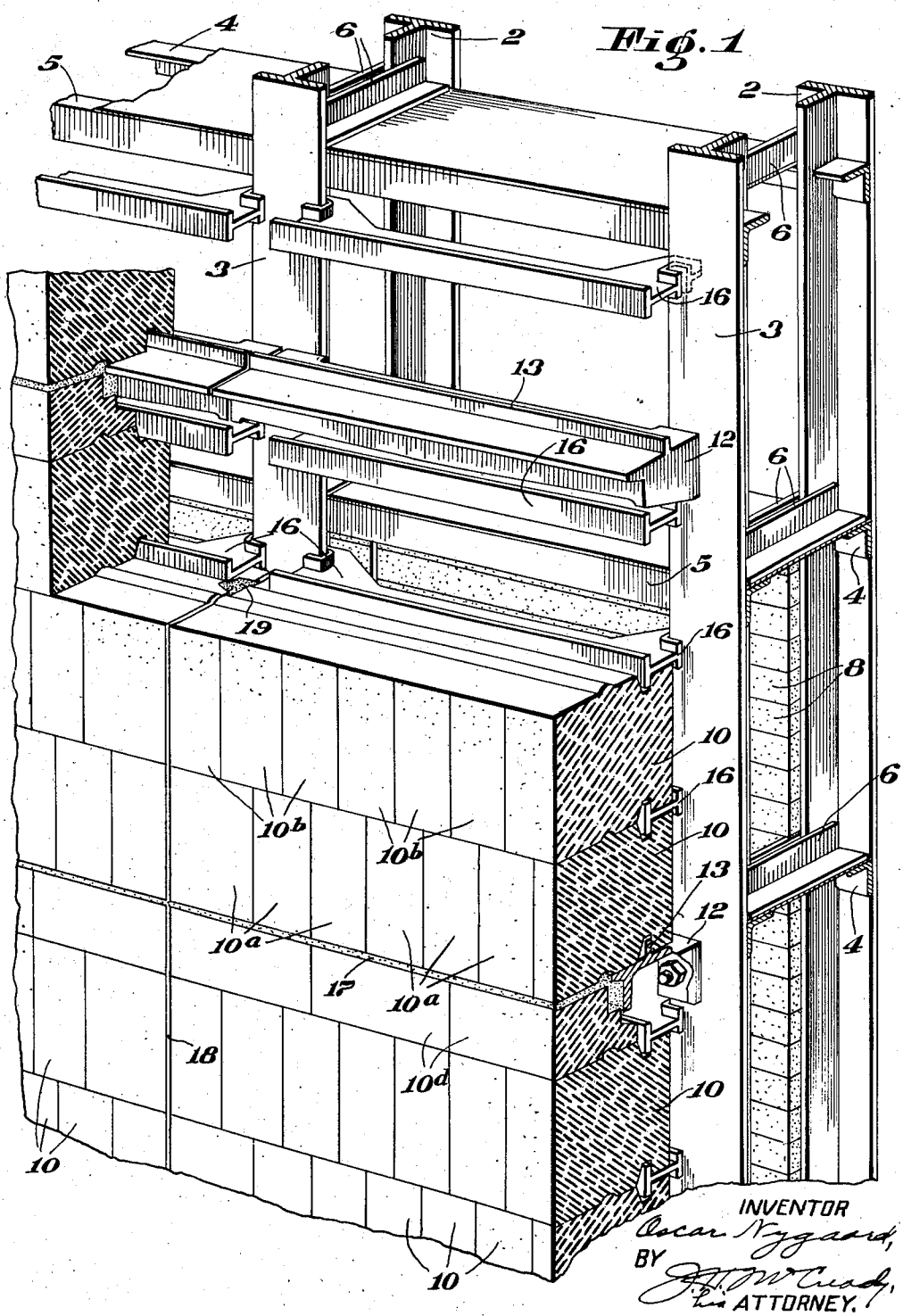
Feb. 27, 1934. O. NYGAARD 1,948,798

FURNACE WALL

Filed Dec. 30, 1931 4 Sheets-Sheet 1

Fig. 1



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FURNACE WALL

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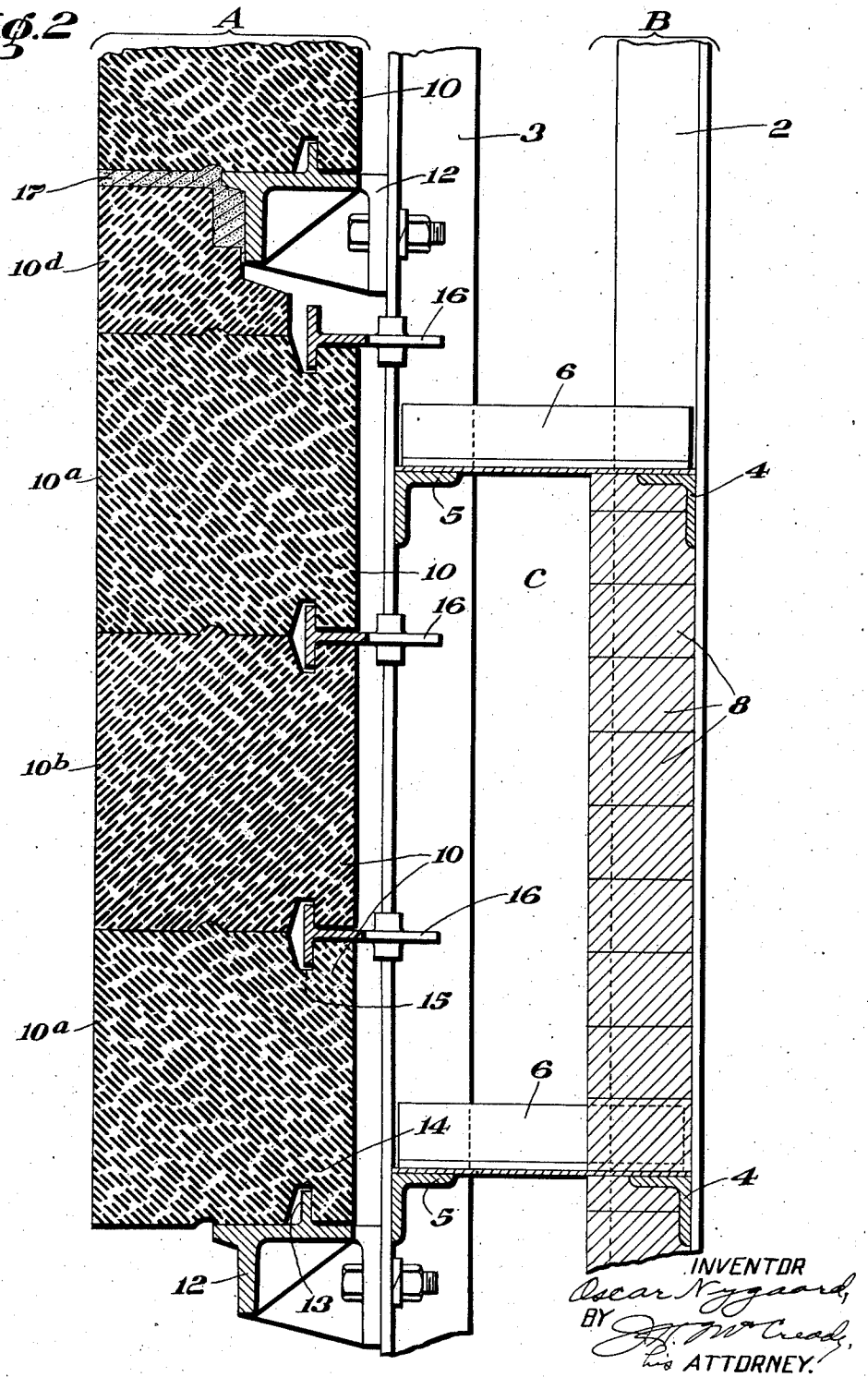
Fig. 2



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FURNACE WALL

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Fig. 3

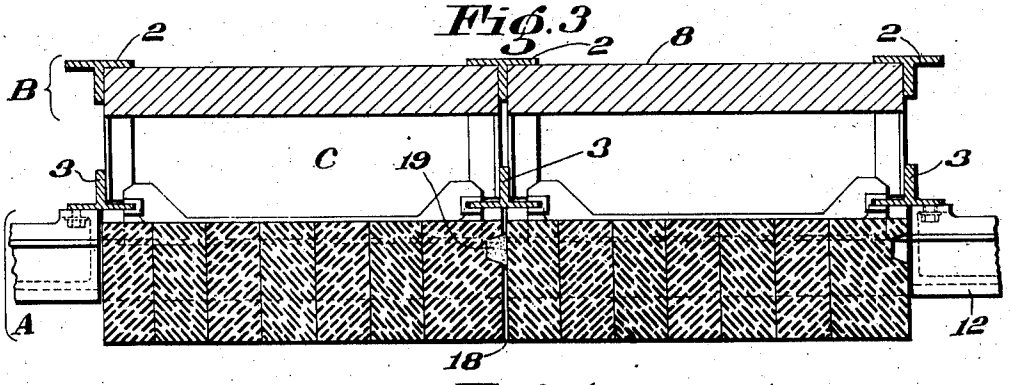
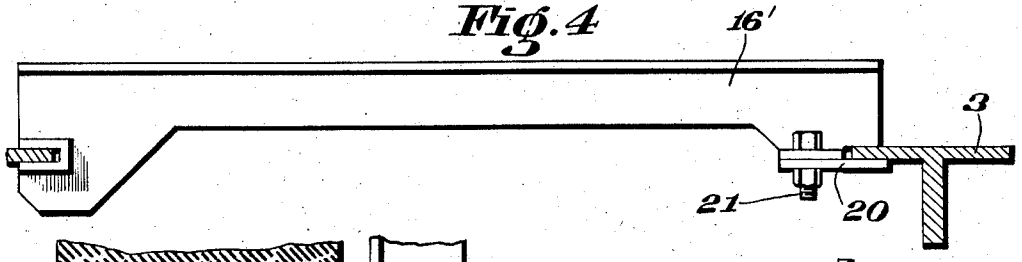


Fig. 4



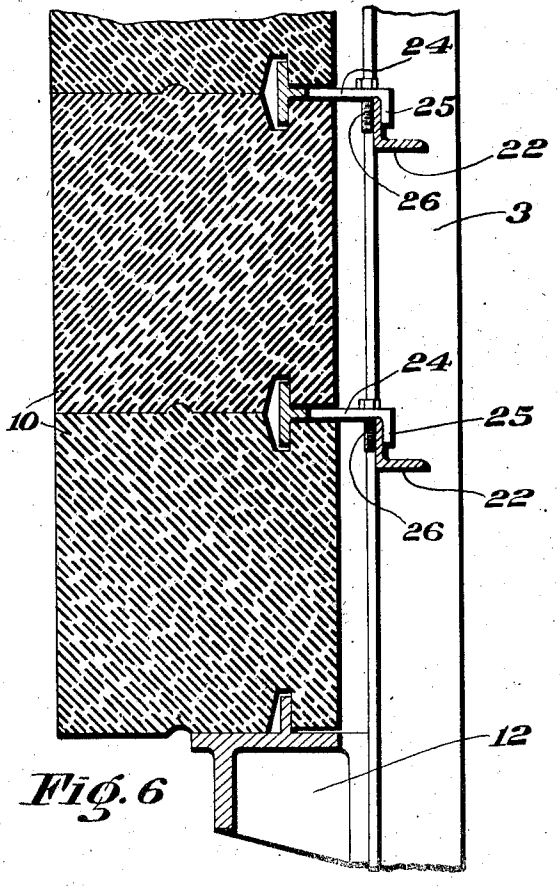


Fig. 6

Fig. 5

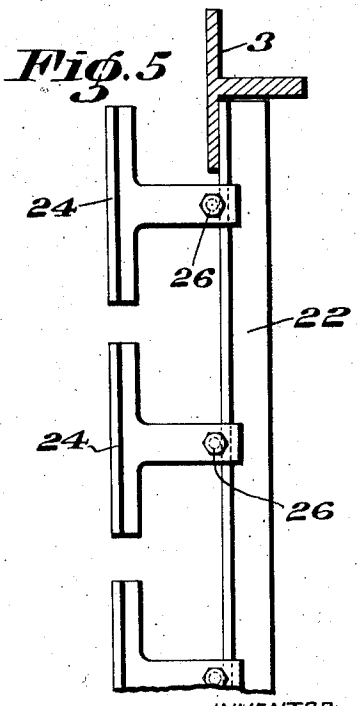


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Fig. 9

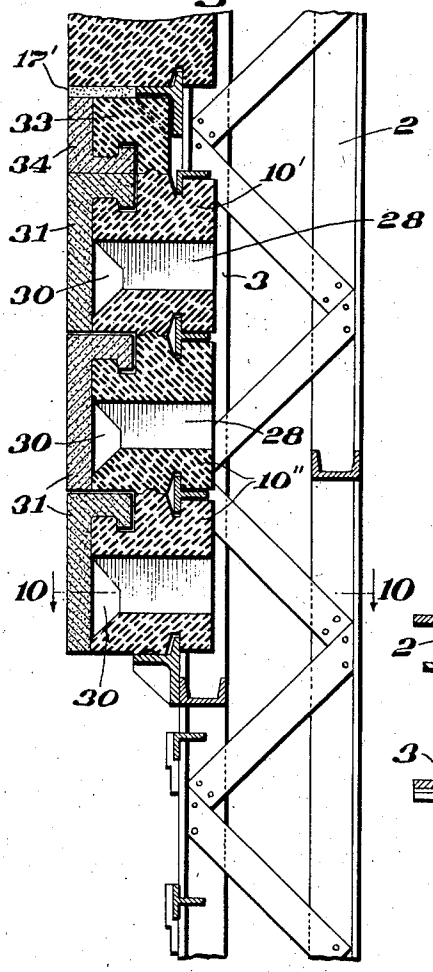


Fig. 7

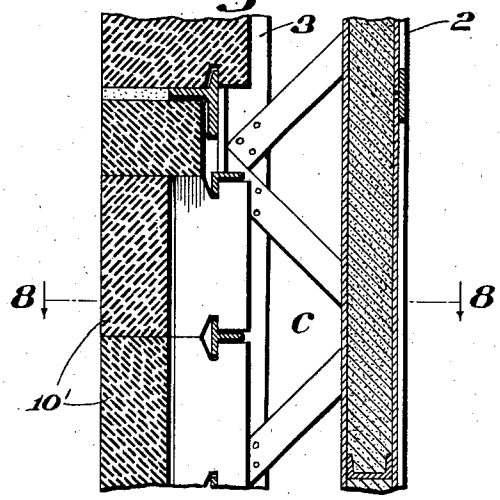
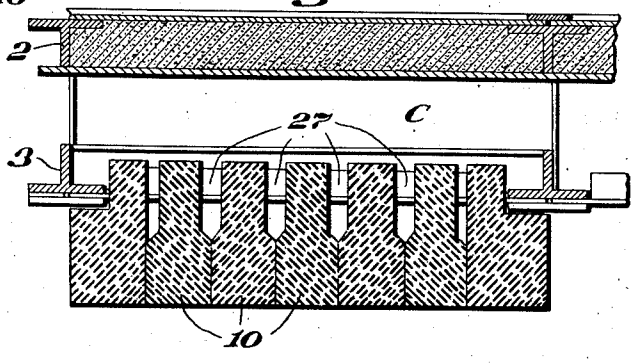


Fig. 8



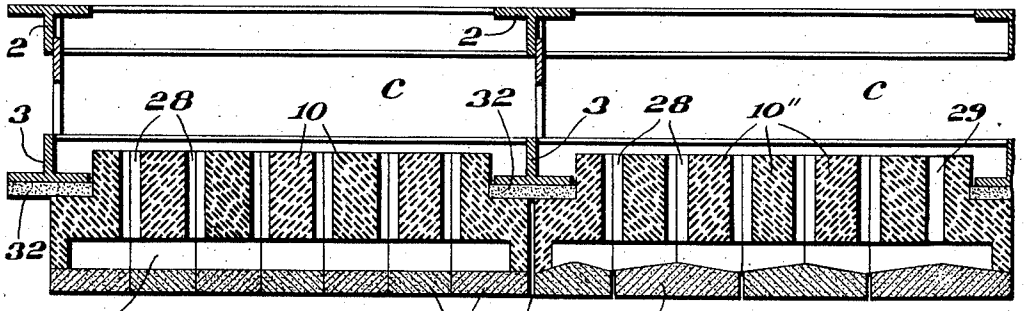


Fig. 10

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UNITED STATES PATENT OFFICE

1,948,798

FURNACE WALL

Oscar Nygaard, Saugus, Mass.

Application December 30, 1931
Serial No. 583,835

24 Claims. (Cl. 72—101)

This invention relates to furnace walls.

In my copending application Serial No. 425,448, filed February 3, 1930, I have shown a sectional steel supported wall which represents a substantial advance in this art. The present invention is especially, but not exclusively, concerned with walls of this general type. It aims to improve such walls with a view to facilitating the erection of the walls, reducing the weight of the structural metal, and more especially the castings used in walls of this general type, and devising a wall structure which can readily be adapted to the requirements of a wide variety of installations. Some features of the invention may also be used to advantage in other types of walls.

The nature of the invention will be readily understood from the following description when read in connection with the accompanying drawings, and the novel features will be particularly pointed out in the appended claims.

In the drawings,

Figure 1 is a perspective view, partly in section, of a partly erected wall embodying this invention;

Fig. 2 is a vertical, sectional view of a portion of the wall shown in Fig. 1;

Fig. 3 is a horizontal sectional view of a part of said wall;

Fig. 4 is a plan view of a modified form of bar for holding certain of the refractory blocks in place;

Figs. 5 and 6 are plan and vertical sectional views, respectively, of another bar construction for holding the blocks in position;

Figs. 7 and 8 are vertical and horizontal sectional views, respectively, of another modification; and

Figs. 9 and 10 are similar views of still another embodiment of the invention.

Referring first to Figs. 1, 2 and 3, the wall structure there shown comprises a front section A, a rear section B, and an intermediate air space C separating said front and rear sections. The wall includes a structural steel frame, the particular design of which necessarily will vary somewhat with the requirements of different installations. In the illustrated construction this frame includes a series of upright posts 2 at the back of the wall, another series of upright posts 3 located at an intermediate point in the wall, all of these posts being of T-shape in transverse section, horizontal beams 4 bolted, riveted, or welded to the posts 2, additional beams 5 similarly connected to the posts 3, and cross pieces 6 which are bolted, riveted or welded to the adjacent flanges of the opposed posts 2 and 3, and which secure the front and rear sections of the frame rigidly to each other. The rear wall section also includes courses of brick 8 and frequently, also, other heat insulating materials which may serve both to close the back of the wall, and also to prevent any great degree of heat loss at the back of the wall.

The front wall section or lining is exposed to the heat generated in the combustion chamber. It must be expected, therefore, that the bricks or blocks used at this point in the wall will require replacement after a reasonable length of time, and the present invention makes provision for such renewal of the lining and for the repair of small individual sections of the lining in the event that blocks become broken. Partly for these reasons the lining is made up of sections or panels which are separated from each other by expansion joints.

In the construction shown in Figs. 1 and 2, the lining is composed chiefly of blocks 10 which may be made of fire clay, silicon carbide, or other suitable refractory materials, silicon carbide ordinarily being preferred. The construction of an individual panel will be clear from an inspection of Figs. 1, 2 and 3, it being observed that the lowermost row of blocks 10^a in the panel shown in Fig. 2 rests directly on a horizontal beam 12 which is bolted to two adjacent posts 3—3. This beam is constructed to support a relatively heavy weight and it is provided on its upper side with an upwardly extending flange or lip 13 which enters a groove 14 formed in the lower face of each of the blocks 10^a. A corresponding groove 15 is formed in the upper face of each of these blocks. Fitting in the latter groove is the end flange of a T-bar 16, the construction of which will be clearly understood from an inspection of the drawings. This bar fits between two adjacent posts 3—3 and is slotted at its opposite ends to receive the upright flanges of said posts so that the bar can slide freely up and down on said flanges. It can be placed in position between two adjacent posts by tipping it into a diagonal or inclined position, inserting first one flange and then the other in the respective slots and then swinging the bar into a horizontal position as shown, for example, in Fig. 1. The panel shown in Fig. 2 includes three horizontal rows of blocks 10, the blocks in the individual rows being indicated at 10^a, 10^b and 10^c. The weight of the entire panel is supported on the beam 12, each of the upper rows of blocks resting directly on the row under it. The bars 16, however, serve to hold the upper rows of

blocks in alinement in the front section of the wall due to the interlocking engagement of the flange of each bar with the blocks immediately above and below it, and also due to the connection of said bar with the posts 3—3. It is preferable, although not necessary, to tongue and groove the blocks, as shown in Figs. 1 and 2, in order to assist further in alining them with each other. At the top of each panel is a course or row of key blocks 10^b which are not engaged by the bars 16 but are held in position by their tongue and groove connection with the blocks 10^c and also by the packing 17 in the expansion joint which separates this panel from the next panel above it.

All of the panels preferably are constructed in the manner just described, each being substantially a duplicate of the other. Adjacent panels are separated vertically by horizontal expansion joints 17 and are separated laterally by vertical expansion joints 18, each of the latter joints including a packing 19, Figs. 1 and 3, of asbestos, magnesium, or other refractory material, mixed with a refractory cement and located chiefly in a groove formed in the blocks at the right-hand edge of the panel. The packing used in both the horizontal and vertical expansion joints should be of a fibrous and yielding nature so that it will effectually close the joints against any undesirable leakage of air or gas through the front section of the wall from the air space c to the combustion chamber, or vice versa, while still permitting expansion and contraction of the panels relatively to each other due to changes in temperature.

In installing the wall the steel frame is first erected. Certain of the beams 12 for supporting the panels are then secured in position, and the individual panels then are assembled. In this operation the bottom row 10^a of blocks is first placed on the beam 12 for that particular panel, a bar 16 next is placed in position with its flange in the grooves 15 of the blocks 10^a, the next row of blocks 10^b then is placed on the first row, and the operations just described are repeated, the key blocks 10^d being finally placed in position. The packings 17 and 19 for each panel are put in place before the assembly of the next panel above is begun but after the beam 12 for that panel has been secured in position.

When the wall has been built up to a point near the top it may then be impossible to use bars like the bar 16 due to the narrow space limits within which the bar must be inserted. At such a point a modified form of bar, like that shown in Fig. 4, may be used to advantage. This member is like the bar 16 except that it is provided at one end with a plate 20 pivoted to the bar by means of a bolt 21. This plate may be loosely fastened to the bar, the bar placed properly on top of the row of blocks which it is to lock in place, and the plate 20 may then be swung into position behind the flange of the post 3 and secured in that position by tightening up the nut on the bolt 21.

In some cases it may be desirable to bolt, rivet, or weld horizontal angle bars 22 to the posts 3, as shown in Figs. 5 and 6, and to use T-bars 24 instead of the bars 16 to hold the blocks 19 in place, each of these T-bars having an end 25 to hook over one of the angle bars 22.

A further modification is shown in Figs. 7 and 8 in which the refractory blocks 10′ are cut away at their opposite sides, as best shown in Fig. 8, to provide air passages 27, extending inwardly from the air space C between the front and rear wall sections to points adjacent to the fire face of the wall. While ordinarily the blocks in the lining are arranged in staggered relationship, as shown in Fig. 1, this arrangement is not necessary and the blocks may be located in vertical alinement with each other so that the air spaces 27 provided between adjacent blocks in one row will line up and register with those in the rows above and below it. Such an arrangement is of advantage in those constructions in which it is desirable to increase the rate of heat transfer from the lining. In such cases usually a forced draft is created through the air space C by means of a blower and the air so preheated may be used for combustion purposes, for drying coal, or in any other desired manner.

If a greater cooling effect is desired at points closely adjacent to the fire face of the wall, the arrangement shown in Figs. 9 and 10 may conveniently be used. In this construction the blocks 10″ are reduced at their opposite sides to provide air passages 28 which open into a horizontal passage 30 extending parallel to the fire face of the wall, the forward portions of the blocks 10″ being cut away to form this passage. In this case each block carries a removable facing brick 31 which completely covers the front face of the block, these bricks being made of silicon carbide, or some other highly refractory material, while the blocks are made of fire clay or the like. As shown in Fig. 9 each block 10″ is notched at its upper edge and the facing brick 31 for it is provided with a hook which fits into said notch, each facing brick thus being hooked on to its respective supporting block 10″. The bricks may fit closely against each other laterally but a clearance space is provided between adjacent rows of these facing bricks, as shown in Fig. 9, so that each row may expand vertically without interfering with the next adjacent row. Lateral expansion of each row of facing bricks is permitted due to the presence of the vertical expension joints 18′. The arrangement shown at the right of Fig. 10 is like that shown at the left of said figure except that each facing brick 30′ is shaped to fit on and protect the forward sides of two adjacent blocks 10″ and is made slightly narrower than the two blocks and not quite as high as the individual blocks so that each brick can expand freely both vertically and laterally. In such an arrangement if an air pressure is maintained in the air space C some air will escape through the front section of the wall into the combustion chamber. This arrangement, therefore, is suitable chiefly for those installations in which it is desired to have air introduced in this manner. No facing brick supports the weight of any other brick.

In these constructions, strips 32, Fig. 10, of refractory material are placed in front of each of the posts 3 both for the purpose of blocking the escape of air or gases through the expansion joints 18 and more particularly to protect the structural steel members from the action of the hot gases in the combustion chamber.

Key blocks 33, Fig. 9, may be used with the blocks 10″ in essentially the manner above described in connection with Fig. 2, and a facing brick 34 may be associated with each key block or filler block but located in a reverse relationship to it from that occupied by the other facing bricks with reference to their respective blocks. A refractory packing 17′ closes the

space between the row of key blocks or filler blocks and the next panel above it.

When it becomes necessary to renew a panel of the wall shown in Figs. 1 and 2, or to replace a broken brick, the packing is dug out of the expansion joint immediately above that individual panel, the key blocks 10^d for that panel are removed and as many of the other blocks 10 are taken out as may be necessary to get down to the broken block. The desired number of new blocks are then placed in position, the other rows of blocks are replaced, and the expansion joint is filled with packing material. The fact that the bars 16 are readily removable facilitates this operation since each bar must be taken out, or at least lifted, before the row of blocks with which it is interlocked can be removed. The wall constructions shown in Figs. 7 and 9 can be repaired in substantially the same manner.

The invention thus provides a furnace wall of the structural steel supported type in which a relatively small weight of metal is required and in which the erecting and repairing operations can be performed very easily and economically. The construction also lends itself readily to the minor modifications required to adapt it to the peculiarities of individual installations. It will be observed that the opposed front and rear posts 3 and 2, respectively, are connected together by cross pieces in such a manner as to form an upright open truss. This construction is of particular advantage when a positive circulation of air is to be maintained through the air space in the front and rear wall sections, either for the purposes of cooling the front section or preheating the air, or both, since it permits a free circulation both vertically and horizontally. At the same time the flow of air can be controlled by baffles inserted at any desired points and secured to the frame. Horizontal baffles are shown, for example, in Fig. 1. The air space C also is of advantage in insulating the rear wall section from the front section and thus reducing the transfer of heat to the extreme rear surface of the wall. In the arrangement shown in Figs. 1, 2 and 3 the structural steel posts 3 are protected from the heat of the combustion chamber both by the inner wall or lining and also by the air space between the posts and the lining. In the wall construction shown in Figs. 7 to 10, inclusive, the posts 3 have been set into the front wall section in order to reduce the overall thickness of the wall and here these members are protected by slabs or strips 32 of asbestos or other refractory material. It is extremely important that the steel members be adequately protected in these wall constructions since they would deteriorate very rapidly if exposed to too high a temperature.

While I have herein shown and described convenient embodiments of my invention, it will be understood that the invention may be embodied in other forms without departing from the spirit or scope thereof.

Having thus described my invention, what I desire to claim as new is:

1. A furnace wall comprising a permanent rear wall section, a structural steel frame in said wall comprising posts located in an intermediate position in the wall and including a horizontal beam secured rigidly to certain of said posts, a horizontal row of refractory blocks resting on said beam and forming a part of the lining for said wall, another horizontal row of lining blocks resting on the first mentioned row, and a bar releasably connected with said frame for holding said additional row of blocks in their operative positions.

2. A furnace wall comprising a permanent rear wall section, a structural steel frame in said wall comprising posts located in an intermediate position in the wall and including a horizontal beam secured rigidly to certain of said posts, a horizontal row of refractory blocks resting on said beam and forming a part of the lining for said wall, another horizontal row of lining blocks resting on the first mentioned row, and a bar slidable vertically on the latter posts and operative to hold said additional row of blocks in their operative positions.

3. A furnace wall comprising a permanent rear wall section, a structural steel frame in said wall comprising posts located in an intermediate position in the wall, a removable lining positioned in front of and spaced from said rear wall section and comprising a plurality of panels each including horizontal rows of refractory bricks positioned one above another, a plurality of horizontal beams secured to said posts and supporting, respectively, the bottom rows of blocks in said panels, and horizontal bars removably mounted on said frame and interlocked with said upper rows of blocks to hold the latter blocks in their operative positions in said lining.

4. A furnace wall comprising a permanent rear wall section, a structural steel frame in said wall comprising posts located in an intermediate position in the wall, a removable lining positioned in front of and spaced from said rear wall section and comprising a plurality of panels each including horizontal rows of refractory bricks positioned one above another, a plurality of horizontal beams secured to said posts and supporting, respectively, the bottom rows of blocks in said panels, and horizontal bars mounted for vertical slidable movement on said posts and engaged with said upper rows of blocks to hold them in their operative positions in said lining.

5. A furnace wall comprising a permanent rear wall section, a structural steel frame in said wall comprising posts located in an intermediate position in the wall, a removable lining positioned in front of and spaced from said rear wall section, said lining comprising a plurality of panels each including a plurality of horizontal rows of refractory blocks, said rows in each panel being positioned one above another, a horizontal beam secured rigidly to certain of said posts and supporting the bottom row of blocks in one of said panels, a horizontal bar releasably connected with said frame and including a flange lying between and interlocked with two superposed rows of blocks in the latter panel, said bar serving to hold the blocks which it engages in their alined positions in said lining, and similar beams and bars cooperating in the same manner with the blocks of the other panels.

6. A furnace wall according to preceding claim 5 in which said panels are separated from each other by expansion joints which are packed to permit relative expansion and contraction of the panels without opening the joints, each panel also including a row of key blocks which are removable from the wall at the fire side thereof, said supporting means for the other blocks of each panel being arranged to permit the removal of the latter blocks of any panel, after the key bricks have been removed, without disturbing either the adjacent panels or the rear wall section.

7. A furnace wall comprising front and rear wall sections with an air space separating said sections, a structural steel frame in said wall for supporting said sections, said front section including horizontal rows of blocks arranged one above another, and said front section having passages extending thereinto from said air space and terminating at points adjacent to the fire face of said wall, through which passages and air space a free circulation of air can be maintained.

8. A furnace wall comprising front and rear wall sections with an air space separating said sections, a structural steel frame in said wall for supporting said sections, said front section including horizontal rows of blocks arranged one above another, and horizontal bars engaging said blocks and cooperating with said frame to hold said blocks properly alined in the wall, said front section having air passages extending thereinto and permitting a circulation of air from said air space to points adjacent to the fire face of the wall.

9. A furnace wall comprising front and rear wall sections with an air space separating said sections, a structural steel frame in said wall for supporting said sections, said front section including horizontal rows of blocks arranged one above another, horizontal bars interlocked with said blocks and holding the blocks properly alined in the wall, said blocks having air passages between them opening into said air space and extending toward the fire face of said front section but terminating at points adjacent to said face.

10. A furnace wall comprising front and rear wall sections with an air space separating said sections, a structural steel frame in said wall for supporting said sections, said frame including upright open trusses through which a horizontal circulation of air through said air space can be maintained, said front section including horizontal rows of blocks arranged one above another, and means carried by said frame for holding said blocks in their normal positions in the wall, said front section having air passages extending thereinto from said air space and terminating at points adjacent to the fire face of the wall, through which air passages and air space a free circulation of air can be maintained.

11. A furnace wall according to preceding claim 3 in which said lining is provided with air passages located behind but terminating adjacent to the fire face of said front wall section and in free communication with said air space between said front and rear wall sections.

12. A furnace wall comprising front and rear wall sections with an air space between them, said front section including blocks supported for removal from the wall at the fire side thereof without disturbing said rear wall section and refractory facing bricks supported on said blocks, said front section having an air passage therein lying parallel to the fire face of the wall and located immediately behind said bricks, said passage extending continuously past several of said bricks and being connected by additional passages with said air space.

13. A furnace wall comprising a permanent rear wall section, a renewable lining located in front of said rear wall section and comprising a plurality of rows of refractory blocks positioned one above another, a structural steel frame in said wall including posts embedded in said lining and carrying at least a part of the weight of the lining, said posts being protected by said blocks from the heat generated in the combustion chamber, and additional insulating material protecting said posts from the heat of the combustion chamber.

14. A furnace wall comprising front and rear wall sections with an air space separating said sections, a structural steel frame in said wall for supporting said sections, said front section including horizontal rows of blocks arranged one above another, means cooperating with said frame for supporting said blocks in their operative positions but permitting the disengagement of the blocks from their supporting means and the removal of the blocks from the wall at the fire side thereof without disturbing said rear wall section, said front section having an air passage therein lying parallel to the fire face of the wall but located behind said fire face and extending across a series of said blocks, said front section also being provided with air ducts connecting said passage with said air space.

15. A furnace wall comprising front and rear wall sections with an air space separating said sections, a structural steel frame in said wall for supporting said sections, said front section including horizontal rows of blocks arranged one above another, means cooperating with said frame for supporting said blocks in their operative positions but permitting the disengagement of the blocks from their supporting means and the removal of the blocks from the wall at the fire side thereof without disturbing said rear wall section, facing bricks of highly refractory material removably supported on said blocks at the fire side of the wall, said front wall section having an air passage therein located immediately behind said facing blocks and extending parallel to the fire face of the wall and connected with said air space by air ducts, whereby a circulation of air can be maintained through said passages and ducts in contact with the rearward surfaces of said facing bricks.

16. A furnace wall comprising front and rear wall sections with an air space separating said sections, a structural steel frame in said wall for supporting said sections, said front section including horizontal rows of blocks arranged one above another, means carried by said frame for supporting said blocks in their operative positions with said blocks disengageable from their said supporting means and removable from the wall at the fire side thereof without disturbing said rear wall section, said front section being provided with air passages extending thereinto from said air space and terminating at points adjacent to the fire face of the wall.

17. A furnace wall comprising front and rear wall sections with an air space between them, said front section including rows of blocks, means supporting said blocks for removal from the wall at the fire side of the wall without disturbing said rear wall section, and refractory facing bricks removably supported on said blocks at the fire side of the wall, said front wall section having air passages leading thereinto from said air space to the rear surfaces of said facing bricks.

18. A furnace wall comprising front and rear wall sections with an air space between them, said front section including rows of blocks, means supporting said blocks for removal from the wall at the fire side of the wall without disturbing said rear wall section, and refractory facing bricks removably supported on said blocks at the fire side of the wall, each row of said facing bricks being spaced from the next adjacent row of simi-

lar bricks by a sufficient distance to permit the vertical expansion of one row independently of the next adjacent row.

19. A furnace wall comprising front and rear wall sections with an air space between them, said front section including rows of blocks, means supporting said blocks for removal from the wall at the fire side of the wall without disturbing said rear wall section, and refractory facing bricks removably supported on said blocks at the fire side of the wall, said facing bricks being arranged in panels separated from each other by expansion joints, and adjacent rows of said bricks being spaced apart by a sufficient distance to permit them to expand and contract independently of each other.

20. A furnace wall comprising front and rear wall sections with an air space between them, said front section including rows of blocks, means supporting said blocks for removal from the wall at the fire side of the wall without disturbing said rear wall section, and refractory facing bricks hooked on said blocks and removable from said blocks at the fire side of the wall while leaving said blocks in their normal positions in the wall, said front wall section having air passages therein for circulating air in contact with the rearward surfaces of said facing bricks.

21. A furnace wall comprising a permanent rear wall section, a structural steel frame in said wall including posts located in an intermediate position in the wall, a renewable lining located in front of and spaced from said rear wall section and supported in its operative position by said frame, said lining comprising a plurality of rows of refractory blocks positioned one above another, said posts carrying the greater part of the weight of said lining and being protected by said blocks from the heat generated in the combustion chamber, and means additional to said blocks for protecting said posts from the heat in said combustion chamber.

22. A furnace wall comprising front and rear wall sections, a structural steel frame in said wall for supporting said sections, said front section including horizontal rows of refractory blocks arranged one above another, and means carried by said frame for supporting said blocks in their operative positions with said blocks disengageable from their said supporting means and removable from the wall at the fire side thereof without disturbing said rear wall section, said front section being provided with internal air passages connected with a supply of air for circulating air through said front section but substantially confining said circulation to regions behind the front face of the wall.

23. A furnace wall comprising front and rear wall sections, a structural steel frame in said wall for supporting said sections, said front section including horizontal rows of refractory blocks arranged one above another, and means carried by said frame for supporting said blocks in their operative positions with said blocks disengageable from their said supporting means and removable from the wall at the fire side thereof without disturbing said rear wall section, said blocks in the front section having renewable front face portions of such dimensions that a clearance will be provided both laterally and vertically between adjacent edges of said face portions when said blocks are in their normal positions in the wall.

24. A furnace wall comprising front and rear wall sections, a structural steel frame in said wall for supporting said sections, said front section including horizontal rows of refractory blocks arranged one above another, means carried by said frame for supporting said blocks in their operative positions with said blocks disengageable from their said supporting means and removable from the wall at the fire side thereof without disturbing said rear wall section, said blocks in the front section including renewable front face portions composed of refractory material having a different co-efficient of expansion from that of the rear sections of said blocks, said front face portions and the rear sections of said blocks being so proportioned that when said blocks are positioned in a wall a clearance will be provided between the adjacent edges of said face portions to allow for expansion, and said front face portions being free to expand and contract independently of the rear sections of said blocks.

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