Dec. 20, 1966 W. BREDTSCHNEIDER 3,292,597

PARTITION FOR BOILER FIRING CHAMBER

Filed March 10, 1965

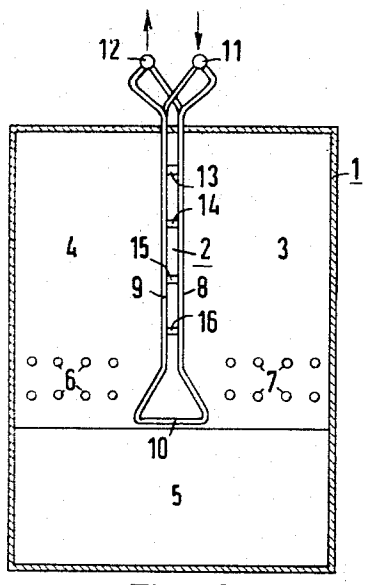

Fig. 2

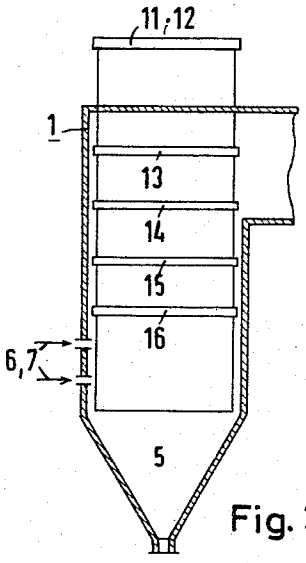

Fig. 3

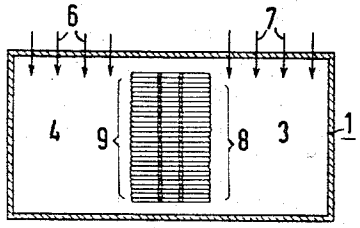

Fig. 1

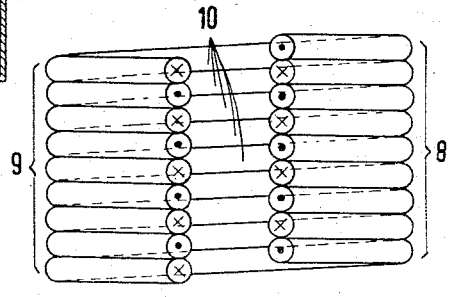

Fig. 4

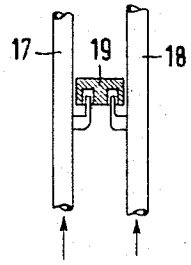

Fig. 5

United States Patent Office 3,292,597
Patented Dec. 20, 1966

3,292,597

PARTITION FOR BOILER FIRING CHAMBER

Walter Bredtschneider, Erlangen, Germany, assignor to Siemens-Schuckertwerke Aktiengesellschaft, Berlin-Siemensstadt, and Erlangen, Germany, a corporation of Germany

Filed Mar. 10, 1965, Ser. No. 439,523
Claims priority, application Germany, Mar. 13, 1964
S 89,994
7 Claims. (Cl. 122—240)

My invention relates to steam generators. More particularly, it relates to forced-flow steam boilers of the "once-through" or series type in which the feedwater is heated, evaporated and the generated steam superheated in a single pass through the tube system of a drumless boiler.

In such boilers, the firing chambers thereof may be subdivided into a plurality of combustion chambers by at least one partition. Such subdivision is often provided in this manner in larger boilers in order to enable the reduction of the height of the boiler. However, in the designing of partitions to effect subdivision of the combustion chambers, many difficulties are encountered. For example, it is difficult to design the partitions with sufficient required rigidity since the supporting structures for the partitions and the partitions with their associated bracing members are subjected to extremely high temperatures during the operation of the boilers whereby great thermal deformations result therein.

In attempts to cope with such difficulties, one technique has been to construct partitions which consist solely of tubes traversed by the working medium, i.e., the fluid heated by the boiler. Such partition forming tubes have been arranged to extend downwardly from the roof of the boiler firing chamber and thence through slide gaps to the outside of the chamber. However, such slide gaps are difficult to seal and frequently are a source of other problems.

Another technique which has been utilized has been the building of planar bulkhead heating surfaces as partitions in firing chambers. However, in large boilers such as those in which firing chamber heights may be 40 meters and greater, such bulkhead heating surfaces become warped and distorted in shape since they cannot be satisfactorily anchored and braced.

Accordingly, it is an important object of this invention to provide a steam boiler having a firing chamber which is partitioned into a plurality of combustion chambers by at least one partition, the partition being so constructed whereby the supporting structures therefor are preserved from warping and distortion through their potection against direct heat radiation.

It is another object to provide a steam boiler in accordance with the preceding object wherein the partition comprises tubes traversed by the working medium, the tubes being arranged to effect the protection for the supporting structures.

In accordance with the invention, the aforesaid objects are attained by effectively forming a partition by providing two spaced parallel arrays of registered closely spaced vertically disposed tubes which are traversed by the working medium. Each of the opposing tubes in the arrays are connected by a base tube whereby there are actually utilized a plurality of open-ended registered U-shaped tubes, each of the tubes formed by two spaced opposing vertically disposed tubes interconnected by a base tube, the bases of the U-shaped tubes forming the base of the array, the planar arrays defining a substantially parallelepiped space therebetween. A plurality of spaced horizontally disposed supoprting bracing members are disposed in this space whereby they provide support but are

saved from warping and distortion by being protected from direct heat radiation.

In accordance with a feature of the invention, the tubes comprising the planar arrays are arranged such that they are alternately traversed, i.e., descendingly or ascendingly, by the working medium, in direct or period alternation. The tubes in the planar arrays are arranged compactly, i.e., closely spaced, even in contact with each other, and protect the support members in the space between the planar arrays from the direct radiation and heating of flame jets. Expansion forces which might cause bending and distortion may be compensated for since upward and downward flow of working medium in the tubes may be made to occur alternately, i.e., serially, in the tubes. To further compensate for expansion forces and to enhance stability, the bases of the U-shaped tubes are preferably in the form of expansion loops which impart an elastic capability.

The supports located in the space between the two spaced planar arrays of vertically disposed tubes may be arranged to permit the vertically disposed tubes to freely extend in the vertical direction but are prevented from being displaced from the planar arrays.

In accordance with another feature of the invention, the U-shaped tubes are arranged whereby one set of alternately occurring tubes are traversed by the working medium in one direction while the other set of alternately occurring tubes are traversed by the working medium in the opposite direction. Thus, in each planar array of vertically disposed tubes, adjacent tubes are traversed by the working medium in opposite directions whereas the vertically disposed tubes from both planar arrays which occur serially, i.e., as by zig-zagging across the space between the arrays, are traversed in the same direction by the working medium. Such staggering of direction of working medium flow need not be confined to alternately occurring single U-shaped tubes but may be effected with groups of tubes.

The upper ends of the two arrays of vertically disposed tubes may terminate some distance from the roof of the firing chamber to permit accessibility to the space between the arrays and the support structures disposed therein. The vertically disposed tubes which are traversed by the working medium in the same direction may be entirely interconnected or may be interconnected by groups thereof, i.e., groups of downwardly traversed tubes and groups of upwardly traversed tubes which respectively have approximately the same temperatures may be combined by groups to achieve an enhancement of the rigidity of the partition. The partition is essentially formed by the two planar arrays of vertically disposed tubes, the space defined therebetween containing only support structures and not structures forming the partition itself.

Generally speaking and in accordance with the invention, there is provided a structure for effecting the partitioning of the firing chamber of a boiler into a plurality of combustion chambers. The structure comprises an array of a plurality of registered closely spaced U-shaped open ended tubes, the tubes being vertically disposed with their bases collectively forming the base of the array, the corresponding legs of the tubes forming two spaced compact substantially planar arrays defining a space therebetween. There are further provided a plurality of spaced substantially horizontally disposed support members substantially coextensive in length with the width of the planar arrays disposed in the space with structures for connecting some of the legs of each of the planar arrays to the support members. Means are provided connected to the respective ends of the aforesaid ones legs of the tubes for supplying working medium to such legs and for collecting heated working medium from the respective other legs of the tubes.

The foregoing and more specific objects and features of my invention will be apparent from, and will be mentioned in the following description of a partition for a boiler firing chamber according to the invention shown by way of example in the accompanying drawing in which FIG. 2 is a schematic depiction of a front elevation partly in section of a partition constructed in accordance with the principles of the invention, FIG. 3 is a schematic depiction of a side elevation of the partition of FIG. 2, FIG. 1 is a cross-sectional view of the depiction shown in FIG. 2, FIG. 4 is a plan view of the partition constructed according to the invention illustrating the alternate arrangement of working medium traversing paths through adjacently disposed tubes, and FIG.5 shows an arrangement in which tubes traversed by the working medium in the same direction may be supportedly connected to the same support member.

Referring now to FIGS. 1 to 4 wherein there is shown a partition for a boiler constructed in accordance with the principles of the invention, the firing chamber **1** of substantiatlly rectangular configuration of a boiler, particularly a large boiler, is effectively subdivided into two combustion chambers **3** and **4** by the partition **2**. An ash funnel **5** is connected to the base of firing chamber **1** and is common to both combustion chambers **3** and **4**. Combustion chambers **3** and **4** are respectively provided with burners **7** and **6**, each of burners **7** and **6** comprising a plurality of jets as shown, the presence of burners **7** and **6** enabling the production of heat through coal dust, oil or gas flame.

Partition **2** comprises a plurality of registered closely spaced or laterally contacted U-shaped tubes, each of the tubes respectively comprising upright tube sections **8** and **9** which form the legs of the U and a portion of **10** which forms the base of the U, tube portion **10** diverging from tube portions **8** and **9** to be shaped as an expansion loop. As is shown in FIG. 2 the tubes are in side by side close contact and in registration whereby the juxtaposed leg portions **8** and **9** respectively collectively present two vertically disposed substantially planar arrays and the juxtaposed base portions **10** collectively present a substantially planar horizontal surface.

Each upright portion **8** or **9** of a tube is individually connected either to an entry distributor **11** or an outlet collector **12**, i.e., each tube has one of its upright sections connected respectively to the distributor and the collector. As shown in FIG. 4 wherein a dot and an X are utilized to indicate whether the flow of working medium is in a downward or upward path therethrough, the U-tubes are so connected to the entry distributor and the collector whereby those upright tube portions which are traversed in the same direction are alternately disposed in the array, i.e., are disposed in series arrangement; consequently, the tubes are alternately traversed by the working medium.

As shown in FIGS. 1 to 3, partition **2**, comprising the array of the tubes, is provided with support structures, viz., braces such as those respectively designed by the numeral **13, 14, 15,** and **16**. As shown these braces are horizontally disposed between upright portions **8** and **9**, the upright portions of the tubes being physically connected thereto. Such connection may be readily visualized by examining FIG. 5.

In this latter figure, a brace such as braces **13, 14, 15** and **16** is shown comprising a horizontally disposed structure **19** to which there are connected tubes **17** and **18** by suitable supports. FIG. 5 is, of course, a schematic detpiction. In practice, a brace such as one of braces **13, 14, 15** and **16** may suitably have randomly connected thereto some of tube portions from the group designated by the numeral **8** and some of the tube portions designated by the numeral **9**. Alternatively, it may be advantageous to consider the tubes as consisting of two types, viz., those in which the working medium passes through in an upward direction and those in which the working medium passes through in a downward direction. With this latter arrangement, an example of which is schematically illustrated in FIG. 5, the advantage is presented that upright tube portions having substantially the same temperature are connected to the same horizontal support **19** of the brace. The tube portions such as represented by tubes **17** and **18** in FIG. 5 are suitably suspended from the roof of the firing chamber and they carry the supporting structure, i.e., members such as support **19**.

It is thus seen, with the firing chamber partition constructed in accordance with the principles of the invention, there is provided a structure utilizing tubes traversed by the working medium in which the support structures therefor are protected from direct heat and consequently are preserved from warping and distorition. The arrangement of flow paths of working medium through the tubes may be chosen to further balance the physical forces at work and thereby further protect the support structures and the tube comprising partition.

It will be obvious to those skilled in the art upon studying this disclosure that partitions for firing chambers of steam boilers according to my invention permit of a great variety of modifications and hence can be given embodiments other than those particularly illustrated and described herein without departing from the essential features of my invention and within the scope of the claims annexed hereto.

I claim:

1. An arrangement for effecting the partitioning of the firing chamber of a boiler having burners at the bottom of the firing chamber into a plurality of combustion chambers comprising an array of a plurality of registered closely spaced U-shaped working medium heating tubes, said tubes being vertically suspended within the firing chamber with their bases forming the base of said array and extending to the vicinity of the burners, the corresponding legs of said tubes respectively forming two spaced planar arrays defining a space therebetween, the legs of each of said U-shaped tubes being staggered relative to each other on opposite sides of said partition so that a leg of one tube on one side of said partition is located opposite a corresponding leg of another tube on the other side of said partition, a plurality of spaced substantially horizontally disposed support members substantially coextensive in length with the width of said planar arrays disposed in said space, structures for connecting some of said legs from each of said arrays to respective ones of said support members, and means connected to the respective upper ends of said tubes for supplying said working medium to and collecting said working medium from said tubes, said supplying and collecting means being connected with said tubes for passing working medium in the same flow direction through the legs of the tubes located at corresponding opposite sides of said partition and for passing working medium in opposite flow direction through adjacent legs of the tubes on the same side of said partition.

2. An arrangement for effecting the partitioning of the firing chamber of a boiler having burners at the bottom of the firing chamber into a plurality of combustion chambers comprising an array of a plurality of registered closely spaced open-ended U-shaped working medium heating tubes, each of said tubes being vertically suspended within the firing chamber and comprising two vertically disposed spaced legs and a base connecting said legs and diverging from said legs to form an expansion loop extending to the vicinity of the burners, the corresponding legs of said tubes respectively forming two spaced planar arrays defining a substantially parallelepiped space therebetween, the legs of each of said U-shaped tubes being staggered relatively to each other on opposite sides of said partition so that a leg of one tube on one side of said partition is located opposite a corresponding leg of another tube on the other side of said partition, the bases forming the base of said tube array, a plurality of spaced substantially horizontally disposed support members

substantially coextensive in length with the width of said planar arrays located in said space, structures for connecting some of the legs from said tube leg arrays to respective ones of said support members, and means connected to the respective upper ends of said tubes for supplying said working medium to and collecting said working medium from said tubes, said supplying and collecting means being connected with said tubes for passing working medium in the same flow direction through the legs of the tubes located at corresponding opposite sides of said partition and for passing working medium in opposite flow direction through adjacent legs of the tubes on the same side of said partition.

3. An arrangement for effecting the partitioning of the firing chamber of a boiler having burners at the bottom of the firing chamber into a plurality of combustion chambers comprising an array of a plurality of registered closely spaced U-shaped working medium heating tubes, each of said tubes being vertically suspended within the firing chamber and comprising two vertically disposed spaced legs and a horizontally disposed base connecting said legs and diverging from said legs to form a substantially trapezoidally shaped expansion loop extending to the vicinity of the burners, the corresponding legs of said tubes forming two spaced planar arrays defining a substantially parallelepiped space therebetween, the legs of each of said U-shaped tubes being staggered relative to each other on opposite sides of said partition so that a leg of one tube on one side of said partition is located opposite a corresponding leg of another tube on the other side of said partition, the bases of said tubes forming a horizontal base for said tube array, a plurality of spaced substantially horizontally disposed support members substantially coextensive in length with the width of said planar arrays located in said space, structures for connecting some of the legs from said planar arrays to respective ones of said support members, working medium supplying means connected to one of the ends of each of said tubes and working medium collecting means connected to the other ends of each of said tubes, said supplying and collecting means being connected with said tubes for passing working medium in the same flow direction through the legs of the tubes located at corresponding opposite sides of said partition and for passing working medium in opposite flow direction through adjacent legs of the tubes on the same side of said partition.

4. An arrangement for effecting the partitioning of the firing chamber of a boiler having burners at the bottom of the firing chamber into a plurality of combustion chambers comprising an array of a plurality of registered closely spaced U-shaped working medium heating tubes, each of said tubes being vertically suspended within the firing chamber and comprising two vertically parallel disposed spaced legs and a horizontally disposed base connecting said legs and diverging from said legs to form a substantially trapezoidally shaped expansion loop extending to the vicinity of the burners, the corresponding legs of said tubes forming two spaced planar arrays defining a substantially parallelepiped space therebetween, the legs of each of said U-shaped tubes being staggered relative to each other on opposite sides of said partition so that a leg of one tube on one side of said partition is located opposite a corresponding leg of another tube on the other side of said partition, the bases of said tubes forming a horizontal base for said tube array, a plurality of spaced substantially horizontally disposed support members substantially coextensive in length with the width of said planar arrays located in said space, structures for connecting some of the legs from said planar arrays to respective ones of said support members, working medium supplying means connected to the ends of one set of alternately occurring tubes located in one of said planar arrays and connected to the ends of the other set of alternately occurring tubes located in the other planar array, and working medium collecting means connected to the other ends of said one group of alternately occurring tubes located in said other of said planar arrays and connected to the other ends of said other set of alternately occurring tubes located in said one planar array, said supplying and collecting means being connected with said tubes for passing working medium in the same flow direction through the legs of the tubes located at corresponding opposite sides of said partition and for passing working medium in opposite flow direction through adjacent legs of the tubes on the same side of said partition.

5. An arrangement for effecting the partitioning of the firing chamber of a boiler having burners at the bottom of the firing chamber into a plurality of combustion chambers comprising an array of a plurality of registered closely spaced U-shaped working medium heating tubes, each of said tubes being vertically suspended within the firing chamber and comprising two vertical parallel disposed spaced legs and a horizontally disposed base connecting said legs and diverging from said legs to form a substantially trapezoidally shaped expansion loop and extending to the vicinity of the burners, the corresponding legs of said tubes forming two spaced planar arrays defining a substantially parallelepiped space therebetween, the legs of each of said U-shaped tubes being staggered relative to each other on opposite sides of said partition so that a leg of one tube on one side of said partition is located opposite a corresponding leg of another tube on the other side of said partition, the bases of said tube forming a horizontal base for said tube array, working medium supplying means connected to the ends of one set of alternately occurring tubes located in one of said planar arrays and connected to the ends of the other set of alternately occurring tubes located in the other planar array, working medium collecting means connected to the other ends of said set of alternately occurring tubes located in said other of said planar arrays and connected to the other ends of said other set of alternately occurring tubes located in said one planar array, and a plurality of spaced substantially horizontally disposed support members substantially coextensive in length with the width of said planar arrays disposed in said space and structures for connecting to respective ones of said support members, respective groups of legs whose ends have like connections to said working medium supplying and collecting means, said supplying and collecting means being connected with said tubes for passing working medium in the same flow direction through the legs of the tubes located at corresponding opposite sides of said partition and for passing working medium in opposite flow direction through adjacent legs of the tubes on the same side of said partition.

6. An arrangement as defined in claim 5 wherein said firing chamber comprises a roof and wherein said tubes are suspended from said roof.

7. An arrangement as defined in claim 6 and further including respective flame jet means for providing heat to each of said combustion chambers.

References Cited by the Examiner

UNITED STATES PATENTS

2,305,611 12/1942 Frisch ..... 122—235

FOREIGN PATENTS

295,788 3/1954 Switzerland.

KENNETH W. SPRAGUE, *Primary Examiner.*