

March 10, 1942.

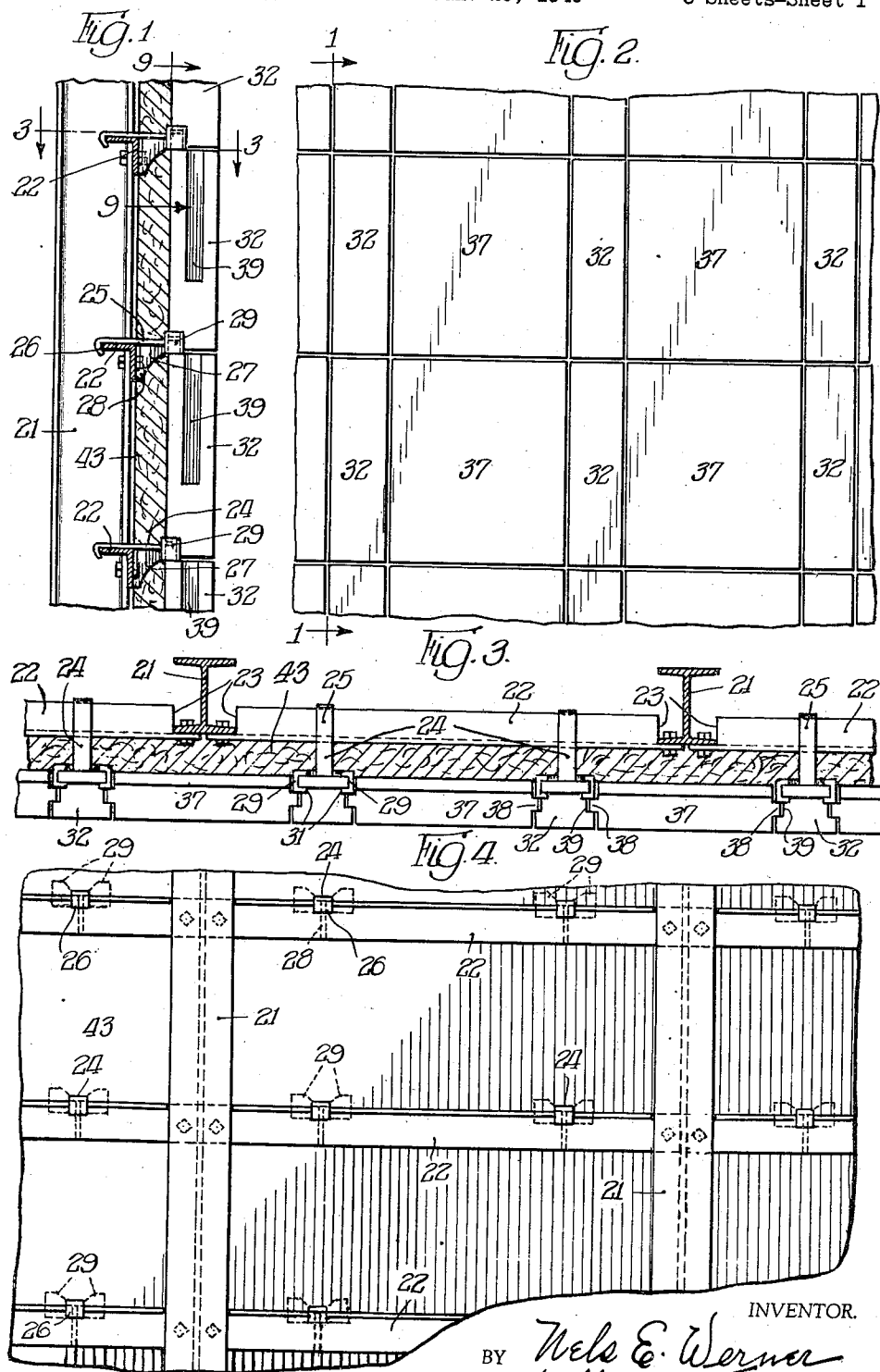
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2,275,933

FURNACE-WALL

Filed Jan. 29, 1940

3 Sheets-Sheet 1



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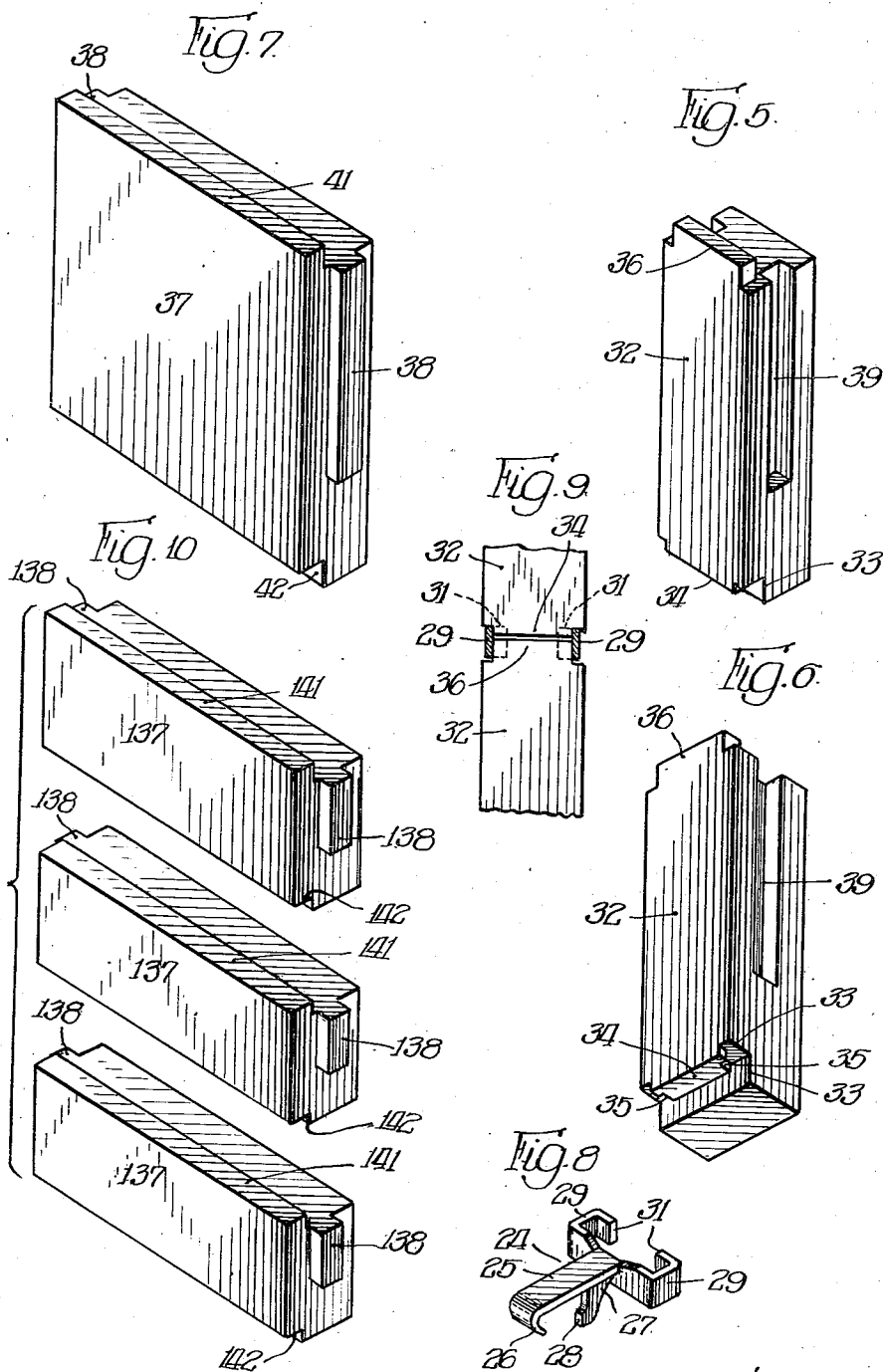
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FURNACE-WALL

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3 Sheets-Sheet 2



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FURNACE-WALL

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3 Sheets-Sheet 3

Fig. 11

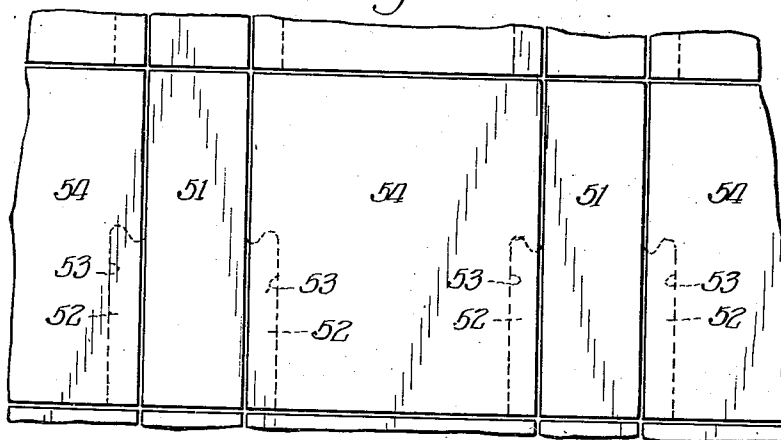


Fig. 12

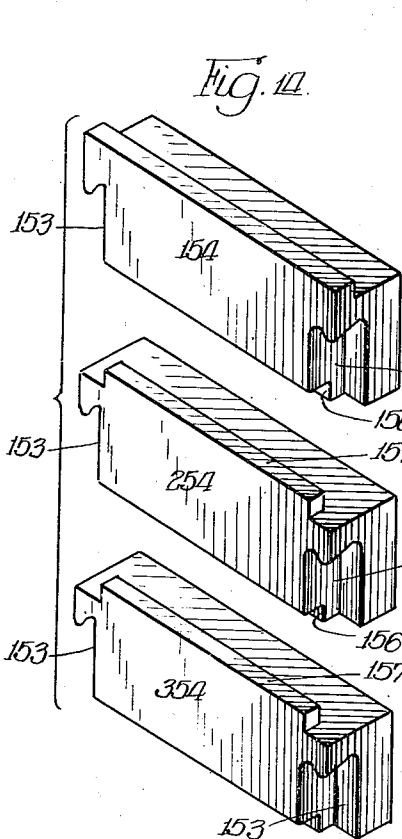


Fig. 13

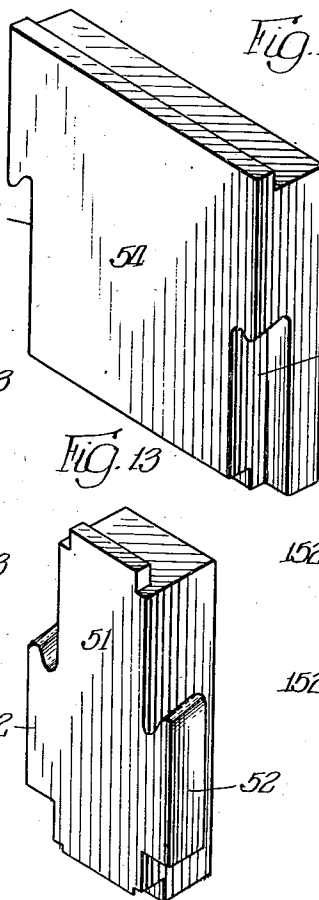
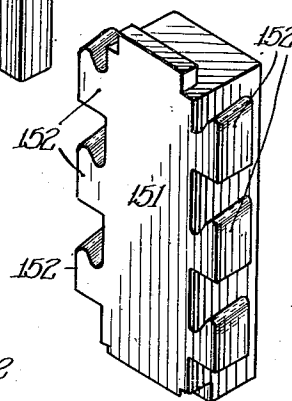


Fig. 15



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UNITED STATES PATENT OFFICE

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FURNACE WALL

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11 Claims. (Cl. 72-101)

The present invention relates to furnace-wall constructions and has for one of its principal objects a design of especially-thin refractories supported in a novel manner to permit high surface-temperatures inside of the furnace without damage to the metal-supports of the wall.

Another aim of the invention is to permit the application of insulating-material to the outside surface of the refractories in any reasonable thickness limited only to its own permissible junction-temperature between the insulation and the refractories.

A further purpose of the invention is to allow a wide column spacing without appreciable increase in the cost of the supporting castings or other metal parts, and without disturbing the structural integrity of the wall.

An added salient feature of the invention is to provide a structure which permits a low cost of direct supports for the tiles and designed in such a manner as to produce low fibre stresses in the metal within the limits of destruction of the metal bond in the metal itself at the varying temperatures imposed upon it.

Heretofore, it has been customary to make the furnace-wall construction such that larger amounts of supporting metal were necessary to produce the refractory-support which, due to its peculiar designs, required heavier castings of larger cross-sectional area to conduct heat from their inner flanges to a large external metal area, and to radiate and to convect the energy to the outer atmosphere therefrom.

An object of the present invention is to adequately support the tile in units, in order to relieve or avoid cumulative loading of the refractories, and with as small a cross-sectional area as is possible in the castings to conduct heat through them to a relatively-small exposed exterior surface to transmit this energy to the atmosphere, which produces a lower overall heat loss for the entire wall for the same given refractory and insulation thickness.

The foregoing is readily understood and appreciated since cast-iron in the range of temperature imposed upon it conducts heat at the rate of approximately 350 B. t. u. per square foot per hour per degree difference in temperature per inch thickness, whereas the insulating-material applied to the exterior of the refractories conducts heat in the mean temperature range imposed upon it of approximately one, or less than one, B. t. u. per square foot per hour per degree difference in temperature per inch thickness, and from this it will be readily comprehended

that the smaller the cross-sectional area of metal projecting through the insulation and the smaller the area of the castings exposed to the atmosphere, since they have such a high rate of thermal conductivity, the lower the overall heat loss of the wall for the same thickness of refractories and insulation.

Moreover, a valuable feature of this invention is the provision of refractory-blocks of peculiar design which permit the support of intervening refractory-tiles from the supporting blocks, thus limiting the number of castings or metal parts projecting through the insulation to sustain the refractories, with attendant lower heat losses and reduced cost of metal supporting material.

A still further object of this invention is to produce a construction which permits the ready application of a combination of plastic and block insulation, with its accompanying support from the wall as designed, to seal the walls thoroughly against deleterious air-infiltration through the same.

Another aim of the invention is to provide a combination of metal parts and refractory-shapes which permit the ready expansion of the individual units in all directions without disturbing the value and functional capacity of the wall by allowing each individual refractory member to expand freely in its original position of installation with an expansion-joint surrounding each tile on four sides.

Moreover, another advantage in the new wall is the fact that all of the metal parts may be mounted by the erector before any of the refractories are applied to the wall, the metal clips or brackets being merely slid along into correct positions as the refractories are applied in place.

Other benefits and superior features of the improved and novel construction will become apparent to those skilled in the art from a consideration of the present preferred embodiments of the invention illustrated in detail in the accompanying drawings forming a part of this specification and to which reference should be had in connection with the following detailed description of the wall structures shown.

In these drawings, for simplicity, like reference numerals have been employed to designate the same parts throughout the several views.

In these drawings:

Figure 1 is a fragmentary, vertical section on line 1-1 of Figure 2 through a furnace-wall incorporating one style of the invention;

Figure 2 is a partial view of such a wall as seen from the inside of the furnace;

Figure 3 is a fragmentary section through the wall on line 3—3 of Figure 1;

Figure 4 is a partial elevation of the wall as viewed from the outside of the furnace;

Figure 5 is a perspective view of one of the supporting tiles or refractory blocks as viewed somewhat from above;

Figure 6 is a similar view of the same element as seen somewhat from below;

Figure 7 is a perspective view of one of the intermediate-tiles which is supported at its opposite ends or sides by two of the refractory-blocks shown in Figures 5 and 6.

Figure 8 is a perspective view of one of the metallic tile-supporting clips or brackets;

Figure 9 is a fragmentary, vertical section on line 9—9 of Figure 1;

Figure 10 presents a modified structure showing the use of an intermediate-tile divided into three sections to take the place of the single tile illustrated in Figure 7.

Figure 11 is a partial elevation of a wall made of refractories of different shapes than those already considered;

Figure 12 is a perspective view of one of the intermediate-refractories employed in the wall of Figure 11;

Figure 13 is a similar view of one of the supporting-refractories of the wall of Figure 11;

Figure 14 shows a sectional-refractory of a plurality of parts which may take the place of that shown in Figure 12 when such sectioned tile is used with supporting tiles such as illustrated in Figure 15; and

Figure 15 is a perspective view of a supporting tile.

Referring first to the construction presented in Figures 1 to 9, inclusive, it will be noted that the wall includes a suitable number of appropriately-spaced columns 21, 21, in the present instance I-beams, to the inner faces of which, as by bolts or rivets, are secured a number of horizontal, vertically-spaced angle-bars or ledge-members 22, 22 with their upper, outwardly-directed flanges cut away at 23, 23 to escape the columns to which their inner depending flanges are fastened.

These angle-bars carry a proper number of metal supporting clips, brackets, or hangers characterized as a whole 24, 24, (see Figure 8) on which the supporting tiles are mounted.

Each such clip or metallic support 24 has a top, flat part 25 directly above and resting on the horizontal flange of the angle-bar 22 with which it is associated, and the outer or rear end of the portion 25 has a depending hook 26 which engages the back edge and marginal part of the angle-bar as shown.

The under side of the portion 25 has a downwardly-directed fin or web 27 which at the lower end of its outer edge has a small boss or projection 28 bearing against the inner or front surface of the vertical flange of the angle-bar, whereby the clip as a whole is firmly secured to the angle-bar so far as bearing a weight by the clip is concerned, the latter, however, being capable of sliding adjustment or movement along the angle-bar.

As illustrated, perhaps most clearly in Figure 8, the inner end of the part 25 has a pair of oppositely-arranged, complementary arms 29, 29 of the form shown whose aligned ends 31, 31 extend toward one another but are spaced apart as indicated.

On each such clip or bracket one of the supporting-tiles or refractory-blocks is mounted, the

clip also receiving and holding in proper position the top end portion of the next lower supporting-tile.

Each such refractory 32 (Figures 5 and 6) is recessed at the bottom of its outer rear face at 33 and the upper wall of such recess has a downwardly-directed lug or rib 34 cut away at its opposite ends at 35, 35, such rib, as shown, being of less length than the width of the tile.

Each such tile or refractory-block 32, when in position in the wall, is supported at its lower end by one of the brackets or clips 24 whose arms 29, 29 embrace or partially surround the projection 34 of the tile with its ends 31, 31 occupying the cavities 35, 35, the top wall of recess 33 resting directly on the upper edges of the arms 29, 29, whereby each such member 32 is adequately and properly supported on the metal-framework and securely held in position against lateral displacement in any direction.

In this connection, it should be noted that the overall horizontal dimension of the pair of arms 29, 29 is substantially the same as the width of the tile as indicated in Figure 3.

Directly above the projection or rib 34, each such supporting-tile at its upper end has an upstanding rib or projection 36 which fits in the lower portion only of the space between the arms 29, 29 of the next higher clip or bracket 24 (see Figure 9).

The lengths of the two ribs 34 and 36 are substantially equal and each is of less length than the width of the tile by the thicknesses of the two arms 29.

These tiles do not rest upon one another, but, due to a horizontal gap between their adjacent ends, each is individually supported by its own clip or bracket, wherefore there is no cumulative loading of such refractory-elements.

Each horizontally-spaced pair of such tiles 32, 32 support a larger, intermediate refractory member or tile 37 of the same thickness and which on its opposite vertical sides or edges has a pair of ribs 38, 38 of less height than the tile 37 and occupying complementary, equal-length grooves 39, 39 in the upright edges of the pair of supporting-tiles 32, 32, the lower end surfaces of the ribs resting on the lower end faces of the grooves.

Along the entire outer edge of its top each such intermediate-tile 37 has an upstanding rib 41 which occupies a companion recess 42 in the underside of the tile 37 next above.

For the most part, the construction referred to of the two sets of tiles 32 and 37 provides overlap joints therebetween, and all of such tiles are of such sizes that each may expand in its own plane in all four directions due to small gaps or spaces all around.

Instead of employing a single-tile 37 between each pair of supporting-tiles 32, 32, the former may be made in a plurality of horizontal parts or sections 137, 137 as presented in Figure 10, and, in this instance, the vertical ribs 138, 138 on opposite ends of each of the three elements unitedly correspond to the pair of ribs 38, 38 of the unit member 37.

Each element 137 has an upstanding, longitudinal top rib 141 and the comparable bottom recess 142 to receive the rib 141 of the next lower section, the rib 141 of the uppermost section corresponding to the rib 41 of tile 37 (Figure 7) and the bottom recess 142 of the lowermost section 137 corresponding to the recess 42 of such

tile 37.

The manner in which the specified elements of the furnace-wall are erected in place is obvious, including the sliding along into place and finally an outer layer 43 of suitable insulation-material, such as asbestos alone or in combination with one or more other materials, is provided at the outer surface of the tile-wall.

Such wall 43 constitutes the main heat-insulating agent, the inner tile-wall forming a heat-protective means or facing therefor.

In passing, it should be noticed that the portions of the brackets or clips which extend through the insulation-wall are relatively small in cross-sectional area with the accompanying advantages specified among the several objects of the invention.

Another embodiment of the invention is presented in Figures 11, 12 and 13, the form of the supporting-tiles being shown in Figure 13, these having their bottom and top ends like the tiles of Figures 5 and 6, except that instead of the tongue and groove structures 38 and 39 (Figures 5, 6 and 7), the modified style 51 has projections 52, 52 extended outwardly from its opposite side faces, the upper ends of such extensions sloping slightly downwardly outwardly and the projections being undercut in similar manner, such extensions of a pair of blocks 51, 51 being adapted to be received in conformable corner recesses 53, 53 in the lower parts of the modified companion intermediate-tile 54.

As will be readily understood, the lugs 52, 52 of adjacent tiles 51, 51 support a tile 54 between them, the sloping characteristics of the lugs and complementary recesses precluding unintentional displacement of the supported tile.

A further embodiment of the invention is depicted in Figures 14 and 15, the former showing a Figure 12 type of tile supplied in three horizontal, superposed parts, and Figure 15 illustrating the shape and form of one of the pair of companion supporting-tiles.

Referring to the three tile-sections 154, 254, and 354, each has its pair of lower undercut recesses or cavities 153, 153 and each of the two sections 154 and 254 has a longitudinal bottom recess 156 positioned in the assembled relation of the sections to receive the top rib 157 of the next lower section, whereby all three sections have overlap joints between them.

Each of the correlative supporting-tiles 151 (Figure 15) has three pairs of lugs or projections 152, 152 similar to, but smaller than, the comparable members 52, 52 (Figure 13).

As in the previous instance, all of the recesses 153 and projections 152 have the undercut and sloping features hereinabove referred to.

Obviously, in this case, each section 154, 254 and 354 has its own pair of lugs 152 of two tiles 151 to support it.

From what precedes, it will be apparent that the new furnace-wall includes the combination of spaced, upright, metal supports, horizontal or level, vertically-separated ledge-members or angle-bars mounted on such uprights, a plurality of metal supporting-elements or castings projecting inwardly from such ledge-members and each supporting a relatively-thin wall-block, each pair of which in turn support between them a comparatively-thin wall-block, the structure employing a minimum weight of metal material to perform this operation and wherein such metal is not stressed beyond that stress which will produce 1% creep in 100,000 hours at the particular temperature imposed on the metal

supports, and by support in this manner relieving cumulative loading of the refractories thereby permitting a wall to be erected to extreme heights, and to allow the ready replacement of refractory blocks or tiles from within or without the furnace, and without disturbing the integrity of the wall above or below or adjacent to the repair area, and with an expansion-joint provided around all four sides of each refractory wall block.

Also, from the foregoing, it will be understood that extremely wide spacing of the upright supports may be employed without appreciably increasing the cost of metal supporting material.

Again, the novel construction limits the inside hot surface temperature of the refractories only by the junction temperature between the refractories and the insulation applied to their exteriors, which junction temperature, of course, must be below that which is permissible for the insulating-material used.

Further, the increased outer surfaces of the refractories allow easier and more homogeneous application of the insulation, thus sealing the walls against detrimental or disserviceable air interpenetration.

The invention as defined by the appended claims is not necessarily limited and restricted to the precise and exact details of structure shown and described because these are subject to modification without departure from the heart and essence of the invention and without the loss or sacrifice of any of its material benefits or advantages.

I claim:

1. In a furnace-wall of the type having a metal-frame-work, including horizontal vertically-spaced metal-bars, metal-brackets mounted on said bars and projecting inwardly of the furnace, a tile-wall including sustaining-tiles and other tiles supported solely thereby, said sustaining-tiles being arranged in spaced-apart upright rows of single-tiles, said supported-tiles being arranged in single upright rows between said sustaining-tile rows and mounted on and solely supported thereby, each said bracket having the lower end of one of said sustaining-tiles mounted on and carried thereby and also retaining in position the top portion of the next lower sustaining-tile of the upright row, the novel features being that each said bracket has at its inner end a pair of opposed oppositely-arranged arms unitedly partially enclosing a space open both at the top and bottom of said arms, the bottom portion of each such sustaining-tile having a rib fitted in the upper part of said space of its bracket, each such sustaining-tile at its top having an upstanding rib occupying the lower portion of said space of the next higher bracket.

2. In a furnace-wall of the type having a metal-framework, including horizontal vertically spaced metal-bars, metal-brackets mounted on said bars and projecting inwardly of the furnace, a tile-wall including sustaining-tiles and other tiles supported solely thereby, said sustaining-tiles being arranged in spaced-apart upright rows of single-tiles, said supported-tiles being arranged in single upright rows between said sustaining-tile rows and mounted on and solely supported thereby, each said bracket having the lower end of one of said sustaining-tiles mounted on and carried thereby and also retaining in position the top portion of the next lower sustaining-tile of the upright row, the novel features being that each said bracket has at its inner end

a pair of opposed oppositely-arranged arms united partially enclosing a space open both at the top and bottom of the arms, the outer side of the bottom of each such sustaining-tile having a recess with a rib of the tile projecting downwardly into such recess and fitted in the upper part of said space of its bracket, each such sustaining-tile at its top having an upstanding rib occupying the lower portion of said space of the next higher bracket.

3. The furnace-wall set forth in claim 1 in which all of said tiles are of the same general thickness and are all in the same plane.

4. The furnace-wall set forth in claim 1 in which each said supported-tile is composed of a plurality of horizontal sections with overlapped joints between them.

5. The furnace-wall set forth in claim 1 in which each of said supported-tiles has an overlap joint with the supported-tile immediately above and below it.

6. In a furnace-wall of the type having a metal-framework including horizontal vertically-spaced metal-bars, each such bar having a front upright plate-portion and a flange extended rearwardly from the top of said plate-portion, metal-brackets mounted on said bars and projecting inwardly of the furnace, a tile-wall including sustaining-tiles and other tiles supported solely thereby, said sustaining-tiles being arranged in spaced-apart upright rows of single tiles, said supported-tiles being arranged in single upright rows between said sustaining-tile rows and mounted on and supported solely thereby, each said bracket having the lower end of one of said sustaining-tiles mounted on and carried thereby and also retaining in position the top portion of the next lower sustaining-tile of the upright row, the novel features being that each such bracket is located above said flange of the corresponding bar, has a downwardly-directed hook taking around the rear edge of said flange, and has a projection bearing only on the lower part of the front face of said plate-portion, each such bracket having at its inner end a pair of opposed oppositely-arranged arms partially enclosing a space open at the top and bottom of said arms, each said sustaining-tile having a recess across the bottom of the outer portion of the tile and into which recess projects a first rib downwardly-extended from the top wall of said recess and also outwardly-projecting from the inner wall of said recess, said rib being of less length than the recessed width of the block, said rib having a longer outer portion directly integrally connected to said inner wall by a shorter inner portion, the top of said block having an upstanding second rib in register with

said first rib and of substantially the same length as the overall length of said first rib, the ends of said second rib and those of the longer portion of said first rib being equally spaced from the sides of the tile, the longer portion of said first rib being fitted in the upper part of said space of its bracket, the second rib of such tile occupying the lower portion of the space of the next higher bracket.

7. A metallic-bracket for mounting a tile on the metal-framework of a furnace-wall, said bracket having a main bar-portion with a downwardly-directed hook at one end, a depending web with a projection on the lower part of its edge toward said hook, and a pair of arms on the end of said bar-portion opposite said hook, said arms unitedly partially enclosing a space open both at the top and at the bottom of said arms.

8. A rectangular tile having a recess across the bottom of the outer portion of the tile and into which recess projects a rib downwardly extended from the top wall of said recess and also outwardly projecting from the inner wall of said recess, said rib being of less length than the recessed width of the tile, said rib having a longer outer portion directly integrally connected to said inner wall by a shorter inner portion, the top of said tile having an upstanding second rib in register with said first rib and of substantially the same length as the overall length of said first rib, the ends of said second rib and those of the longer portion of said first rib being equally spaced from the sides of the block.

9. The tile presented in claim 8 in which the opposite sides of the block have vertical grooves extended downwardly from the top of the block and terminating short of the bottom of the block.

10. A rectangular-tile having a plane bottom edge except for a recess across the full width of the tile at the back of the bottom edge thereof, the top of said tile having a plane edge except that at its back it has an upstanding rib of substantially the same dimensions as said recess, the opposite vertical sides of said tile having means for supporting the tile by cooperating means of adjacent members.

11. A rectangular-tile divided horizontally to provide a plurality of sections, the bottom section having a recess across the full width of said section at the back of the bottom thereof, the top of the uppermost section having at its back an upstanding rib of substantially the same dimensions as said recess, the opposite vertical sides of the sectioned tile having means for the support of the tile by cooperating means of adjacent members, said sections having overlapped joints between one another.

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