

March 14, 1933.

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1,901,560

SECTIONAL FURNACE WALL

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Fig. 4^c Fig. 4^a Fig. 4

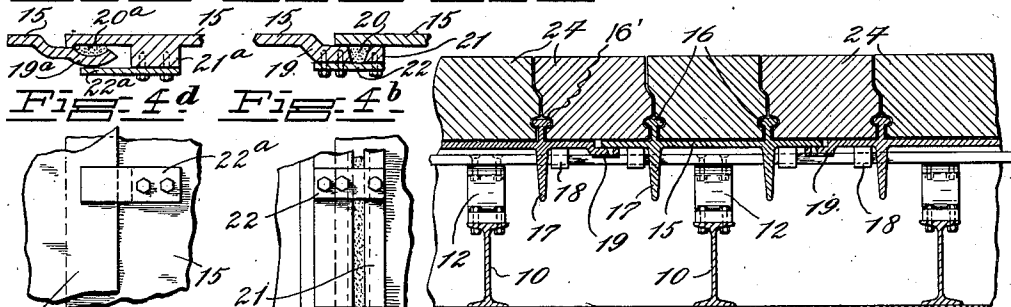


Fig. 3

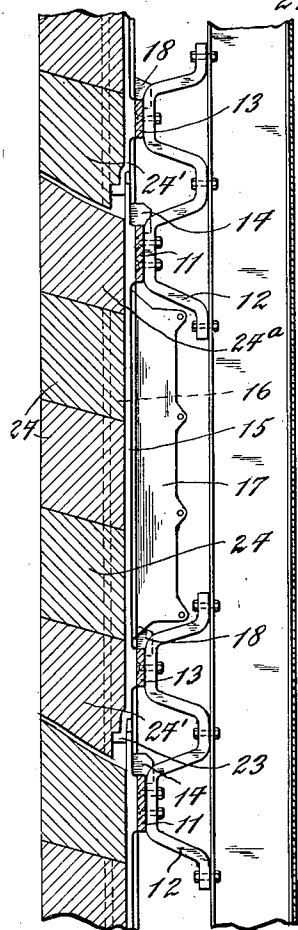
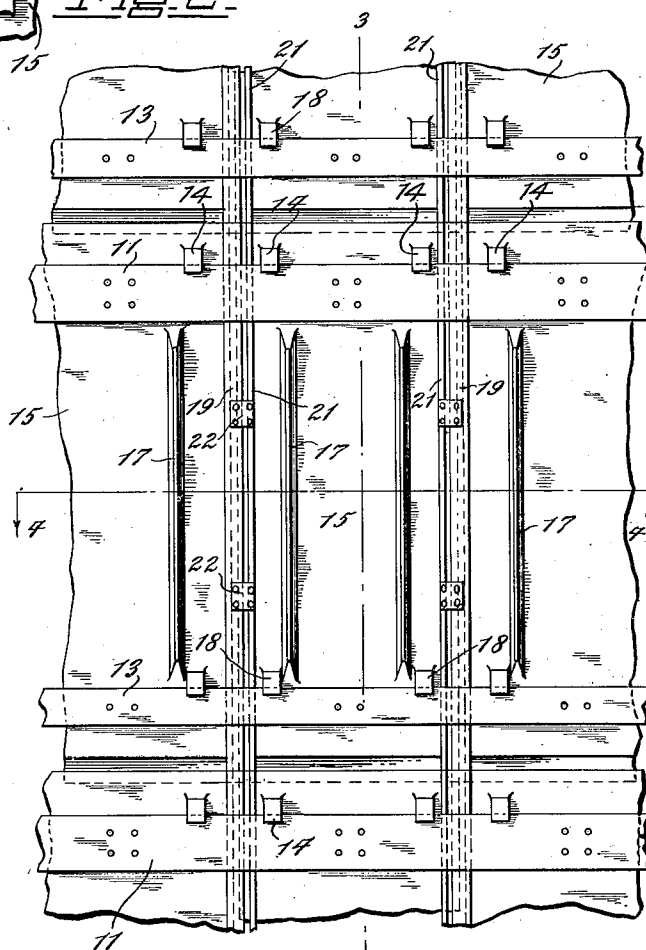


Fig. 2



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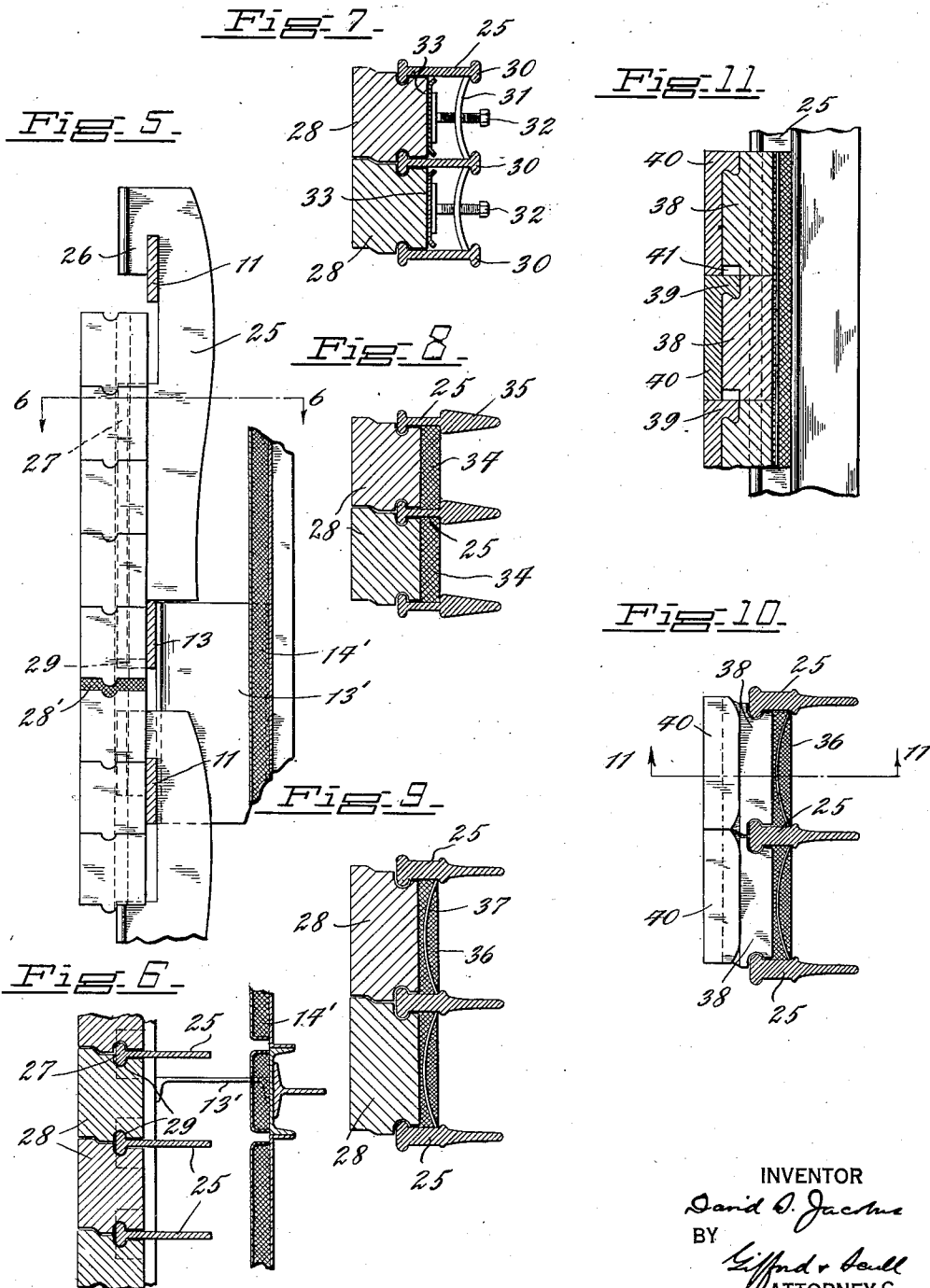
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Fig. 12.

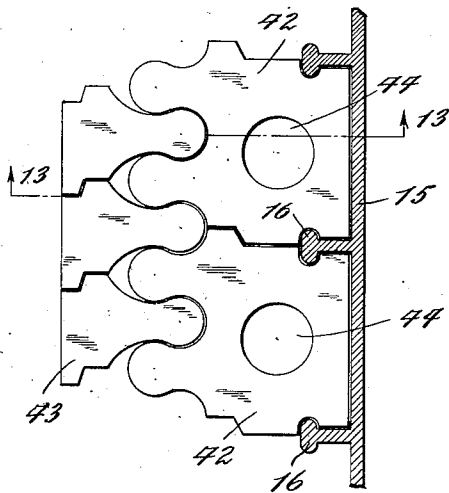


Fig. 15.

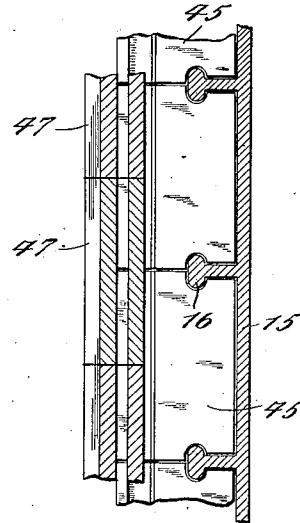


Fig. 13.

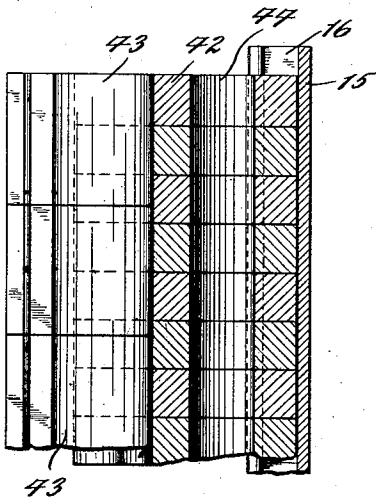
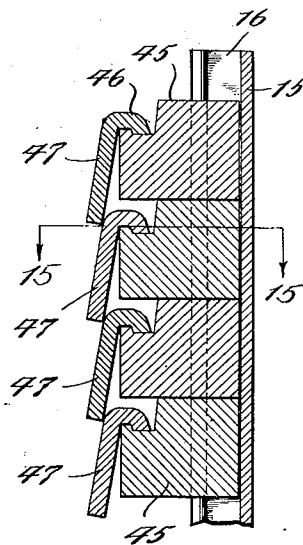


Fig. 14.



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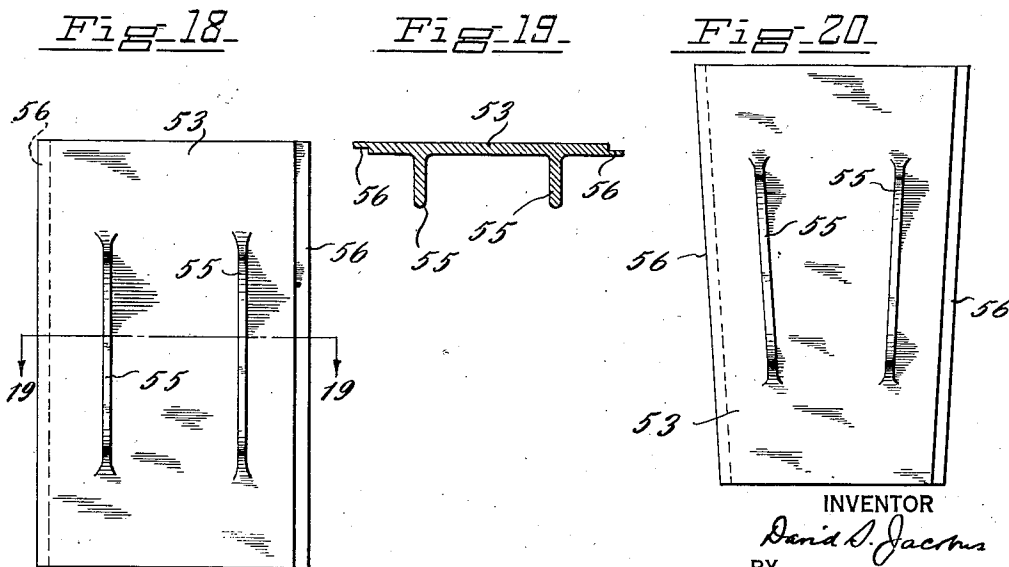
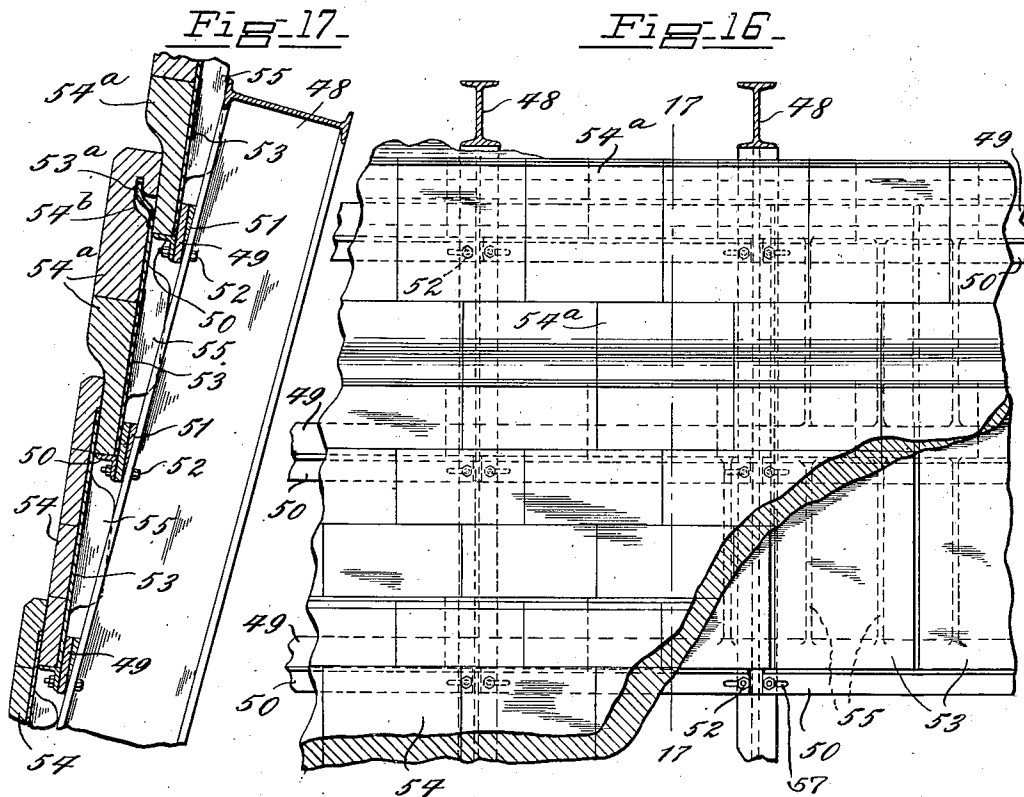
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TO FULLER LEHIGH COMPANY, A CORPORATION OF DELAWARE

SECTIONAL FURNACE WALL

Application filed January 13, 1925, Serial No. 2,081. Renewed January 5, 1932.

My present invention relates to furnace walls, particularly to such walls adapted for use with an air-cooling system and to such walls built in sections so that the building and repair thereof may be readily done and so that certain difficulties arising from very high and extensive walls will be avoided.

My invention will be best understood from the following description and the annexed drawings, in which Fig. 1 is a vertical section of a furnace for a steam boiler embodying one form of my invention; Fig. 2 is a rear elevation on a large scale of a part of one of the walls shown in Fig. 1, with the supporting columns removed to better illustrate the construction; Fig. 3 is a section on the line 3—3 of Fig. 2; Fig. 4 is a section on the line 4—4 of Fig. 2; Fig. 4^a is a plan and Fig. 4^b a side elevation of a detail shown in Figs. 2 and 4; Figs. 4^c and 4^d are similar to Figs. 4^a and 4^b, showing a modification; Fig. 5 is a side elevation similar to Fig. 3 showing a modification and Fig. 6 is a section on the line 6—6 of Fig. 5; Figs. 7, 8 and 9 are views similar to Fig. 6, each illustrating a modification; Fig. 10 is still another modification and Fig. 11 is a section on the line 11—11 of Fig. 10; Fig. 12 is a plan and Fig. 13 a section on the line 13—13 of Fig. 12, showing a modification of the tile arrangement of the preceding figures; Figs. 14 and 15 are views similar to Figs. 13 and 12, respectively, showing a modification, Fig. 15 being a section on line 15—15 of Fig. 14; Fig. 16 is an elevation of parts of a wall embodying still another modification of my invention and Fig. 17 is a section on the line 17—17 of Fig. 16; Fig. 18 is a side view and Fig. 19 a section on the line 19—19 of Fig. 18, showing a detail of the arrangement of Figs. 16 and 17, and Fig. 20 is similar to Fig. 18, but showing a modification.

Like reference characters indicate like parts in the different views.

In the arrangement shown in Fig. 1, I have chosen for purposes of illustration a type of steam boiler furnace adapted for use with powdered fuel.

The boiler may be of any desired type

and, for purposes of illustration, I have shown a horizontal water tube boiler having tubes 60 connected to headers 61 and 62, these, in turn, being connected to a steam and water drum 63. Baffles 64, 65 and 66 direct the gases transversely of the water tubes and over a superheater 67 to a gas outlet 68 and down through an air heater 69 to the gas outlet 70. A fan 71 forces air down through the air heater 69 to an air inlet 72 connected to a wall cooling system to be more particularly described hereinafter.

The furnace illustrated has vertical walls which preferably are made up of sections, as will be more fully described hereinafter, the sections being supported on fixed vertical members 10 spaced from the walls themselves with a casing 11^b on the outside of the vertical members 10, the spaces between the casing 11^b and the exterior of the furnace wall proper constituting air-cooling passages through which cooling air may be forced by the fan 71.

The heated air from air heater 69 passes through outlet 72 into the upper part of the air-cooling spaces at the rear of the furnace, thence down to the space beneath the furnace floor 73, thence upward through the air-cooling spaces along each of the side walls of the furnace to a duct 74, one of which is positioned above each side wall. Ducts 74 connect with a front duct 75 located above and connected to the air-cooling spaces of the front furnace wall, the air from the side walls flowing through ducts 74 and 75 and thence down to and through the openings 78 in the front wall into the furnace chamber. If desired, some of the heated air from duct 75 may be drawn through pipe 76 by a fan 77 and supplied to a powdered fuel or other burner, as illustrated. Partitions may be placed beneath the furnace floor 73 to distribute the air uniformly from front to rear along the side walls. Partitions may also be placed in the rear and side walls for securing an even distribution of the cooling air over the side walls. Such partitions are not essential to the success of the invention and therefore have not been shown.

The arrangement just described is particularly advantageous where air heaters are used as the fan for forcing the air can be placed on the inlet side of the air heater, which reduces the power to force the air through the air heater over what it would be should the air first be passed through the ventilating ducts, then to a fan and into the air heater, as in the latter case, the fan would have to handle the heated air, which would have a greater volume and require more power to force it through the air heater than the cooler air. The heated air secured by passing the air through the ventilating ducts before passing it through the air heater would also absorb less heat from the flue gases than the cooler air secured with the preferred arrangement described and shown. The preferred arrangement, however, produces a positive pressure in the air-cooling or ventilating spaces outside the walls and makes it desirable that the walls shall be as nearly air-tight as possible.

Preferably I construct the walls of the furnace so that they are, in effect, made up of independent sections, which sections may be made as small as desired. I also preferably construct these sections so that the parts of any one of them may be taken out and replaced without disturbance of any substantial portion of the remainder of the wall, and I also arrange these sections in relation to each other so that relative movement may take place therebetween so as to take up the expansions and contractions to which such a wall is subjected.

In the arrangement illustrated in Figs. 1 to 4, inclusive, the I-beams 10 constitute the vertical fixed supporting members and as many as desired of these I-beams will be spaced horizontally across the wall. Supported on these fixed members 10 are a plurality of horizontally disposed supporting bars 11, these bars being held to the members 10 by bent supports 12. In the form illustrated, these bent supports also connect auxiliary bars 13 to the supports 10.

Hanging on the bars 11 by hooks 14 are tile supports which, in the form illustrated, are metallic plates 15 having on their inner faces bulbed ribs 16 extending vertically of the plates, these plates also having cooling ribs 17 of any desired form on their outer faces. Preferably the plates are also provided at their lower portion with hooks 18 extending over the auxiliary bars 13.

The plates 15 are rectangular in outline and are arranged side by side both vertically and horizontally to form a continuous backing plate for the tile of the wall.

Space is provided between the adjacent edges of these plates with provision to cover the joint without interfering with the relative motion of the respective plates. One form of this arrangement is shown on a

large scale in Figs. 4^a and 4^b, one of the plates 15 having a projection 19 overlapping the adjacent edge of the next plate 15, so as to cover the space between them. Preferably these overlapping portions 19 are provided on alternate plates only, so that at least some of the plates, such as the center plate in Fig. 4, can be moved inward (or upward in Fig. 4) without interfering with the plates at either side of the plate being removed. In order to seal the joint between the projection 19 and the adjacent plate 15, I provide, in the form illustrated, strip of packing material 20 extending along the edge of the projection 19 which is inwardly beveled for that purpose, this packing being held in place by a vertical metallic strip 21 connected at intervals to the projection 19 by plates 22. This arrangement permits the projection 19 to slide along the outer surface of the adjacent plate 15 without breaking the seal formed by the packing 20.

An alternative form of sealing is shown in Figs. 4^c and 4^d. One edge of a plate 15 is formed at 19^a, as shown in Fig. 4^c, so as to form a kind of receptacle with the adjacent edge of the next plate 15, packing material 20^a filling this receptacle. Plates 22^a fastened to bosses 21^a on plates 15, serve to keep the adjacent edges in contact with each other.

Each of the plates 15 is provided at the bottom with an inward projection 23 preferably extending for the full width of the plate 15. Tile 24, as best shown in Fig. 4, are connected to the plates 15 by the bulbed ribs 16 disposed in recesses 16' in the tile, the lowermost tile 24' of each row resting on the projection 23. The rib 16 terminates below the top of the plate 15 and a special tile 24^a rests on the uppermost tile 24 between such uppermost tile of one section and the lowermost tile 24' of the next section above. Preferably the upper and lower faces of the tile are inclined, the upper face of the tile 24^a and the lower face of the tile 24' being also preferably curved in an inclined direction, so as to permit the easy removal of the tile 24^a while, at the same time, making it difficult for such tile to fall out of place. The tile 24' is preferably carried below the projection 23 on the bottom of the plate 15 so as to protect the same from the heat.

In the arrangement shown, it will be obvious that each of the sections comprising a plate 15 is independent of the other sections of the wall, so that expansion between the respective sections may be taken up by the joints provided between the respective sections both vertically and horizontally. It will also be seen that alternate horizontally adjacent sections or any tile of any section may be removed from the wall and replaced without disturbing the remaining sections,

the tile 24^a first being removed and then successively the tile 24 and 24'. Then the plates 15 may be raised to disengage the hooks 14 and 18, respectively, from the bars 11 and 13. The parts may be replaced in the reverse order. The other alternate sections, which are those having the projections 19, may be removed by first removing an adjacent section comprising a plate 15 not having said projections, and then sliding the section with the projections horizontally along the bars 11. In either case, the section to be removed is slid vertically upwards to disengage the hooks 14, and then manipulated to pull inwardly the lower edge of the plate, which plate is then pulled downwards.

Instead of the plates 15 with their hooks 14, I may use a form of tile support shown in Figs. 5 and 6, these supports, in the arrangement shown, being vertical plates 25 with hooks 26 engaging the bars 11 and with the lower ends of the plates resting against the auxiliary bars 13. The bulbed rib 27 connects the tile 28 to the supports 25, a projection 29 supporting the vertical column of tile carried by the plate 25.

The bars 11 and 13 may be supported by short channel sections 13' which also serve to separate a casing 14' from the tile to form air-cooling passages therebetween. A similar arrangement of casing may be applied to any of the other forms illustrated. Plastic material 28' fills the space between the several vertical rows of tile 28.

If desired, the separate members 25 of the arrangement of Figs. 5 and 6 may be provided with means for closing the space between them so as to seal the wall or to provide the equivalent of the backing plate of the arrangement shown in Figs. 2 to 4, inclusive. One form of such arrangement is shown in Fig. 7, in which the members 25 are provided with projections 30. A metallic plate 31 has its edges resting against the plates 25 and behind the projections 30, these plates 31 each having a threaded hole through which a screw 32 passes, the end of the screw resting against a plate 33 behind the tile 28, so that as the screw 32 is tightened, the plate 31 is pressed against the projections 30. The opposite edges of the plates 33 may be bent outward, as shown in Fig. 7, to provide a space which may be filled with any suitable plastic packing, not shown. Another form of such closure is shown in Fig. 8, a layer of material 34 suitable for preventing undue leakage being placed between the plates 25 and behind the projections formed thereon. It is usually advantageous to select a material 34 which will have a high heat conductivity in order to assist in air cooling the wall, although in some cases it may be advantageous to use a material that will have a lower heat conductivity in order to maintain hot-

ter furnace walls. This layer of conducting material carries the heat from the wall into the ventilating spaces between the wall and the outer casing and the plates 25 will preferably be provided with long extensions 35 to conduct the heat more readily into this space.

In Fig. 9, the closure is in the form of a layer 36 of a plastic material which may conveniently be held in place by means of metallic strips or wire 37 curved as shown so that its ends engage projections on the plates 25.

It is sometimes desirable to form the wall of two kinds of tile or brick, and one arrangement by which this may be done is shown in Figs. 10 and 11, in which the inner or wall tile proper 38 are carried by the plates 25 as before, but are provided at their top with notches which are engaged by projections 39 of facing tile 40, one facing tile being provided for each wall tile 38. This facing tile may be made thin and of a more expensive material than the main wall tile 38. A recess 41 is provided at the bottom of each of the wall tile 38 so that the next lower facing tile 40 may be lifted to disengage the projection 39 from its notch in the tile 38 after removal of the facing tile next above.

In Figs. 12 and 13, the tile supporting members are shown in the form of the plates 15 of Figs. 2 and 3, with the bulbed ribs 16 engaging wall tile 42 which may be relatively thick and which, in the form shown, are provided at their outer edges with engaging notches into which extend projections on the facing tile 43, so that after the wall tile 42 have been slipped downward into position along the ribs 16, the facing tile may similarly be slipped downward into position, the projections as shown in Fig. 3 at the bottom of the plates 15 being carried out far enough to also support the facing tile 43. If desired, an opening 44 may be made in each of the tile 42 so as to provide a kind of flue through which air may be circulated to cool the tile 42, or which will act to reduce the amount of heat conducted from the furnace side of the wall through the tiles 42.

In Figs. 14 and 15 is shown an arrangement similar to that of Figs. 12 and 13 but in which each of the wall tile 45, suspended on the ribs of the plates 15, is provided at its upper part with a notch which is engaged by hook-like projections 46 on a facing tile 47, the lower end of each tile 47 extending below the top of the next lower tile 47 so as to make a shingle-like effect on the interior surface of the wall, it being obvious that any tile 47 may be readily removed by lifting it to clear the notch in the tile 45 and then drawing it outward, the next higher tile 47 swinging to permit this.

The arrangement which I have shown in Figs. 16 to 19, inclusive, is particularly adapted for furnace walls which are inclined. In this case, the fixed members are

5 vertically extending I-beams 48 similar to the I-beams 10 but set at an inclination sufficient to produce the desired inclination of the furnace wall. Horizontal bars 49 extend across the members 48, each bar 49

10 having an angle piece 50 and a wedge-shaped bar 51 being inserted between the bar 49 and the upwardly disposed face of the fixed member 48, so that the parts may be held in position by bolts 52 running through all of

15 them. The tile supporting plates in this form may be simple flat plates 53, the lower edge of which rests on the angle 50 and against the bar 49, the upper end of the plate also resting against the outer edge of

20 an angle 50. This arrangement is possible because of the inclination of the wall, it being obvious that gravity will hold the plates 53 in position. The tiles 54 and 54^a are arranged in groups, each group being sup-

25 ported by one of the plates 53 and the corresponding angle 50. Preferably the upper tiles 54 and 54^a in each section are made to overlap the upper end of the plate 53 for that section so as to completely protect the

30 plate 53 from the heat of the furnace and also preferably the upper most tiles 54 and 54^a of each section overlap the lowermost tile of the next higher section, as shown in

35 Fig. 17, the uppermost tile of each section preferably being notched with a sufficient space between the bottom of the notch and the top of the plate 53, so that no binding can occur. The tiles 54 shown in the lower-

40 most two courses in Fig. 17 are plain flat tiles and the tiles 54^a shown in the uppermost courses in Fig. 17 are special tile of the form shown. In order to hold the upper tile 54^a securely, the upper edge of the plate 50 may be bent out to form a kind of hook 53^a, the

45 upper tile 54^a being provided with a recess 54^b into which hook 53^a extends. This recess 54^b is preferably made deep enough so that it does not contact with the top of the hook 53^a when the tile are in position. This

50 hook arrangement is desirable to prevent dislodgment of the upper tile 54^a in case the plates 53 become warped.

If desired, the plates 53 may be provided with cooling ribs 55 and with projections 56

55 at their lateral edges to overlap the adjacent edges of the next plates to form a relatively tight joint and yet permit expansion and contraction of the several plates. They may also be provided with packed joints at their

60 edges of either of the forms shown in Figs. 4^a, 4^b, 4^c and 4^d.

Preferably the angles 50 will be made of short lengths with a space between the lengths where they are fastened to the I-

65 beams 48. Preferably the holes 57 through

the angles 50 will be slotted to permit relative motion and also to permit easy removal in case of repair.

If the furnace is conical or pyramidal, then the plates 53 will be formed, as shown

70 in Fig. 20, with their lateral edges inclined so that when such plates are placed side by side, the desired form of furnace will be had.

In all of the arrangements which I have

75 shown, it will be obvious that the independent sections may have relative movement between them without destroying the wall and that any section may be removed in whole or in part without disturbing its

80 neighbors. While the arrangements which I have shown to accomplish this purpose are my preferred forms for various constructions, it will be understood that the arrange-

85 ments may be widely varied and that the forms which I have shown are merely illustrative. While I have shown and described my invention as being applied specifically to the vertical side walls in the embodiments shown, nevertheless it is to be understood

90 that the invention is equally applicable to any other wall of a furnace and by the term "wall" in the claims, I intend to cover not only the vertically disposed walls of a fur-

95 nace, but also those walls which are generally described as floors and roofs of furnaces.

I claim:

1. A furnace wall comprising a plurality of fixed vertically disposed supports, hori-

100 zontal supporting members connected to said fixed supports and spaced apart vertically thereon, a group of tile supports for each horizontal supporting member and arranged

105 side by side thereon across the wall, and tile supported on and by each of said groups to constitute an independent section of the wall, each tile support including a rectangular

110 backing plate with each of its edges adjacent an edge of an adjacent backing plate to form a continuous backing plate for the wall.

2. A furnace wall comprising a plurality of fixed vertically disposed supports, hori-

115 zontal supporting members connected to said fixed supports and spaced apart vertically thereon, a group of tile supports for each horizontal supporting member and arranged

120 side by side thereon across the wall, and tile supported on and by each of said groups to constitute an independent section of the wall, each tile support including a rectangular

125 backing plate with each of its edges adjacent an edge of an adjacent backing plate to form a continuous backing plate for the wall and some of the backing plates having a projection at each vertical edge overlapping the vertical edge of the adjacent back-

130 ing plate to close the joint between said edges.

3. A furnace wall comprising a plurality of fixed vertically disposed supports, horizontal supporting members connected to said fixed supports and spaced apart vertically thereon, a group of tile supports for each horizontal supporting member and arranged side by side thereon across the wall, and tile supported on and by each of said groups to constitute an independent section of the wall, each tile support including a rectangular backing plate with each of its edges adjacent an edge of an adjacent backing plate to form a continuous backing plate for the wall, some of the backing plates having a projection at each vertical edge overlapping the vertical edge of the adjacent backing plate to close the joint between said edges and each plate having a projection extending along one of its horizontal edges and overlapping the joint between said plate and the horizontal edge of the adjacent plate.

4. A furnace wall comprising a plurality of fixed vertically disposed supports, horizontal supporting members connected to said fixed supports and spaced apart vertically thereon, a group of tile supports for each horizontal supporting member and arranged side by side thereon across the wall, and tile supported on and by each of said groups to constitute an independent section of the wall, each tile support including a rectangular backing plate with each of its edges adjacent an edge of an adjacent backing plate to form a continuous backing plate for the wall, each backing plate having projecting cooling fins on the side away from the tile supported on said plate.

5. A furnace wall comprising a plurality of fixed vertically disposed supports, horizontal supporting bars connected to said fixed supports and spaced apart vertically thereon, a group of tile supports for each supporting bar and arranged side by side thereon across the wall and having a projection at its upper end extending over said bar, whereby said tile support is suspended by gravity only on said bar, and tile supported on and by each tile support to constitute an independent section of the wall, each tile support including a rectangular backing plate with each of its edges adjacent to but movable with respect to an edge of an adjacent plate to form a continuous backing plate for the wall, the plates being provided with sealing means to provide a substantially air-tight joint between the plates.

6. An air ventilated furnace wall having a plurality of horizontally and vertically overlapping metallic sections, tile supported on each of said sections to protect the sections from the heat of the furnace, joints between said sections permitting them to move relatively to each other on expansion or contraction, and means keeping said

joints substantially air-tight in all of the relative positions of the sections.

7. An air ventilated furnace wall having a plurality of independently supported horizontally and vertically overlapping metallic sections, tile supported on each of said sections to protect the sections from the heat of the furnace, joints between said sections permitting them to move relatively to each other on expansion or contraction, and means keeping said joints substantially air-tight in all of the relative positions of the sections.

8. An air ventilated furnace wall having a plurality of independently supported horizontally and vertically overlapping metallic sections, each provided with projecting cooling fins on its rear surface, tile supported on each of said sections to protect the sections from the heat of the furnace, joints between said sections permitting them to move relatively to each other on expansion or contraction, and means keeping said joints substantially air-tight in all of the relative positions of the sections.

9. An air ventilated furnace wall having a plurality of independently supported horizontally and vertically overlapping metallic sections, tile supported on each of said sections to protect the sections from the heat of the furnace, and joints between said sections permitting them to move relatively to each other on expansion or contraction, said joints being provided with packing to maintain them substantially air-tight in all of the relative positions of the sections.

10. In a furnace wall, a plurality of fixed members, a plurality of metal plates parallel to the face of the wall with their edge portions arranged to allow expansion and contraction of the plates relative to each other, means to attach said plates to said fixed members, and refractory tile forming the inner face of the wall, each of said tile being held in position on one of said plates.

11. In a furnace wall, a plurality of metallic plates each carrying a plurality of tile, a support, means for detachably securing said plates to said support with the tile carried thereby forming a refractory wall, and means forming substantially air-tight joints between said plates, whereby the plates form a substantially air-tight lining back of said refractory wall.

12. In a furnace wall, a plurality of metallic plates each carrying a plurality of tile, a support, means for detachably securing said plates to said support with the tile carried thereby forming a refractory wall, means forming substantially air-tight joints between said plates, whereby the plates form a substantially air-tight lining back of said refractory wall, said last-named means permitting said plates to move relative to each other as they expand and contract.

13. In a furnace wall, a plurality of me-

tallic plates each carrying a plurality of tile, a support, means for detachably securing said plates to said support with the tile carried thereby forming a refractory wall, means forming substantially air-tight joints between said plates, whereby the plates form a substantially air-tight lining back of said refractory wall, and a casing spaced from said lining and forming therewith a space for the passage of air.

14. In a furnace wall, a plurality of metallic plates each carrying a plurality of tile, a support, means for detachably securing said plates to said support with the tile carried thereby forming a refractory wall, means forming substantially air-tight joints between said plates, whereby the plates form a substantially air-tight lining back of said refractory wall, a casing spaced from said lining and forming therewith a space for the passage of air, said last-named means permitting said plates to move relative to each other as they expand and contract.

15. In a furnace wall, a plurality of metallic plates each carrying a plurality of tile, a support, means for detachably securing said plates to said support with the tile carried thereby forming a refractory wall, means forming substantially air-tight joints between said plates, whereby the plates form a substantially air-tight lining back of said refractory wall, a casing spaced from said lining and forming therewith a space for the passage of air, and metallic projections on said plates extending outwardly therefrom into said space.

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