June 13, 1961 L. S. LONGENECKER 2,987,856

INTERLOCKING CHAIN WALL

Filed May 21, 1958 6 Sheets-Sheet 1

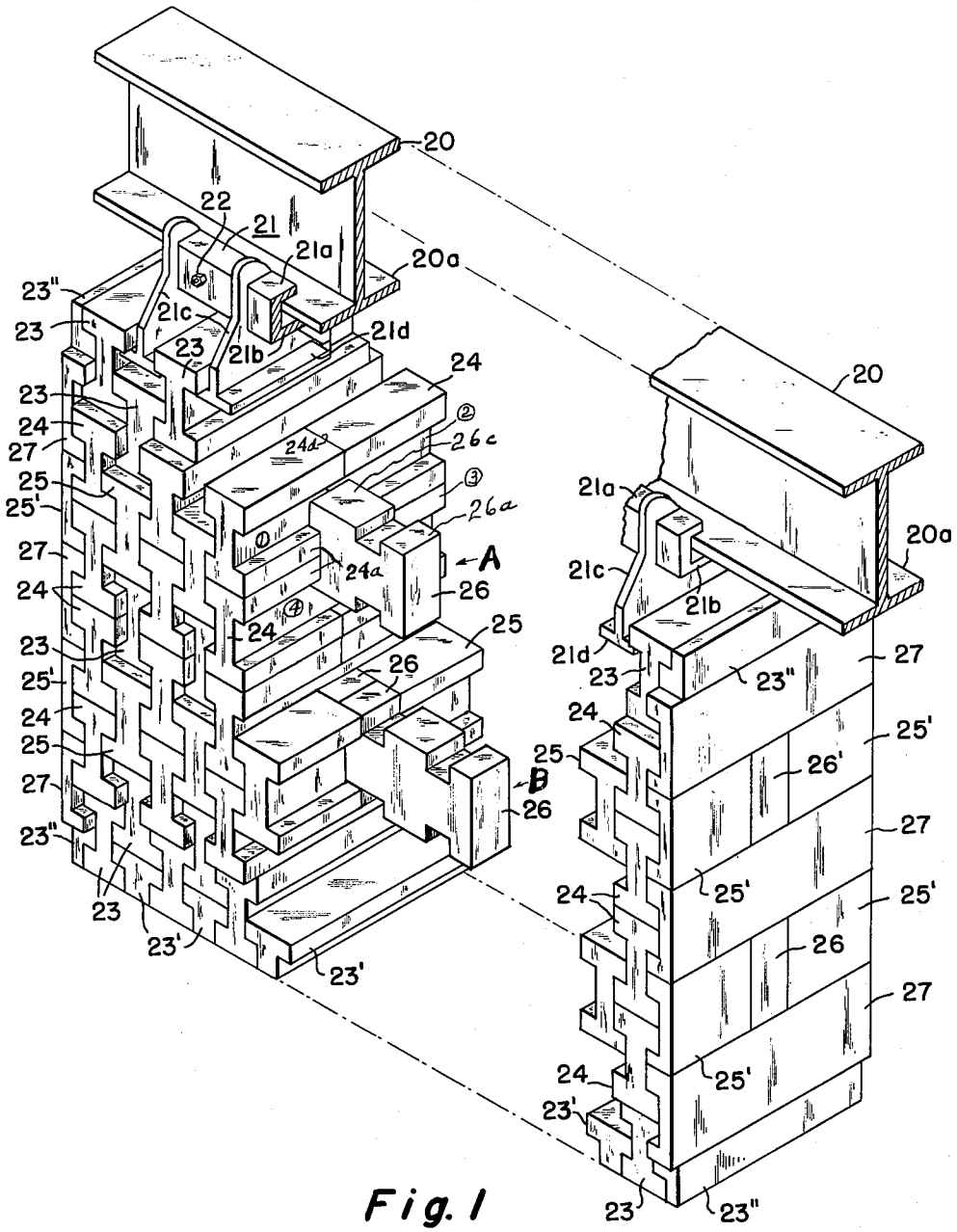

Fig. 1

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INTERLOCKING CHAIN WALL

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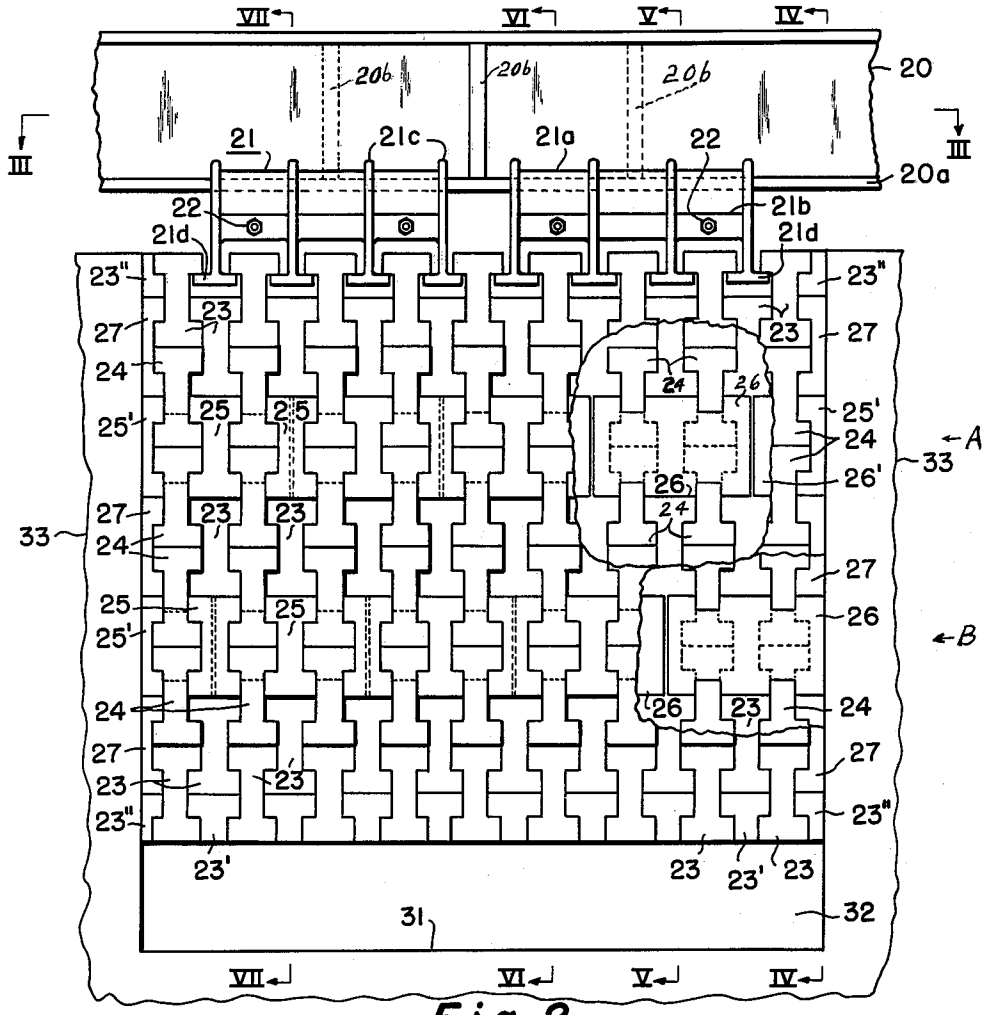

Fig. 2

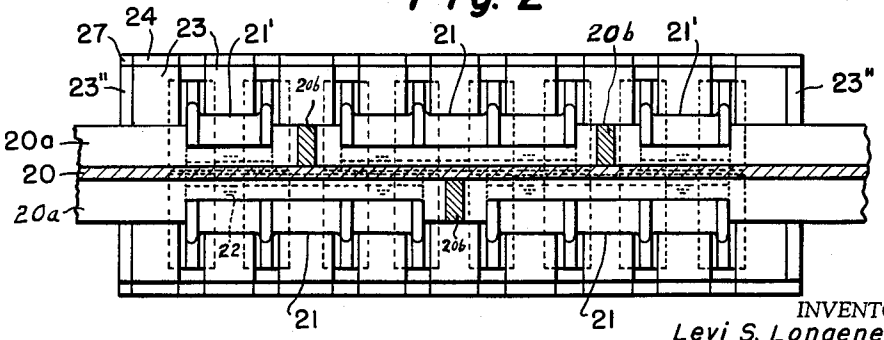

Fig. 3

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INTERLOCKING CHAIN WALL

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Fig. 5

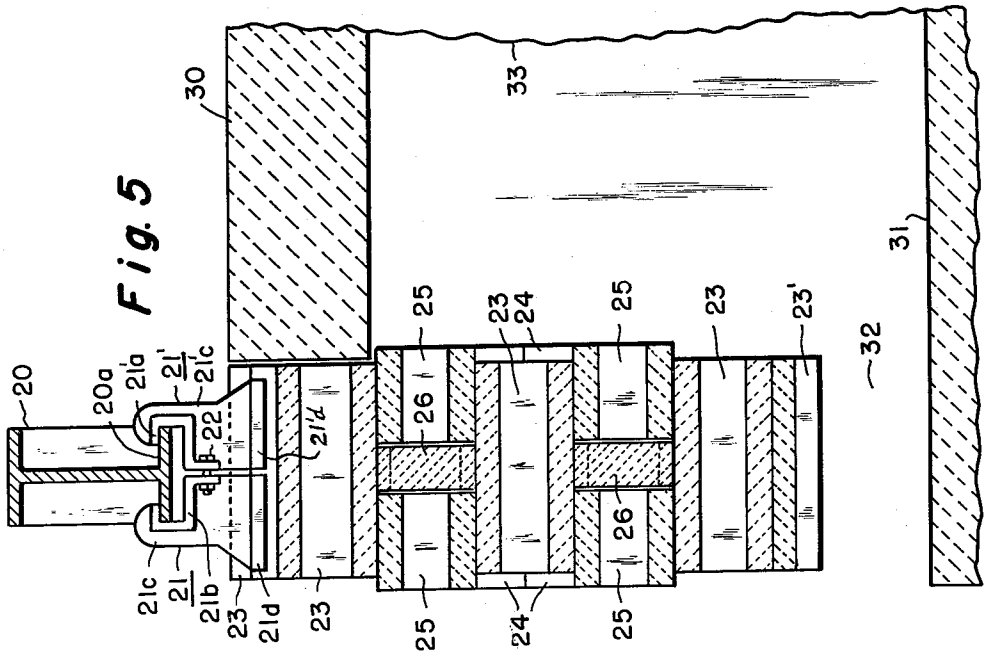
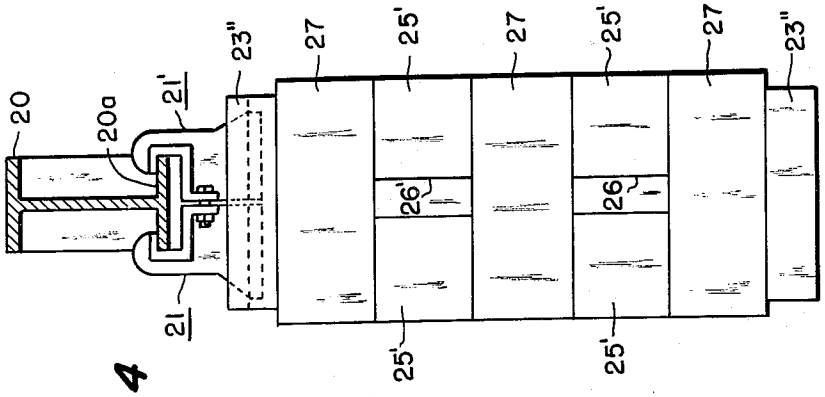


Fig. 4



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INTERLOCKING CHAIN WALL

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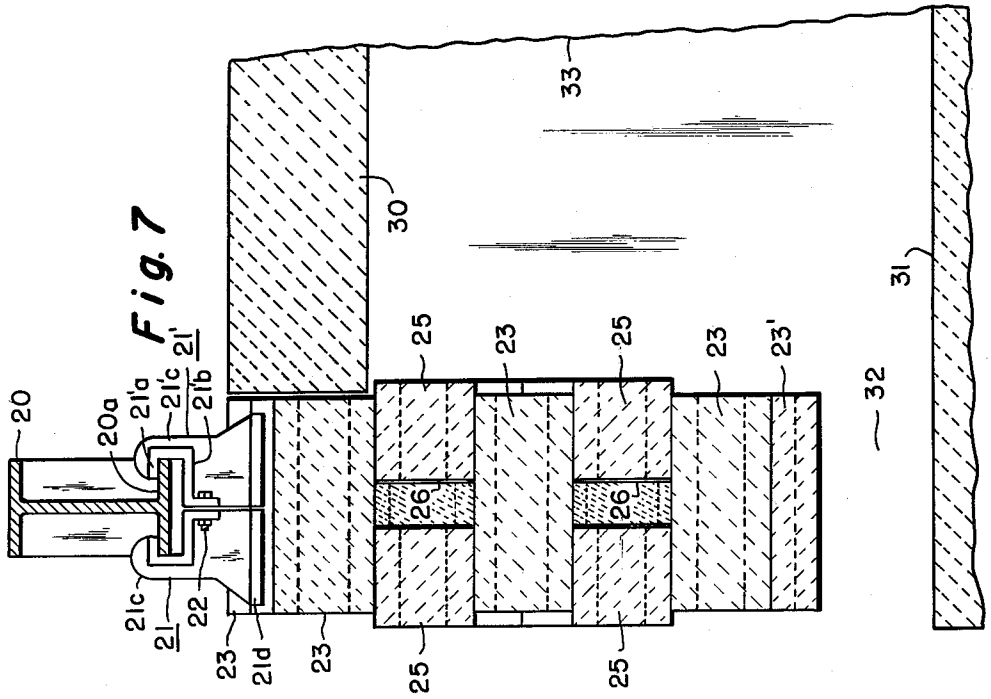

Fig. 7

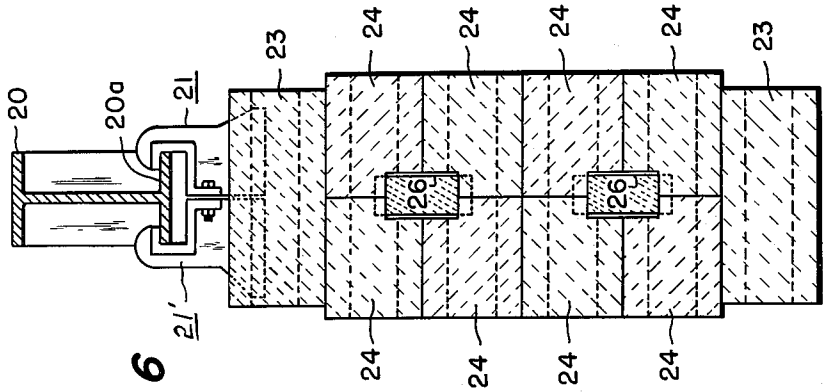

Fig. 6

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INTERLOCKING CHAIN WALL

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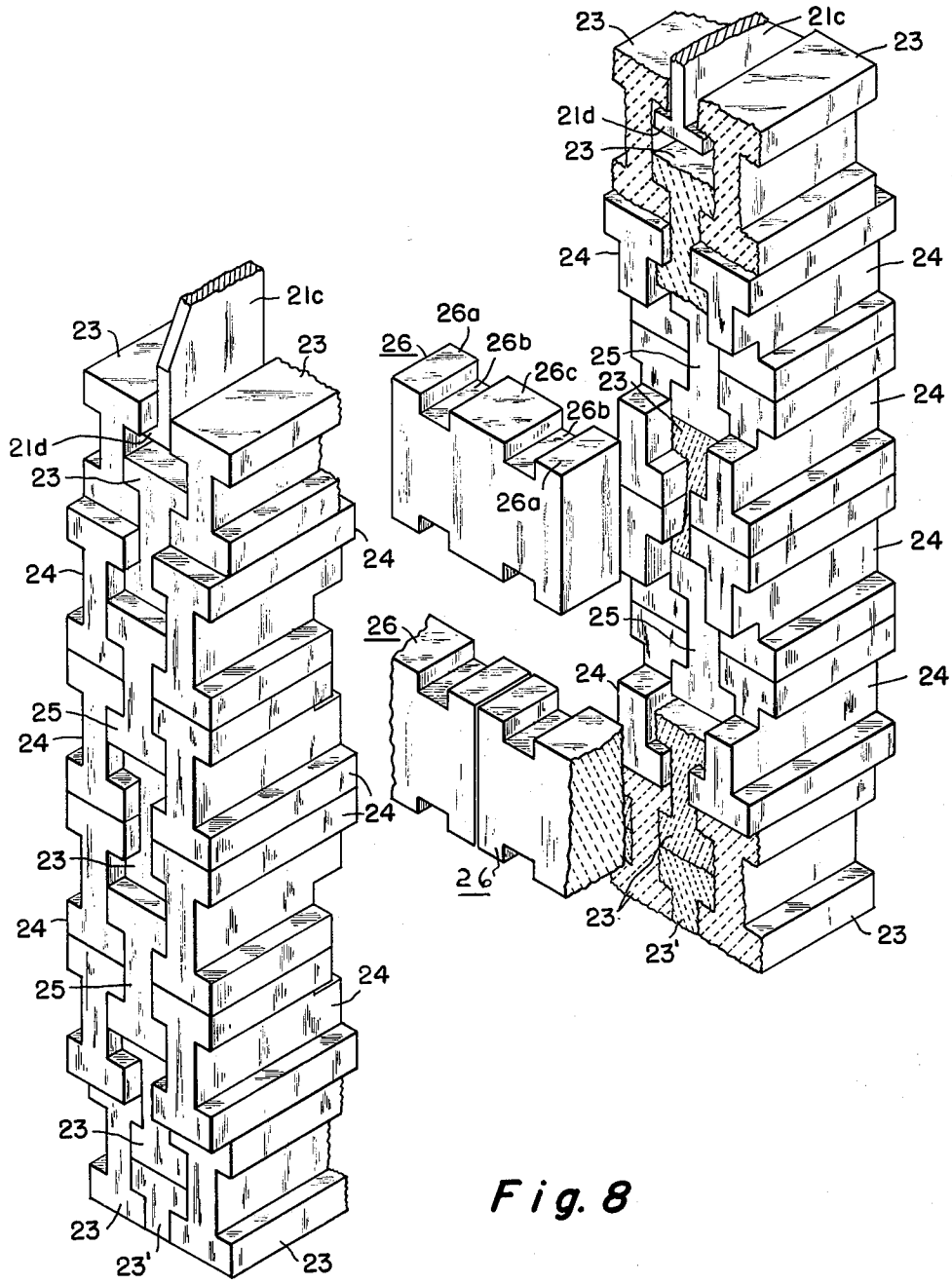

Fig. 8

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INTERLOCKING CHAIN WALL

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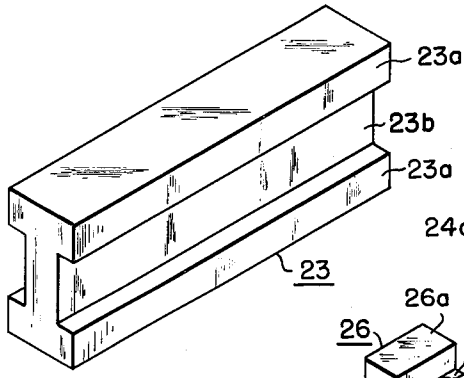

Fig. 9

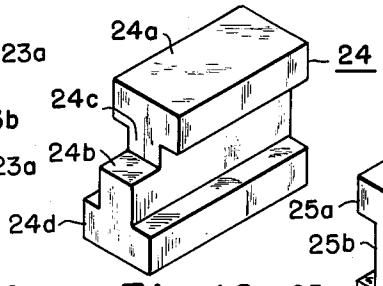

Fig. 10

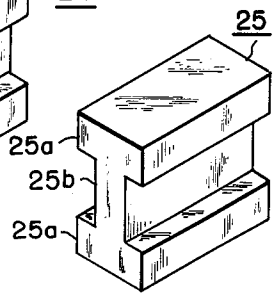

Fig. 11

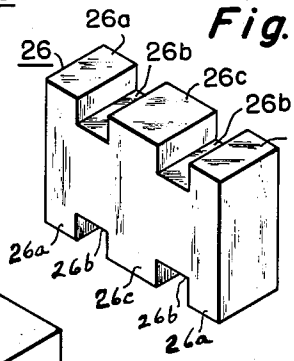

Fig. 12

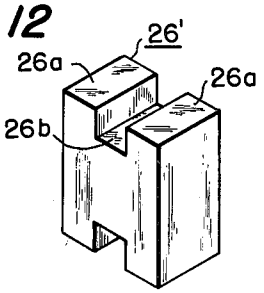

Fig. 14

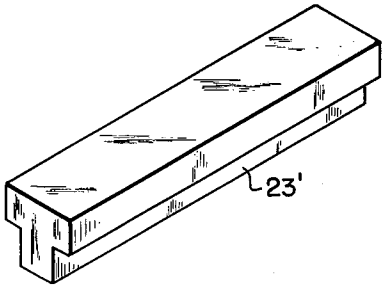

Fig. 13

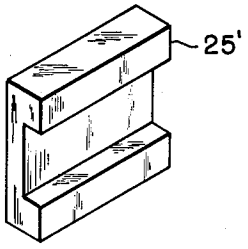

Fig. 15

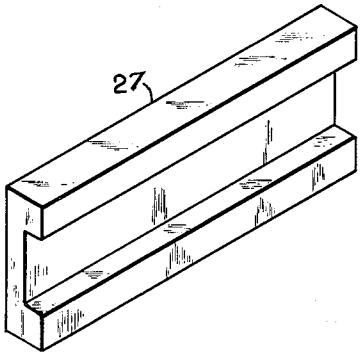

Fig. 16

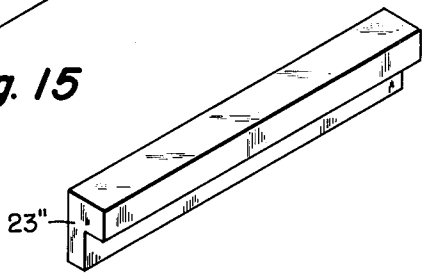

Fig. 17

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United States Patent Office 2,987,856 Patented June 13, 1961

2,987,856

INTERLOCKING CHAIN WALL

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Filed May 21, 1958, Ser. No. 736,872
20 Claims. (Cl. 50—429)

This invention relates to wall structures and particularly, to an improved refractory block or tile construction and assembly therefor. A more specific phase of the invention deals with an interlocking or chain type of hung wall that may be employed as a baffle or curtain wall, a door lintel or an end wall of a furnace construction.

Prior to my invention there have been two general types of hung curtain walls. In one, the wall is made up of symmetrical or substantially like-shaped full length I-beam tiles which interfit sidewise with each other by means of their upper and lower flanges. The disadvantage of this type is that there is no practical way of obtaining enough pressure from the ends of the tiles to keep them firmly meshed. In this connection, it may be noted that the tiles extend fully endwise of the width of the wall. As a result, there is a tendency for failure, particularly on larger jobs, by reason of the lack of means to keep them firmly meshed. This type of tile, however, has the advantage that it can be formed from its sides, since there is no undercutting involved.

In a second type of construction, as in the first type, the tile members are of the same construction and interfit sidewise of the wall, but have flanges that are under-cut so as to provide an interlocking relationship. This type of tile, however, must be made, as a result of the undercutting, by press-forming it from its ends, with the result that the tile or block is relatively weak and does not stand up well in service. The tile or block of both types of constructions are of an I-beam shape, except that the tile of the first-mentioned construction has substantially planar and parallel undersurfaces along its flanges.

My construction has been developed to incorporate the advantageous features of the prior art constructions without their disadvantageous features, in order to provide an improved interlocking wall whose tile or block members are of a relatively strong and long-life type. I have been able to meet the basic factors of strength and interlocking ability by employing a plurality of blocks in a novel type of system, arrangement or assembly. However, all of the blocks or tiles are of such a nature or shape that they can be made by side-pressing, as distinguished from end-pressing. In addition, the assembly is such that a third factor of permitting heat expansion without damage has also been taken care of.

It has thus been an object of my invention to develop a solution to the problem which has heretofore been presented in the construction, assembly and utilization of refractory tiles or blocks to provide an improved curtain, interlocking or chain type of arrangement;

Another object has been to devise a new and improved tile or block assembly system or interfitting combination and to provide block or tile members suitable for cooperative utilization therein;

A further object of my invention has been to provide a refractory block or tile wall construction suitable for furnace utilizations under stress, strain, and expansion conditions that are inherent in such utilizations;

A still further object has been to provide a new and improved type of wall construction in which the interlocking members may be formed by a side-pressing operation and which members, when utilized, will stay in position and permit necessary expansion and contraction, and will provide a wall with a better and more trouble-free operating life;

These and other objects will appear to those skilled in the art from the description and the claims.

In the drawings,

FIGURE 1 is an isometric view in elevation with tile parts or members broken away to illustrate a hung wall constructed in accordance with my invention;

FIGURE 2 is a front view in elevation on the scale and of the wall of FIGURE 1;

FIGURE 3 is a top view on the scale of and taken along the line III—III of FIGURE 2;

FIGURE 4 is an outer end view on the scale of and taken along the line IV—IV of FIGURE 2;

FIGURE 5 is a vertical or end section on the scale of and taken along the line V—V of FIGURE 2;

FIGURE 6 is a vertical or end section on the scale of and taken along the line VI—VI of FIGURE 2;

FIGURE 7 is an end section on the scale of and taken along the line VII—VII of FIGURE 2 and illustrating an application of my wall construction as a lintel for a furnace door opening;

FIGURE 8 is an isometric view in elevation on an enlarged scale with respect to FIGURE 1, somewhat diagrammatically illustrating how interlocking members of the wall are employed; and,

FIGURES 9 to 17, inclusive, are perspective views in elevation of block or tile members that may be employed in the construction of the wall of FIGURE 1;

More specifically, FIGURE 9 illustrates a full length type of transverse tile of I-beam shape;

FIGURE 10 represents a principal load-supporting, half length tie type of transverse tile of I-beam shape that is undercut at one of its ends to interfit with a longitudinal or key tile, such as shown in FIGURE 12;

FIGURE 11 illustrates a half-length tranverse filler tile of I-beam shape that also aids in carrying the vertical load with the tile of FIGURE 10;

FIGURE 12 illustrates a cross key or longitudinal tile of rectangular shape that projects endwise-longitudinally of the wall and interfits with the tile of FIGURE 10;

FIGURE 13 represents a full length transverse tile of T-shape having half the section of the type of FIGURE 9 for finishing a bottom of the wall;

FIGURE 14 represents a cross key tile of H-shape having half the section of the type of FIGURE 12 for finishing vertical ends of the wall;

FIGURE 15 represents a half length transverse tile of channel or U-shape having half the section of the type of FIGURE 11 for finishing vertical ends of the wall;

FIGURE 16 represents a full length channel or U-shaped transverse tile having half the section of the type of FIGURE 9 for finishing vertical ends of the wall; and,

FIGURE 17 represents a full length transverse tile of angle shape having a quarter of the section of the type of FIGURE 9 and half the section of the type of FIGURE 13 for finishing vertical ends of the wall.

As shown particularly in FIGURES 1, 2 and 3 of the drawings, I have provided a load-supporting or overhead I-beam member **20** as a means for supporting or suspending a refractory wall constructed in accordance with my invention. As illustrated, particularly in FIGURES 2 and 3, the beam **20** has a lower flange **20***a* that is connected at staggered positions along opposite sides of its web by longitudinally spaced-apart vertical rib portions **20***b* that are also connected to the top flange. Hangers, support members, halves, castings, or parts **21** and **21'** are shown mounted in a staggered relationship with respect to the vertical rib portions **20***b*, and with respect to each other over opposite side edges of the bottom flange **20***a*, and on opposite sides of the web of the load member **20**.

The hangers or support members **21** are shown provided with two pairs of clamping tongues, brackets, hooks or feet portions **21***c* that, at their upper end portions, are integrally secured in a longitudinally spaced-apart up-

right relationship along a clamping channel portion **21***a*. The portion **21***a* fits over and extends along one of the side edges of the bottom flange portions **20***a* of the load-carrying member. The hook or foot portions **21***c*, at their other ends, are integral with and constitute web portions for a block-supporting flange **21***d* that extends transversely from opposite sides of the portions **21***c* and at right angles to or crosswise of the flanges **20***a* of the beam **20**. As shown in FIGURE 3, shorter length hangers, support members or castings **21'** are also provided and are of the same construction, except that they have only a pair of hooks or feet portions **21'***c* (see aiso FIGURES 5 and 7), each of which has a block or tile supporting bottom flange portion **21'***d*. Other portions of the hangers **21'** that correspond to the full size hangers **21** are distinguished therefrom by prime suffixes.

As shown particularly in FIGURES 2, 3 and 5, the hangers or hanger parts **21** and **21'** are in a horizontally-staggered relationship with respect to each other along the bottom flange **20***a* of the load member **20**, and are securely clamped together by bolt and nut assemblies **22**. This staggered relation causes them to serve as a lengthwise binder to hold the top courses of transverse wall tile in mesh. It may be noted that longitudinally-extending, interlocking cross key tile **26** accomplishes the binding for the remainder or bottom portions of the hung wall, thus my interlocking type of hung chain wall will hold together without any heavy pressure from its ends.

As shown in FIGURES 1, 2, 3, 5, 6, 7, 8 and 9 of the drawings, I have provided what may be termed substantially full length I-beam shaped full length transverse tile or blocks **23** which hold together half-length tile extending in the same direction along the thickness of the wall construction. The full length tile **23** are carried in a top group or interlocking clusters with respect to each other adjacent to suspension fingers or brackets **21***c* and **21'***c*, as shown in FIGURE 8 of the drawings, to interfit and cooperate with half length intermediate blocks or tiles. There is also a bottom group or cluster that interfit and cooperate with half length intermediate blocks or tiles. They also lie in vertical rows of blocks that are vertically spaced with respect to each other by half-length transverse filler blocks or tiles **25** of I-beam shape. Thus, the filler blocks **25** which also help to carry the vertical load, cooperate with the transverse blocks **23** to define vertical rows in the wall construction, endwise of its thickness. The transverse blocks **23** lie in vertical rows that are horizontally spaced by vertically-aligned rows of main load support, suspension tie, half-length, transverse blocks or tiles **24**.

It should be noted that the half or short length filler blocks **25** lie in the same vertical rows as the transverse blocks **23**, and that the latter do not lie in the same horizontal rows as cross key, longitudinal blocks or tiles **26** of rectangular shape. The interlocking relation of the key tiles **26** is primarily effected with respect to the vertical, load-carrying, transverse blocks **24**. Each block **24**, as shown particularly in FIGURE 10, has shortened flange and web portions that are defined by a half depth, cut-out or inwardly-offset end portion **24***a*. The offset or cut-out end portion **24***a* is provided by a step portion **24***b* and a riser portion **24***c*. This leaves substantially the other depthwise half of the block **24** with an endwise-projecting portion **24***d*.

On the other hand, as shown in FIGURE 12, the cross key or longitudinal blocks **26** are shown of rectangular shape, with opposed (upper and lower) narrow side walls, and opposed (vertical) wider side walls. The cross key or longitudinal blocks may be of any suitable shape, but should have tongue and groove portions for interfitting with other blocks. Cross groove, inwardly-offset, slotted or cut-out portions **26***b* provide top and bottom alternate, cross summit, tongue or shoulder portions **26***a* and **26***c* that are separated thereby. It will be noted, as shown in FIGURES 1 and 2, that the cross key blocks **26** extend in horizontal rows that are spaced vertically with respect to each other, see the upper and lower rows A and B of FIGURES 1 and 2.

As to the key block row A, the short length or cut-out end portions **24***a* of a horizontally-aligned adjacent pair of half-length tile **24** are positioned to cooperate with and abut against opposed vertical or wide side walls of the key tiles **26**. The projecting or greater length end portion **24***d* of one tie tile **24** is positioned to project halfway into a slotted portion **26***b* of a key block **26** in endwise alignment and into abutment with a similar end of a horizontally-adjacent second tile or tie tile **24**. The offset or cut-out web portions of both such adjacent tie tiles **24** are also positioned to project halfway into the same slotted or groove portion **26***b* of the same key block **26** to interlock therewith.

As to the same longitudinal key block of row A, it will be noted that the lower flange portions of an upper transverse pair of horizontally adjacent tie blocks **24** rest upon the upper flange portions of a vertically adjacent, next lower, transverse pair of horizontally adjacent tie blocks **24**. The shorter length end portions of the upper and lower pairs of tie blocks **24** lie adjacent to each other and abut against the opposed wide sides of the same key block **26**. Thus, the extending end portions of the lower pair of blocks **24** fit within a slotted portion **26***b* on an under, narrow side of the same key block **26**, in vertical alignment with the extending end portions of the upper pair of blocks **24** that project within a similar slotted portion **26***b* on the upper, narrow side of the same key block.

In FIGURE 1, the block row B illustrates how transverse pairs of filler blocks **25** are positioned in end-abutment with opposite sides of the key blocks **26**, but do not directly interlock therewith, as do the tie blocks **24**. However, the filler blocks **25** center abutting vertical ends of pairs of the key blocks **26** (see FIGURE 1). The key blocks **26** of rows A and B (see FIGURE 2) pass between and have their top and bottom narrow sides in abutment with the flanges of the transverse full-length blocks **23**. The interfitting of the transverse blocks **23** with the filler blocks **25**, of these blocks with the tie blocks **24**, and of finish blocks, such as **23'**, **23''**, **25'**, and **27**, is effected by their flange portions. Half length key blocks **26'** and full length key blocks **26** interlock with tie blocks **24** through the agency of the tongue and groove portions of the former and the offset end portions of the latter.

As shown in FIGURE 1, see row A, four tie blocks **24**, see (1), (2), (3), and (4), form or define a doughnut type of interlock or assembly around one end of each key block **26**. A similar type of assembly interlocks four more of the tie blocks **24** with the other end of the same key block **26**. It will be noted that a similar arrangement is employed in row B, but that the key blocks **26** of such row are staggered with respect to the key blocks **26** of row A to provide a continuous interlock from end to end of the wall.

In the various figures and, as shown particularly in FIGURES 9 to 17, inclusive, I have designated end or filler tile or block members by the same reference numerals (except **27** of FIGURE 16) as corresponding full section members, but by prime suffixes, and have designated quarter section members by double prime suffixes. In this connection, the main block members are represented as **23**, **24**, **25** and **26**. The half or quarter section members are employed for top, bottom, and end finishing of the wall, as shown particularly in FIGURE 1 of the drawings. For example, the half horizontal section members **23'** of FIGURE 13 provide bottom finish tile for the bottom group or cluster of full length members **23'**, and, the quarter section members **23''** of FIGURE 17 provide top and bottom end finish tile for the full-length members **23**. The half section filler members

25' of FIGURE 15 provide vertical end finish tile with half key members 26' of FIGURE 14. The channel-shaped members 27 of FIGURE 16 provide finish tile for the vertical ends of the wall and are vertical half sections of the transverse tile 23 that tie the half length tile members together. In this connection, the finish tile members 27 have their flanges interfitting with the flanges of outer rows of the tie tile members 24 (see FIGURE 1), and at the top and bottom of the wall, with full length members 23 of the top and bottom groups or clusters.

In accordance with my invention, the block or tile members are all shaped in such a manner that their flange or interlocking portions require no under-cutting or offsetting, such as would necessitate making them by end-pressing, as distinguished from side-pressing operations. Thus, all of my tile or block members have full strength for their curtain wall utilization. There are no weak tiles.

It will be noted that the wall is interlocked or keyed together by means of the longitudinal tiles 26 which are vertically staggered in horizontal rows A and B, in order to obtain the effect of a continuous binder. Each of the transverse tiles 24 is notched at one of its end corners to interfit with like-notched corners of adjacent transverse tiles 24 and to interlock with or into the longitudinal key tiles 26. The transverse tiles 25 serve to fill in space and help to carry the vertical load. The full length transverse tiles 23 hold the half-length tiles from splitting apart and bind the top and bottom portions of the hung wall.

It may be noted that the more completely the bearing flanges of the I-beam shaped tiles of my construction are held in mesh, the stronger and more durable is the hung wall. Any normal deflection of the supporting beam 20 will cause the tiles to loose up in the bottom rows at the center. However, no amount of pressure from the ends can prevent such loosing up, unless it should be great enough to carry the whole wall load, jack arch fashion, in which case the steel support is not needed.

In FIGURES 5 and 7, I have shown how a wall of my construction may be applied as a lintel for a door opening 32 of a heating furnace having a chamber 33, a refractory roof 30 and a refractory floor 31.

What I claim is:

1. An assembly of interlocking refractory blocks, one block being of I-beam shape and the other block being a cross-key block of rectangular shape and having a pair of opposed wide sides and a pair of opposed narrow sides; said one block at one end having an endwise-inwardly offset end portion and an adjacent extending end portion; said cross-key block having an alternate shoulder portion and groove portion across at least one of its narrow sides, the extending end portion of said one block being positioned within the groove portion of said cross-key block and along the shoulder portion of said cross-key block, and the offset end portion of said one block abutting against one of the opposed wide sides of said cross-key block.

2. An assembly as defined in claim 1 wherein, a second block of I-beam shape of the defined construction of said one block is provided and its extending end portion is positioned within the same groove portion and along said shoulder portion from an opposed wide side of said cross-key block and in endwise alignment with the corresponding extending end portion of said one block, and the offset end portion of said second block abutting against the other opposed wide side of said cross-key block.

3. An assembly as defined in claim 1 wherein, the endwise-inwardly offset end portion of said one block is defined by one of its flanges and an adjacent portion of its web, and the extending end portion of said one block is defined by its other flange and an adjacent remaining portion of its web.

4. An assembly of refractory blocks as defined in claim 2, wherein a pair of filler blocks of I-beam shape are provided and are positioned with their flanges interfitting with and along flanges of said one and second blocks and with their opposed end portions in abutment with opposed wide sides of said cross-key block.

5. An assembly as defined in claim 4 wherein, a transverse block of I-beam shape has its flanges interfitting with flanges of said one and second blocks to tie them together end to end with respect to each other, said pair of filler blocks have their flanges interfitting with the flanges of said first and second blocks that define their offset end portions; bottom and end finish blocks interfit with flanges of said transverse, said first, and said second blocks; and said end finish blocks cooperate with said cross-key block to provide substantially planar bottom and end walls for the assembly.

6. An assembly as defined in claim 4 wherein, a full length block of I-beam shape has its flanges interfitting with flanges of said one and second blocks to tie them together end to end with respect to each other.

7. An assembly as defined in claim 5 wherein, said pair of filler blocks have their flanges interfitting with the flanges of said first and second blocks that define their offset end portions, and said full length block has its flanges interfitting with the flanges of said first and second blocks that are positioned in endwise alignment with each other within the groove portion of said cross-key blocks.

8. An assembly as defined in claim 6 wherein, bottom and end finish blocks interfit with flanges of said full length, said first, and said second blocks; and said end finish blocks cooperate with said cross-key block to provide substantially planar bottom and end walls for the assembly.

9. A refractory wall construction made up of a plurality of full-length wall thickness extending blocks of I-beam shape; endwise-aligned half length pairs of suspension tie blocks of I-beam shape, each at its opposed end having one of its flanges and an adjacent portion of its web defining an endwise-inwardly offset end portion, and its other flange and an adjacent remaining portion of its web projecting beyond said offset end portion to define an extending end portion; longitudinally-endwise aligned cross-key blocks of rectangular shape, each having a pair of wide sides and a pair of opposed narrow sides and having alternate shoulder and groove portions across its narrow sides open to its opposed wide sides; endwise-aligned half length pairs of I-beam shaped filler blocks abutting endwise against the opposed wide sides of said rectangular key blocks; the extending end portions of pairs of said tie blocks being positioned within one of the groove portions of said key blocks with their flanges in an endwise-opposed relation with each other along adjacent shoulder portions of said key blocks, and with their offset end portions abutting against opposed wide sides of said key blocks; said full length blocks at an upper end of said wall having their flanges interfitting with respect to each other and with respect to upper flanges of said pairs of tie blocks; and said filler blocks having their flanges vertically abutting bottom flanges of said full length blocks in alternate positions between said full length blocks, and having their flanges interfitting with upper and lower flanges of said tie blocks.

10. A wall construction as defined in claim 9 wherein said cross-key blocks are positioned in vertically spaced-apart longitudinal rows along the wall.

11. A wall construction as defined in claim 9 wherein, said cross-key blocks are positioned in longitudinal rows along the wall with the blocks of one row in a staggered relation with the blocks of another row of said cross-key blocks.

12. A wall construction as defined in claim 9 wherein said full length blocks at a lower end of said wall have

their flanges interfitting with each other and with respect to lower flanges of said tie blocks.

13. A wall construction as defined in claim 9 wherein said filler blocks define vertical rows with said full length blocks and define horizontal rows with adjacent vertical pairs of said tie blocks.

14. A wall construction as defined in claim 9 wherein, said tie blocks define horizontally spaced vertical rows, and said full length and filler blocks define horizontally spaced vertical rows between vertical rows of said tie blocks.

15. A refractory wall made up of full and partial length blocks of I-beam shape that extend endwise-transversely of the thickness of the wall and whose flange portions are in an interfitting relation with each, and cross-key blocks extending endwise-longitudinally of the wall and having tongue and groove portions interfitting with flange and rib portions of said blocks of I-beam shape.

16. A wall as defined in claim 15 wherein, said cross-key blocks are positioned in vertically-spaced rows that are located intermediate opposite sides of the wall, at least one group of four blocks of I-beam shape define a doughnut assembly about at least one cross-key block, and the blocks of said cross-key rows are in a staggered relation with each other.

17. A refractory wall as defined in claim 15 wherein, said blocks of I-beam shape have open flange portions, so that they may be slid sidewise as well as endwise into and out of an interfitting relation with each other, and said cross-key blocks having groove portions that are open to opposite side faces and top and bottom faces thereof.

18. In a refractory block assembly employing a cross-tie block of rectangular shape provided with a pair of opposed wide sides and a pair of opposed narrow sides and with alternate cross-extending tongue and groove portions along its opposed narrow sides, a block of I-beam shape that at one end has one of its flanges and an adjacent portion of its web defining an endwise-inwardly offset end portion across its full transverse extent, and its other flange and an adjacent remaining portion of its web extending beyond said inwardly-offset end portion to define an extending end portion; said end portions of said block of I-beam shape together defining a latching end for the block to interfit with the tongue and groove portions of said cross-tie block and extend endwise-transversely thereof.

19. An improved refractory wall construction for suspension from bottom flange portions of hangers comprising, blocks of I-beam shape extending endwise transversely of the thickness of the wall and having their flange portions in an interfitting relationship, cross-key blocks extending endwise longitudinally of the wall and having tongue and groove portions interfitting with flange and web portions of said blocks of I-beam shape, and flanges of upper blocks of said blocks of I-beam shape being adapted to interfit with the bottom flange portions of the hangers to suspend the wall construction therefrom.

20. A refractory block for a furnace wall construction, said block having a body of I-beam shape, one of the flanges and an adjacent portion of the web of one end of said body having an endwise-inwardly offset riser end portion across its full transverse extent and defining a step portion with the remaining portion of the web, said step portion being perpendicular to the riser portion, the other flange and said adjacent remaining portion of the web of the same one end of said body extending beyond said inwardly-offset riser end portion to define an extending end portion, and said offset riser and extending end portions together defining a latching end for the block.

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