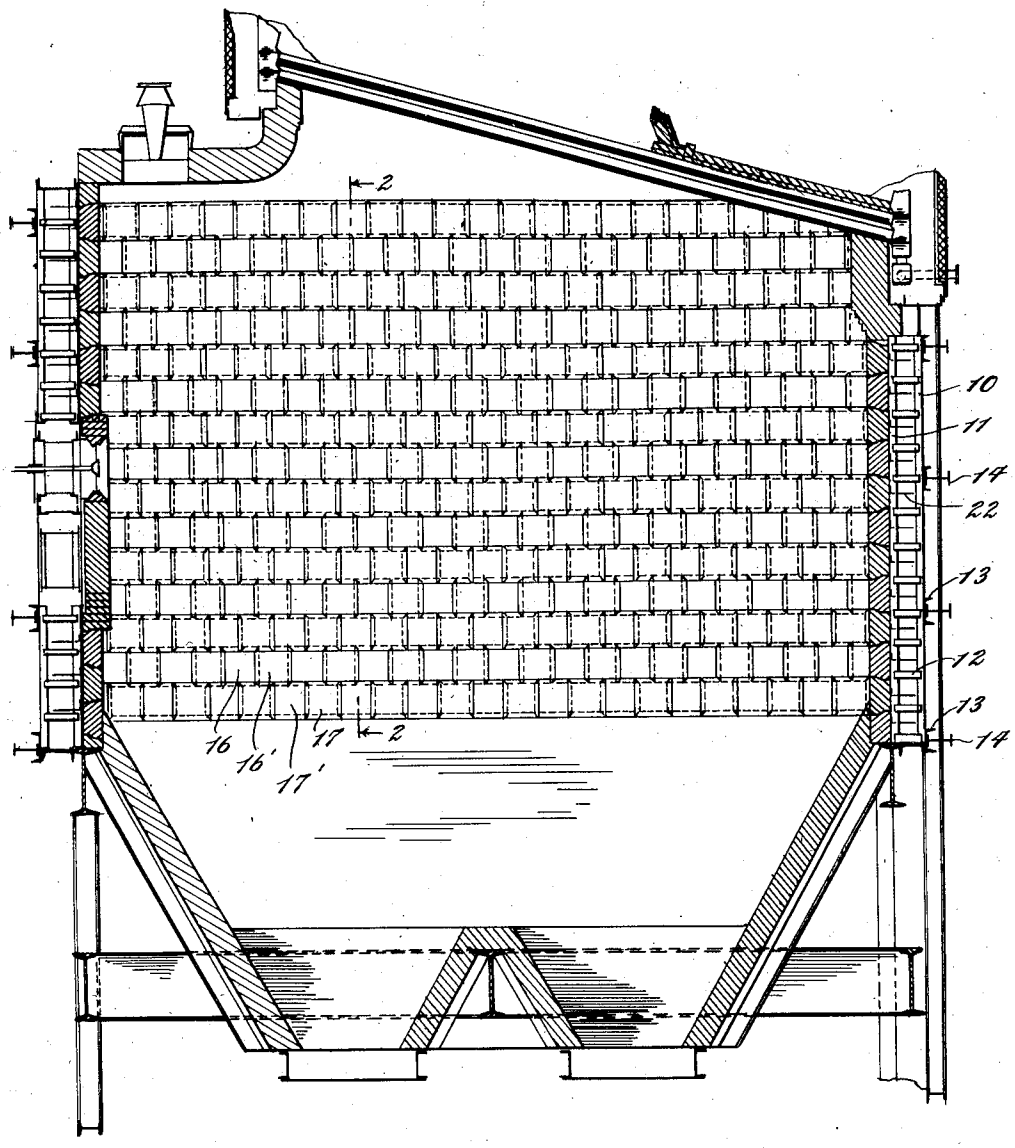
July 2, 1929. D. S. JACOBUS ET AL 1,719,475

FURNACE

Filed Oct. 15, 1925 4 Sheets-Sheet 1

Fig. 1.

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FURNACE

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Fig. 2.

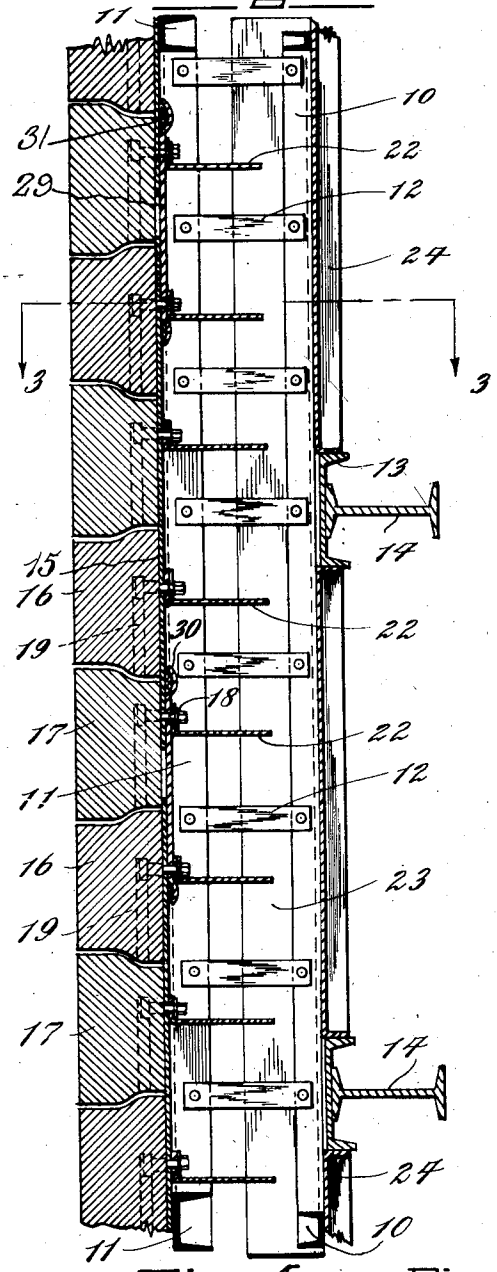


Fig. 3.

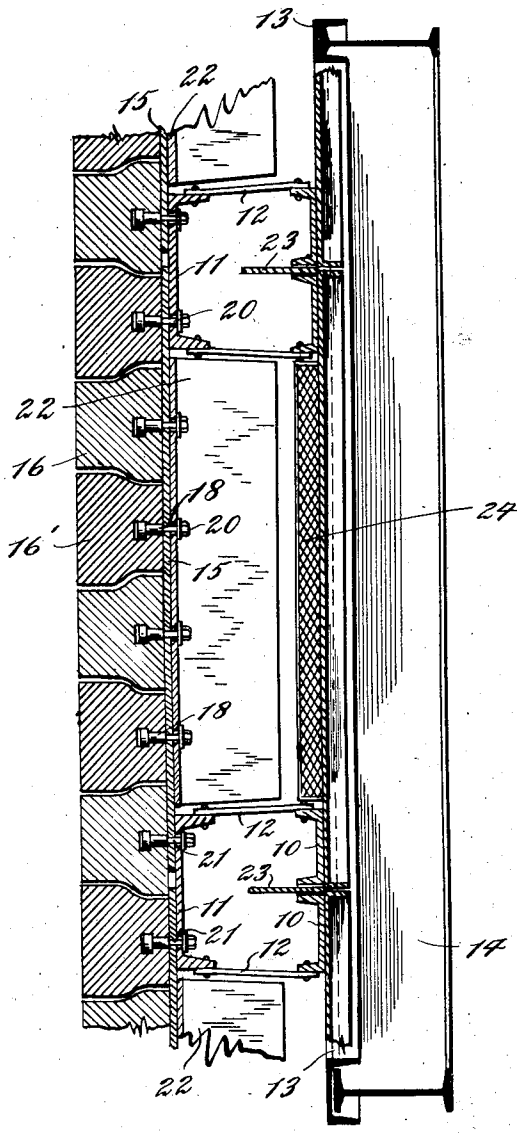


Fig. 4.

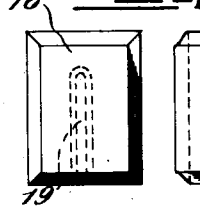


Fig. 5.

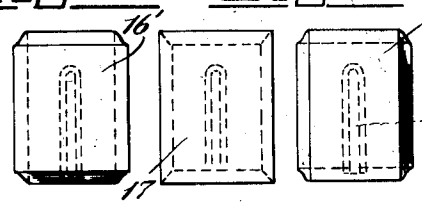


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Fig. 6

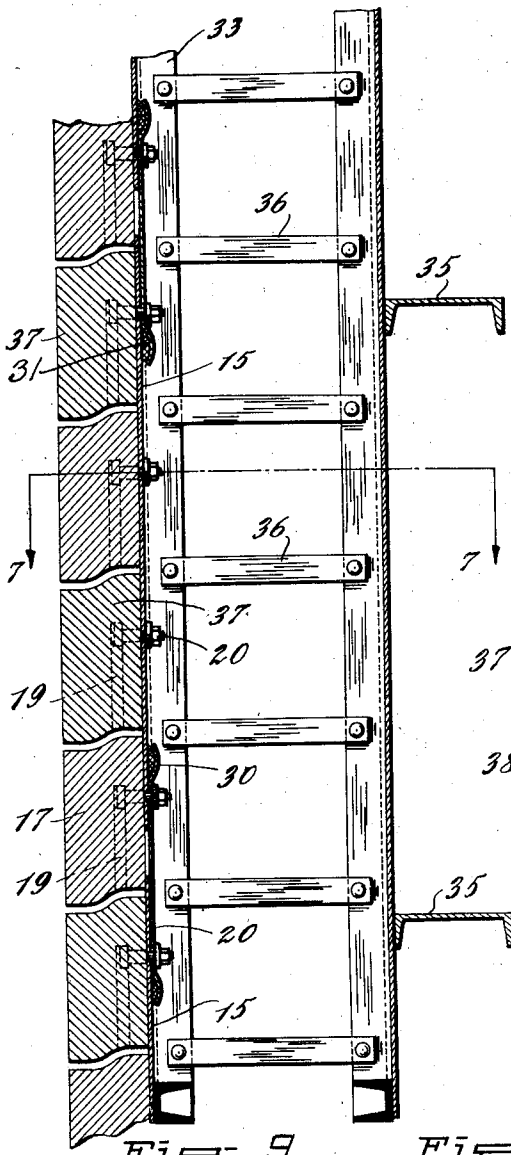


Fig. 7

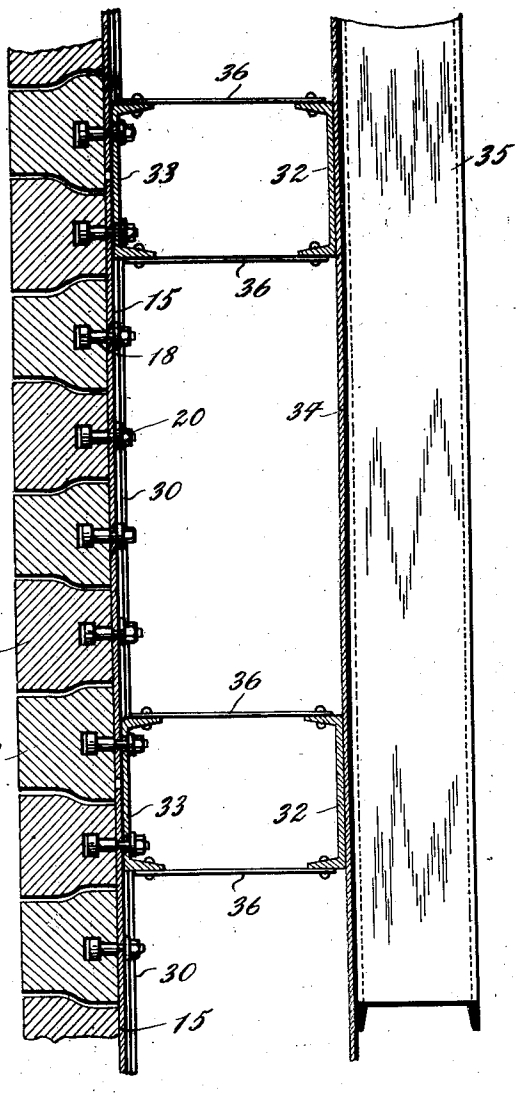


Fig. 9

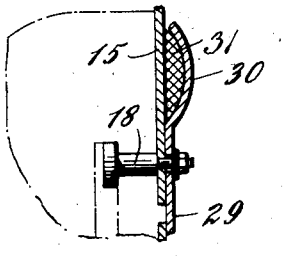


Fig. 8

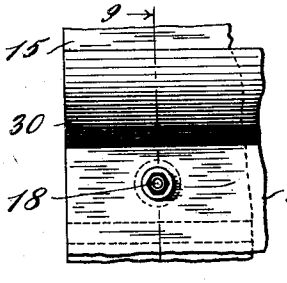


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Fig. 10

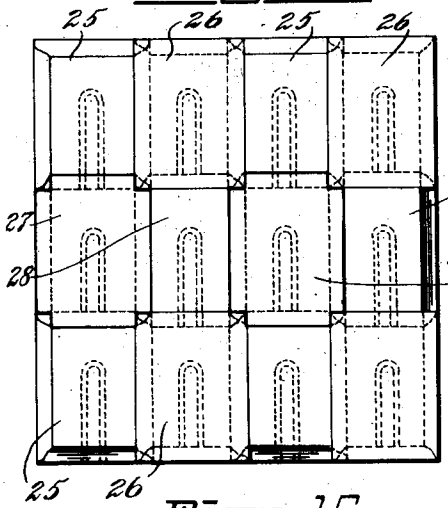



Fig. 11

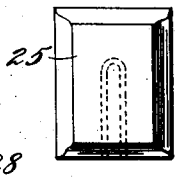



Fig. 12

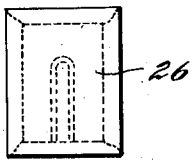



Fig. 13

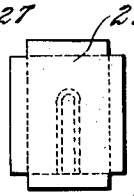



Fig. 14

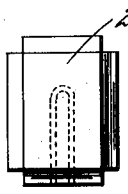



Fig. 15

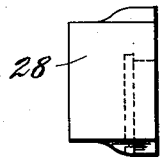



Fig. 16

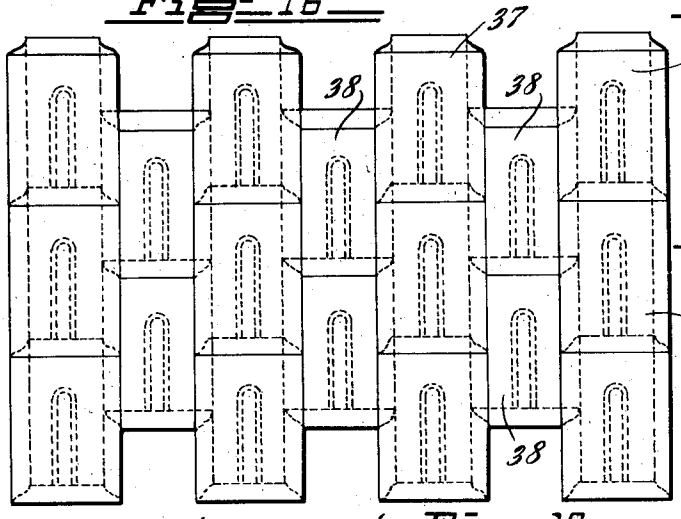



Fig. 17

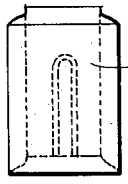



Fig. 18

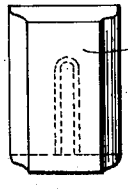
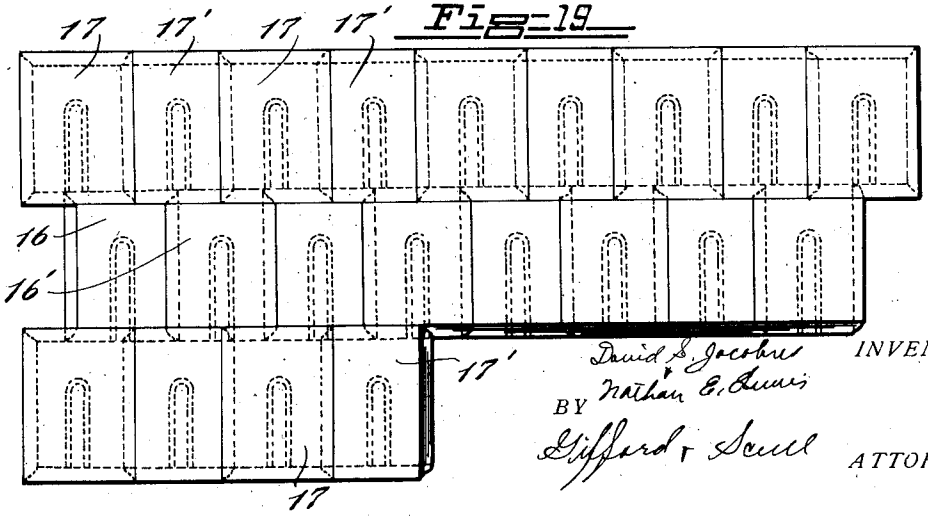



Fig. 19

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Patented July 2, 1929. 1,719,475

# UNITED STATES PATENT OFFICE.

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## FURNACE.

Application filed October 15, 1925. Serial No. 62,513.

Our present invention relates to improvements in furnaces, and particularly the walls thereof, and will be best understood from the following description and the annexed drawings, in which Fig. 1 is a vertical longitudinal section of a typical form of furnace chamber for a steam boiler which we have chosen for purposes of illustration of our invention; Fig. 2 is a vertical section on a larger scale of a portion of the wall shown in Fig. 1; Fig. 3 is a section on the line 3—3 of Fig. 2; Fig. 4 is a front view of a pair of adjacent tile of one of the courses shown in Fig. 1; Fig. 5 is a front view of a pair of adjacent tile in another of the courses shown in Fig. 1, the tile in Figs. 4 and 5 being separated laterally for purposes of illustration; Fig. 6 is a view similar to Fig. 2, but showing a modification; Fig. 7 is a section on the line 7—7 of Fig. 6; Fig. 8 is a front view of a portion of the sealing device used in each of the forms of our invention which we have illustrated; Fig. 9 is a section on the line 9—9 of Fig. 8; Fig. 10 is a front view of a portion of the wall, showing a different arrangement of tile from that shown in Fig. 1; Figs. 11, 12, 13 and 14 are front views respectively of individual tile used in the arrangement shown in Fig. 10; Fig. 15 is a side view of Fig. 14; Fig. 16 shows the front view of another arrangement of tile; Fig. 17 and Fig. 18 are front views of the individual tile used in Fig. 16, and Fig. 19 is an enlarged view of the arrangement of the tile shown in the wall of Fig. 1.

Like reference characters indicate like parts in the several views.

One of the objects of our invention is to provide a wall which, when used in an air-cooled furnace, will provide ducts for the air under pressure so that such air may flow along the outer face of the wall to cool it without danger of excessive infiltration of such air through the refractory wall, provision being made, in some embodiments, to cause the air to be distributed more or less evenly over the entire outer face of the wall.

Another of the objects of our invention is to provide a furnace wall in which the refractory tile may be formed in panels, each panel being made up of a metallic plate to which some of the tile are attached, this metallic plate, in turn, being supported on fixed members.

In the arrangement shown in Figs. 1, 2 and 3, the furnace chamber has vertical walls which may be substantially the same in construction and a description of one of which, therefore, will suffice for the entire furnace.

In the illustrative embodiment, the exterior of the wall is provided with vertical channels 10 and 11 spaced apart and held in such spaced relation by spacing members 12. The outer channels 10, in the arrangement shown, are fastened to transverse channels 13, which, in turn, are fastened to I-beams 14. It will be understood that the channels 13 and I-beams 14 are part of the furnace setting and are rigidly held at their ends so that the vertical channels 10 and 11 are also fixed members by being attached in the manner shown.

Attached to the channels 11 are plates 15, these plates being, in the form illustrated, rectangular and substantially square. The edges of each adjacent pair of plates 15 are spaced apart a sufficient distance to take care of any expansion of the plates due to the heat of the furnace. The refractory tile 16, 16′, 17 and 17′ are connected to the plates 15 by shouldered studs 18, each stud having an enlarged head which enters a vertical T-shaped slot 19 in the tile, so that when the stud is drawn up by the nut 20 until its shoulder is against the plate 15, the tile are connected to and suspended from the plate 15, the shoulder on the stud being long enough, preferably, so that the tile is not clamped to the plate 15 but merely hangs on the stud 18.

The vertical edge portions of the plates 15 have special studs 21 which are like the studs 18, except that they are made long enough to extend through the web of the channel 11, the hole in the channel 11 preferably being made large enough so that as the plate 15 expands, the studs 21 can move laterally a sufficient distance either horizontally or vertically to accommodate such expansion. A suitable washer will be provided beneath the nut 20 on studs 21 to span this enlarged hole. As many of the studs 21 may be provided along the edge of each plate 15 as desired, and preferably each of the studs entering the channels 11 will be made with an enlarged hole to permit the desired freedom of motion of the plate 15.

Between the channels 11 we provide, in the form shown in Figs. 2 and 3, angled plates

22 with the studs 18 entering holes in one of the angled flanges of these plates, the angles 22 extending horizontally along the wall for the purpose of forming separate air ducts, or at least to divide the air flow horizontally into parallel streams, the plates 22 for this purpose extending adjacent to the outer casing which is carried on and between the outer channels 10. The angled plates 22 assist in holding the studs 18 which support the tile and also prevent the plates 15 from buckling by acting as stiffening members. The angled plates 22 also assist in preventing overheating of the plates 15 by acting as cooling fins. Preferably the outer channels 10 are arranged in pairs, as shown best in Fig. 3, and a plate 23 is held between each pair of channels. This plate extends toward the web of channel 11 so as to force any air flowing horizontally through the space between the inner and outer walls to contact with the web 11 to cool the same. The outer casing, in the illustrative form, is provided with removable panels 24 by which access to the nuts 20 of studs 18 may be had.

The tile 16 and 17 in the form shown in Figs. 2 and 3 are arranged with their adjacent edges so that radiant heat from the furnace cannot contact with the plate 15 even though a rather wide crack or joint is left between such adjacent edges to permit each individual tile to expand with the heat without contacting with its neighbor. In the arrangement shown in Figs. 1, 2, and 3, the tile are arranged in horizontal courses with the joints broken between each pair of courses. For instance, the lowermost course in Fig. 1 is made up of tiles 17 and 17′ (Fig. 5) arranged alternately and the course above is made up of tiles 16 and 16′ arranged alternately but with their vertical line of contact out of vertical alinement with the corresponding line in the courses above and below.

Instead of the tile formed and arranged as in Figs. 1, 2, 3 and 19, they may be formed as in Figs. 10 to 15, inclusive. In this arrangement, the joints between the tile are not broken either horizontally or vertically in the ordinary sense, but somewhat of the same effect is obtained as if both horizontal and vertical joints were broken. The upper course in Fig. 10 is formed of tiles 25, 26, alternating in the course. In the next lower course, tile 27 and 28 are correspondingly alternated, the curved tops and bottoms of these tile being formed to conform to the top and bottom curves of the tile 25, 26, particularly at the corners of the tile.

In order to seal the joints between the edges of the plates 15, we have provided sealing devices, one form of which is illustrated in Figs. 2, 8 and 9. A plate 29 having two of its opposite edges 30 outwardly curved to form a kind of pocket, is held against the plates 15 by the studs 18 passing through holes in plates 15 and 29, the plate 29 extending across the joint between plates 15, and the hole in one of the plates being large enough to permit relative movement between the plates, as best shown in Fig. 9. The pockets of plates 29 may be filled with a soft packing material 31, such as asbestos fiber. The vertical joints between plates 15, in the form illustrated, are covered by the webs of the channels 11, so that no further seal is required.

In Figs. 6 and 7, the wall is made up much as in Figs. 2 and 3. The vertical channels 32 and 33 are held spaced apart by bars 36, the outer casing being permanently closed, in this form, by plate 34 connected to channels 32. Beams 35 complete the support of the outer wall. The edges of plates 15 are connected to channels 33 by studs 18 as described above, and sealing plates 29 close the horizontal joints between the plates 15, the vertical joints being covered by the webs of channels 33.

The tile, in this illustrative form, are arranged with broken horizontal joints, as best shown in Fig. 16. The tile 37 and 38 are arranged in vertical rows, with the tile in each such row all alike. The positions of the studs 18 on the plates 15 are staggered, so that the horizontal joints between the tile are broken. It will be noted that, in this form of wall, only two tile shapes are required. This is due to the making of two opposite sides of the tile (in this case, the top and bottom, Fig. 6) parallel to each other.

In the form of Figs. 6 and 7, no attempt is made to direct the air flow between the walls. Since the casing is permanently closed, the space between the walls is made large enough so that a workman can get between them to remove nuts 20, the bars 36 serving as ladders by which the workman can reach any part of the wall. A convenient door will be provided for access to this inter-wall space.

It will be understood that any of the several tile arrangements which we have shown may be used with any form of wall in which the wall is divided into separately supported panels and that the several parts of our invention may be used independently of other parts thereof. For instance, the panel-supported tile may be used in a simple furnace wall not provided with means to direct cooling air along the exterior of the wall.

In the arrangement we have described, a wall is provided which is particularly useful in air-cooled furnaces in which air under pressure is caused to flow along the exterior of the refractory wall. The metallic lining is substantially air-tight so that the joints in the refractory wall may be open and yet

no considerable quantity of air will flow into the furnace chamber through such joints. At the same time, the metallic lining is arranged so that it can expand and contract under varying temperatures, without breaking the lining or opening up joints therein to permit air to infiltrate into the furnace. The wall and the lining may be repaired in sections without disturbing the remainder of the wall.

We claim:

1. In a furnace wall, a refractory wall comprising a plurality of tiles placed edge to edge with the edges spaced, means supporting each tile so that each tile is permitted to expand without contacting with an adjacent tile, a substantially air-tight metallic lining over the exterior of said refractory wall, and a casing spaced from said lining and forming an air passage between said lining and said casing.

2. In a furnace wall, a refractory wall comprising a plurality of tiles placed edge to edge, and spaced from each other to form wide joints therebetween, a substantially air-tight metallic lining over the exterior of said refractory wall, and a casing spaced from said lining and forming an air passage between said lining and said casing.

3. In a furnace wall, a refractory wall comprising a plurality of tiles placed edge to edge and spaced from each other to form wide joints therebetween, a substantially air-tight metallic lining over the exterior of said refractory wall and a casing spaced from said lining and forming an air passage between said lining and said casing, the edges of the tiles being constructed and arranged to preclude radiant heat from the furnace passing through the joints between adjacent tiles and reaching said metallic lining.

4. In a furnace wall, a refractory wall, a substantially air-tight metallic lining over the exterior thereof, a casing spaced from said lining to form an air passage therebetween, a plurality of substantially parallel members spaced apart and extending partially across said passage to divide the flow of air therethrough, and a plurality of other members also extending partially across said passage and disposed at an angle to said first named members, for the purpose set forth.

5. In a furnace wall, a refractory wall, a substantially air-tight metallic lining over the exterior thereof, a casing spaced from said lining to form an air passage therebetween, a plurality of substantially parallel members spaced apart and extending into said passage from one side thereof and extending partially across said passage, and a plurality of other members disposed at an angle to said first named members and extending into said passage and partially across the same from the other side thereof.

6. In a furnace wall, a refractory wall comprising a plurality of tiles placed edge to edge with the edges spaced, means supporting each tile so that each tile is permitted to expand without contacting with an adjacent tile, a substantially air-tight lining over the exterior of said refractory wall and comprising a plurality of plates with expansion joints therebetween whereby the plates may expand relatively to each other, and a casing spaced from said lining and forming an air passage between said lining and casing.

7. In a furnace wall, a refractory wall having a substantially air-tight metallic lining over the exterior thereof, said lining comprising a plurality of plates overlapping at their edges, packed joints at the overlapping parts of said plates, attachments holding said plates together and passing through holes in said overlapping parts, said holes being so constructed and arranged as to allow said plates to expand and contract relatively to each other.

8. In a furnace wall, a refractory wall having a substantially air-tight metallic lining over the exterior thereof, said lining comprising a plurality of plates overlapping at their edges, packed joints at the overlapping parts of said plates, attachments holding said plates together and passing through holes in said overlapping parts, said holes being so constructed and arranged as to allow said plates to expand and contract relatively to each other, and a casing spaced from said lining and forming an air passage between said lining and casing.

9. In a furnace wall, a refractory wall, a substantially air-tight metallic lining made in overlapping sections on the exterior thereof, a casing spaced from said lining by means of cross members to form air passages therebetween, a plurality of substantially parallel cooling and stiffening members attached to said air-tight metallic lining, said cooling and stiffening members being spaced apart and extending partially across said air passage so as to be swept over by the cooling air in the direction of their length.

10. In a furnace wall, a refractory wall, a substantially air-tight metallic lining made in overlapping sections on the exterior thereof, a casing spaced from said lining to form an air passage therebetween, a plurality of substantially parallel cooling and stiffening members attached to said sections, said cooling and stiffening members being spaced apart and extending into the passage from one side thereof and extending partially across said passage.

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