June 7, 1938. R. M. HARDGROVE ET AL 2,120,129

FURNACE

Filed June 24, 1936 2 Sheets-Sheet 1

Fig. 1

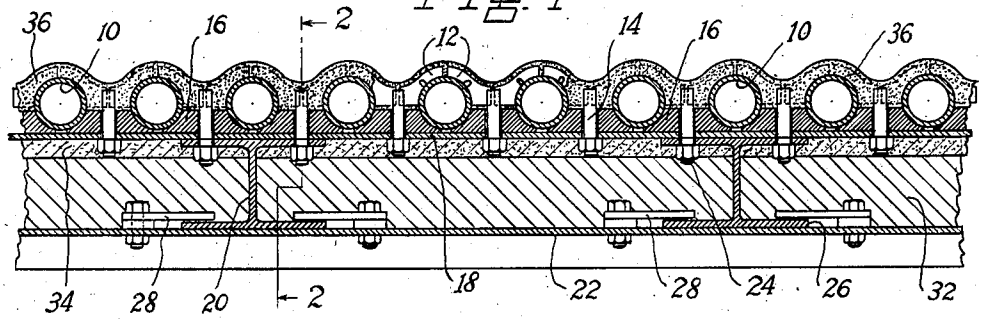


Fig. 3

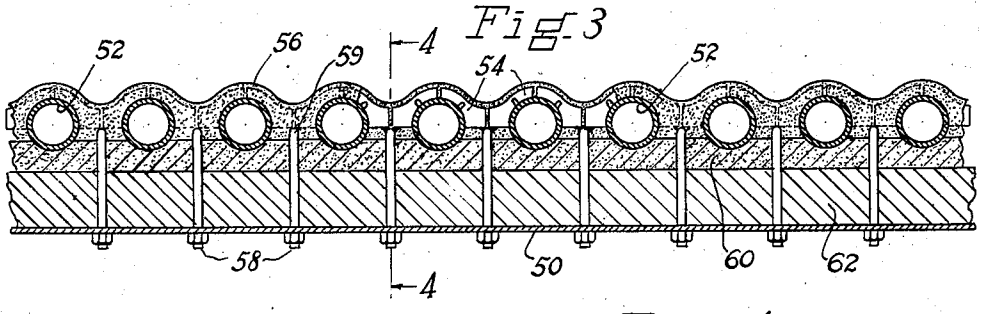


Fig. 2

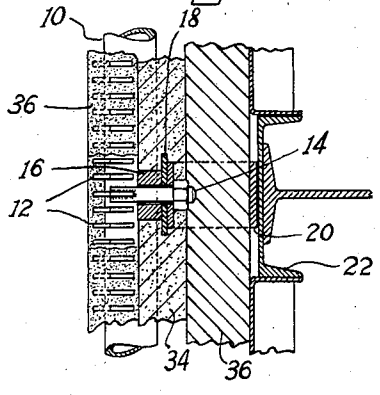


Fig. 4

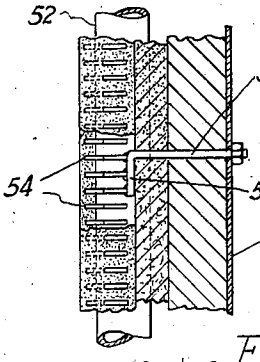


Fig. 17

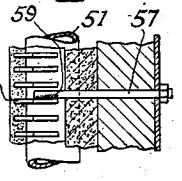


Fig. 5

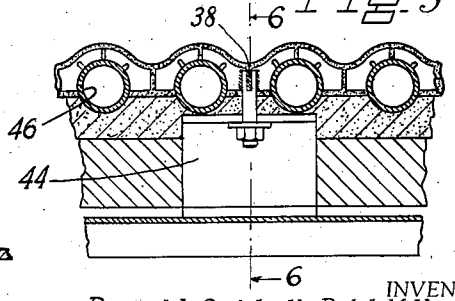
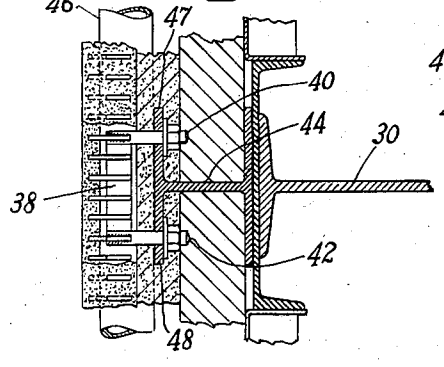


Fig. 6



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Fig. 7

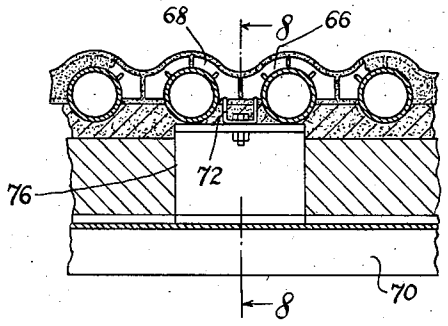


Fig. 8

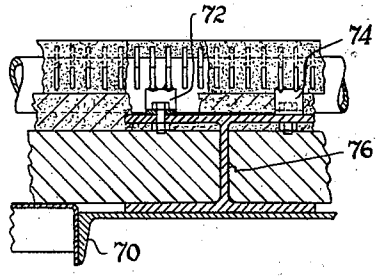


Fig. 9

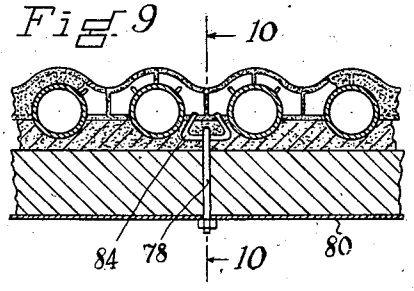


Fig. 10

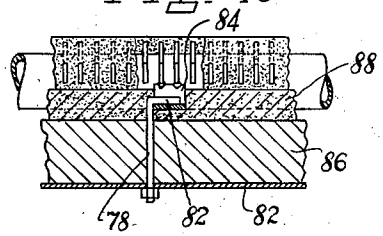


Fig. 11

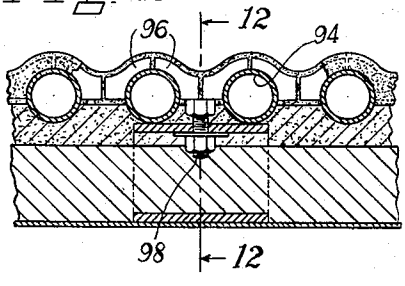


Fig. 12

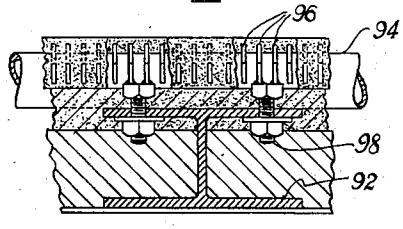


Fig. 13

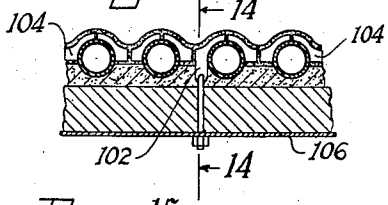


Fig. 14

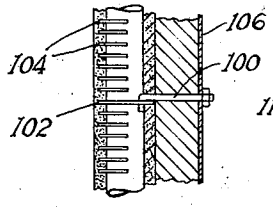


Fig. 16

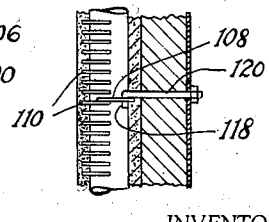
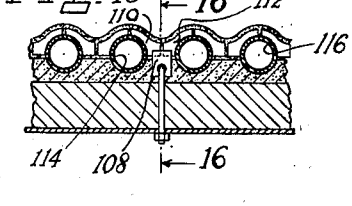


Fig. 15



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UNITED STATES PATENT OFFICE

2,120,129

FURNACE

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Application June 24, 1936, Serial No. 86,896

10 Claims. (Cl. 122—6)

This invention relates to furnaces, and, more particularly, to furnaces which include fluid cooled walls.

An object of the invention is to provide a furnace wall with a row of fluid cooled tubes having extended surface members so associated with bonding elements that the tubes are maintained in alignment and insulating material is maintained thereby exteriorly of the tubes so as to prevent heat losses and maintain the wall elements in their bonded relationships.

Another object of the invention is to minimize difficulties which have been experienced in placing the wall insulating material and the outer casing in their operable positions with respect to the inner part of the wall which includes the fluid cooled tubes. By the present invention, bonding members may be placed in position with the insulating material and interlocked with cooperating bonding members secured to extended surface elements on the tubes in such a way as to increase the maximum tolerances in the positioning of the cooperating bonding members on the extended surface elements and the wall casing, respectively.

Other objects of the invention will appear as the accompanying description proceeds.

The invention will be described with reference to the particular embodiments shown in the accompanying drawings, in which:

Fig. 1 is a transverse section of the furnace wall indicated in Fig. 2 of the drawings.

Fig. 2 is a longitudinal section of the Fig. 1 wall, taken on the line of 2—2 of Fig. 1.

Fig. 3 is a transverse section of the wall indicated in Fig. 4.

Fig. 4 is the longitudinal section of Fig. 3 wall, taken on section line 4—4 of Fig. 3.

Fig. 5 is the transverse section of the embodiment of the invention indicated in Fig. 6 of the drawings.

Fig. 6 is the longitudinal section taken on the section line 6—6 of Fig. 5.

Fig. 7 is the transverse section of the Fig. 8 wall.

Fig. 8 is the longitudinal section taken on line 8—8 of Fig. 7.

Fig. 9 is a transverse section of the embodiment of the invention indicated in Fig. 10 of the drawings.

Fig. 10 is a longitudinal section taken on the line 10—10 of Fig. 9.

Fig. 11 is a transverse section of an additional embodiment of the invention.

Fig. 12 is a longitudinal section taken on the section line 12—12 of Fig. 11.

Fig. 13 is a transverse, or horizontal, section of an embodiment of the invention in which the extended surface elements of the tubes afford parts of the tension means which bond the inner, or tube wall, to the casing and the insulating material.

Fig. 14 is a longitudinal, or vertical, section taken on the line 14—14 of Fig. 13.

Fig. 15 is a transverse section of a wall in which parts of the bonding means are provided by members which also tie together adjacent extended surface elements projecting toward positions midway of adjacent wall tubes.

Fig. 16 is a longitudinal, or vertical, section taken on the line 16—16 of Fig. 15.

Fig. 17 is a partial vertical section of a modified furnace wall construction in which the tension element is unilinear with its inner end welded to the stud plates.

In the furnace construction indicated in Fig. 1 of the drawings, the inner wall includes the fluid cooled wall tubes 10 which are arranged in a row as shown. These tubes are connected into the fluid circulation system and, on their sides presented toward the burning fuel of the furnace, they are provided with extended surface elements in the form of the transverse metal plates 12. The plates are preferably welded to the tubes and they are so formed that they extend into the inter-tube spaces. That is, the plates extending from the facing sides of adjacent tubes extend towards each other. Their adjacent ends are, however, preferably slightly spaced.

At positions preferably midway between adjacent tubes, the ends of plates 12 are received in the slots formed in the inner ends of the tie bolts 14. In order that the wall tubes may be maintained in their wall alignment, each tie bolt is preferably welded to the tube plates contacted by it.

The tie bolts 14 extend through saddle blocks 16 and then through appropriately spaced openings in a plate 18. This plate is held against short structural steel sections 20 which are shown secured to the channel 22, which is a part of the supporting steel-work. Some of the tie bolts extend through the flanges of the sections 20, as indicated at 24, and it will be clear that the inner wall is tightly held in place when the tie bolts are tightened.

The outer flanges 26 of the sections 20 are held against the buckstay channel 22 by the clips 28,

and this channel may be reinforced by such an I-beam as that shown in Fig. 6 at 30.

Between the channel plate 22 and the plate 18, there is located insulating material 32. This material may be in the form of blocks and, between its inner surface and plate 18, a loose insulating layer 34 may be located. The wall is completed by refractory material 36 of high heat resisting capacity, installed as a plastic over the plates 12 and the tubes 10.

When the adjacent tubes 10 of the furnace wall are tied together by bars 38 positioned between the plates 12 of adjacent tubes and welded thereto, a construction is presented like that shown in Figs. 5 and 6. In Fig. 6 a section of the bar 38 is indicated as extending between two adjacent tie bolts 40 and 42. They also may be welded thereto. It will be noted that, in the Fig. 6 construction, the structural steel section 44 extends transversely relative to the tubes 46, so that the tie bolts 40 and 42, secured to oppositely extending flanges 47 and 48 of that section, will be spaced longitudinally of the tubes. Also in the modification indicated in Figs. 5 and 6, the tubes 46 may rest directly against the section 44.

Figs. 3 and 4 show a modification of the invention wherein the tubes are bonded to the casing 50 at positions between adjacent buckstays. In this modification the inner wall is provided with tubes 52 and the extended surface plates 54 are arranged in the same manner as they are in Fig. 1. The inner wall also includes a similar refractory material 56 forming the fire face of the wall. In this construction, however, the tie bolts 58 and their inner ends 59, bend at right angles as shown in Fig. 4. These inner ends thus extend longitudinally of the tubes so that they contact with a plurality of the plates 54 extending from each tube. The tie bolts are preferably welded to all of the contacting plates, and the bolts contact with a plurality of plates extending from each of two adjacent tubes, the tubes and plates being thereby held in alignment. The bolts extend through insulating layers 60 and 62, similar to those described with reference to the modifications shown in Fig. 1.

In all of the remaining embodiments the arrangement of the inner wall including the tubes, the extended surface plates, and the refractory forming the fire face of the wall is the same as that described with reference to the preceding embodiments. Figs. 7 and 8 illustrate the plates 66 and 68 as secured to the buckstay channel 70 by U-shaped clips 72 and 74. Each clip is preferably welded to adjacent plates extending towards each other from adjacent tubes as shown, and the clips are bolted to the H-beam sections 76 which, in turn, may be rigidly secured to the channel 70 in any desired manner.

The embodiment shown in Figs. 9 and 10 includes an L-shaped bolt 78 extending through the casing 80 and having its inner end 82 bent at right angles and extending down through a clip 84. The clip 84 is similar to the corresponding element indicated in Figs. 7 and 8, but it is so formed as to give greater latitude in connecting the casing 80 and the interposed insulation 86 and 88 to the tubes. In erecting a furnace wall of this type, this particular arrangement of elements is advantageous because it does not demand an exact alignment between the casing openings for the elements 78 and the cooperating bonding elements 84, secured to the extended surface plates.

The modification indicated in Figs. 11 and 12 includes an H-beam section 92 which contacts with the tubes 94 as shown. The extended surface plates 96 are secured to the elements 92 by bolts 98, the heads of which are welded to the plates, as shown.

In the modification shown in Figs. 13 and 14, the L-shaped bolts 100 extend downwardly through openings formed in some of the extended surface plates 102. These plates are shaped somewhat differently from the plates 104, and have portions extended toward the casing 106.

The modification shown in Figs. 15 and 16 of the drawings include plates 108 which overlap the stud plates 110 and 112 extending toward each other from the tubes 114 and 116. Each of these plates 108 is provided with an opening through which extends the downwardly projected end 118 of the casing bolt 120.

It is to be understood that the tie bolts, or tension members shown in Figs. 5–17 inclusive, may be employed for each pair of wall tubes. Some may be arranged so that the tubes of each pair of successive wall tubes have a tie bolt between them, or, in the event that the stud extensions from adjacent tubes are otherwise bonded, the tie bolts may be arranged with a greater spacing. Such clips as those shown in Fig. 1 may also be employed in the constructions indicated in Figs. 5, 7, and 11.

In the Fig. 17 embodiment the tie rod 57 is a straight extension bolt welded to the nearest stud plate or to a pair of the plates 53 extending from adjoining tubes 51. Such a weld is indicated at 59.

Whereas the invention has been described with reference to the detail structures of a few modifications it is to be appreciated that it may not be considered as limited thereto. It is rather of a scope commensurate with the scope of the subjoined claims.

We claim:

1. In a furnace wall adapted for use as a part of a steam boiler or other fluid heat exchange apparatus, an inner wall construction including spaced wall tubes having transverse extended surface elements welded thereto, an outer metallic structure, ceramic refractory material presenting a furnace face and positioned between the tubes and also between the elements, heat insulation material between the outer structure and the inner wall, and transverse tension means each secured to a plurality of extended surface elements on adjacent tubes and extending through said insulation material for bonding the wall elements together.

2. In a furnace wall, spaced wall tubes having transverse metal plates welded thereto, ceramic refractory material bonded by the plates and positioned between them so as to present a furnace face, a metallic casing, heat insulation material between the casing and the tubes, metallic bonding members in the form of transverse tension elements each of which is secured to a plurality of the plates extending from adjacent tubes, and refractory material installed as a plastic over the tubes and the plates to form the fire face of the wall.

3. In a furnace, spaced wall tubes, transverse metal plates welded to the tubes, ceramic refractory material between the tubes and also between the plates, an outer metal structure, heat insulation material between the tubes and said structure, and metallic tension means each secured to separate plates extending toward each

other from adjacent tubes and engaging said structure to bind the tubes and said structure against the insulating material, said means including inter-engaging elements capable of relative movement without detracting from the bonded condition of the wall.

4. In a furnace wall adapted for use as a part of a steam boiler or other fluid heat exchange apparatus, an inner wall construction including spaced wall tubes having transverse metal plates welded thereto, ceramic refractory material between the plates and forming a furnace face, an outer metallic structure, heat insulation material between said structure and the inner wall, and slotted tie-bolts each secured to a plurality of plates from adjacent tubes and extending through said insulation material for bonding the wall elements together.

5. In a furnace wall adapted for use as a part of a steam boiler or other fluid heat exchange apparatus, an inner wall construction including spaced wall tubes having transverse metal plates welded thereto, ceramic refractory material between the plates and forming a furnace face, a metallic outer structure, heat insulation material between said structure and the inner wall, and transverse tension means each secured to plates extending from adjacent tubes and each extending through said insulation material for bonding the wall elements together.

6. In a furnace wall adapted for use as a part of a steam boiler or other fluid heat exchange apparatus, an inner wall construction including spaced wall tubes having transverse metal plates welded thereto, ceramic refractory material between the plates and forming a furnace face, a metallic outer structure, heat insulation material between said outer structure and the inner wall, and tension bolts each having slot and pin connections with the plates extending from adjacent tubes, said bolts extending through said insulation material for bonding the wall elements together.

7. In a furnace wall, spaced wall tubes having transverse extended surface elements welded thereto, ceramic refractory material presenting a furnace face and positioned between the tubes and also between the elements, a metallic casing, heat insulation material between the casing and the tubes, metallic tension members each of which is connected to a plurality of said elements extending from adjacent tubes, and refractory material installed as a plastic over the tubes and said elements to form the fire face of the wall.

8. In a furnace, spaced wall tubes, transverse extended surface elements welded to the tubes, ceramic refractory material presenting a furnace face and positioned between the tubes and also between the elements, an outer metal structure, heat insulation material between the tubes and said structure, and metallic tension means each connected to separate elements extending toward each other from adjacent tubes and engaging said structure to bind the tubes and said structure against the insulation material.

9. In a furnace wall, spaced wall tubes having transverse extended surface elements welded thereto, ceramic refractory material presenting a furnace face and positioned between the tubes and also between the elements, an outer metallic structure, heat insulation material between the outer structure and the tubes, metallic bonding members each of which is secured to a plurality of said elements extending from adjacent tubes, and refractory material installed as a plastic over the tubes and said elements to form the fire face of the wall, said bonding members extending through the insulation material to press the tubes and the outer structure toward the insulation material.

10. In a furnace spaced wall tubes, transverse extended surface elements welded to the tubes, ceramic refractory material presenting a furnace face and positioned between the tubes and also between the elements, an outer metal structure, heat insulation material between the tubes and said structure, and metallic tension each means connected to surface elements extending toward each other from adjacent tubes and engaging said structure to bind the tubes and said structure against the insulation material, said means including inter-engaging clips and bolts capable of relative movement without detracting from the bonded condition of the wall.

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