UNITED STATES PATENT OFFICE

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WATER-WALL AND MUD-DRUM CONNECTION

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The general object of my present invention is to provide an improved arrangement and construction of the parts of steam and water circulating system of a steam generator and the provisions of means by which said parts are kept in contact with the varying temperatures in the generator, corresponding movements are given to other parts of the circulating system which are connected to the first mentioned parts, to thereby prevent the disruption of the connections between said parts. More particularly, the object of my invention is to provide a steam generator of the vertical tube type with means permitting movement of the lower water drum without disrupting the tube connection between said drum and a transverse header of a water wall at the rear of the combustion chamber of said generator.

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, however, and the advantages possessed by it reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described a preferred embodiment of the invention.

Of the drawings:

Fig. 1 is a side elevation of a Stirling boiler provided with a preferred embodiment of my invention; and

Fig. 2 is an enlarged view of part of the apparatus shown in Fig. 1.

In the drawings I have conventionally illustrated a vertical water tube boiler A of the Stirling type having a combustion chamber A' and a plurality of steam and water drums B, B' and B" suitably supported in a well known manner from the boiler setting connected to a mud drum B", by a multiplicity of vertically disposed inclined tubes B'. The tubes B' are arranged in three banks connecting the upper drums to the mud drum and separated by inclined baffles C', C" and C"'. Located in the second pass of the boiler behind the baffle C' is a superheater B" having its inlet connected to the upper part of the steam and water drum B and its outlet connected to a steam main (not shown).

The combustion chamber of the boiler is shown as provided with a series of powdered coal injecting nozzles D and a superposed series of air inlet ports D' in the front wall of the combustion chamber A". The lower part of the combustion chamber is formed by an inclined wall E supported on beams B", extending from the ash pit A to a bridge wall F, forming the rear wall of the combustion chamber. The inclined wall E comprises a water wall G imbedded in and connected to the wall E by spaced connections E'. The water wall is composed of a series of side by side steel tubes G", each of which is encased in short cast iron elements and connected at its upper and lower ends to headers G" and G"', respectively.

The mud drum B" is connected to the lower header G" of the water wall by a downcomer pipe H having a main vertical portion and oppositely extending end portions connected to the header and drum respectively. The upper header G" is connected to the mud drum by a series of side by side tubes G', forming a water wall for the fire brick wall F. The upper end of each tube G' is connected to a corresponding inclined tube B", forming part of the second bank of tubes of the circulating system. The tubes G' are connected to the header G" by an inclined lower end portion G" and to the tubes B" by horizontally extending upper end portions G"', supported on the upper part of the bridge wall F. The ends of the tube portions G" project through openings in the side of the mud drum and are connected to the tubes B" by arc-shaped tubes G" located wholly within the mud drum. Each of the tubes G" has its upper end secured in the expanded end of the corresponding tube B" and its lower end flanged and connected to the flanged end G" of the tubes G". The tubes G" are located within the mud drum thereby avoiding the passage of the tubes G" vertically through the first bank of tubes B" and baffle C'. It is preferable to connect the tubes G" to an in-
Intermediate bank rather than to the lower tube bank B₂ as such an arrangement would undesirably increase agitation in the drum B² and friction losses in the tubes G².

The present invention comprises means for preventing the disruption of the connections of the tubes G² to the mud drum and upper header G². The wall F at the rear side of the combustion chamber comprises a lower foundation section F¹ and an upper section F⁴, which forms the bridge wall of the combustion chamber. A channel bar F³ is arranged transversely of the combustion chamber and connected by transversely and horizontally extending plates J to a composite girder F⁸ composed of parallel upper and lower plates spaced apart by an I-beam and channel bar structure. The upper section F³ is supported on the girder F⁸ and is arranged with a horizontally spaced series of peep-hole openings F⁹ substantially triangular in vertical section. Each peep-hole has its larger end opening to the combustion chamber and its smaller outer end closed by a hinged door F⁹.

The inclined water wall E is arranged with the upper end of the supporting beam structure E² resting on a cut away portion F² of the foundation section F¹. The refractory portion of the wall E and the water tubes are supported with the header G² on the channel bar F³. The upper ends of the tubes G are not provided with cast iron casing sections, but are arranged to be covered together with the inner face of the upper header G² by refractory brick sections F⁸, between which extend layers of compressible material F⁹, such as asbestos rope.

The upper section of the bridge wall F is connected to the rear wall of the boiler housing by a wall N, having its upper face covered with fire brick and mounted on a series of transversely extending 1-beams N⁸. The mud drum B² is arranged at the rear side of the bridge wall and partially supported thereon, but not secured thereto. An irregular space between the adjacent sides of the mud drum and bridge wall is filled with plastic cement as shown at B⁹.

The mud drum is provided at its lower side with a horizontally spaced series of depending flanges B⁴, each substantially triangular in form and provided with a central opening B⁵. The upper header G² is arranged with a horizontally spaced series of arc-shaped flanges M extending around the upper side of the header and secured thereto and each of which is constructed with an opening M⁴ at the outer end thereof. A series of connecting links K having upper and lower enlarged end portions K² and K⁵ perforated and connected to the flanges B⁴ and M⁴, respectively, are arranged to pass through openings N⁴ in the wall N which are provided at their upper ends with cover-

Secured to one side of the inner I-beam N⁴, there are a horizontally spaced series of projecting flanges N⁵, each of which is provided with a central opening N⁶. A horizontally spaced series of parallel radius arms O are arranged with enlarged perforated upper and lower end portions O² and O³, pivotally connected to the flanges N⁵ and M⁴, respectively, by pins N⁷ and M⁷. The arms O are arranged to extend at right angles to the vertical axis of movement of the mud drum as shown by the arrow in Fig. 2. In the construction shown, all of the pins K², M² and N² are parallel with each other and with the horizontal axis of the upper header G².

With the construction described the boiler tubes B² contract or expand as the temperatures within the furnace decrease or increase. On a contraction of the tubes B², the mud drum B² moves relative to the bridge wall F in the direction of the arrow in Fig. 2, which tends to break the connections between the tubes G² and the upper header G². With the pin provisions illustrated, however, any movement of the mud drum causes a corresponding movement of the upper part of the water wall E. The radius links K move with the mud drum and transmit the movement of the drum to the header and water wall structure, the direction of movement of which is regulated by the radius arms O, which by their construction can only move in a small arc about the pivot point N⁴. The movement of the header and water wall is therefore in a direction substantially parallel to the movement of the mud drum, as shown by the arrows in Fig. 2, thus eliminating any strain on the connections of the tubes G² to the header and mud drum. The shape of the downcomer pipe H, connecting the interior of the mud drum to the lower header G², permits small changes in the position of the mud drum with respect to the lower header without affecting the pipe connections. On the expansion of the tubes B² the movement of the drum and header will be opposite to the movement just described.

My invention is characterized by the simplicity, effectiveness and reliability of the arrangement of parts. The auxiliary link provisions may be incorporated in existing boiler installations without materially changing the construction and at a relatively low cost.

While in accordance with the provisions of the statutes, I have illustrated and described the best form of embodiment of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the form of the apparatus.
disclosed without departing from the spirit of my invention as set forth in the appended claims and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a steam generator of the type comprising a fluid container supported by means subject to substantially vertical movements on temperature variations in said generator, a second fluid container parallel with and spaced away from said first container, connections between said containers, and means connected to each of said containers for moving the second container on a movement of the first container to prevent disruption of said connections.

2. In a steam generator of the type comprising a drum supported by means subject to substantially vertical movements on temperature variations in said generator, a header parallel with and spaced away from said drum, tube connections between said drum and header, and means connected to said header and drum for moving the former on a movement of the latter to prevent disruption of said tube connections.

3. In a steam generator of the type comprising a water tube suspended drum subject to movement on temperature variations in said generator, a header parallel with and spaced away from said drum, a series of side by side tubes forming a water wall and connected at their ends to said drum and header, and means connected to said drum and header for moving the latter on a movement of the former to prevent disruption of said tube connections.

4. In a steam generator of the type comprising a water tube suspended drum subject to movement on temperature variations in said generator, a water wall in one side of the combustion chamber of said generator and comprising a series of side by side tubes connected at their upper ends to a transverse header, a plurality of tubes connecting said header to said drum, and means connected to said header and drum for moving the former on a movement of the latter to prevent disruption of said tube connections.

5. In a steam generator of the type comprising a water tube suspended drum subject to movement on variations in temperature in said generator, a water wall in one side of the combustion chamber of said generator and comprising a series of side by side tubes connected at their upper ends to a transverse header, a plurality of tubes connecting said header to said drum, a radius arm having one end pivoted to the generator housing and its opposite end pivoted to said header and a link connected to said drum and header.

6. In a steam generator of the type comprising a water tube suspended drum arranged to be moved on variations in temperature in said generator, a water wall in one side of the combustion chamber of said generator and comprising a series of parallel tubes connected at their upper ends to a transverse header, a plurality of tubes connecting said header to said drum, a radius arm pivotally secured to said header and to the generator housing and a link having one end connected to said drum and its opposite end to said header at a point in alignment with the point at which said radius arm is connected.

7. In a steam generator of the type comprising upper and lower steam and water drums, said lower drum being supported from said upper drum by vertically disposed tubes and subject to movement due to the expansion or contraction of said tubes on an increase or decrease in temperature in said generator, a water wall in the combustion chamber of said generator comprising a series of parallel water tubes, a transverse header connected to the upper ends of said tubes, a series of tubes connecting said lower drum and header, and means connected to said lower drum and header for moving said header on a movement of said lower drum to prevent disruption of said tube connections.

8. In a steam generator of the type comprising a steam and water drum, a mud drum below said steam and water drum and supported therefrom by a multiplicity of tubes, said mud drum being subject to movements when said tubes are expanded or contracted on a variation of temperature in said generator, a water wall in the combustion chamber of said generator comprising a series of parallel tubes connected at their upper ends to a transverse header, a plurality of tubes connecting said header and mud drum, and means connected to the header and mud drum for moving the former in a direction parallel to the movement of the latter whereby disruption of said tube connections is prevented.

9. A steam generator comprising a plurality of steam and water drums, a mud drum located below and connected to said steam and water drums by a multiplicity of tubes, a combustion chamber, a water wall located in said combustion chamber forming part of the circulating system of the generator, said water wall comprising a series of parallel water tubes, a header connected to one end of each of said water tubes, a series of tubes connected to said mud drum and header, and a series of means connected to said header, mud drum, and a fixed point in said generator whereby on a movement of the mud drum due to the contraction of said first mentioned tubes, said header will be cor-
respondingly moved to prevent disruption of the connections between said header and mud drum.

Signed at New York city, in the county of New York, and State of New York, this 29th day of September, A. D. 1927.

WALTER F. KEENAN, Jr.