Aug. 11, 1953 W. J. KUNZ 2,648,315

BOILER FURNACE WALL CONSTRUCTION

Filed Jan. 22, 1947 2 Sheets-Sheet 1

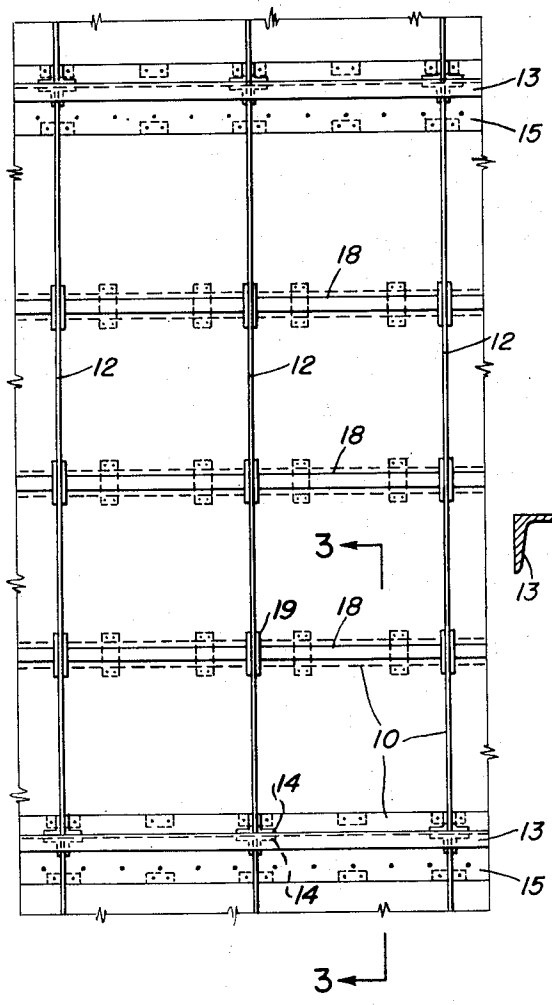


Fig. 1.

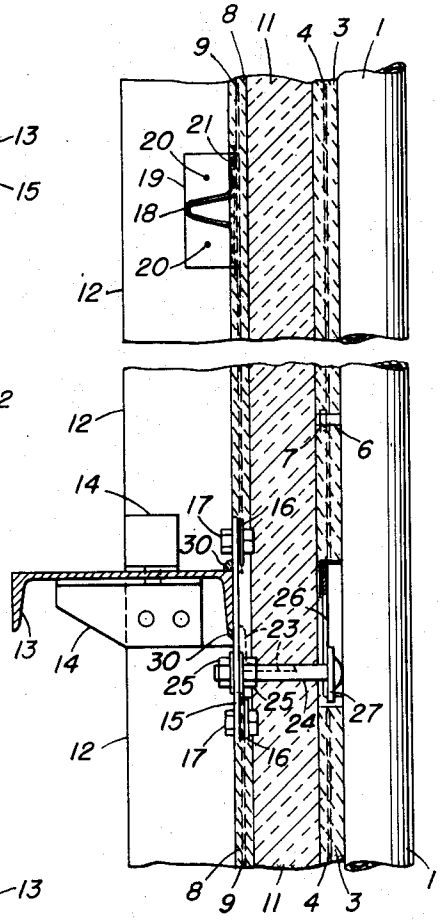


Fig. 3.

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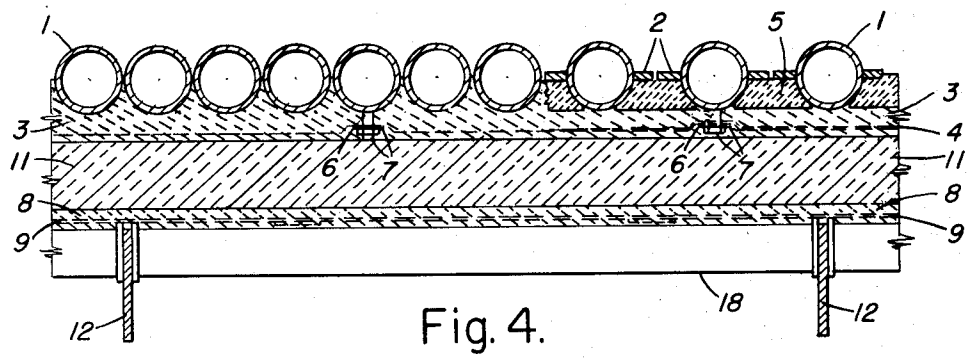


Fig. 4.

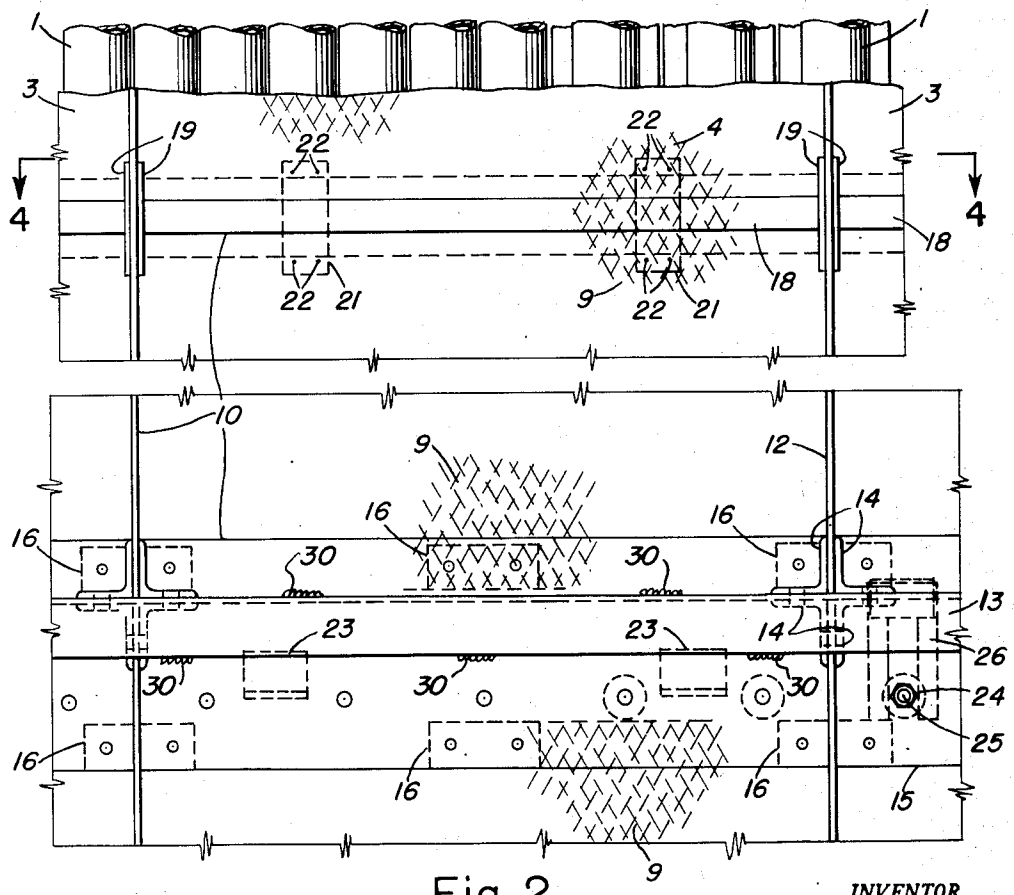


Fig. 2.

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BOILER FURNACE WALL CONSTRUCTION

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4 Claims. (Cl. 122—6)

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This invention relates to furnace walls and in particular to furnace walls whose inner faces are lined with fluid-cooled tubes, as in the furnaces for steam generators.

A satisfactory construction of furnace walls for a steam generator comprises an inner lining of fluid-cooled tubes which are exposed on their inner sides to the heat from the burning fuel and are covered on their outer sides with a layer of refractory material backed by a layer of insulation and the whole wall structure covered by a steel casing built sufficiently strong to resist furnace pressures. Because of the cost of this steel enclosed construction there have been increased requests for less expensive walls of plastic construction.

In general, the plastic walls as heretofore constructed, are made in one homogeneous mass, necessitating the expansion and contraction of the entire wall as a unit. Because of the variation in temperatures through the wall, from the inside or hot side to the outside or cold side, cracks develop throughout the wall to relieve the stresses imposed by the resulting differences in expansion. In some instances these cracks are sufficiently large to cause gas or air leakage within or through the wall and patching becomes necessary to stop such leaks.

It is an object of this invention to provide an improved furnace wall construction with the use of plastic material.

In the following description I have set forth in detail the preferred embodiment of the invention. Of the drawings:

Figure 1 is a fragmentary elevation of the outside of a furnace wall embodying my improved structure;

Figure 2 is an enlarged fragmentary elevation of a typical panel shown in Figure 1;

Figure 3 is an enlarged section in elevation taken on line 3—3 of Figure 1; and

Figure 4 is a section taken on line 4—4 of Figure 2.

The furnace wall here illustrated comprises a row or bank of vertical fluid-cooled tubes 1 lining the outside of the furnace. These tubes are exposed on their inner sides to the heat from the burning fuel, the temperature of combustion being generally well over 2000 deg. F. In steam generators such furnace tubes are connected, for flow of cooling fluid therethrough, into water circulation with the boiler in a well known manner. The tubes 1 may be arranged in a row in side by side relation as shown in the left half of Figures 2 and 4 or they may be in spaced

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apart relation as shown in the right half of said figures. In the latter arrangement they are preferably provided with welded on fins 2 which project into the intertube space to substantially close the gap between tubes. These fins absorb heat which flows to the tubes and into the water therein.

On the outer side of the row of tubes 1 there is provided an inner, metal reinforced slab 3 of plastic refractory material, the reinforcing metal 4 being preferably an expanded metal or heavy wire mesh. This reinforced slab 3 extends continuously over the entire outside surface of the tube wall and is of substantially uniform thickness, forming a monolithic layer or backing to the tubes. In case the tubes 1 are arranged in side by side relation as shown on the left half of Figure 4, the plastic of slab 3 may extend into the spaces between tubes. In case the tubes 1 are arranged in spaced apart relation as shown in the right half of Figure 4, the intertube space 5 between the fins 2 and the plane tangent to the backs of the tubes is preferably filled in by high heat resisting refractory blocks shaped to fit into the space or by a plastic of said refractory material.

The plastic slab 3 is of substantial thickness and due to its reinforcement resists bending as well as cracking. The slab 3 will cooperate with the remaining wall structure, to be hereafter described, in resisting and distributing the pressures both internal and external of the furnace.

The reinforcing 4, or expanded metal, is spaced from the backs of the tubes by studs 6 which are welded to the tubes 1 and extend rearwardly therefrom. The reinforcing is held in place and is supported by studs 6 as by nuts and washers or other suitable fastening devices 7. In this manner the entire inner slab 3 is supported by and secured to the tube bank 1.

The inner slab 3 approaches the average temperature of the rearward portion of the fluid-cooled steel tubes and fins. The expansion of the tubes 1 and the refractory material 3 and the reinforcing steel 4 are substantially the same for the same range in temperature. Consequently the bank of tubes 1 and slab 3 expand together in directions parallel to the tube bank and any injurious expansion strains between the two to cause cracks are thereby avoided.

Spaced from and parallel to the inner wall slab 3 is an outer, metal reinforced slab 8 of plastic material and similar in construction to the inner slab 3. Preferably expanded metal or heavy wire mesh reinforcing 9 is used. This outer reinforced

slab 8 is supported from an outer structure of steelwork 10 independently of the tube bank and the inner slab 3. Intermediate the inner and outer slabs 3 and 8 is a layer of heat insulating material 11 which preferably comprises a multiplicity of rectangular blocks placed side by side to fill the entire inter slab space.

The outer steel structure 10 of the illustrated example, comprises horizontally spaced, vertical bars 12 which are suspended in a well known manner from steel beams (not shown). At spaced vertical intervals along the length of bars 12 are horizontal buckstays 13 extending across the width of the furnace wall and fastened, at the corners of the furnace, to the corresponding buckstays of the adjacent walls to form a wall stiffening, girth member around the furnace which maintains the alignment of all wall members and is capable of resisting any outward pressure exerted by possible internal explosion.

The buckstays 13 or channels are fastened to the bars 12 as by angle clips 14. To each buckstay 13 is fastened, such as by welding 30, a girth plate 15 extending flush within the outer surface of the outer slab 8. The sheets of expanded metal reinforcing 9 of the outer slab 8 extend partly across the back of girth plate 15 from above and below and are clamped thereto for support by a multiplicity of small plates 16 which are placed on the inner sides of the reinforcing 9 and held to the girth plate 15 by bolts 17.

Intermediate the buckstays 13 and between bars 12, are a multiplicity of vertically spaced, horizontal stiffeners 18 fastened at their ends to vertical bars 12 as by clips 19 and bolts 20. Fastened to the inside of each stiffener 18 are plates 21 which lie within the outer slab 8 and to which the reinforcing 9 of the outer slab is fastened as by wires passing through holes 22. In this manner the entire outer slab 8 is supported and stiffened by the outer steel structure 10.

The girth plates 15 of buckstays 13 have angle clips 23 fastened to their inner sides at horizontally spaced intervals (Figures 2 and 3). One leg of the clips 23 extends inwardly to act as a support for blocks of heat insulation 11 between the inner and outer slabs 3 and 8.

To maintain a fixed spaced relation between the inner and outer slabs 3 and 8, each girth plate 15 is provided with a multiplicity of horizontally spaced, spacing means. In the illustrated form, each spacing means comprises a spacing bolt 24 rigidly fastened to girth plate 15 as by nuts 25 and extending inwardly with its head adjacent the outer side of the furnace tubes 1. A vertically slotted channel member 26 is fastened, as by welding, to a furnace tube 1, located with its slot straddling the spacing bolt 24 and spaced from the tube to allow the head of the bolt to freely move between the slot and tube. The width of the slot is greater than the diameter of the spacing bolt 24 to allow for some relative horizontal as well as vertical movement, and a washer 27 prevents the bolt head from passing through the slot. The spacing bolts 24 are adjusted by means of nuts 25 to snugly contain the insulation 11 between the inner and outer slabs 3 and 8. The spacing means described above is similar to that shown in the U. S. patent to W. J. Kunz et al. No. 2,223,215, issued November 26, 1940, and also serves to hold the furnace tubes in spaced alignment with the furnace steelwork 10.

In operation, wheen fuel is being burned within the furnace, the inner slab 3 approaches the average temperature of the rearward portion of the tubes and fins and the entire structure including the tube bank and slab expand together without injurious expansion strains which may cause cracks. The outer slab 8 approaches the temperature of the boiler room and its movement due to expansion is entirely independent of that of the inner slab 3. The outer surface of the inner slab 3 and the inner surface of the outer slab 8 constitute substantially parallel planes between which is held the insulation 11. The outer surface of the inner slab 3 that adjoins the insulation 11 provides a plane along which relative movements occur due to different expansions of the inner slab and the outer slab with respect to the installation.

Obviously if desired, the inner reinforced plastic slab 3 may be used in combination with an outer steel casing structure in place of the outer reinforced slab 8 as described.

While the preferred embodiment of my invention has been shown and described, it will be understood that changes in construction, combination and arrangement of parts may be made without departing from the spirit and scope of the invention as claimed.

What I claim is:

1. In a furnace wall, the combination of fluid-cooled tubes disposed along the wall's inner face in heat receiving relation to the furnace combustion chamber; an inner monolithic slab of plastic refractory material positioned against the backs of said tubes and having expansion characteristics which substantally match those of said tubes over the range of temperatures encountered during furnace operation; mesh-like reinforcing metal incorporated into said slab; stud bolts welded to the backs of said tubes and extending into the slab and cooperating with said reinforcing metal to secure said inner slab to the tube backs and to support said slab from said tubes for expansion and contraction together therewith; an outer slab of plastic refractory material positioned substantially parallel to said inner slab in spaced relation thereto and having reinforcing metal incorporated therein; said outer slab also comprising a layer of heat insulating material filling the aforesaid space between the inner and outer plastic slabs and serving to separate same in a way which permits relative movement between the slabs along the inner slab surface that adjoins the insulating layer and which latter causes the outer plastic slab temperature to be substantially independent of the inner slab temperature; an external structure for holding said outer plastic slab in its aforesaid position and for stiffening said entire wall against movement outwardly from the furnace center, said structure comprising spaced buckstay, stiffening and supporting members disposed adjacent the outer slab's exterior surface; and means cooperating with the outer slab's reinforcing metal and with the heat insulating material, for supporting said insulating material from the aforesaid external structure and for fastening said outer slab to the said external structure so as to provide for outer plastic slab stiffening and support which is independent of the earlier described support derived by said inner plastic slab from the furnace tubes whereby each of the aforesaid inner and outer slabs is permitted to expand and contract independently of the other without transmission of resultant movements therebetween or inducement in either

slab of injurious mechanical stresses due to temperature differentials encountered during furnace operation.

2. A furnace wall comprising a layer of parallel side by side tubes making up the inner surface thereof, a reinforced plastic refractory slab supported from and positioned against the back of these tubes and having expansion characteristics substantially matching those of the tubes, a second reinforced plastic slab spaced outwardly of the first mentioned slab, heat insulation disposed in the space between the two slabs, outer support structure supported independently of the tubes and secured to the reinforcing of the outer slab thereby supporting the same independently of the tubes, and means effectively secured to the outer support structure and associated with said heat insulation for supporting the same from said structure.

3. A furnace wall comprising a plurality of parallel tubes arranged in side by side relation and making up the inner face of said wall; an inner slab of plastic refractory material having expansion characteristics the same as those of the tubes and having reinforcing wire mesh embedded therein; studs disposed between certain of said tubes and said reinforcing means and secured to both thereby supporting said inner plastic slab from said tubes whereby the two move in unison; an outer plastic slab lying parallel to and spaced outwardly from said inner slab and having reinforcing wire mesh embedded therein; steel stiffening and support members positioned adjacent the outer surface of the outer slab and supported independently of said tubes, said members including bars disposed parallel to said tubes and buckstays disposed transversely of said tubes, said bars and buckstays being effectively secured to the reinforcing in said outer slab thereby supporting said outer slab; means effective to maintain the spacing between the tubes and the outer slab substantially constant while permitting limited relative movement; a rigid insulating material disposed within and filling the space between said slabs; and means effectively secured to said buckstays for supporting said insulating material whereby it moves in unison with the outer slab and steel support members.

4. A furnace wall as defined by claim 3 wherein the buckstays are provided with girth plates disposed in the plane of the other plastic slab and to which the reinforcement in said slab is secured, and wherein the means for supporting the insulating material disposed in the space between the slabs comprises angular members secured to said girth plate and projecting into said insulation.

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