Feb. 15, 1944. P. W. ANTILL 2,341,971

SECTIONALLY SUPPORTED WALL

Filed Dec. 13, 1940 2 Sheets-Sheet 1

Fig. 4.

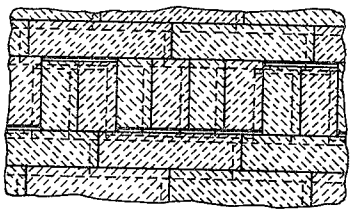


Fig. 3.

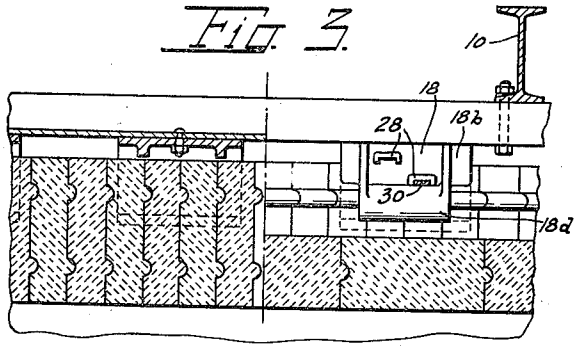


Fig. 1.

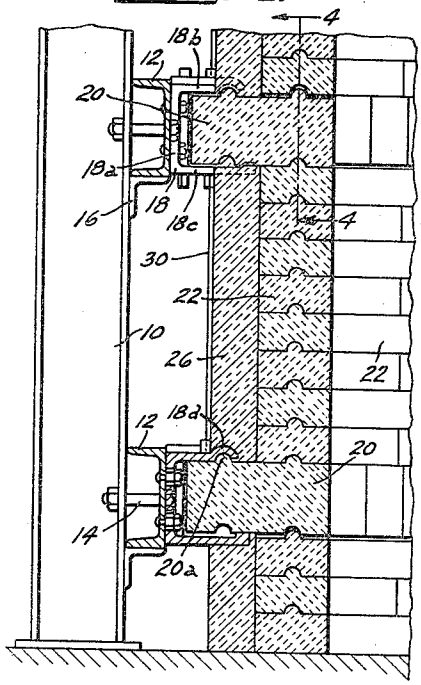


Fig. 2.

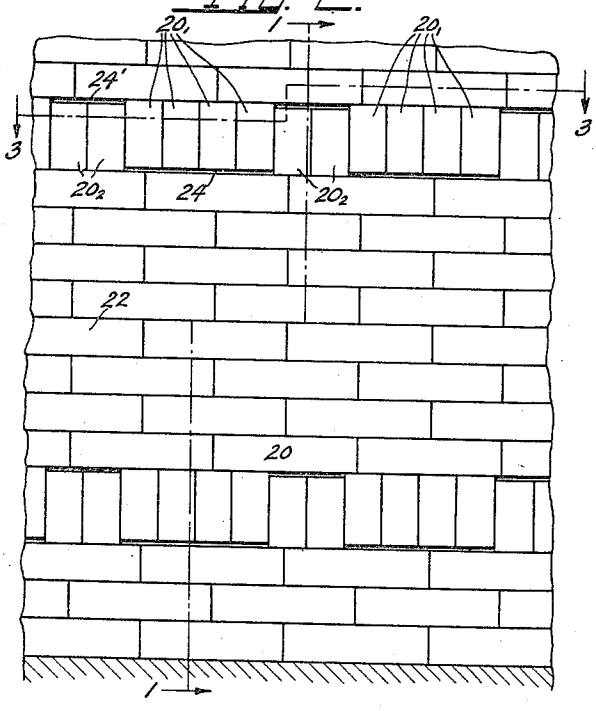


Fig. 6.

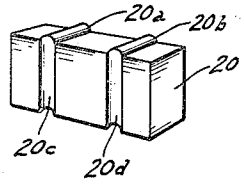


Fig. 7.

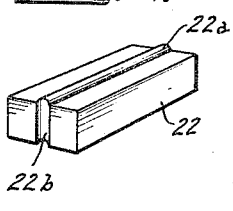
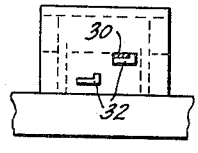


Fig. 5.



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SECTIONALLY SUPPORTED WALL

Filed Dec. 13, 1940 2 Sheets-Sheet 2

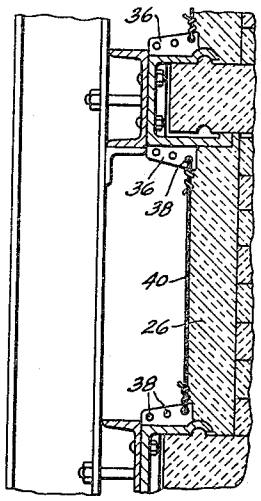


Fig. 12.

Fig. 10.

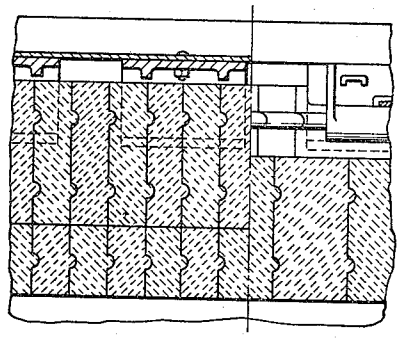
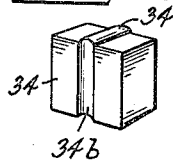


Fig. 11.



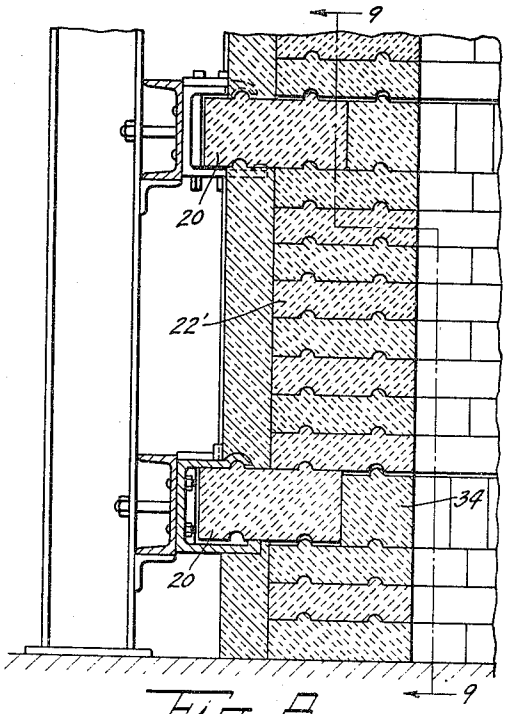


Fig. 8.

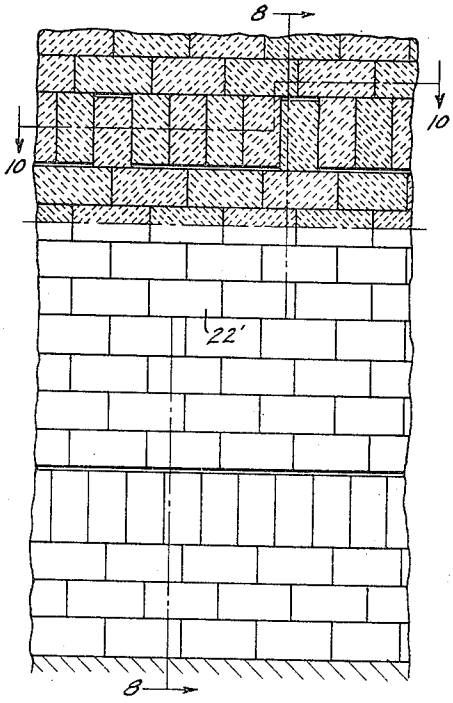


Fig. 9.

Fig. 13.

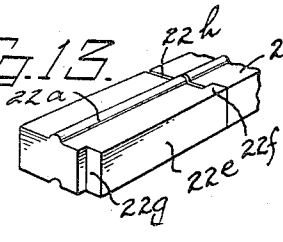
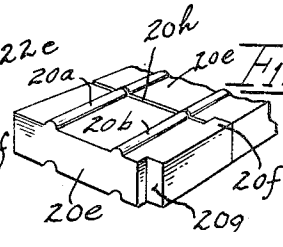


Fig. 14.



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UNITED STATES PATENT OFFICE

2,341,971

SECTIONALLY SUPPORTED WALL

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Application December 13, 1940, Serial No. 370,013

13 Claims. (Cl. 72—101)

The present invention relates to sectionally supported wall structures and has particular reference to sectionally supported walls of refractory blocks or tile for furnaces or other high temperature chambers.

Amongst the several objects of the invention are; to provide a novel form of sectionally supported wall structure which is simple and relatively inexpensive, which involves the minimum of metallic supporting structure for the refractories, which provides a plurality of independently supported sections or belts, each built up of courses of refractory blocks and in which the several sections as well as the individual courses of each section are restrained against lateral displacement without use of special metal retaining members or other parts specially employed for this purpose, in which the full depth of refractory material is maintained throughout the area of the wall, which may be built up to provide walls of different thickness with the minimum number of refractory shapes, in which horizontal expansion of the refractories in the plane of the wall on the furnace side thereof may be readily provided for and insured, in which effective sealing against leakage of gases through the wall is provided for, in which the outer side of the wall presents a substantially clear and unobstructed plane surface well adapted for the application thereto of insulating material in block form and in which simple and inexpensive means is provided whereby insulating material of different thicknesses may readily be applied to the wall as desired.

As will hereinafter be pointed out more in detail, the above and other and further objects are obtained by the provision of a wall structure consisting of a suitable outer metal supporting structure including horizontally extending, vertically spaced hanger members for independently supporting the several sections or belts of the refractory wall structure, combined with a refractory structure in which each separately supported section consists of a series of courses of interengaging refractory blocks which mutually engage each other to prevent lateral displacement of the courses relative to each other in the same section and in which the lateral movement of the section as a whole relative to the superjacent section is restrained by engagement between certain of the blocks in the lowermost or supporting course of the superjacent section with blocks immediately below them and constituting a part of the top course of the immediately subjacent section.

For a better understanding of the detailed nature of the invention and preferred means for carrying it into effect, reference may best be had to the ensuing portion of this specification and the accompanying drawings in which are described and illustrated by way of example suitable forms of wall structure embodying the invention.

In the drawings:

Fig. 1 is a view partly in vertical section and partly in elevation of a wall structure embodying the principles of the invention, taken on the line 1—1 of Fig. 2;

Fig. 2 is an elevation taken at right angles to Fig. 1 looking from the right of the latter figure;

Fig. 3 is a section taken on the line 3—3 of Fig. 2;

Fig. 4 is a section taken on the line 4—4 of Fig. 1;

Fig. 5 is a fragmentary view, looking from below, and showing one of the hanger members illustrated in Figs. 1 and 3;

Figs. 6 and 7 are perspective views of the supporting and supported blocks respectively employed in the wall shown in Figs. 1 and 2;

Fig. 8 is a view similar to Fig. 1 and taken on the line 8—8 of Fig. 9, showing the construction of a wall embodying the invention and of greater thickness than the wall shown in Fig. 1;

Fig. 9 is a view taken on the line 9—9 of Fig. 8;

Fig. 10 is a section taken on the line 10—10 of Fig. 9;

Fig. 11 is a perspective view of a filler block used in the wall shown in Figs. 8 and 9;

Fig. 12 is a fragmentary section showing a form of hanger member different from that illustrated in Fig. 1;

Fig. 13 is a perspective view of a form of refractory supported block providing for horizontal expansion in the plane of the wall; and

Fig. 14 is a similar view of supporting block embodying the horizontal expansion feature.

Referring now more particularly to the embodiment illustrated in Figs. 1 to 7, the outer supporting structure is formed by a series of vertical buck stays, one of which is shown at 10. These may be of any desired section and in the embodiment shown are I-beams.

A series of horizontally extending vertically spaced supporting members 12, which in the embodiment shown are of channel section, are secured to the buck stays by any suitable means such as the bolts 14, and may further be vertically supported by angles 16 welded or otherwise secured to the buck stays.

A series of horizontally extending vertically spaced hanger members, preferably in the form of castings 18, are fastened to the horizontally extending channels 12 by means of bolts 20, these hanger castings preferably being horizontally spaced from each other for reasons which will later be more fully explained.

The hanger castings 18 are of generally channel shape in section, consisting of a web portion 18*a*, a top flange portion 18*b*, and a bottom flange portion 18*c*. With the web portion of the hanger castings bolted to the horizontal supporting members, these castings provide a series of sockets adapted to receive and support the supporting blocks 20 which are of oblong rectangular shape and which are provided with transversely extending projections 20*a* and 20*b* on two of their sides and corresponding transversely extending grooves or recesses 20*c* and 20*d* on their remaining two sides.

As will be seen more clearly from Fig. 1, the upper flange portions 18*b* of the hanger castings are provided with overhanging lips 18*d* at their inner edges. The supporting blocks 20 are inserted endwise into the recesses provided by the hanger castings and as will be observed from Fig. 1, the upper and lower faces of the blocks are engaged respectively by the upper and lower flange portions of the hanger castings, with the projections 20*a* on the upper faces of the blocks engaging the recesses provided by the lips 18*d* of the hanger castings to provide not only vertical support for the supporting blocks, but to also provide support against tilting thereof. As will be seen from Fig. 3, the length of each hanger casting is such that it supports a plurality of adjacent blocks 20. In the embodiment illustrated, four such blocks are supported by each casting.

The supporting blocks 20 extend inwardly of the furnace beyond the hanger members for a substantial distance, in the present instance about half of the length of the blocks extending beyond their supports. These supporting portions of blocks 20 form the support for the supported tile 22 which are also of oblong rectangular form and are provided with projections 22*a* on two sides and corresponding grooves or recesses 22*b* on the two ends. As will be seen from Fig. 7, the projections and grooves extend longitudinally of the blocks. The supported blocks 22 are laid in courses on the supporting blocks, the projections and grooves of adjacent blocks in the same course and of the blocks in adjacent courses interengaging to prevent movement of the blocks relative to each other laterally toward or away from the furnace. Obviously, the number of courses of supported blocks in each section may be varied as desired and in erecting the wall the vertical spacing between hangers 18 is selected, with respect to the number and thickness of supported blocks, so that a suitable vertical clearance space is left between the upper face of the top course of each section and the lower face of the bottom or supporting course of the section immediately above to allow for independent expansion and contraction of the several sections. This space 24 is filled with suitable refractory material, the nature of which will permit of the desired movement of the sections relative to each other under the influence of expansion and contraction.

For practical considerations of manufacture, handling during transportation, and erection it is highly desirable that the grooves and projections on the several blocks be shaped in section so that the projections will be sufficiently strong to be not easily broken. This requires that the projections in section be relatively low and the preferred section is semi-circular as illustrated in the figures. In theory the projections 22*a* on the upper side of the top course of supported block of each section engage in the grooves 20*d* in the bottom faces of the supporting blocks of the section next above and thus provide the required lateral engagement between adjacent sections necessary to prevent the possibility of a section being tilted inwardly of the wall due to force applied from the outside. In practice, interengagement of this nature does occur to some extent, but because of the clearance or expansion space 24 which it is necessary to provide between sections and the relatively low height of the projections and corresponding shallow grooves which are desirable, the interengaging areas at this place constitute only a part of the normal full interengaging area. Refractory blocks used in the construction of walls of the kind under consideration are ordinarily not precisely uniform in dimensions and the erection of such walls is not on what may be termed a precision basis. Taking into account the variations in the size of the parts and the variations in spacing which may occur in erection, together with variations in expansion and contraction, it will be apparent that in many instances the clearance space 24 may approach or even equal the height of the projections on the blocks so that no lateral interengagement, or only a very slight and easily overcome interengagement, is provided at one or more places in the wall.

In order to overcome this difficulty and to provide a positive interengagement in all cases, regardless of variations in dimensions of parts or in erection, the present invention provides a very simple and effective interlock between adjacent sections through the medium of certain of the supporting blocks that are not supported by the hanger castings 18. By spacing these castings, certain of the blocks 20 are permitted to slide vertically relative to the adjacent supported blocks with which they interengage, so as to be supported directly by blocks of the top course of the subjacent section. As shown in Fig. 2, the spacing of the hangers is such that groups of four blocks each, indicated at 20_1, are supported by adjacent hanger castings, while intermediate these groups are groups 20_2 of two blocks each which rest directly upon the top course of blocks 22 of the subjacent section. The blocks in the groups 20_2 provide full interengaging contact, as will be observed from Fig. 1, with the subjacent section and above these blocks clearance space 24' is provided similar to the space 24 below the supported groups 20_1. The blocks in the groups 20_2, while not restrained against lateral movement by engagement with hanger castings, are effectively restrained against such movement by interengagement of their grooves and projections with the grooves and projections on the sides adjacent blocks in groups 20_1 which are restrained against lateral displacement, and consequently a fully effective interengagement operating to positively hold the subjacent section against lateral displacement is provided. Less than full engagement is provided at the expansion space 24' between blocks in groups 20_2 and the blocks 22 immediately above them, but as will be seen from Fig. 2, the blocks 22 which are immediately above the blocks in groups 20_2 also extend over and

fully engage certain of the blocks in the adjacent groups 20' of hanger engaging blocks.

From the foregoing it will thus be apparent that the expansion space between adjacent sections is effectively bridged to provide full and positive interengagement of all of the blocks against lateral displacement, without resort to either special block shapes for this purpose or special metal locking devices. This provides important practical advantages since it does not increase the number of different parts required for the construction of the wall and further does not at any place decrease the effective depth of refractory thickness of the wall.

As will readily be seen from Fig. 1, the above described construction provides a refractory wall structure of uniform thickness having a plane unobstructed outer surface over the entire area of the supported blocks, which area constitutes substantially the entire wall area. This makes this wall structure particularly adapted for the application of insulation directly to the outer face of the refractory. Thus, insulating material is readily applied in the most convenient form, namely, in blocks or slabs commonly known to the trade as "bats." Such material is shown at 26 in Fig. 1.

Bats of insulating material are available commercially in different standard thicknesses and it will be appreciated that depending upon different circumstances in different cases it may be desirable to employ different thicknesses of insulation on different walls.

In accordance with another feature of the present invention, means is provided whereby bats of insulating material of different thicknesses may readily be held in position in contact with the refractories without requiring any change in the wall structure. To this end, the hanger castings are provided with lugs on their upper and lower flange portions shaped to act as retainers for rods or the like which act to hold the insulation in place, a series of such lugs being provided on each face spaced at different distances from the plane of the web portion of the hanger, so as to be located at different distances from the outer face of the refractory wall after the wall is erected.

In Fig. 3 two such lugs 28 are shown on the upper flange 16*b* of hanger 16, these being of U-shaped form opening inwardly of the wall and adapted to hold a retaining rod such as that shown at 30. The lower flanges of the hangers are provided with L-shaped lugs 32 correspondingly spaced. After the refractory wall has been erected, the bats of insulation are placed against the outer face of the wall. Rods 30 are then set into the sockets formed by the U-shaped lugs 28 and the outer face of the bat of insulation and are then moved into their final retaining position by moving the upper ends of the rods laterally into position between the outer face of the insulation and the appropriate one of the L-shaped lugs 32.

The form of construction embodying the present invention is also readily adapted for the construction of a wall of greater refractory thickness than that just described and such a wall is illustrated in Figs. 8 to 11, to which reference will now be had.

The construction of the outer supporting frame work and hanger castings is essentially the same as that previously described and need not again be described in detail.

In the present construction the hanger engaging blocks 20 are of the same shape as previously described but in the present instance this same shape of block is used for making up the courses of supported block 22', both supporting and supported blocks being placed with their longest dimension at right angles to the plane of the wall.

As will be seen from Fig. 8, the supported blocks 22' are laid so as to overhang the supporting blocks 20 and as will also be observed from this figure and Fig. 10, certain of the supporting blocks 20 do not engage the hanger castings but are supported directly on blocks 22' of the top course of the subjacent section. The overhanging relation of the supported blocks to the supporting blocks leaves horizontally extending recesses in the wall in front of the inner ends of the blocks 20 and these recesses are filled by means of filler blocks 34 having projections 34*a* on two sides and corresponding grooves 34*b* on the remaining two sides. These filler blocks are supported entirely by the top course of supported blocks 22' of the subjacent section.

In Fig. 12 a slightly different form of hanger casting is illustrated. In this form, instead of the provision of lugs of the kind shown at 28 and 32 in the previously described embodiment, the casting is provided with vertically extending top and bottom webs 36, each having a series of holes 38 formed therein at different distances from the plane of the web of the casting. These holes 38 provide means for attachment of retaining wires 40 which may be located at appropriate different distances from the outer face of the refractory wall to accommodate different thicknesses of insulating bats.

In some instances, particularly in the case of high temperature furnaces, it is desirable to provide for horizontal as well as vertical expansion, particularly with respect to the portions of the refractories on the furnace side of the wall, which are subjected to the highest temperatures and which consequently have the greatest range of expansion and contraction. This may readily be provided for and insured with wall structures embodying the present invention, by the use of refractory shapes of the form shown in Figs. 13 and 14.

Referring more particularly to Fig. 13, which illustrates a supported block shape, to be used in the manner similar to the shape shown in Fig. 7, it will be seen that the block 22*e* is provided with a projection 22*f* at one corner and a corresponding recess 22*g* at the opposite end of the block. It will further be noted, however, that the projection 22*f* is somewhat longer than the depth of the recess 22*g* so that when the blocks are laid end to end in the manner shown in the figure, a clearance space 22*h* is provided between horizontally adjacent blocks except for a very small portion at the outer face of the wall. The difference between the length of the projection and the depth of the recess is advantageously of the order of a sixteenth of an inch, to give approximately this amount of clearance space between individual bricks. This clearance can, of course, can be varied as desired. By making the blocks of this form, allowance for desired clearance is insured regardless of how the blocks may be laid up by the erector of the wall.

It will further be observed that this construction provides a broken or ship-lap joint between adjacent blocks in the same course and since this ship-lap joint is present, the projections and grooves on the ends of the blocks may, if desired,

be omitted as in the blocks illustrated in the figure. Obviously, the grooves and projections on the block ends, as shown in Fig. 7, may be retained in addition to the ship-lap feature. It further will be evident that in the form of blocks shown in Fig. 7, in which the ship-lap feature is omitted, the grooves and projections on the ends of the block provide a joint between adjacent blocks which is broken and which operates as a deterent to leakage in the manner of the ship-lap joint.

From the preceding description of the supported block shape shown in Fig. 13, the similar construction of the ship-lap form of supporting block 20*e*, shown in Fig. 14, will be apparent and need not be described in detail.

The interengaging construction which provides a positive interlock against inward displacement of the tile toward the furnace is particularly useful in connection with insulated walls because of the fact that in erecting the insulation there is ordinarily a tendency to produce pressure tending to force the refractories inwardly of the furnace and because of variations in thickness of insulation and other variations or irregularities in erection there may be a substantial initial and remaining pressure tending to force the walls inwardly of their normal position. Consequently, in this form of wall it is highly desirable to have a firm and positive lock resisting inward displacement under the influence of such forces.

It will be apparent that many specific variations in the construction and arrangement of the wall structure may be made without departing from the principles of the invention. Thus, the specific construction of the outer supporting wall structure or framework may be varied as desired as may also the specific shape and arrangement of the hanger means. While separate hanger castings are to be preferred, it will be apparent that a horizontally continuous casting may be employed with the bottom flange recessed or cut away at intervals to permit desired ones of the supporting blocks 20 to be supported by the refractories of the subjacent section of the wall. Also, the grouping of the supporting blocks which engage the hangers and which are supported by the subjacent section may be varied as circumstances require, it being sufficient in some instances to have only single ones of the blocks 20, at spaced intervals, supported by refractories of the subjacent section. It will further be apparent that blocks which are to be supported by refractories of a subjacent section do not necessarily have to be of the same shape as the hanger engaging blocks. For example, it will be evident that the desired interengaging action will be secured if blocks of the shape of block 34 are substituted for the blocks having the shape of block 20 in the groups 20_2 or in the groups corresponding thereto in the form of the wall shown in Fig. 8. Practically, however, the use of such special shapes is not ordinarily desirable because of the greater practical importance of being able to erect the wall from a minimum number of block shapes.

It is accordingly to be understood that the invention is limited in its scope only by the scope of the appended claims when they are construed as broadly as is consistent with the state of the prior art.

What is claimed is:

1. A sectional refractory wall structure for furnaces and the like comprising horizontally extending vertically spaced hanger structure providing horizontally extending spaced recesses for the reception of hanger engaging supporting blocks, courses of supporting blocks inserted in said recesses and projecting therefrom, a plurality of courses of supported blocks supported by each of said courses of supporting blocks to provide a plurality of horizontally extending belts or sections, said supporting and supported blocks having interengaging projections and recesses for preventing lateral displacement of the blocks relative to each other and certain of the blocks in each supporting course being located between said spaced recesses of the hanger structure and deriving their sole vertical support from and interengaging with the top course of supported blocks of the subjacent section, whereby to prevent lateral displacement of said top course of supported blocks relative to the bottom course of blocks of the superjacent section.

2. A refractory wall structure for furnaces and the like comprising outer supporting structure, a plurality of horizontally extending vertically spaced rows of hanger castings carried by said outer supporting structure, the hanger castings of each row being spaced from each other and providing horizontally extending spaced recesses, a plurality of spaced groups of supporting blocks engaging the recesses in the hangers of each row, a plurality of continuous courses of supported blocks supported by the groups of hanger engaging blocks of each row to form horizontally extending belts or sections, and refractory blocks located between each two adjacent groups of hanger engaging supporting blocks, said refractory blocks being located between said spaced hanger castings and being vertically supported by the top course of supported blocks of the subjacent section and the refractory blocks having projections and recesses interengaging with complementary recesses and projections of the hanger engaging blocks of the same course and of the course of supported blocks providing the vertical support, whereby the refractory blocks operate to prevent lateral displacement of the top course of blocks of the subjacent section relative to the bottom course of blocks of the superjacent section.

3. In a refractory sectionally supported wall structure, a bottom course of supporting blocks for each section of the structure, an outer supporting structure having spaced horizontally extending recesses, certain of said supporting blocks engaging the recesses in said outer supporting structure and deriving both vertical and lateral support therefrom, certain other blocks of said course deriving vertical support from the top course of a subjacent section, all of said blocks having interengaging projections and recesses for preventing lateral displacement of any one of the blocks relative to the blocks adjacent to it, whereby to prevent lateral displacement of the top course of blocks of the subjacent section relative to the bottom course of blocks of the superjacent section.

4. A sectionally supported refractory wall structure comprising a plurality of horizontally extending vertically spaced hangers providing recesses for the reception of refractory blocks, a plurality of oblong supporting blocks inserted in said recesses and projecting therefrom, said supporting blocks being arranged with their longest dimension at right angles to the plane of the wall and the projecting portions thereof having projections and recesses thereon extending transversely of the blocks in the plane of the wall, a

plurality of courses of supported blocks carried by said projecting portions, and said supported blocks having projections and grooves extending parallel to the lengths of the blocks, said supported blocks being laid lengthwise in the plane of the wall and said grooves and projections of the supporting and supported blocks interengaging to prevent lateral displacement of the blocks relative to each other, and means comprising refractory blocks supported by the top course of supported blocks and interengaging the same and the blocks of the bottom course of a superjacent section for preventing displacement of said top course of supported blocks relative to said bottom course of said superjacent section.

5. A refractory sectionally supported wall structure comprising a plurality of horizontally extending vertically spaced hanger means providing horizontally extending recesses for the reception of refractory blocks, a plurality of oblong refractory supporting blocks inserted in said recesses and projecting therefrom, each of said supporting blocks having two spaced sets of transversely extending projections and recesses, the projections of one set engaging with said hanger means and the projections and grooves of the second set being located on the projecting portion of the blocks, a plurality of courses of supported blocks of similar configuration as that of the supporting blocks, said supported blocks being overhung with respect to the supporting blocks and projections and grooves thereon interengaging with the projections and grooves on the projecting portions of the supporting blocks, and a course of filler blocks between the inner ends of said supporting blocks and the inner face of the wall, said filler blocks being supported by the overhung portions of the top course of supported blocks of a subjacent section.

6. A refractory sectionally supported wall comprising a plurality of independently supported horizontally extending belts or sections of refractory blocks, each comprising a plurality of courses of supported blocks and a bottom course of supporting blocks, said supporting blocks extending outwardly beyond said supported blocks and engaging hanger members to independently support each section, said supported blocks providing plane outer wall surfaces between said courses of supporting blocks, bats of insulating material in contact with said outer surfaces, retaining rods for holding said bats in position and means formed on said hanger members for holding said retaining rods in position.

7. For use in refractory wall structures, a hanger casting of generally channel section providing a web portion adapted to be secured to an outer supporting structure and upper and lower flange portions adapted to engage a refractory block to be supported thereby, said flange portions each being provided with a series of retaining lugs and the lugs of each series being spaced at different distances from the plane of said web portion.

8. For use in refractory wall structures, a hanger casting of generally channel section providing a web portion adapted to be secured to an outer supporting structure and upper and lower flange portions adapted to engage a refractory block to be supported thereby, said flange portions each being provided with an external web extending substantially at right angles to the plane of the web portion of the member and each of said webs having a plurality of holes therethrough located at different distances from the plane of said web portion.

9. A refractory block for furnace walls and the like, said block being of generally rectangular oblong shape and having a projection at one end and a recess at the opposite end providing shouldered end faces, said projection having greater length than the depth of said recess, whereby to provide shoulders of different depth on the opposed ends of the block and to thereby provide a clearance space between portions of the end faces of adjacent blocks when the blocks are laid end to end with the projection of one block seated in the recess of the adjacent block.

10. A refractory block as set forth in claim 9 having a projection extending longitudinally of the block on one side face thereof and a corresponding groove extending longitudinally of the side face of the block opposed to the face having said projection.

11. A refractory block for furnace walls and the like, said block being of generally rectangular shape, a projection extending from one side face at the corner of the block, a recess correspondingly located in the opposite side face of the block, said projection and recess providing shouldered opposed side faces and the height of said projection being greater than the depth of said recess whereby to provide clearance space between adjacent side faces of adjacent blocks when the blocks are laid up with the projection of one block in the corresponding recess of an adjacent block.

12. A block as set forth in claim 11 in which the non-shouldered side faces of the block are provided with at least two sets of transversely extending grooves and projections.

13. A sectional refractory wall structure for furnaces and the like comprising horizontally extending vertically spaced hanger structure providing horizontally extending recesses for the reception of hanger engaging supporting blocks, courses of supporting blocks inserted in said recesses and projecting therefrom, certain of said blocks in each course being spaced horizontally from adjacent supporting blocks, a plurality of courses of supported blocks supported by each of said courses of supporting blocks to provide a plurality of horizontally extending belts or sections, said supporting and supported blocks having interengaging projections and recesses for preventing lateral displacement of the blocks of each course relative to each other, and locking blocks in each supporting course located in the space between certain of said supporting blocks and deriving their sole vertical support from the top course of supported blocks of the subjacent section, the sides of said locking blocks interengaging with adjacent supporting blocks and the bottoms of said locking blocks interengaging with the top course of supported blocks of said subjacent section, whereby to prevent lateral displacement of said top course of supported blocks relative to the superjacent course of supporting blocks.

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