Sept. 1, 1942. L. S. LONGENECKER 2,294,788

FURNACE WALL CONSTRUCTION

Filed April 7, 1938 2 Sheets-Sheet 1

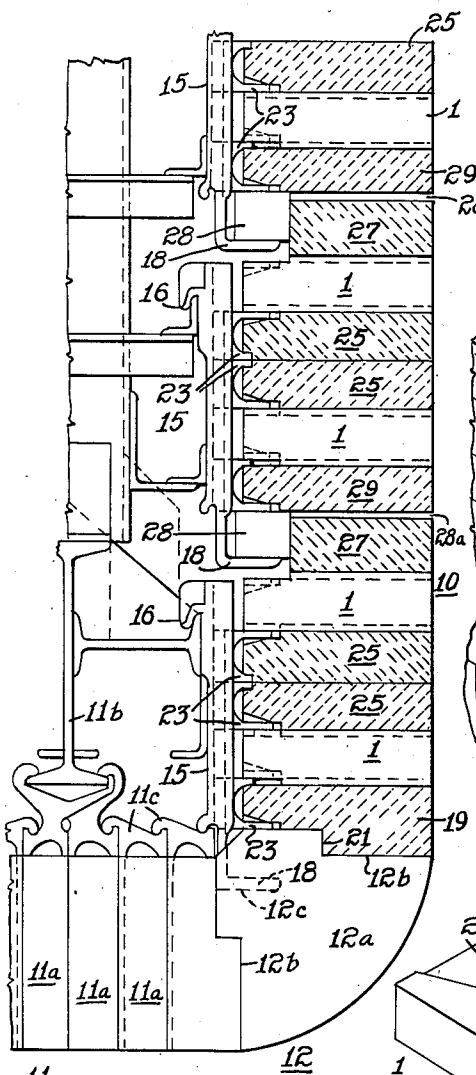


Fig. 3

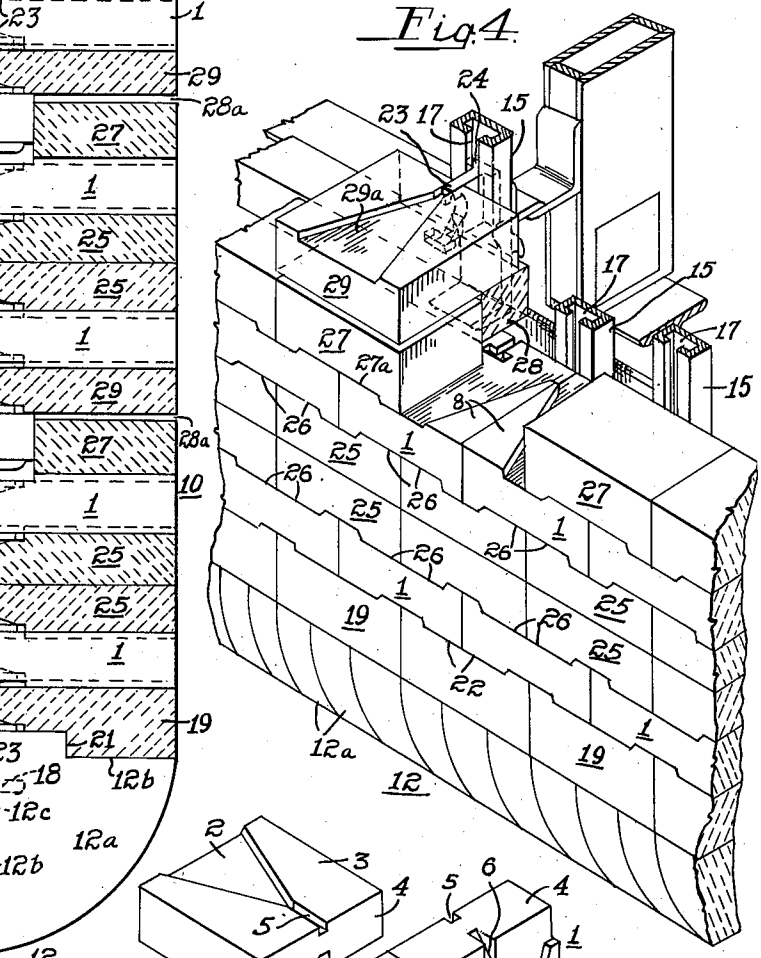


Fig. 4

Fig. 2

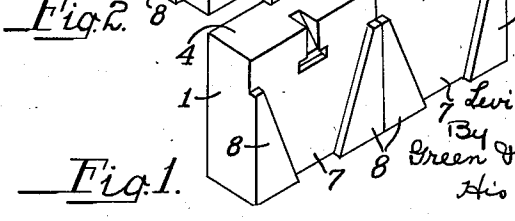


Fig. 1

INVENTOR
Levi S. Longenecker
By Green & McCallister
His Attorneys

Sept. 1, 1942. L. S. LONGENECKER 2,294,788

FURNACE WALL CONSTRUCTION

Filed April 7, 1938 2 Sheets-Sheet 2

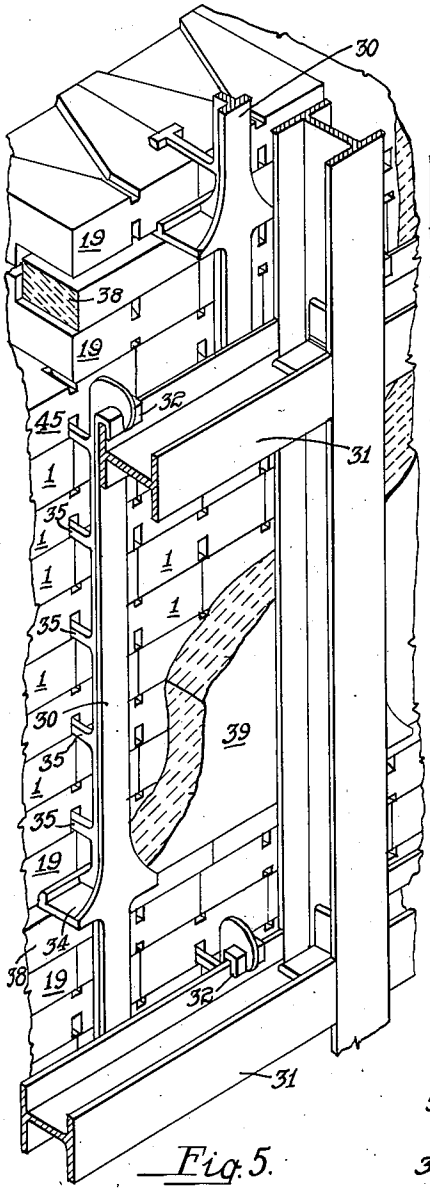


Fig. 5.

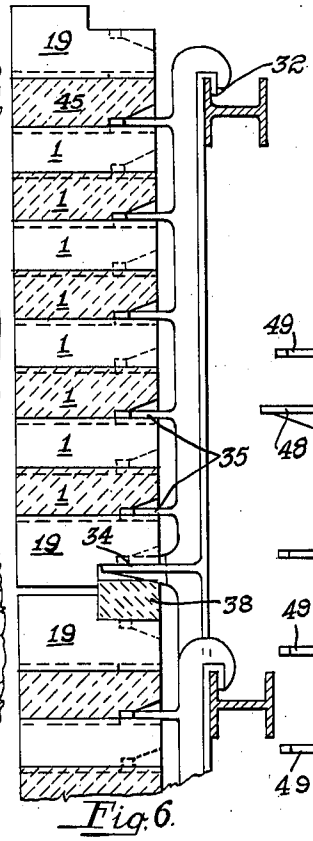


Fig. 6.

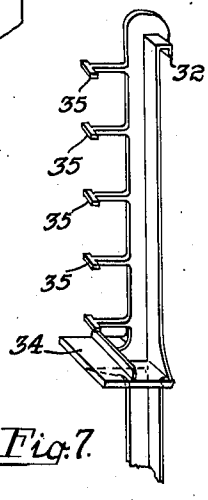


Fig. 7.

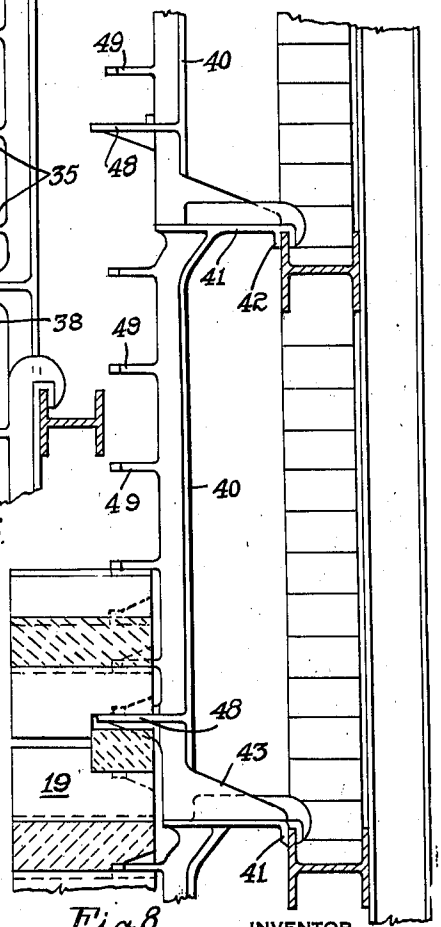


Fig. 8.

INVENTOR

Levi S. Longenecker

By Green & McCallister

His Attorneys

Patented Sept. 1, 1942

2,294,788

UNITED STATES PATENT OFFICE

2,294,788

FURNACE WALL CONSTRUCTION

Levi S. Longenecker, Pittsburgh, Pa.

Application April 7, 1938, Serial No. 200,667

10 Claims. (Cl. 72—101)

This invention relates to furnace structures, and more particularly to an improved refractory block, tile or the like for building up sectionally supported side walls and apron walls for such furnaces.

One object of the present invention is to provide improved refractory blocks or tiles for use in the building up of independently supported wall sections of boilers and furnaces having their opposite faces shaped to permit the building of an interlocked and bonded wall structure.

Another object is to provide a refractory block having means for permitting the blocks to be laid side by side in vertical courses, rows or tiers, with the blocks in the next succeeding row overlapping the blocks in the preceding row and for interconnecting the blocks in one row with the blocks of the adjacent row to provide an interlocked and bonded wall.

A further object is to provide improved refractory blocks or tiles which may be laid in overlapping rows to build up independently supported wall structures for boilers and furnaces and which are provided with cooperating tongues and grooves for interlocking the blocks in one row with the blocks in the adjacent rows and whereby inward movement of the blocks is prevented although only every other block in alternate rows is secured to or engaged by the wall supporting means.

A still further object is to provide an improved hanger for supporting the blocks of a section of the side or apron wall of a furnace.

These and other objects which will hereinafter be made apparent to those skilled in this particular art are accomplished by means of this invention, one embodiment of which is described in the following specification and illustrated in the accompanying drawings, wherein:

Figure 1 is a perspective view of two of my improved blocks arranged side by side and showing the tongues on one face of the blocks;

Fig. 2 is a perspective view of one of my improved blocks showing the grooved surface on the face opposite to that shown in Fig. 1;

Fig. 3 is a sectional view of a furnace arch or roof having a sectional apron wall constructed of my improved refractory blocks supported above the nose and roof structure in accordance with my invention;

Fig. 4 is a perspective view of a portion of the apron wall shown in Fig. 1, showing the bonding and interlocking construction obtained with my improved refractory blocks;

Fig. 5 is a perspective view of the outer side of a furnace wall built up of refractories made in accordance with my invention and illustrating a modified type of hanger for supporting the blocks;

Fig. 6 is a vertical section of the wall shown in Fig. 5;

Fig. 7 is a perspective view on a reduced scale of the hanger used to support the side wall shown in Figs. 5 and 6; and

Fig. 8 is a sectional view of an air cooled wall showing a modified type of hanger construction.

Referring first to Figs. 1 and 2 of the drawings, the numeral 1 represents a refractory block or tile made in accordance with my invention for building a bonded and interlocked furnace wall. The block 1 has a triangularly shaped groove 2 in one surface 3 thereof with the apex thereof located centrally of the surface 3 and about three-quarters of the distance from one end thereof and the groove diverges outwardly from the apex and opens into the end face of the block which is adapted to come into contact with the heat of the furnace. Adjacent the end face 4 or external end of the block, the surface 3 is provided with a slot 5 which cooperates with a T-shaped slot 6 in a surface 7 opposite the surface 3 for receiving a suitable hanger, which may be of the character shown and described in Letters Patent No. 1,977,799, granted to me on October 23, 1934, for supporting the block on the superstructure of the furnace.

Surface 7 of the block is also provided with two triangularly shaped tongues 8, along each side thereof, the apieces of which start at a point about the same distance from the ends of the block as the apex of the groove 2, and each tongue is of a shape and size substantially equal to one-half of the shape and size of the triangular groove 2 in the surface 3 of the block.

In Figs. 3 and 4 I have shown one type of interlocked and partially bonded sectional apron wall 10 which may be built up of refractories embodying my present invention in connection with other refractory blocks. The apron wall 10 is shown in conjunction with a furnace roof or arch 11 to which it is connected by a nose 12. The wall 10, roof 11 and nose 12 are all supported from the superstructure of the furnace.

The roof or arch 11 is of the flat arch type and comprises a plurality of refractory tile or blocks 11*a* suspended from an I-beam 11*b* by means of hangers 11*c* in the manner disclosed in Letters Patent No. 1,913,168, granted to me on June 6, 1933.

The nose 12 is made up of a series of sector-shaped blocks or tiles 12*a* which are preferably

supported between the roof 11 and the apron wall 10 in accordance with the arrangements shown and described in my aforesaid Letters Patent No. 1,977,799. Each of the blocks 12a is provided with shouldered side edges 12b for interlocking the nose with the roof 11 and with the apron wall 10, and the edge edjacent the roof 11 is also provided with a slot 12c for aiding in supporting the nose in place on the superstructure of the furnace, as will more fully appear.

The apron wall 10 is composed of a plurality of similar sections independently supported one above the other on the superstructure of the furnace. In building an apron wall with refractories made in accordance with my invention, a series of supporting members 15 are secured in spaced relation on the superstructure of the furnace for supporting the individual blocks of the apron wall. Each member 15 is provided at its upper end with a hook 16 adapted to fasten over one of the horizontal beams of the superstructure (shown in the drawings as angles and I-beams) and is of such a length that it abuts against the horizontal beam immediately below the one on which the member 15 is hooked, whereby turning movement of the member about its supporting beam is prevented. Each member 15 terminates at its bottom in a horizontal shelf portion 18 which is adapted to project into the slots 12c and thus partially support the nose blocks 12a and has a T-shaped slot 17 therein above the shelf 18. Each section of the apron wall 10 is composed of a series of vertical tiers or rows of refractory blocks and in constructing each such section, the members 15 are hooked onto the superstructure and are so spaced horizontally that one such member will be centered behind each of the blocks of the bottom row of the wall.

After the members 15 have been so positioned, the nose 12 of the furnace is built up and the individual blocks 12a are partially supported through the slot 12c on the shelf portion 18 of such members. A row of blocks 19 are then laid on the nose blocks 12a. Each block 19 has a shouldered surface 21 and an opposed surface having a triangularly shaped groove 22 therein of substantially the same shape and size as the groove 2 in the block 1, and prior to laying over the nose blocks 12a is secured to a hanger 23 in the manner set forth in my aforesaid Letters Patent No. 1,977,799. Hanger 23 is provided with a T-shaped back 24 that is adapted to be received in the T-shaped slot 17 of one of the members 15 and when the row of blocks 19 is to be laid, the back 24 is inserted at the top in the slot 17 and the block lowered until the shouldered surface 21 engages the shouldered surface 12b of the nose block 12. Since the hangers 23 prevent inward movement of the blocks 19, it is apparent that the coacting shoulders 21 and 12b form an interlock which holds the nose blocks 12a in proper position.

A row or tier of blocks 1 are then placed on top of the row or tier of blocks 19 in overlapping relation therewith to provide a bonded wall. The blocks 1 are positioned on the blocks 19 with the surface 7 down so that the tongues 8 on adjacent blocks are received in and fill the groove in the top of one of the blocks 19. As the blocks 1, which are of the same width as the blocks 19, overlap the latter blocks, the sides of the blocks 1 are on the center lines of the blocks 19 in front of the members 15. Consequently, hangers cannot be used with this row of blocks.

In order to hold this row of blocks 1 against inward movement, a row or tier of blocks 25 are placed on the row of blocks 1 in overlapping relation therewith, which interlock with the grooves 2 in the blocks 1. Each block 25 has a pair of triangularly shaped tongues 26 on one face, of the same shape and size as the tongues 8, and a smooth flat face opposite the tongued face. The blocks 25 are each secured to a hanger 23 adapted to be received in the slot 17 of one of the members 15 and are laid with the tongues 26 down so that they project into the grooves 2 in the top of the blocks 1 and thus interlock with and prevent inward movement of such latter blocks.

Another row of blocks 25, each of which is provided with a hanger 23 for securing them to the members 15, is then positioned on the preceding row of blocks 25 in such a way that the flat surfaces thereof engage the flat surfaces of the first laid row of blocks 25 and whereby the tongues 26 project upwardly. Another row or tier of blocks 1 is then laid on the top of the upper row of blocks 25 in bonding relation therewith so that the tongues 26 project into the grooves 2 and prevent inward movement of the blocks 1 although such blocks are not provided with hangers and are not secured to the members 15. A section of the apron wall is completed by sliding a relatively short block 27 having a triangularly shaped groove 27a in the lower surface thereof over the cooperating tongues 26 of two of the blocks 1 of the last laid row or tier.

In building succeeding sections of the wall 10 and after the members 15 have been secured to the superstructure, a course of bricks 28 is built up on the shelves 18 to support the lowermost blocks of such succeeding section. Since such succeeding sections do not come in contact with the nose 12, there is no need to use the shouldered block 19 and, consequently, I prefer to employ a series of blocks 29 having one flat smooth surface and an opposed surface having a triangularly shaped groove 29a therein. The lowermost row of blocks 29, which are held against inward movement relative to the casting by hangers 23 positioned in the T-shaped slot, are laid with the groove 29a uppermost and support, as in the previous section, a row or course of blocks 1 which in turn are interlocked by the two rows or course of blocks 25. The section is completed in the manner hereinbefore set forth.

The course of bricks 28 not only forms a support for the lowermost blocks 29 of the section but are of sufficient height to provide a space 28a between the bottom row of blocks of one section and the top row of blocks of the subjacent section. As a result of this construction, free expansion of each section is permitted and any wall section is thus free to move relatively to any other section without destroying the seal between such sections, since the course of bricks 28 seals, at all time, the space 28a between the adjacent sections, regardless of the expansion or contraction of such sections.

While I have described each section of the apron wall as comprising six rows or tiers of blocks, it is to be understood that each section may have more or fewer rows or tiers, if desired, and that if additional rows or tiers are desired, additional rows of blocks 1 are inserted in the wall. In this construction, it should also be noted that each section of wall is completely interlocked although only partially bonded.

In Figs. 5, 6 and 7, I have shown a completely bonded and interlocked sectional side wall for

a furnace built up of refractory blocks made in accordance with my invention. In this construction, a series of hangers 30 are used which have a substantially flat back portion adapted to abut against the cross beams 31 of the furnace frame. Each hanger 30 is provided with a hook 32 at the top thereof for supporting the hanger on the flange of one of the cross beams and a plate 34 adjacent the bottom on the opposite side from the hook 32. Plates 34 are of sufficient width to form a substantial support for two of the bottom row of blocks 19 and are of such depth that the shoulders 21 of the block are in close proximity to the outer edge thereof when the blocks are positioned thereon. Each hanger 30 also has a series of vertically spaced T-shaped members 35 which project inwardly from the back portion above the plate 34 for receiving the T-shaped slots 6 in the blocks 1.

In constructing the furnace wall, the hangers 30 are hooked over the cross beams 31 (shown as H beams) in proper spaced relation and two of the blocks 19 are positioned on the plate or shelf 34 of each of the hangers with the shoulder 21 down and with the edges of the blocks underneath the lowermost T-shaped member 35 of the hanger, which is so spaced above the plate that it engages the upper grooved surface of the blocks. After the row of blocks 19 has been positioned on the hangers, one of the blocks 1 is mounted on each of the hangers 30 with the slot 6 positioned over the lowermost T-shaped member 35. In this position, a block 1 overlaps the edges of the blocks 19 supported on the shelf 34 of each hanger and the tongues 8 project into and partially fill the grooves 22 on both of the blocks 19. A block 1 is then placed between the blocks 1 which are secured to the hangers to complete the row and the tongues on these last placed blocks project into and fill the remaining portions of the grooves in the blocks 19 and thus interlock the unattached blocks to the blocks 19.

Succeeding rows of blocks 1 are then laid on the preceding rows of blocks in overlapping relation to build up the wall. The T-shaped members 35 on the hanger 30 are so spaced that every other row of blocks 1 is secured to the hangers 30, as heretofore explained, and only every other block in such secured row is attached to a hanger.

When it is desired to finish the side wall section, a row of turnover blocks 45 is laid on the top of the last row of blocks 1 and every other block in such row of turnover blocks is secured to one of the T-shaped members 35 of the hanger 30. The turnover blocks 45 differ from blocks 1 in that both surfaces of each turnover block are exactly the same and are similar in size and shape to the tongued surface 7 of the block 1. The tongues along the side edges of the lower face of the turnover block 45 project into the grooves 2 in the blocks 1 when the turnover blocks are laid thereon to interlock the preceding row with the turnover row and the tongues on the upper surface thereof are received in the grooves 22 of the row of blocks 19 which are positioned on the turnover blocks 45 with the shoulder 21 upward to complete the wall section. The wall section immediately above such independent section is of the same construction and the top row of blocks of each section has a shouldered surface projecting upwardly and the bottom row of each section has a shouldered surface projecting downwardly to provide a space therebetween which is filled with a suitable sealing brick, such as firebrick 38, to provide an expansion joint between the two sections. The hangers 30 of each section are preferably staggered in respect to the hangers of the section immediately therebelow. The space between the hangers 30 and the backs of the blocks may be filled with a suitable insulating material as at 39, if desired.

In Fig. 8, I have shown a modified type of hanger 40 for building a sectional air-cooled wall. In this construction, the hanger is provided at its upper end with a rearwardly extending portion 41 of substantial length which terminates in a hook 42 for fitting over the flange of a cross member connected to a cross beam of the frame and the lower end of the hanger terminates in a rearwardly extending portion 43 having a downwardly projecting flange 44 for abutting against the outer face of one of the cross members of the furnace. The hanger is also provided with a shelf or plate 48 and a series of T-shaped members 49 for cooperating with the slots in the blocks to be supported on the hanger.

From the foregoing description of my invention, it is apparent that I have provided refractory blocks for building independently supported sections of furnace walls in which the blocks are laid in rows and the blocks in one row are not only bonded with the blocks in adjacent rows but are so interlocked that inward movement of one block relative to other blocks of the wall is prevented, even though only every other row of blocks is supported on the hangers and only alternate blocks in supported rows are attached to such hangers.

While I have described one embodiment of my invention, it is apparent that additional hangers may be used, if desired, and that the hangers may be designed to support the special row of blocks at the top and bottom of the section, if desired, without departing from the spirit of my invention or the scope of the appended claims.

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

1. A refractory block having on one of its faces a substantially V-shaped groove and on its other face a pair of triangularly shaped spaced marginally disposed tongues, each of which conforms in shape and size to the shape and size of one-half of said groove.

2. A refractory block having on one face a substantially V-shaped groove with the mouth of the groove centrally disposed along one edge, and on its other face a projection along each side thereof of a size and shape substantially equal to the size and shape of half of said groove, both said groove and said projections being shorter than the corresponding block faces.

3. A furnace wall composed of refractory blocks arranged in vertical courses with the blocks in each course held together by the pressure between their engaging surfaces and overlapping the blocks of the preceding row, each pair of blocks in one course being interconnected to a straddling block in the adjacent course, each such block being formed as set forth in claim 2.

4. A furnace wall comprising a series of independently supported wall sections, each formed of a plurality of refractory blocks formed as set forth in claim 1, means for supporting alternate rows of blocks in each section, a row of unsupported refractory blocks between said supported sections, and means for uniting the supported

blocks with the unsupported blocks to provide an interlocked and bonded wall.

5. A furnace wall structure comprising a series of vertical courses of refractory blocks configured as set forth in claim 1 and arranged so that each block in each succeeding course overlaps two of the blocks in the preceding course, means for supporting alternate blocks of alternate courses thereof, and means for uniting the supported blocks with the unsupported course and with the unsupported blocks in the supported course to prevent lateral movement of the unsupported blocks relative to the supported blocks.

6. A furnace wall composed of refractory blocks arranged in vertical rows or tiers with the blocks in each row in edge to edge relation and the blocks in succeeding rows overlapping the joints between the blocks in the preceding row, the blocks in one course being facially interconnected with the blocks in the adjacent courses and each such block being formed as set forth in claim 1.

7. A wall hanger for the refractory blocks of a sectional furnace wall of the character described which comprises an elongated metal body having a flat back portion adapted to abut against a cross beam of the furnace wall framework and a series of unitary vertically spaced outwardly projecting rod-like members each of which terminates in a cross bar which is receivable in a complementary slot in the adjacent refractory block, said body being additionally provided at the top thereof with a hook member which is capable of supporting the hanger on a cross beam flange and which extends in an opposite direction to the said rod-like members and a supporting plate below and parallel with the said rod-like members and forming a support for a pair of blocks.

8. A furnace wall comprising a row of refractory blocks arranged side by side and each having a grooved upper surface, means for supporting each of said blocks to prevent inward movement thereof, at least one row of blocks supported on said first mentioned row and in overlapping relation therewith and with each other, each block of said series of rows having tongues on its lower surface for projecting into and partially filling the grooves in adjacent blocks of the row thereunder and a groove in the upper surface thereof for receiving the tongues on the blocks of the row thereabove, at least one row of turnover blocks each having a pair of tongues on both its lower and upper surfaces, and a top row of blocks each having a grooved lower surface for receiving the tongues on adjacent blocks of the subjacent row.

9. An interlocked and bonded sectional furnace wall, composed of independently supported refractory blocks arranged in overlapping rows and including a bottom row of blocks each having a grooved surface, at least one row of blocks each having a pair of tongues on one surface for coacting with the grooves in the blocks of an adjacent row and a grooved surface for receiving the tongues on the blocks of another row, and a row of turnover blocks having a pair of tongues on two opposed sides thereof.

10. A refractory block of the character described one face of which is provided with a V-shaped recess extending centrally from one edge of the block and terminating in an apex near the other edge of the block, the recess being shorter than the said face and symmetrically disposed with respect to the center line thereof, and the opposite face of which is provided with two spaced triangular projecting portions marginally disposed and each having the size and shape of a longitudinal half of said recess.

LEVI S. LONGENECKER.