Feb. 4, 1958 W. J. VOGEL 2,821,965

DUAL FURNACE WITH PRESSURE EQUALIZING MEANS

Filed Oct. 1, 1952 4 Sheets-Sheet 1

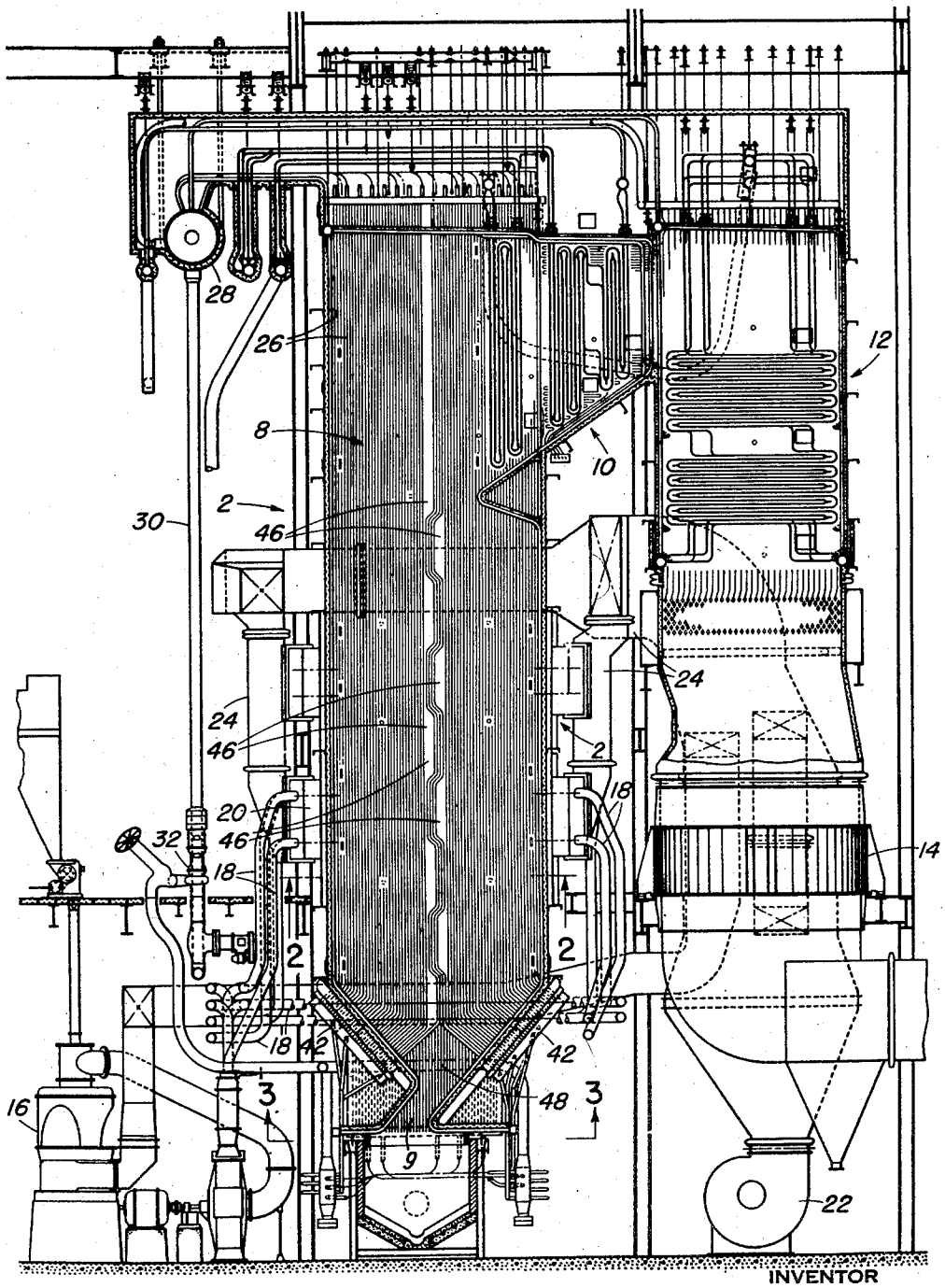


Fig. 1.

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Fig. 2.

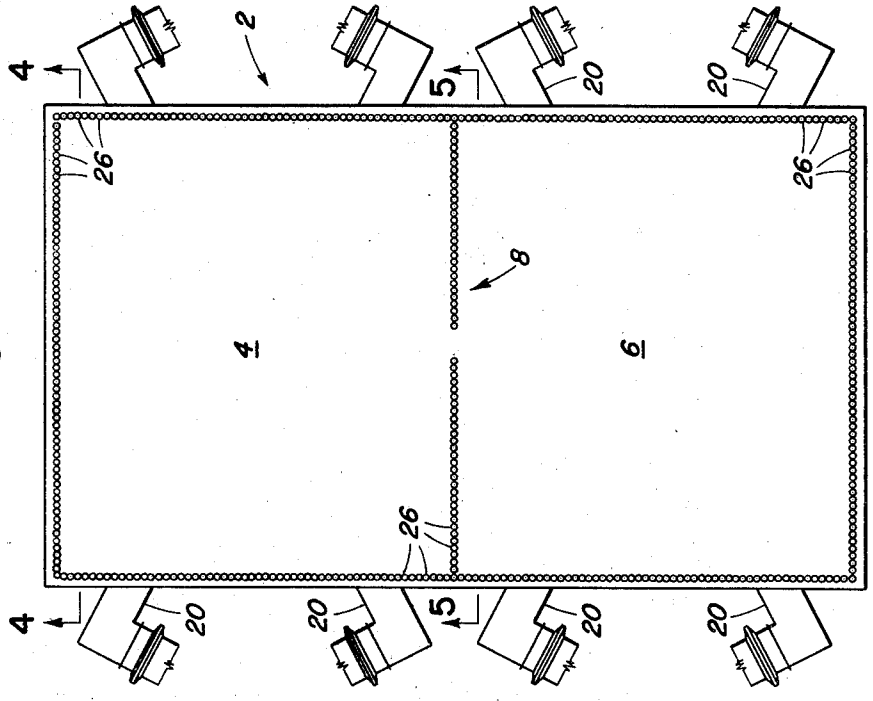
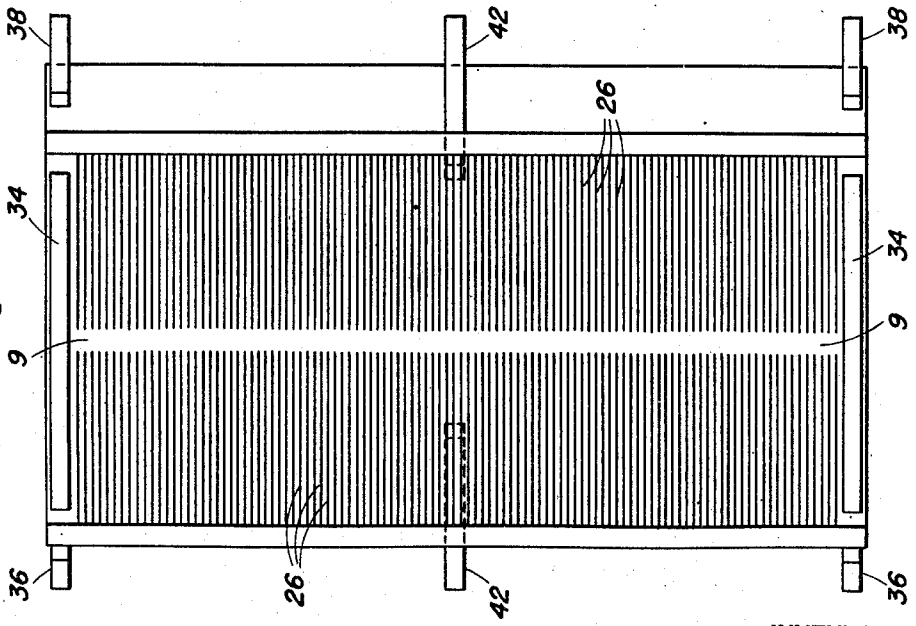


Fig. 3.



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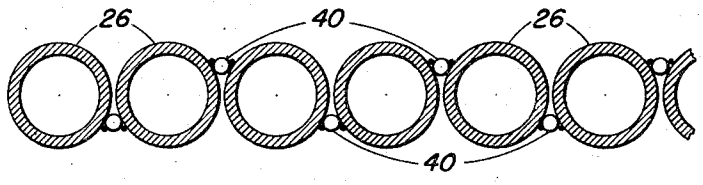


Fig. 7.

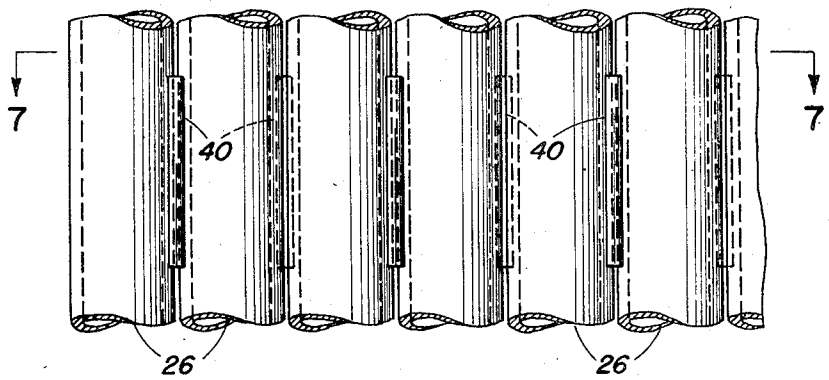


Fig. 6.

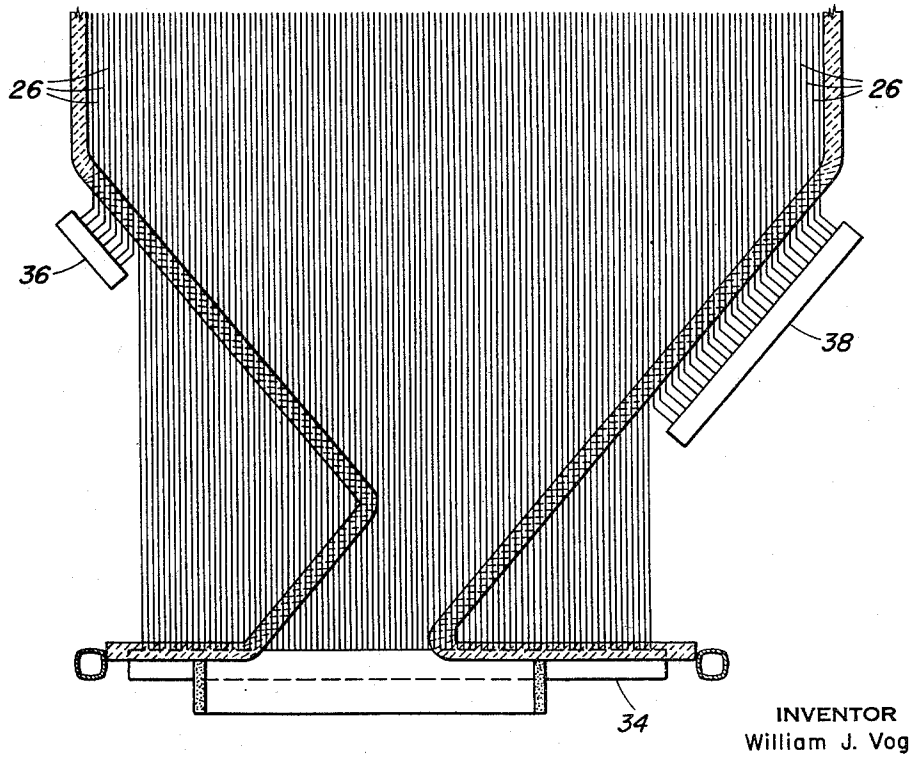


Fig. 4.

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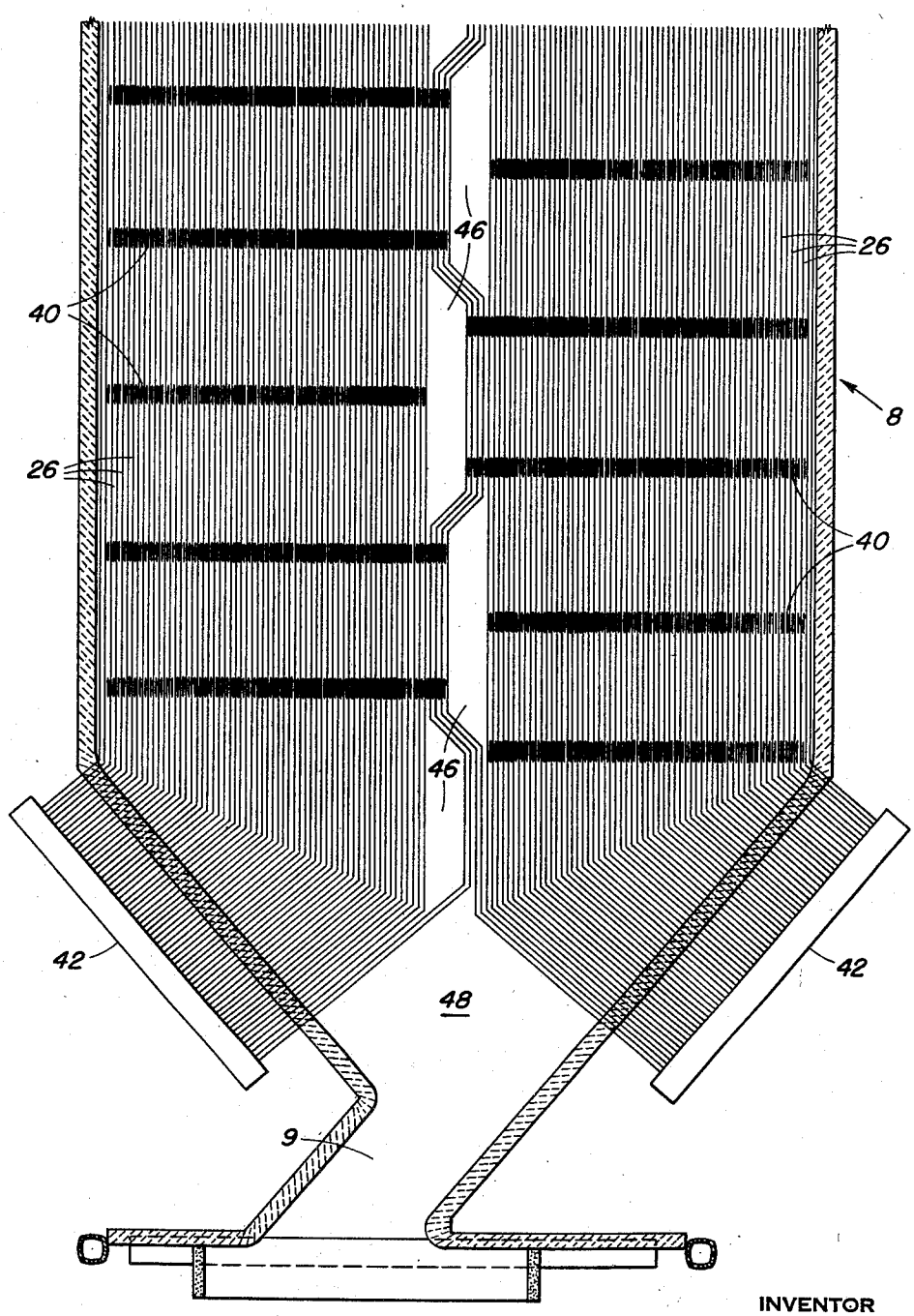


Fig. 5.

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2,821,965

DUAL FURNACE WITH PRESSURE EQUALIZING MEANS

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Application October 1, 1952, Serial No. 312,514

6 Claims. (Cl. 122—240)

My invention relates generally to water walled furnaces for steam generators of large capacity and specifically to a dual furnace of this type wherein need exists for means for equalizing the pressure within the two chambers of the furnace.

It is the general object of my invention to provide a multi-chambered water walled furnace with means for equalizing the pressure within the various furnace chambers.

A more specific object is to provide a dual furnace of the water wall type with centrally located openings in the division wall thereof effective to equalize the pressure on each side of said division wall.

Other and further objects of my invention will become apparent to those skilled in the art as the description hereof proceeds.

With the aforementioned objects in view, my invention comprises an arrangement, construction and combination of the elements of the dual furnace which attains the results desired as hereafter more particularly set forth in the following detailed description of an illustrative embodiment, said embodiment being shown in the accompanying drawings wherein:

Fig. 1 is a view, partially in section, of a large capacity steam generator embodying my invention;

Fig. 2 is a transverse sectional view of the furnace of said generator taken generally on line 2—2 of Fig. 1 and showing the disposition of the division wall and the location of the burners for each of the furnace chambers;

Fig. 3 is a transverse sectional view taken generally on line 3—3 of Fig. 1 and showing the header arrangement at the lower portion of the furnace;

Fig. 4 is a sectional view taken generally along line 4—4 of Fig. 2 and showing in detail the construction of the lower portion of one of the furnace side walls;

Fig. 5 is a sectional view taken generally along line 5—5 of Fig. 2 and showing in detail the construction of the lower portion of the central division wall;

Fig. 6 is an enlarged view of a portion of said division wall showing the means for rigidly binding the tubes together; and

Fig. 7 is a sectional view taken generally along line 7—7 of Fig. 6.

While my invention is herein disclosed as employed with a controlled circulation steam generator it is to be understood that this is merely illustrative and not restrictive and that the invention is adaptable for use in other and different installations than the one herein illustratively disclosed.

In designing the water walled furnace of a modern high capacity steam generator one of the primary features that must be considered is the ratio of the projected area of water wall surface of the furnace to the volume of said furnace. In order to have a highly efficient furnace this ratio must be maintained within predetermined limits and it is obvious that, with the use of side walls alone, this ratio will change as the furnace size changes

due to the fact that the area increases by the square while the volume increases by the cube. Thus, in order for the extremely large furnaces of present day design to have the desired projected area of water wall surface to volume ratio it has been necessary to provide these furnaces with center division walls to increase the projected area of water wall surface sufficiently to compensate for the relative greater increase in furnace volume.

Since both sides of such a division wall are exposed to hot combustion gases the conventional means for rigidly securing the wall tubes together, including bars extending transversely of the tubes and welded thereto, cannot be used because they would quickly be destroyed by the intense heat of said gases. This is due to the fact that these bars project laterally from the tubes and thus would extend into the flow path of the hot combustion gases.

Resort must therefore be had to means for fastening the tubes together which does not project a substantial distance laterally of the tubes and which is in good heat exchange relation with the tubes. Such means will necessarily result in a wall somewhat weaker than the ordinary furnace wall and for this reason it is necessary to provide some means for equalizing the pressure on each side of the wall in order to prevent distortion or vibration thereof. This becomes clearly evident when it is considered that division walls for furnaces of modern high capacity steam generators are in the order of one hundred feet high and forty feet wide so that a slight pressure differential results in a large force acting upon the tremendous area of such a wall.

My invention contemplates a dual furnace having a novel division wall which is extremely practical and entirely satisfactory in operation, satisfying all of the aforementioned requirements.

The illustrative steam generator here shown

Referring to the drawings wherein like reference characters are used throughout to designate like parts, the steam generator of Fig. 1 includes an elongated generally vertical furnace 2 of rectangular transverse section divided into furnace compartments 4 and 6 by vertically extending division wall 8 disposed between and interconnecting the front and back walls of the furnace. The upper portion of said furnace is in communication through its rear wall with horizontal gas pass 10 which extends substantially the full distance across said rear wall and which communicates with the upper end of gas pass 12 leading to air preheater 14. Fuel is supplied to said furnace through a conventional system including pulverizers 16, conduits 18 and burners 20.

Said burners 20, as best shown in Fig. 2, are located adjacent the corners of the two furnace compartments 4 and 6 for the purpose of tangential firing in a well known manner. Preheated air is supplied to the furnace by means of forced draft fan 22 arranged to force cold air through preheater 14 from which it is conveyed by ducts 24 to furnace 2 and introduced into the same adjacent burners 20. The lower portions of the front and rear walls of the furnace slope inwardly to form a hopper bottom for the furnace with an ash removal opening 9 located centrally thereof.

The furnace of the illustrative steam generator of Fig. 1 is of the water cooled type and for this purpose has the inner face of the four walls lined with steam generating tubes 26 and division wall 8 completely made up of said tubes 26. Said tubes are connected into the boiler circulation system in a well known manner, said circulating system including steam and water drum 28, downcomers 30 and circulation pumps 32 all fluidly interconnected. Suitable headers are provided to distribute the water to the tubes of the various walls with

each of the side walls having a horizontal header 34 and angularly disposed headers 36 and 38 (Fig. 4) and the center wall having headers 42 positioned adjacent to and in parallel relation with the sloping portions of the front and rear walls of the furnace. Pumps 32 are effective to circulate the water from steam and water drum 28 downwardly through downcomers 30 into the various headers from whence said water flows upwardly through tubes 26 and back into said drum 28. In the steam generator herein disclosed each of the steam generating tubes is preferably provided with a flow restrictor (not shown) associated with the inlet thereof to control the flow through the tubes in a predetermined manner.

The furnace division wall

My novel division wall 8 as herein illustratively disclosed (Figs. 5, 6 and 7) is fabricated of steam generating tubes 26 as aforementioned, said tubes extending vertically throughout the length of furnace 2 and being positioned in a common plane in side by side relation. The tubes of said division wall are rigidly secured together by means of rods 40 positioned on alternate sides of and intermediate adjacent tubes and welded thereto. Said rods 40 are relatively short (see Fig. 16), being in the order of a few inches, and are positioned in spaced horizontal rows (Fig. 5) throughout the length of the wall. The diameter of the rods is such that when said rods are in position intermediate the tubes they lie well inwardly of the outermost extent of the surface of the division wall (see Fig. 7).

The lower ends of the division wall tubes are bent outwardly so that they intersect at substantially 90 degrees the sloping portion of the front and rear walls which form the hopper bottom for furnace 2, with the tubes on the side of the center of said division wall adjacent the front wall being bent to intersect and pass through said front wall and the remainder of said tubes being oppositely bent to intersect and pass through the rear wall. The tubes are bent so that the distance between tube centers, of tubes bent in the same direction, remains constant with the tube bends lying in a line which has a more gradual slope to the horizontal than the slope of the walls of the hopper bottom.

The ends of said tubes are connected into headers 42, which headers are parallel with the walls of said hopper bottom. By arranging the division wall tubes in this manner an extremely compact tube and header design is achieved which produces a large centrally located passage 48 establishing communication between furnace compartments 4 and 6 and effective to equalize the pressure in the two furnace compartments.

A plurality of immediately adjacent centrally located tubes of the division wall 8 are sinuous or horizontally offset at a number of vertical positions, as clearly shown in Figs. 1 and 5, thereby forming a number of openings 46, which, together with the large passage 48, effectively establish communications between chambers 4 and 6 throughout the length of division wall 8. The communication thus established quickly eliminates any differential in pressure between the compartments 4 and 6 developed through unequal supply of fuel or air to said compartment or for any of a number of other reasons. Since said communication is established through the center of the wall, where the wall is the weakest and the deflection caused by a differential pressure in the two compartments the greatest, the deflection of said wall produced during the time required for the elimination of any differential pressure in said compartments is reduced to a minimum. With the openings effectively extending throughout the length of the wall, obviously unequal pressures will be equalized throughout the length of the wall.

Summary

It will thus be seen that I have provided a dual furnace for a modern high capacity steam generator with a division wall of an extremly unique and compact design and which has numerous centrally disposed openings effectively establishing communication between the compartments of said furnace throughout the length of said wall and that the lower ends of the tubes of said wall are uniquely arranged to form a large pressure equalizing opening and are connected into suitable headers compactly disposed adjacent the sloping walls of the furnace's hopper bottom.

While I have illustrated and described a preferred embodiment of my novel dual furnace organization it is to be understood that such is merely illustrative and not restrictive and that variations and modifications may be made therein without departing from the spirit and scope of the invention. I therefore do not wish to be limited to the precise details set forth but desire to avail myself of such changes and alterations as fall within the purview of my invention.

What I claim is:

1. In a steam generator of the type described, an elongated furnace having an outlet for combustion gases adjacent one end thereof, a partition wall extending from a point adjacent the other end of said furnace throughout the length thereof to said one end, said wall dividing said furnace into two compartments each of which is in direct communication with said outlet, said wall comprising contiguous steam generating tubes in tangent relation to one another, the axis of said tubes being disposed in a single plane and extending longitudinally of said furnace, a number of centrally disposed immediate adjacent tubes being bent uniformly, to the same extent and in unison within said plane first in the one direction and then in the opposite direction a plurality of times throughout the length of the wall to form a plurality of openings along the length of said wall for eliminating pressure differentials between the two compartments, and juxtaposed tubes of said wall being rigidly connected together at a plurality of points throughout the length of the wall.

2. In a steam generator of the type described, an elongated furnace having an outlet for combustion gases adjacent one end thereof, a partition wall extending from a point adjacent the other end of said furnace throughout the length thereof to said one end, said wall dividing said furnace into two compartments each of which is in direct communication with said outlet, said wall comprising steam generating tubes disposed in a single plane in immediately adjacent side by side relation so that adjacent tubes are tangent, with the tubes extending longitudinally of said furnace, means rigidly welding said tubes together including a plurality of longitudinally spaced rows of relatively short rods, said rods being disposed between and welded to adjacent tubes and being contained entirely within the outermost extremities of the wall surfaces, a number of centrally disposed immediately adjacent tubes being bent uniformly, to the same extent and in unison within said plane, first in one direction and then in the opposite direction a plurality of times throughout the length of the wall to form a plurality of openings along the length of said wall for eliminating pressure differentials between the two compartments.

3. A dual furnace for a steam generator or the like comprising a plurality of elongated vertical outer walls joined at their vertical edges to form a chamber of polygonal section with two of said walls being opposed and parallel and having their bottom portions sloped inwardly to form a restricted opening for the removal of refuse, a division wall positioned within said furnace and extending between said opposed walls from a position adjacent the sloped portions vertically throughout the length thereof, thereby forming two furnace chambers, said division wall including numerous vertical contiguous tubes positioned in a common plane and rigidly welded together, at least one of said tubes having a plurality of horizontally offset portions within said plane providing openings

in said division wall thereby effectively establishing communication between the two furnace chambers throughout the length of the division wall, the lower ends of a substantial number of immediate adjacent tubes being bent to intersect the sloping portion of the adjacent one of said parallel walls at substantially right angles and the lower ends of the remainder of said tubes being oppositely bent to intersect the sloping portion of the other of said parallel walls at substantially right angles with the distance between tube centers of the tubes of each group remaining substantially constant, whereby an opening of substantial size interconnecting the two chambers is formed at the bottom of said division wall, said last mentioned opening together with said first mentioned openings being effective to equalize the pressure within the two furnace chambers.

4. A dual furnace for a steam generator or the like comprising a plurality of elongated vertical outer walls joined at their vertical edges to form a chamber of polygonal section with two of said walls being opposed and parallel and having their bottom portions sloped inwardly to form a restricted opening for the removal of refuse, a division wall positioned within said furnace and extending between said opposed walls from a position adjacent the sloped portions vertically throughout the length thereof, thereby forming two furnace chambers, said division wall including numerous vertical contiguous tubes positioned in a common plane and rigidly welded together, at least one of said tubes having a plurality of horizontally offset portions within said plane providing openings in said division wall thereby effectively establishing communication between the two furnace chambers throughout the length of the division wall, the lower ends of a substantial number of immediate adjacent tubes being bent to intersect the sloping portion of the adjacent wall at right angles and the lower ends of the remainder of said tubes being oppositely bent to intersect the sloping portion of the other wall at right angles with the distance between tube centers of the tubes of each group remaining substantially constant, whereby an opening of substantial size interconnecting the two chambers is formed at the bottom of said division wall, and a header juxtaposed to the sloping portions of each of said walls in parallelism and having the lower ends of the division wall tubes intersecting the respective walls connected thereinto.

5. In a steam generator, a dual furnace having two pairs of opposed elongated vertical walls joined to form a vertically elongated chamber of rectangular transverse section, one of said pairs of opposed walls sloping sharply inward at the bottom thereof for a predetermined distance to form a hopper bottom for said furnace provided with an opening in the lower portion thereof through which refuse may be removed, a lateral offtake extending substantially the entire distance across the upper portion of one of the walls of said one pair of opposed walls for egress of hot combustion gases from said furnace, a vertical division wall extending between said one pair of walls and bisecting the same said division wall extending from a position adjacent the sloping portions of said walls upwardly throughout the length thereof, thereby

forming two furnace chambers in direct communication with said lateral offtake, said division wall being fabricated of vertically disposed tubes in side by side relation having their axes disposed in a common plane with adjacent tubes rigidly welded together, a number of centrally located immediate adjacent tubes being of serpentine form within said common plane thereby providing openings which effectively establish communication between said two furnace chambers throughout the length of said division wall, the lower ends of the tubes on one side of said serpentine tubes being bent to intersect the sloping portion of one of the walls of said one pair of walls with the tube bends lying along a line disposed at a substantially smaller angle to the horizontal than said sloping portion of said one wall, the tubes on the other side of said serpentine tubes being similarly bent but in the opposite direction to intersect at right angles the sloping portion of the other wall of said one pair of walls with the tube bends lying along a line disposed at a substantially smaller angle to the horizontal than the sloping portion of said other wall whereby an opening is formed at the bottom of said division wall interconnecting the two furnace chambers, and header means disposed in parallel relation to the sloping portions of said walls and into which the ends of said tubes associated with the particular wall are connected.

6. A furnace for a steam generator comprising a plurality of vertical outer walls joined at their vertical edges to form a chamber of polygonal section with two of said walls being opposed and parallel and having their bottom portions sloped inwardly to form a restricted opening for the removal of refuse, a division wall positioned within said furnace generally normal to and extending the entire distance between said opposed walls from a position adjacent the sloped portions vertically throughout the length thereof thereby forming two furnace compartments, said division wall comprising vertical tubes placed in side by side relation and rigidly welded together, the lower ends of the tubes disposed generally on one side of the center of the wall being bent to intersect the sloping portion of the adjacent one of said parallel walls at substantially right angles and the lower ends of the remainder of said tubes being oppositely bent to intersect the sloping portion of the other of said parallel walls at substantially right angles with the distance between tube centers of the tubes of each group remaining substantially constant, and header means disposed adjacent and generally parallel to said sloping portions and into which said tubes are connected.

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