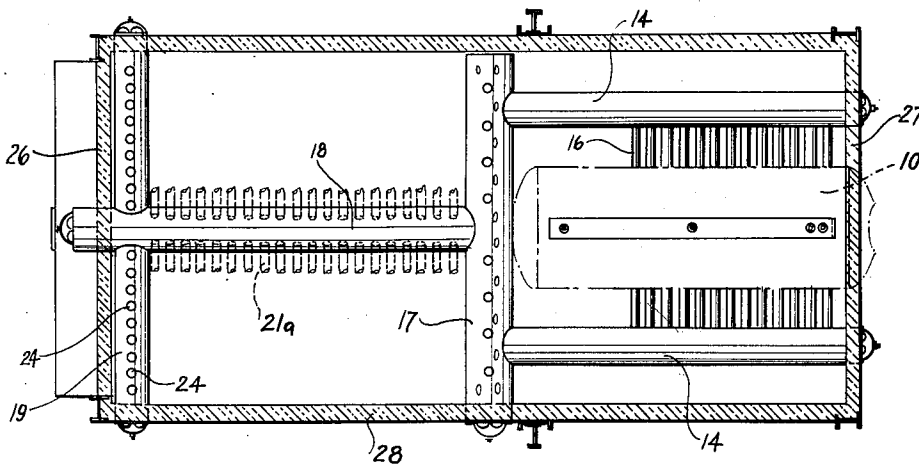


FIG. 5

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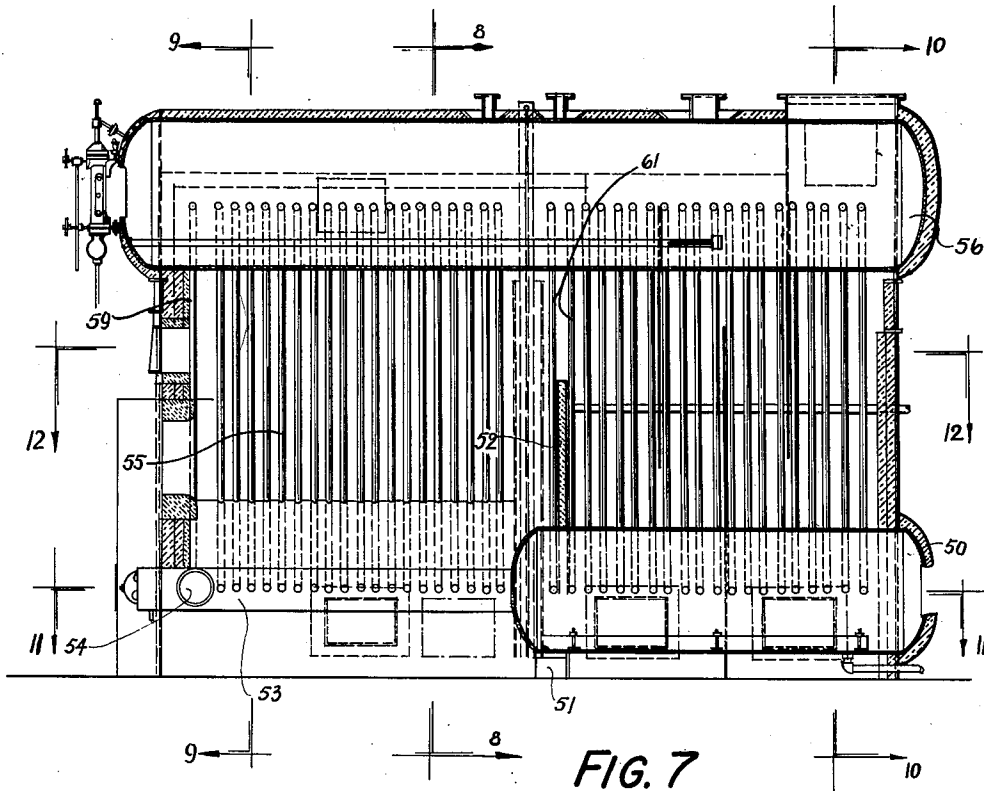


FIG. 7

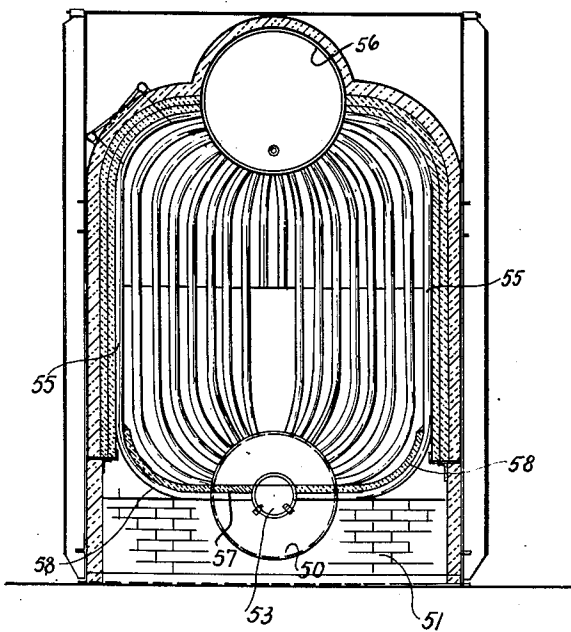


FIG. 8

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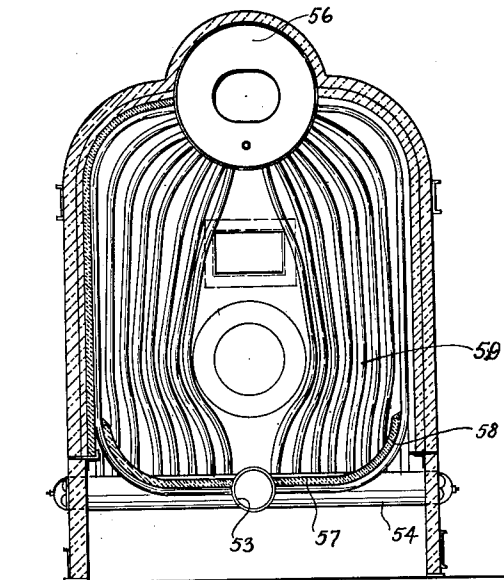


FIG. 9

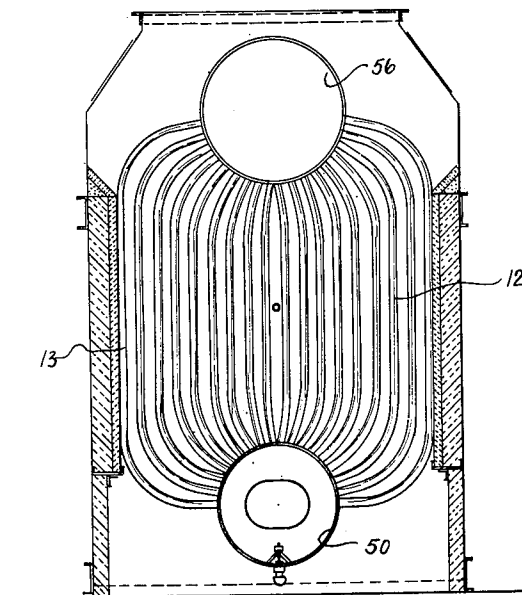


FIG. 10

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Filed July 20, 1950

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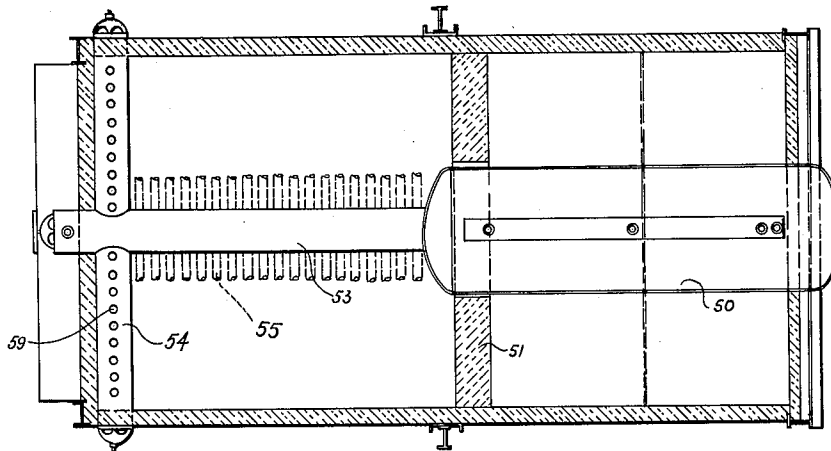


FIG. 11

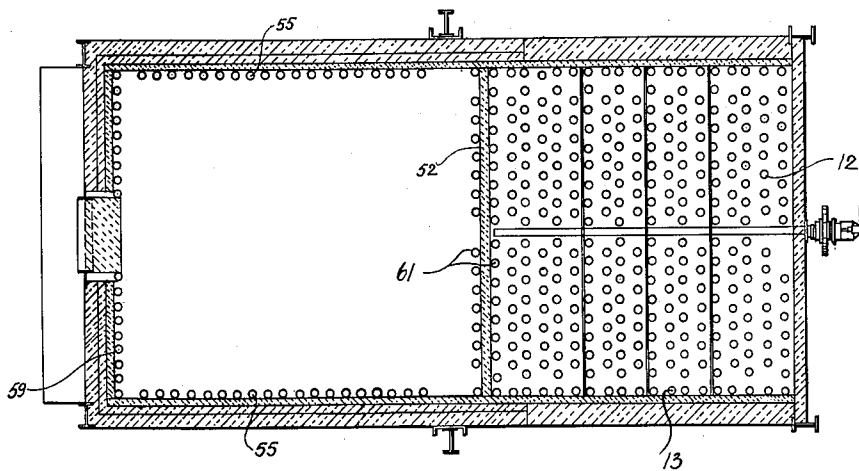


FIG. 12

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UNITED STATES PATENT OFFICE

2,630,790

STEAM GENERATOR

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Application July 20, 1950, Serial No. 174,971

10 Claims. (Cl. 122—347)

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This invention relates to improvements in boilers of the water tube type, limited to the use of fuels, in liquid, gaseous, or other non-solid forms to generate steam from water, and more particularly to a generator of this type having an improved furnace or combustion chamber requiring a minimum of brickwork.

Prior generators of the water tube type with which I am familiar require a substantial amount of furnace brickwork upon installation which adds considerably to the installation expense. According to the invention, I provide a relatively short water drum and a single longitudinally extending water wall header is disposed forwardly of the water drum and centrally of the furnace floor. The water wall tubes extend transversely from this header and then upwardly along the side walls of the furnace to the steam and water drum which extends the full length of the setting. The header and the transverse portions of the water wall tubes form support for refractory material which is disposed thereon to form the furnace floor.

Other than the usual setting including the front wall and a bridge wall at the rear of the furnace it is only necessary to dispose refractory material on the lower transversely extending portions of the water wall tubes in the furnace zone to complete the furnace brickwork. Further, the provision of a single centrally disposed header extending longitudinally along the furnace floor permits of a simple arrangement for cooling the front wall and bridge wall. In one embodiment of the invention the header connects directly with the front end of the water drum and the bridge wall is cooled by tubes which connect directly with the water drum. A transverse header communicates with the longitudinal header adjacent the front wall, and the water tubes for cooling the front wall extend from the transverse header to the upper or water and steam drum. In another embodiment of the invention a second transverse header is disposed immediately forwardly of the front end of the water drum and the longitudinal header connects with this header instead of the water drum. The water tubes for cooling the bridge wall connect directly with this header.

Subject to present railroad clearance limitations, the boiler construction to be described permits units to be shipped completely assembled since all the necessary refractories can be installed before the boiler leaves the point of manufacture and it is unnecessary for a bricklayer to do any work inside the boiler after it arrives at its destination. Of course, it is necessary to

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provide a suitable foundation for the assembled unit at its point of installation.

It is a primary object of the invention to provide a generator of the water tube type having a furnace adapted to none-solid forms of fuel and wherein a minimum amount of furnace brickwork is required.

Another object of the invention is to provide a generator of the above type which can be shipped as a completely assembled unit, the unit size being limited only by shipping clearance requirements, and which requires no interior brickwork at the place of installation.

Another object of the invention is to provide a generator of the above type having a relatively simple arrangement for cooling the front wall of the setting and a bridge wall at the rear of the furnace.

Another object of the invention is to provide a generator of the above type which is economical of manufacture and installation.

Other objects of the invention and the invention itself will become increasingly apparent from a consideration of the following description and drawings wherein:

Figure 1 is a medial longitudinal sectional view of a generator embodying the invention taken along a vertical plane.

Figure 2 is a transverse section taken along the line 2—2 of Figure 1.

Figure 3 is a transverse section taken along line 3—3 of Figure 1.

Figure 4 is a transverse section taken along line 4—4 of Figure 1.

Figure 5 is a horizontal section taken along the line 5—5 of Figure 1.

Figure 6 is a horizontal section taken along the line 6—6 of Figure 1.

Figure 7 is a medial longitudinal sectional view of a generator embodying a modification of the invention taken along a vertical plane.

Figure 8 is a transverse section taken along line 8—8 of Figure 7.

Figure 9 is a transverse section taken along line 9—9 of Figure 7.

Figure 10 is a transverse section taken along line 10—10 of Figure 7.

Figure 11 is a horizontal section taken along line 11—11 of Figure 7, and

Figure 12 is a horizontal section taken along line 12—12 of Figure 7.

Referring now to the drawings, and particularly to Figures 1 to 6 inclusive, I have shown at 10 a lower water drum and at 11 an upper water and steam drum. As best illustrated in Figure 4, a plurality of generally vertically extending

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tubes 12 inter-connect the drums with certain of said tubes indicated at 13 acting as side wall cooling tubes. A pair of longitudinally extending headers 14 are disposed one at each side of drum 10 and are connected to the drum by nipples 16. The headers 14 connect with a transverse header 17 adjacent the front end of drum 10. Extending from header 17 longitudinally and centrally of the generator is a header 18 which communicates with a second transverse header 19 adjacent the front wall of the generator.

A plurality of generally vertically extending tubes 21 extend from header 18 to upper drum 11 and act as side wall cooling tubes in the furnace or combustion chamber zone. Tubes indicated at 24 extend from transverse header 19 to the upper drum 11 and act as front wall cooling tubes.

The parts described are encased in a setting of refractory material comprising a front wall 26, a rear wall 27, side walls 28—28, and a top wall 29. The walls are suitably reinforced and supported in a conventional manner by metal structural members as illustrated.

A bridge wall 31 extends transversely between the side walls and immediately forwardly of the lower drum. A passage 32 above the bridge wall permits hot gases to pass from the furnace or combustion chamber generally indicated at 33 and under a baffle 34 extending from the top wall 29, thence over a baffle 36 extending from the generator base, and thence under a baffle 37 extending from the top wall to be discharged through a gas outlet 38. Water cooling tubes 39 extend from transverse header 17 on each side of the bridge wall 31 to the upper drum 11.

It will be noted that in the furnace zone only a single row of tubes 21 is provided at each side wall and that the lower ends of these tubes connect with the longitudinal header 18. The lower portions of tubes 21 are inclined from the horizontal as indicated at 21a and form a support for refractory material 41 which forms the furnace floor. The central longitudinal portion of the furnace floor is horizontal as indicated at 42 and is supported by the top surface of header 18. The front wall 26 of the generator is provided with a fuel entry port 43.

It will now be understood that apart from the usual setting including the generator walls it is only necessary to provide the bridge wall and the refractory material forming the furnace floor to complete the furnace and that a minimum amount of brickwork is required.

The parts so far described will be assembled at the place of manufacture and shipped as a unit. This, of course, applies to units of a size that can be shipped completely assembled within present railroad clearance limitations.

At the place of installation it is only necessary to prepare a suitable foundation for the unit. The foundation illustrated is formed of concrete and comprises a floor 44 extending horizontally beneath the setting side walls to support the same, the floor being dished between the setting side walls and provided with a plurality of up-standing transverse walls to form chambers indicated at 46, 47 and 48.

Referring now to Figures 7 to 12 inclusive, I have illustrated an embodiment of the invention generally similar to the embodiment illustrated in Figures 1 to 6 inclusive. In this embodiment, the lower water drum 50 is suspended from the upper drum 56 by tubes 12 in the same manner that drum 10, illustrated in Figure 1, is suspended

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from upper drum 11. In both embodiments, the boiler is supported on a structural steel frame including four corner columns with cross girders under the front and rear ends of the upper drum. A transverse wall 51 at the front end of drum 50 extends to the setting side walls and directly above this wall a bridge wall 52 extends upwardly from the lower drum. A longitudinal header extends directly from the front end of drum 50 and communicates with a transverse header 54.

In the furnace or combustion chamber zone a single row of side wall cooling tubes 55 at each side of the generator extends from the longitudinal header 53 to the upper water and steam drum 56. It will be understood that header 53 is suspended from the upper drum by tubes 55 in the same manner that header 18, illustrated in Figure 1, is suspended by tubes 21. The lower portions of tubes 55 form a support for refractory material 57 forming the furnace floor, the refractory material extending upwardly along the curved portions of tubes 55 as indicated at 58. Cooling tubes for the generator front wall extend from transverse header 54 to the upper drum as indicated at 59.

It will be noted by reference to Fig. 6 that the steam generating tubes 12 disposed rearwardly of bridge wall 31 comprise a plurality of transverse rows and that the tubes of one row are staggered or out of longitudinal alignment with the tubes of an adjacent row whereby combustion gases passing from the furnace 33 to the outlet 38 are caused to travel a sinuous path around tubes of succeeding rows. It was previously pointed out that the combustion gases pass over bridge wall 31, under baffle 34, over baffle 36, and under baffle 37 to outlet 38. Thus, the combustion gases are caused to travel a sinuous path due to the staggered arrangement of the tubes and an undulating path in a vertical zone due to the baffle arrangement resulting in a highly efficient heat exchange. It will be noted, by reference to Figs. 7 and 12, that the same staggered tube and baffle arrangement causing undulating flow is employed rearwardly of bridge wall 52 as described above rearwardly of bridge wall 31 in connection with the embodiment illustrated in Fig. 6.

The embodiment of the invention illustrated in Figures 7 to 12 inclusive may be installed at the point of installation as an assembled unit upon a foundation having a flat top surface. The term foundation as herein used is intended to include masonry piers suitable to support a unit of the type described. It will now be understood that I have provided a boiler or steam generator of the non-solid fuel type adapted to be shipped as an assembled unit, the unit size being limited only by shipping clearance requirements, and which will not require any interior brickwork or labor at the point of installation. Further, the provision of a relatively short water drum and a single longitudinal header extending forwardly of the water drum and centrally of the furnace zone permits of a construction wherein the furnace or furnace floor can be completed prior to shipment thereby eliminating the necessity for further interior brickwork at the point of installation.

I wish it to be understood that I do not desire to be limited to the exact details of construction shown and described, for obvious modification will occur to persons skilled in the art.

What I claim is as follows:

1. In a steam generator having a furnace adapted to the use of non-solid fuel, a setting,

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an upper water and steam drum extending the length of the setting, a lower water drum extending from the rear of the setting to the mid zone thereof, a refractory bridge wall extending transversely of the setting to the sides thereof and adjacent the forward end of the lower drum, a central longitudinal header communicating with the lower drum and extending forwardly thereof to the front of the setting, water wall tubes forwardly of the bridge wall and extending upwardly from the header along the sides of the setting directly to the upper drum, the lower portions of the tubes extending transversely from the header to the setting sides and forming a support for refractory material, and refractory material on said lower portions of the tubes to provide a water cooled furnace floor extending between the setting sides and from the front of the setting to the bridge wall.

2. The generator as described in claim 1 and wherein a transverse header communicates with the longitudinal header adjacent the front of the setting, and water wall tubes extend from said transverse header directly to the upper drum for cooling the front of the setting.

3. In a steam generator having a furnace adapted to the use of non-solid fuel, a setting having a gas outlet at the rear thereof, an upper water and steam drum extending the length of the setting, a bridge wall extending transversely of the setting and dividing the interior thereof into a front furnace compartment and a rear heating compartment, a lower water drum having at least the major portion thereof within the heating compartment, a central longitudinal header communicating with the lower drum and extending forwardly thereof to the front of the setting, water wall tubes within the furnace compartment having lower portions extending transversely from the header and upper portions extending upwardly adjacent the setting sides directly to the upper drum, a fuel entry port in the front of the setting, rows of steam generating tubes in the heating compartment extending from the lower drum to the upper drum, and refractory material superposed on and supported by said lower portions of the water-wall tubes forming a water cooled furnace compartment floor.

4. The generator as described in claim 1 and wherein the bridge wall is disposed slightly rearwardly of the front end of the lower drum, the lower portions of the tubes comprise a curved section and a horizontal section, and the refractory material extends along both sections and abuts the side walls of the header.

5. The generator as described in claim 1 and wherein the lower portions of the tubes comprise a curved section and an inclined section, refractory material extends along the curved sections and a part of the inclined sections, and refractory material extends horizontally in abutting relation with the header top wall to join the refractory material on the inclined sections.

6. The generator as described in claim 1 and wherein a pair of longitudinal headers are provided, one at each side of the lower drum and communicating therewith, the bridge wall is disposed slightly forwardly of the front end of the lower drum, a second transverse header is disposed beneath the bridge wall and is connected with said pair of headers, and the central longitudinal header interconnects both transverse headers.

7. The generator as described in claim 1 and

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wherein the setting has a gas outlet at the rear thereof, rows of steam generating tubes extend from the lower drum to the upper drum rearwardly of the bridge wall, the tubes of one row being staggered with respect to the tubes of an adjacent row, and baffle means are disposed rearwardly of the bridge wall causing heated gases issuing from the furnace to travel in an undulating path through the staggered rows of tubes to the gas outlet.

8. In a steam generator having a furnace adapted to the use of non-solid fuel and which can be shipped as an assembled unit eliminating interior brickwork at the point of installation, a frame for the generator including four structural steel corner columns, an upper water and steam drum extending the length of the generator, cross guides of structural steel supporting the front and rear ends of the upper drum and secured to the corner columns, a relatively short lower water drum extending from the rear of the generator, a plurality of steam generating tubes extending from the upper drum to the lower drum whereby the lower drum is suspended from the upper drum, a longitudinal header extending forwardly of and communicating with the lower drum, a row of water wall tubes extending directly from the upper drum to the header along each side of the generator whereby the header is suspended from the upper drum, the lower portions of the said row tubes extending generally horizontally from the generator side walls to the header, and refractory material supported on the lower portions of the row tubes forming a water-cooled furnace floor.

9. The generator as described in claim 8 and wherein a bridge wall of refractory material is disposed adjacent the front end of the lower drum to provide the rear wall of the furnace.

10. In a steam generator having a furnace adapted to the use of non-solid fuel, a setting, an upper water and steam drum extending the length of the setting, a lower water drum extending from the rear of the setting to the mid zone thereof, a refractory bridge wall extending transversely of the setting adjacent the forward end of the lower drum and dividing the setting interior into a front furnace compartment and a rear heating compartment, a central longitudinal header extending from the front of the lower drum to the front of the setting, water wall tubes extending from said header upwardly adjacent the setting side walls directly to the upper drum, the lower portions of said tubes extending transversely and substantially horizontally from the header towards the setting side walls, a transverse header communicating with the longitudinal header adjacent the setting front wall, water wall tubes extending from the transverse header directly to the upper drum, a fuel entry port in the front of the setting, rows of steam generating tubes in the heating compartment extending from the lower drum to the upper drum, water wall tubes extending from the lower drum to the upper drum along each side of the bridge wall, and refractory material superposed on and supported by the said lower portions of the tubes extending transversely from the longitudinal header forming a water cooled furnace compartment floor whereby the floor and all upstanding walls of the furnace compartment are water cooled.

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