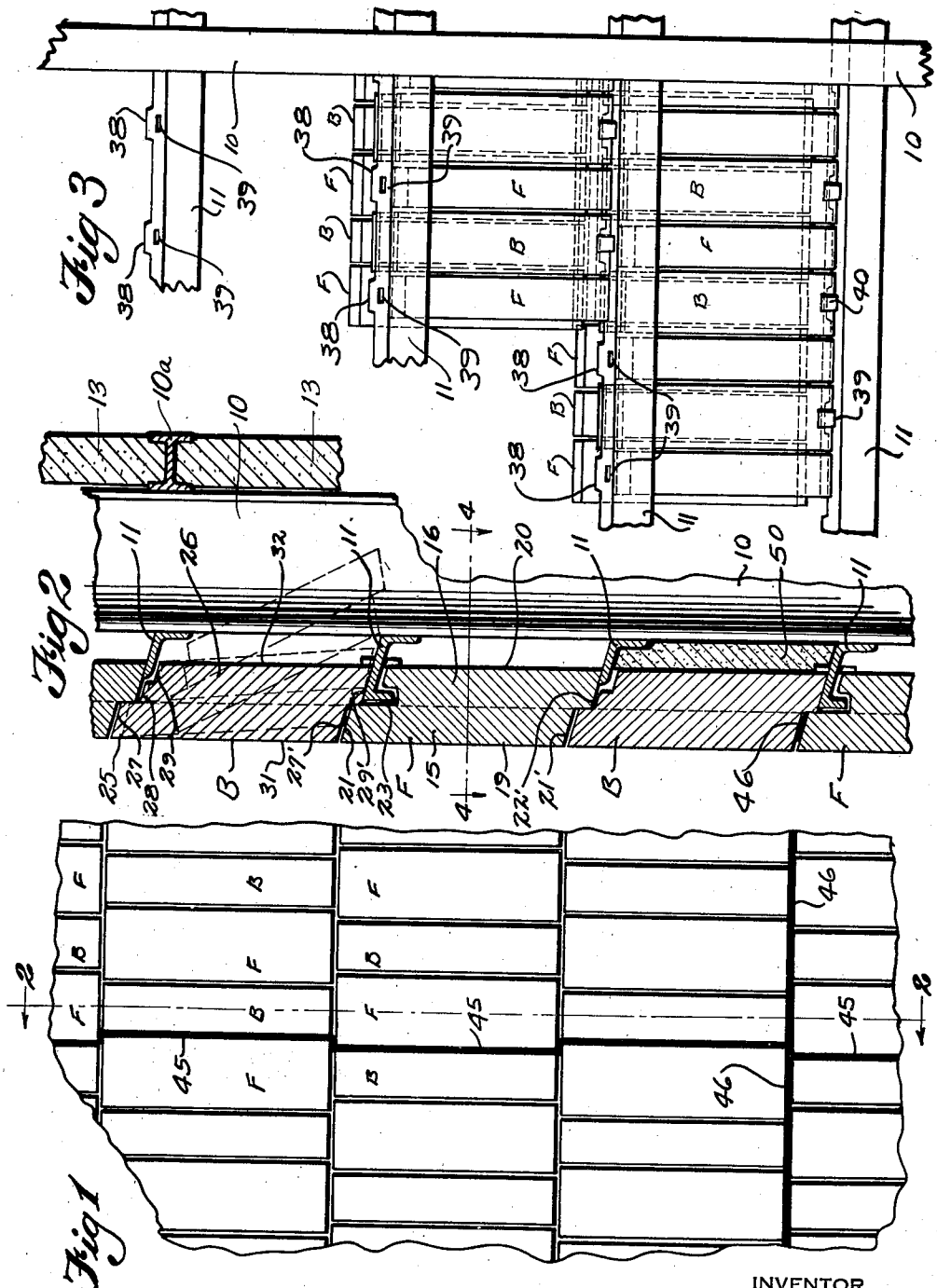
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FURNACE CONSTRUCTION

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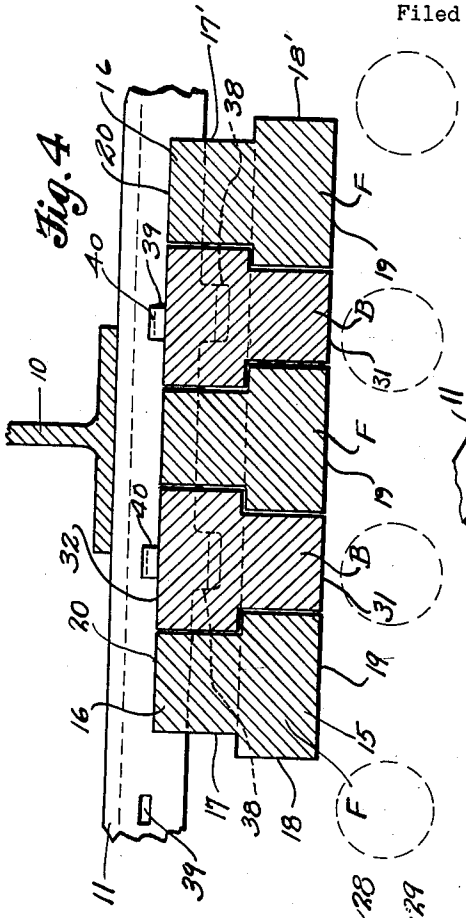


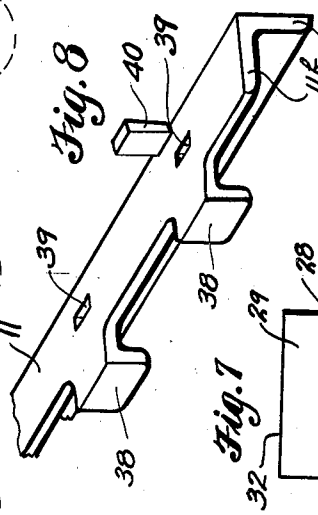
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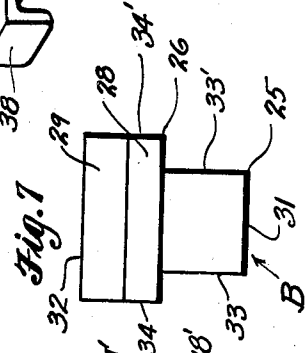
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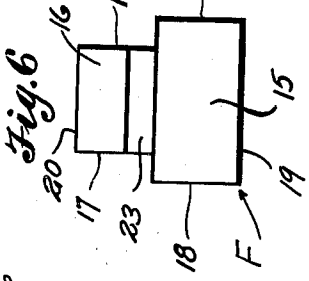
FURNACE CONSTRUCTION

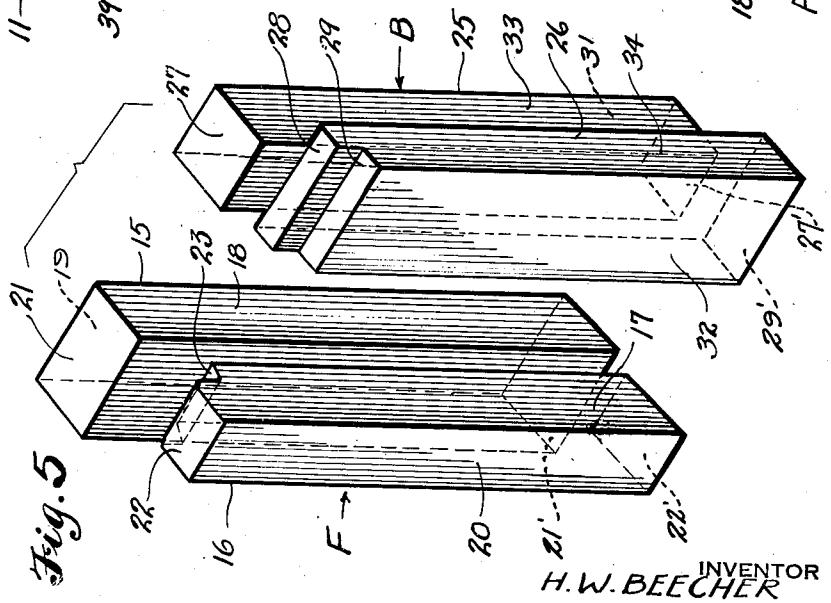
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FURNACE CONSTRUCTION

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Application May 13, 1939, Serial No. 273,545

16 Claims. (Cl. 72—101)

This invention relates to improvements in furnace construction, and it has reference more particularly to furnaces having heat resisting walls comprising refractory tiles suspended from, or supported by a metallic frame-work located at the outside of the refractories.

More specifically, the present invention relates to the details of construction and combination of refractories for a furnace side wall, and in the assembly and relationship of these refractories with a supporting framework including special beams for attachment and support of the refractories; it being the principal object of the present invention to provide a furnace side wall construction that is especially suited for use as a water wall backing, and from which wall structure, damaged refractories may be removed, for replacement, from the outside of the furnace through the frame or casing, without interference by the water tubes and without disturbing the refractories other than those immediately adjacent the one being replaced in the wall structure.

It is a further object of the present invention to provide a wall structure which employs refractories, or tile, of a minimum number of different shapes; which refractories are easily and readily assembled with the supporting structure in the building of a wall, and whereby, in their assembled relationship, all wall joints between refractories both horizontal and vertical, will be effectively sealed by the overlapping of parts, constituting "broken joints."

Still another object of the invention resides in the provision of refractories of the above character designed to accommodate a frame structure of such special form as to provide for positively retaining the refractories against inward displacement from the supports and wherein removable keepers, or keys are utilized to retain the refractories against outward displacement; the keepers being manually removable when it is desired to release a refractory for removal and replacement.

A further object of the invention is to provide for a quick and easy removal of any tile from the wall by withdrawing it outwardly, and which does not require in its withdrawal that it be moved or tilted inwardly beyond the plane of the inside surface of the wall lining.

Still other objects of the invention reside in the details of construction, and in the combination of parts constituting the wall, as will hereinafter be fully described.

In accomplishing these and other objects of the invention, I have provided the improved details of construction, the preferred forms of which are illustrated in the accompanying drawings, wherein—

Fig. 1 is an elevation of a section of the wall structure, as seen from the inside of a furnace.

Fig. 2 is a vertical, sectional view of the furnace wall structure taken on line 2—2 in Fig. 1.

Fig. 3 is an elevation of a section of the wall structure as viewed from the outside, but omitting the outside, insulating wall or casing.

Fig. 4 is a horizontal section taken on the line 4—4 in Fig. 2.

Fig. 5 is a perspective view of the two refractories used in the present wall construction.

Figs. 6 and 7 are plan views of the two refractories, respectively.

Fig. 8 is a perspective view of a part of one of the horizontal frame members or supporting beams.

Before going into the detailed description of the present furnace, it will be stated that various items are essential. First, it is desirable that there be as few different shapes of tile as possible, and that the shapes employed shall be easy and inexpensive to manufacture. Secondly, it is essential also that the tile be of such construction that in their assembled condition, an effective seal will be formed against infiltration. Thirdly, when it is desired that the wall be used as a backing for water walls, it is essential that provision be made for withdrawal of the refractories from the outside of the furnace since the water wall, in many cases, would prevent their being inwardly displaced. Furthermore, it is very essential that provision be made for expansion of the wall both horizontally and vertically and it is preferable that the weight be kept as low as practicable. These points have been kept in mind in the present instance, as will be apparent from the following description.

Referring more in detail to the drawings—

As herein illustrated, the present side wall construction comprises a structural steel framework on which the refractories are assembled as an inside lining for the furnace and as a protection to the framework. This framework, in its preferred design, comprises vertical structural members 10, which may be I-beams, channels, T-beams, or the like, of a strength adequate for their intended use, and spaced at such intervals along the wall as found consistent with good practise and as calculated to carry the superimposed loadings. Fixed to the vertical columns 10 at the inside edges, are horizontal beams 11,

of special form, presently to be described, and spaced at regular, vertical intervals for the support of the present refractories thereon. Fixed to the outside of the columns 10, are horizontal beams 10a on which a wall is built up of insulating bricks 13, as in Fig. 2, this constituting the casing.

In the present instance, the refractories constituting the lining are arranged in horizontal courses, each course being supported upon one of the horizontal beams 11, with alternate tile in the course interlocked at their upper ends with the next higher beam, as hereinafter explained.

In the building of the present furnace wall, only two different shapes of refractories, or tile, are employed and tile embodying these two shapes have been shown in perspective view in Fig. 5. For convenience in this description, these two refractories, or tiles, will be designated, respectively, by reference characters F and B. In the description of these refractories, the "outside" will have reference to that side facing toward the outside of the furnace, while the term "inside" will designate the surface facing toward the inside of the furnace.

The tile here designated by reference character F comprises one solid, integral piece, embodying what will be referred to as inner and outer sections, 15 and 16, respectively, the relationship of which will best be understood by reference to the plan view in Fig. 6. The outer section 16 is of rectangular outline in horizontal cross section, but is of lesser width than the inner section 15 and is symmetrically located relative thereto thus to provide that the opposite side surfaces 17 of the section 16 are inwardly, or laterally offset from the side surface 18 of section 15.

The inner surface 19 of section 15 and the outer surface 20 of section 16 of this tile F lie in parallel planes. Likewise, the opposite side surfaces 17—17' and 18—18' of the sections of the refractory are in parallel planes, which planes are perpendicular to the planes of the inner and outer surfaces. Furthermore, there are no irregularities in any of these surfaces, and this is of material advantage in the manufacture of these tile, as will be readily understood by persons familiar with the art.

Viewing the tile F in section, as seen in Fig. 2, it will be observed that the upper and lower end surfaces 21 and 21' of the section 15 which form the horizontal joints between the adjacent ends of tile in next adjacent courses, are equally inclined downwardly and outwardly toward the supporting frame structure, and also that the upper and lower end surfaces 22 and 22' of the sections 16 are likewise downwardly and outwardly sloped. It will further be noted that the section 16 extends somewhat below the lower end surface 21' of section 15 and that, at its upper end, it terminates short of the upper end surface 21 of the section.

Another detail of construction in refractory F resides in the provision of a transverse, upwardly opening notch or channel 23 in the upper end surface of the section 16, adjacent the upwardly extending portion of the section 15, thus providing for reception of means for anchoring the upper end of the tile in place, as will presently be explained.

The refractory B is substantially the reverse in cross sectional shape of refractory F, as best understood by reference to Figs. 6 and 7. This tile comprises an inner section 25 and an outer section 26, and in horizontal cross sectional form, the section 25 corresponds in size to that of section 16 of refractory F, and the section 26 likewise corresponds in size to section 15 of refractory F. However, this may not be the case in all installations, especially with reference to thickness, and it is not material except to the extent that the tiles shall properly interfit when assembled.

The opposite end surfaces 27—27' of section 25 are sloped to correspond to the slope of the two end surfaces of the adjacent tile, and it will be observed that section 26 is offset below the section 25 to correspond to the relationship of the sections 15 and 16 of tile F. Also, it is to be noted that the upper end surface 28 of section 26 is cut away along the outside corner to provide a recess 29 to accommodate the horizontal shelf of the next adjacent upper beam of the supporting frame, as seen in Fig. 2.

The inner and outer surfaces 31 and 32 of the tile B lie in parallel planes, as also do the opposite side surfaces 33—33' and 34—34', and in thickness and overall width and length, the two tile F and B are equal, as here shown, but this is not essential and may vary so long as consistent with this invention.

The dimensions and design of these two tile provides that, in their being assembled in a furnace wall, alternately, in a horizontal course, they will interfit, as noted in Fig. 4, with all vertical joints sealed by reason of the overlapping of the opposite side portions of sections 15 of refractories F with the side portions of the section 26 of the refractories B.

It is further to be observed that in the placement of the refractories F and B alternately in horizontal courses in the furnace wall, they are supported by contact of the lower end surfaces of sections 16 and 26 resting upon the horizontal beams 11. It will be noted in Fig. 2 that the horizontal beams have vertical flanges 11a of a depth to provide desired strength through which bolts 35 are applied to attach them to the vertical supporting columns 10, and that each has an upwardly and inwardly sloping flange 11b forming a shelf upon which the lower ends of the refractories rest. The slope of these latter flanges corresponds to the slope of the lower end surfaces of the refractories and is of such degree as to prevent inward displacement of the tile from the shelf. Furthermore, this slope affords gravity retention of the tile on the supports.

It is further to be observed that at regular intervals along the edges of the flanges 11b of beams 11, there are downwardly formed hooks 38 adapted to extend into the notches 23 in the upper ends of the refractories F to retain these tile against inward tipping at their upper ends. Note also that there are keeper openings 39 through the flanges 11b in which keepers or pins 40 are inserted as stops for preventing outward displacement of the lower ends of B tiles from the supporting flange 11b. These keepers may be of sufficient length to extend through the beam and overlap the upper end portion of the tiles of the next lower course, as an aligning and holding means, as noted in Fig. 2. It will be understood, by reference to Fig. 1, that in the assembly of refractories in successive horizontal courses, the refractories F and B of adjacent courses alternate in vertical alinement, and the upper end portions of the sections 15 of the refractories F overlap the lower end portions of

sections 26 of the refractories B. Likewise, the upper end portions of sections 25 of the refractories B overlap the lower end portions of sections 16 of the refractories F, thus providing a seal of all horizontal joints.

Viewing the wall, as seen in Fig. 4, it will be noted that both kinds of tile are substantially what might be called T shaped in cross section, and since they are alternately reversed in position, they provide the overlap or breaking of the vertical joints between them. Also, it will be understood that with the F tile positively anchored at their upper ends against both outward and inward tilting, the B tile will consequently be anchored against outward tilting by reason of the inside overlap of their upper end portions across the supporting beam of the next higher course, and will be sustained against inward tilting by reason of the overlap of their side edges with the side edges of the F tile.

Furthermore, the lower ends of all tiles in any course are positively held against inward displacement, by reason of the slope of the shelf on which they rest and also by reason of the fact that they have downwardly stepped lower end portions overlapped by upwardly stepped upper end portions of the anchored tile in the next lower course, and all will be held against outward displacement by reason of the use of the keepers 40 which directly engage the tile B, and thus indirectly retain the tile F since they are overlapped by the tile B.

The tile, as seen in side view, present parallel inside and outside surfaces and these surfaces are flush in the assembled wall. Note also that each of the tile has the downwardly stepped portion across the outside of its lower end surface, which rests upon the shelf of the supporting beam 11, and that at the upper end of each tile there is the upwardly stepped portion across the outside of the end surface, which overlaps, at the inside of the wall with the downwardly stepped portions of tile of the next higher course. By reason of the slope of the shelf portion of the beams, and the stepping of the lower end surfaces of the tile as shown, the outward withdrawal of the tile, without interference by the beams and without requiring displacement of the tile inside of the plane of the lining, is possible.

With the wall so constructed, should it be desired to withdraw any of the B refractories, it is only necessary to withdraw a keeper 40 from the flange of the supporting beam back of the tile to be removed, then to pull the bottom edge of the tile outwardly. As it moves outwardly, the upper end will move downwardly and thus disengage itself from the hook 38 engaged with its upper end; the tile, in its removal, passing successively through the dotted line positions shown in Fig. 2. It is to be noted that, at no time during removal, is the tile required to be extended inwardly beyond the plane of inside surface of the furnace wall, and thus will not interfere with the water wall tubes when the construction is used as an encasement for water cooled wall areas.

In the removal of a tile F, it is required first to remove an adjacent B tile, then the F tile is shifted laterally into the clear of the adjacent tile and is outwardly withdrawn as was the B tile; it being required that a clear space be provided in order that the side edge flange of tile F can be displaced from back of the adjacent B tile.

In this arrangement of refractories, expansion joints can be provided where necessary as is designated by the heavy vertical line 45 in Fig. 1. Also, suitable packing could be placed where necessary or desirable in the joint to make a better seal, for example as indicated at 46 in Fig. 2.

It is also contemplated that heat insulation may be used in conjunction with this wall construction where the inside temperature of the furnace warrants its use. Such insulation may be disposed directly behind the refractories as indicated at 50 in Fig. 2. It is to be understood that heat will travel much slower through this insulation than through the refractories B and F, and that a much higher temperature may be safely maintained when such insulation is used. In this use of insulation, the outer portion of the flange 11a should not be covered, but should be exposed to the air, the heat being conducted from the tile refractories to their supporting beams 11, and dissipated from the flange 11a to the air which circulates thereby.

By this construction, all joints are closed and the framework is adequately protected; the objects and advantages previously mentioned have been obtained in a practical manner.

It is obvious that such refractories and wall construction are capable of modification without departing from the invention, and therefore, it is not intended that the appended claims shall limit the invention to the details of construction, but that they shall be given an interpretation commensurate with the spirit and scope of the invention disclosed.

Having thus described my invention, what I claim as new therein and desire to secure by Letters Patent is—

1. In a furnace wall, in combination, a frame structure including vertically spaced horizontal beams and a refractory lining at the inside of the frame structure comprising tiles arranged in horizontal courses, with each course supported upon one of said beams; the tiles of each course resting at their lower ends upon one of the supporting beams and adapted for outward displacement therefrom for removal from the wall, and having their upper end portions overlapped with the lower end portions of tiles of the next higher course across the inside of the supporting beam for that course, to be sustained thereby against outward tilting; alternate tiles of each course having holding contact at their upper ends with the frame beams for sustaining the course against inward tilting and releasable from said holding contact by the outward and downward displacement of their lower ends from their supporting beam, and the intermediate tiles of the courses having side edge portions overlapped with the side edge portions of the said alternate tiles, to normally sustain them against inward displacement, and the alternate tiles against outward displacement.

2. In a furnace wall, in combination, a frame structure including vertically spaced, horizontal beams and a refractory lining comprising tiles arranged in horizontal courses and supported on said beams; the tiles of each course having upper end portions overlapped with the lower end portions of the tiles of the next higher course across the inside of the supporting beam for that course; alternate tiles of each course having holding contact at their upper ends with the supporting beam for the next higher course to sustain the course tiles against inward tilting; and the intermediate tiles having outside overlap along

their side edges with the side edges of the said alternate tiles, and means applied to the supporting beams to engage the lower ends of the said intermediate tiles to normally retain the lower end of the course tiles against outward displacement from their supporting beam.

3. In a furnace wall, in combination, a frame structure including vertically spaced, horizontal beams and a refractory lining comprising tiles arranged in horizontal courses and supported on said beams; the tiles of each course having upper end portions overlapped with the lower end portions of the tiles of the next higher course across the inside of the supporting beam for that course, alternate tiles of each course having holding contact at their upper ends with the supporting beam for the next higher course to sustain the course tiles against inward tilting, and the intermediate tiles having outside overlap along their side edges with the side edges of the said alternate tiles, keepers removably applied to the supporting beams to engage the lower ends of the said intermediate tiles to retain them normally against outward displacement.

4. In a furnace wall, in combination, a frame structure including vertically spaced horizontal beams and a refractory lining at the inside of the frame structure comprising tiles arranged in horizontal courses and supported at their lower ends on said beams for outward displacement therefrom in their removal from the wall; each tile having a downwardly stepped portion across the outside of its lower end resting on the supporting beam, and having an upwardly stepped portion across the inside of its upper end overlapped, across the supporting beam of the next higher course, with the downwardly stepped portions of the tile of the next higher course and providing flush surfaces at the inside of the lining, each alternate tile of a course having opposite side edge portions overlapping the side edges of the adjacent intermediate tile at the inside of the wall to provide broken vertical joints, and having a transverse channel in its upper end, and said beams having depending hooks at spaced intervals for projecting into said channels to sustain the course against inward tilting.

5. In a furnace wall, in combination, a frame structure including vertically spaced horizontal beams, each with a downwardly and outwardly sloping shelf, with hooks depending, at regular intervals from its inner edge, and a refractory lining at the inside of the frame structure comprising tile arranged in horizontal courses and supported at their lower ends on said beams; each tile having a downwardly stepped lower end surface across its outer portion sloped in accordance with the slope of the supporting shelf and resting thereon, and having an upwardly stepped upper end portion overlapping the downwardly stepped lower end portion of the tile of the next higher course across the inside of the supporting beam for said next higher course, alternate tiles of each course having upper end recesses to receive the hooks depending from the beam for the next higher course, to prevent inward tilting of the tile, and keepers applied to the shelf to retain the tile against outward displacement at their lower ends.

6. A furnace wall as in claim 5, wherein the upper and lower end surfaces of all tile are sloped in accordance with the outward and downward slope of the shelf portions of the supporting beams and wherein the tile are disengageable from the said hooks by outward and downward movement of the lower ends of the tiles on their supporting shelfs and without displacement of the tile inside the plane of the lining.

7. A wall tile comprising integral inner and outer sections of rectangular cross section, with opposite side surfaces of both sections in parallel planes; the outer section being the narrower, and having its opposite side surfaces symmetrically offset within the side surfaces of the inner section, and the inner section being offset at its opposite ends above the ends of the outer section, and the upper end surface of the outer section being provided with a transverse channel.

8. A tile as in claim 7 wherein the opposite end surfaces of the sections are all similarly sloped downwardly toward the outside of the tile.

9. A wall tile comprising integral inner and outer sections, of rectangular cross section with opposite side surfaces in parallel planes; the outer section being of greater width and having its side surfaces symmetrically offset from the side surfaces of the inner section, and the inner section being offset at its opposite ends above the corresponding ends of the outer section, and the upper end surface of the outer section is formed with a down stepped offset across its outer edge.

10. A tile as in claim 9 wherein the upper and lower end surfaces of both sections are similarly sloped downwardly toward the outside of the tile.

11. In a furnace wall, a frame including vertically spaced horizontal beams, a horizontal course of tile closing the space between adjacent beams, each tile of the course resting at its lower ends on one of the beams, for outward displacement only in its removal from the wall, alternate tile having holding contact at their upper ends with the next higher beam, and releasable incident to outward and downward displacement of their lower ends from the supporting beam, and the intermediate tile of the course having holding contact at its upper end with the next higher beam and provided with opposite side edge portions overlapped with the side edge portions of adjacent tile, to hold the latter against outward displacement.

12. In a furnace wall, a frame including vertically spaced horizontal beams, a horizontal course of tile filling the space between beams, all tile of the course being supported at their lower ends on one beam and adapted only for one-way displacement therefrom in removal from the wall, each alternate tile of the course having a retaining interlock at its upper end with the next higher beam and held thereby against inward or outward tilting and releasable therefrom incident to the displacement from and downward movement of the lower end of the tile from its supporting beam; the intermediate tile having opposite side edge portions overlapping the adjacent side edges of the said alternate tile to break joints and retain the said alternate tile from being displaced from the supporting beam and means removable from the frame normally retaining the lower ends of the said intermediate tile against displacement from the supporting beams.

13. In a furnace wall, a frame including vertically spaced horizontal beams, a horizontal course of tile filling the space between adjacent beams, all tile of each course being disposed at their lower ends on their supporting beams for outward displacement only in removal from the wall; each alternate tile in the same course being of one shape and having a holding interlock at its upper end with the beam supporting the

next higher course, and releasable therefrom incident to displacement of its lower end from its supporting beam, and each of the other tile of that course being of another shape and having a portion at its upper end in contact with the supporting beam of the next higher course for retaining that end against outward displacement and having opposite side edge portions overlapped with the side edges of said alternate tile to retain the latter against outward displacement from their supporting beam, and keepers removably applied to the beams to retain the tile of the second shape in position; the tiles of successive courses being arranged in vertical rows and tile of one shape alternating with those of the other shape.

14. In a furnace wall, a frame structure including vertically spaced horizontal beams with flat, outwardly and downwardly sloping top surfaces, and a refractory lining at the inside of the frame structure comprising tiles arranged in single, horizontal courses between adjacent beams; each tile having a sloping bottom surface seated flatly upon the top surface of its supporting beam for outward and downward displacement of the tile from the frame; alternate tile in the course having outside overlap along their side edges with adjacent tile to retain the latter against outward displacement on the supporting beam and keys applied to the supporting beam and normally retaining the said alternate tile against outward displacement.

15. A furnace wall as recited in claim 14 wherein the said alternate tile in the course have upper end portions overlapping the next higher supporting beam across the inside edge thereof and wherein the said adjacent tile have interlock at their upper ends with the next higher beam, displaceable only by outward and downward displacement of their lower end portions from the supporting beam.

16. A wall tile comprising integral inner and outer sections of different width and of the same length and wherein the opposite side portions of the wider section extend equally beyond the opposite side surfaces of the narrower section and wherein the sections are offset endwise, providing that each extends at one end beyond the end of the other section, and wherein opposite end surfaces of the two sections are similarly sloped downwardly toward the outside surface of the tile.

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