

Aug. 3, 1965

A. A. USMIANI ETAL
FURNACE ROOF CONSTRUCTION

3,198,147

Filed June 21, 1962

4 Sheets-Sheet 1

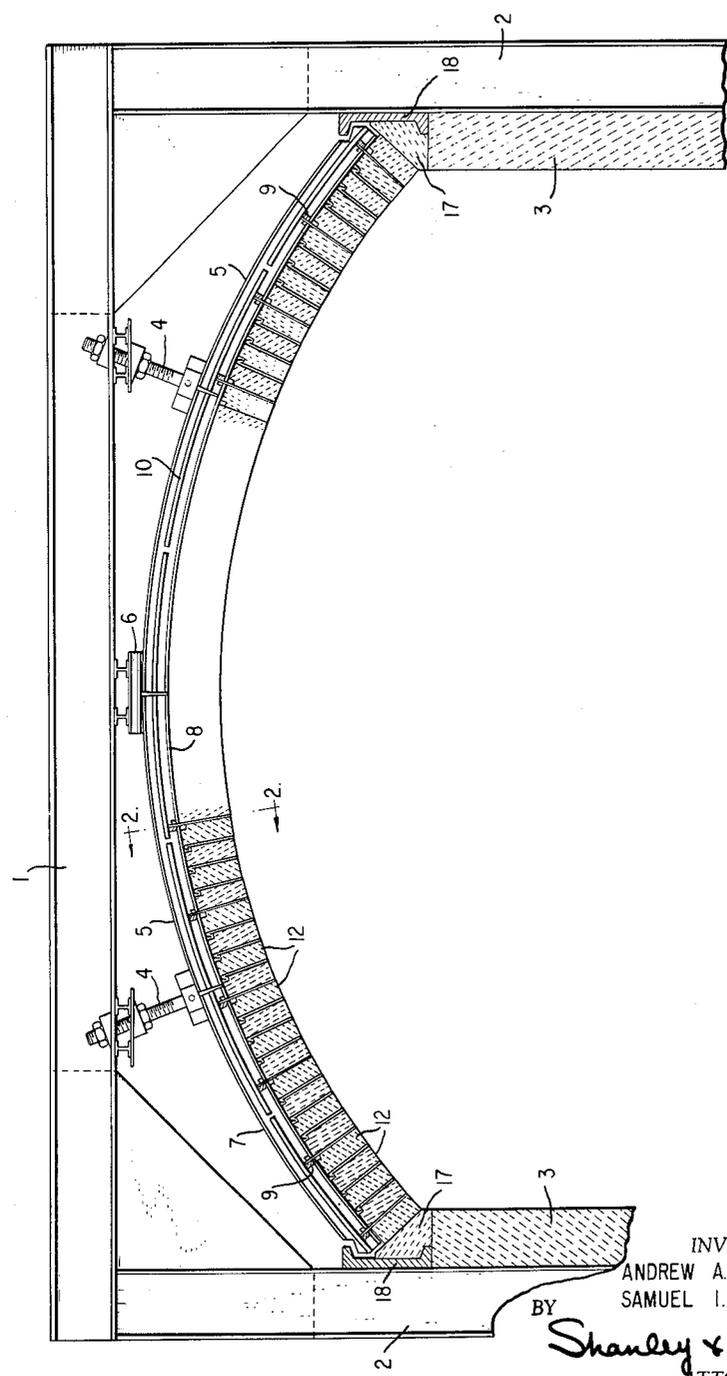


FIG. 1

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FIG. 2

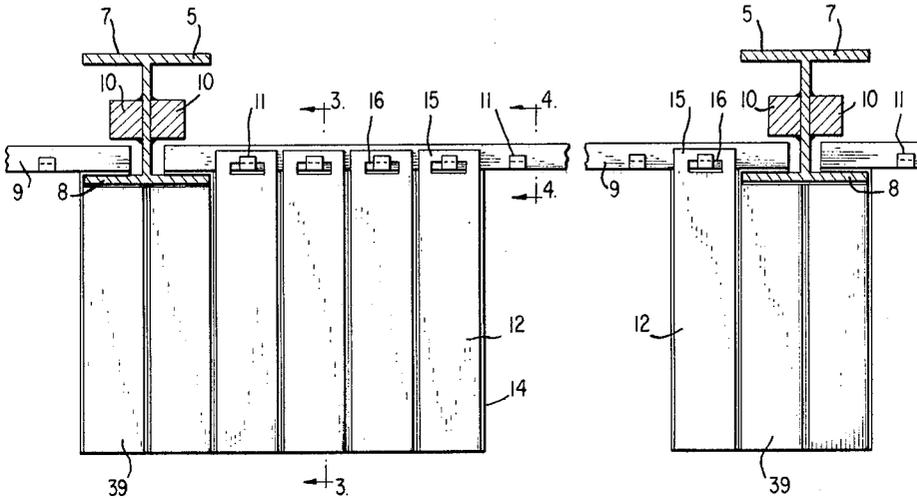


FIG. 3

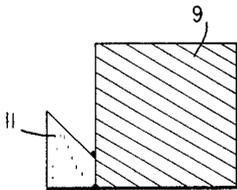
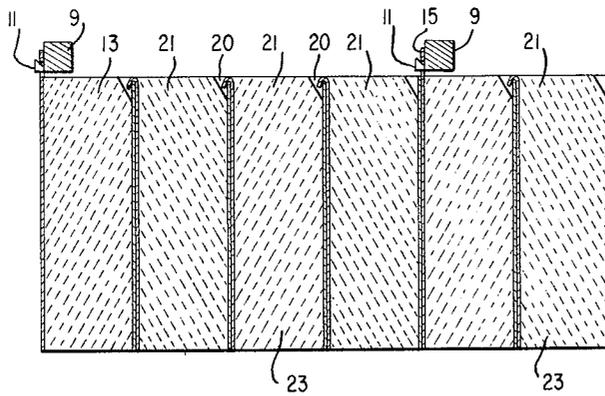


FIG. 4

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FIG. 5

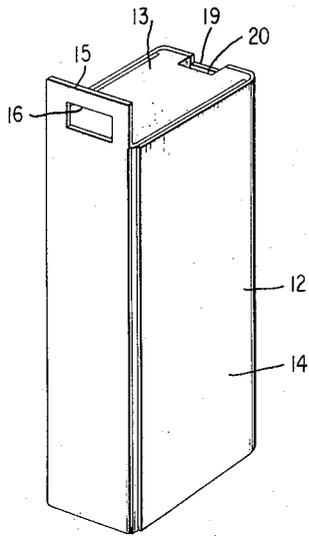


FIG. 6

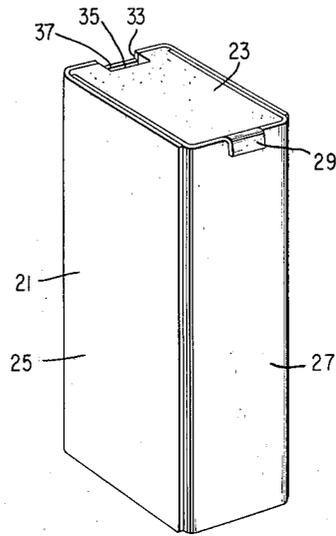


FIG. 7

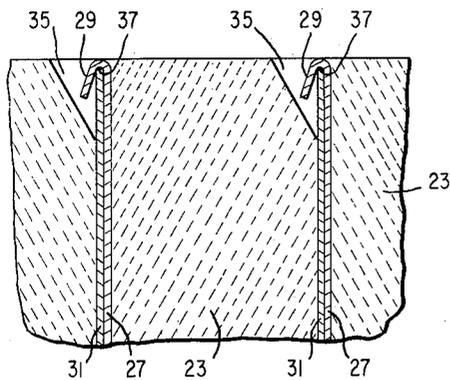
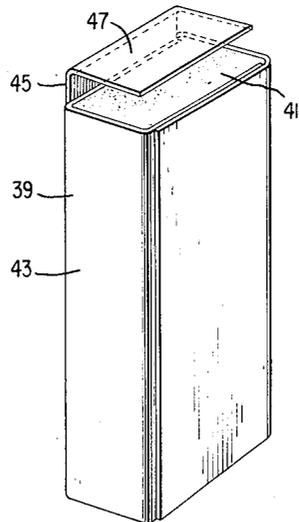


FIG. 8



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FIG. 9

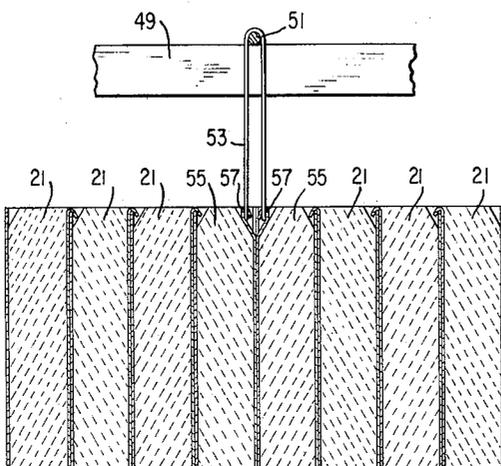
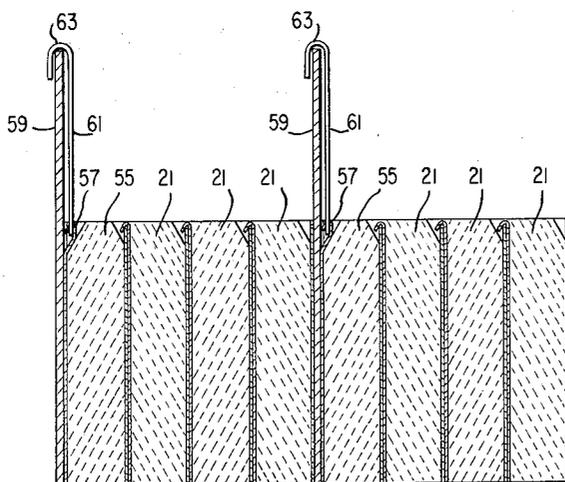


FIG. 10



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FURNACE ROOF CONSTRUCTION

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 Filed June 21, 1962, Ser. No. 204,192
 12 Claims. (Cl. 110-99)

The present invention relates to furnace roof construction, more particularly of the type comprising a multiplicity of refractory bricks.

Furnace roofs as heretofore known have generally been arched, but have sometimes been flat. Arched roofs are usually installed in one of two ways: either the individual blocks are held by hangers that support the blocks from the fixed supporting structure of the furnace, or else the blocks support each other on the arch principle, that is, the side walls of adjacent blocks press against each other in such a way as to retain all the blocks in the configuration of an arch. Flat roofs, which cannot take advantage of the arch principle, have heretofore been supported by hangers.

Serious problems arise, however, when it is attempted to install a roof of any of the types described above. In the case of flat or arched roofs supported by hangers, it has ordinarily been necessary heretofore to provide a hanger for each block, as in U.S. Patent No. 2,997,008. Arrangements have been proposed for supporting a plurality of blocks from a single hanger, as in U.S. Patent No. 2,187,669. In each case, however, it has ordinarily been necessary to provide hanger construction contacting each block, so that the installation and replacement of an individual block inevitably entails manipulation of this hanger structure by which the block was supported from fixed supporting structure of the furnace. The manner of installation and repair of arched roofs has been somewhat different from that of flat roofs in that the use of hangers for arched roofs can sometimes be avoided. Even so, in this latter case, it has been necessary to provide a form of scaffolding or support for the arch until the heat of the furnace caused the metal sheathing to oxidize so that the arch became a unitary whole, and this is true not only of the arch during initial construction but also of the arch during repair as by replacement of individual blocks.

During the course of the replacement of an individually suspended block, it is necessary, in the case of a roof in which all the blocks are supported by hangers, to manipulate the hanger of the block to be removed in a rather cumbersome way, and similarly to manipulate the hanger with respect to the block that replaces the removed block. In the case of an arched roof without hanger support, it has been necessary to provide special support for an individually replaced block until such time as the furnace heat integrates the new block with the previous blocks, at least when a plurality of contiguous blocks were simultaneously installed or replaced.

The present invention solves the foregoing problems by providing furnace roof construction including a multiplicity of contiguous refractory bricks of which not more than half are suspended, while not less than half are supported on each other. Preferably, the number of bricks supported on each other is several times the number of bricks suspended from the roof-supporting structure of the furnace. It is also preferred that the suspended bricks be suspended from their metal sheathing and that the supported bricks be supported on the metal sheathing of other bricks.

The invention also comprises an arched roof structure in which arched beams support horizontal support mem-

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bers on their lower flanges, the support members in turn carrying the bricks.

Accordingly, it is an object of the present invention to provide furnace roof construction that enables the construction of new furnace roofs with no special supporting structure.

Another object of the present invention is the provision of furnace roof construction comprised of a multiplicity of furnace roof blocks, characterized in that furnace roof repairs can be effected by individual replacement of the blocks with no special fittings or attachments.

Finally, it is an object of the present invention to provide furnace roof construction that will be relatively simple and inexpensive to manufacture, easy to install, maintain and repair, and rugged and durable in use.

Other objects and advantages of the present invention will become apparent from the following description, taken in connection with the accompanying drawings, in which:

FIGURE 1 is a transverse cross-sectional view of a furnace embodying furnace roof structure according to the present invention;

FIGURE 2 is an enlarged cross-sectional view taken on the line 2-2 of FIGURE 1;

FIGURE 3 is an enlarged cross-sectional view on the line 3-3 of FIGURE 2;

FIGURE 4 is a still further enlarged fragmentary cross-sectional view on the line 4-4 of FIGURE 2;

FIGURE 5 is a perspective view of a suspended furnace roof block according to the present invention;

FIGURE 6 is a perspective view of a supported furnace roof block according to the present invention;

FIGURE 7 is an enlarged fragment of FIGURE 3, illustrating how blocks shown in FIGURE 6 are supported on one another;

FIGURE 8 is a perspective view of a furnace roof block of the type shown in FIGURE 2 directly under the I-beams;

FIGURE 9 is a view similar to FIGURE 2, but showing a modified form of roof according to the present invention; and

FIGURE 10 is a view similar to FIGURE 2, but showing a still further form of furnace roof construction according to the present invention.

Referring now to the drawings in greater detail, there is shown in FIGURE 1 furnace structure including a furnace roof according to the present invention, comprising a plurality of transverse horizontal main supporting beams 1 which are carried at the upper ends of uprights 2 that form the buckstays of the furnace walls 3.

Hangers 4 depend from crossbeams 1 and adjustably support arched beams 5. In the illustrated embodiment, two arched beams 5 are disposed end to end to make a composite arched beam structure and are secured together at their adjacent ends by means of connector 6. It will be understood, however, that a single arched beam 5 could be used to comprise the beam structure of the present invention.

In the embodiment shown, beams 5 are in the form of I-beams and have relatively wide top flanges 7 and bottom flanges 8. Supported at their ends on the upper surfaces of the lower flanges of beams 5 are bars 9 that are horizontally disposed and that extend between beams 5 transverse to the length of beams 5. Bars 9 in the illustrated embodiment are shown to be square in cross section, but they of course may have any of a variety of desired cross-sectional configurations. Bars 10 are secured to opposite sides of the webs of arched beams 5 parallel to the length of the beams and midway between the upper and lower flanges thereof, and project laterally outward in opposite directions from the webs of those beams

to provide hold-down means for the ends of bars 9. Secured to and projecting laterally outward from a lower portion of a side face of each bar 9 is a plurality of equally spaced apart brackets 11, which in the illustrated embodiment have each an upper surface that is inclined downwardly toward the adjacent face of bar 9. Brackets 11 are secured to bars 9 as by welding or the like.

Depending from each bracket 11 is a suspended furnace roof block 12 comprising a brick 13 of conventional refractory material, encompassed on all four sides, but not at its top or bottom, by a metal case or sheathing 14. Extending upwardly from one side of this metal sheathing and integral therewith is a hanger 15 having a horizontal slot 16 therethrough above the level of brick 13. The blocks 12 are thus suspended by insertion of a bracket 11 through slot 16, whereupon the hung block slips downward along the upper surface of bracket 11 until it is in contact with bar 9. All the blocks 12 on a given bar 9 are thus kept nicely in alignment with each other both lengthwise and laterally of the bar.

The individual blocks in the roof are in contact with each other along their lateral sides, except for those along the side edges of the roof, which rest against and are supported in part by skewback blocks 17 that are carried in skewback channels 18 at the tops of side walls 3.

On its side opposite the side that carries hanger 15, the metal sheathing of roof block 12 has a notch 19 in the upper edge of that opposite side of the metal sheathing. Notch 19 is disposed centrally of its associated upper edge of the metal sheathing and is rather shallow. Brick 13 is recessed as at 20 to space brick 13 a substantial distance from notch 19.

There are two principal varieties of furnace roof blocks that are used in the course of the present invention, and these are not alternative to each other. Instead, they are used simultaneously. The first type is the suspended roof block 12, characterized by hanger 15. The second type is a supported furnace roof block shown in one of its many forms in FIGURE 6. In that figure, for example, there is shown a supported furnace roof block 21 which comprises a brick 23 of conventional refractory material encased by a metal casing or sheathing 25.

Supported roof blocks 21 are supported in the sense that they are not individually suspended as are suspended blocks 12 and as were furnace roof blocks according to the prior art. Instead, blocks 21 are supported on other furnace roof blocks; and for this purpose, one side 27 of metal sheathing 25 of each block 21 terminates upward in a hook 29 which extends from the upper edge of side 27 outward and downward and terminates a substantial distance below the upper edge of side 27. Hook 29 is integral with side 27 and may be formed by bending over a tab of appropriate size in the form of a hook. Hook 29 extends along side 27 a distance substantially less than the width of side 27 and is disposed centrally of the upper edge of side 27. Needless to say, in addition to the formation of hook 29 by bending a tab, hook 29 could also be formed by welding or riveting a member to the upper edge portion of side 27, in which latter case hook 29 would still be integral with side 27 within the meaning of the present invention. It should also be noted that hook 29 projects laterally outward beyond the plane of its associated side, while hanger 15 is disposed in the same plane as that portion of the metal sheathing with which it is integral.

The side 31 of metal sheathing 25 opposite hook 29 is provided at its upper edge with a downwardly extending shallow notch 33 of an extent lengthwise of the upper edge of side 31 substantially less than the length of that edge. Like hook 29, notch 33 is centered between the ends of its associated upper edge, and is of an extent lengthwise of that edge substantially greater than the

lengthwise extent of hook 29. Brick 23 adjacent notch 33 is recessed as at 35 to a length about equal to the length of notch 33. Bottom edge 37 of notch 33 is disposed a substantial distance above the bottom of the brick recess at 35, and bottom edge 37 provides in effect a continuation of the upper edge of side 31, albeit at a different level from other portions of that upper side edge.

In use, the suspended blocks 12 are hung on brackets 11 and the supported blocks 21 are hung on each other and on suspended blocks 12. This latter is done by disposing hook 29 in a notch 19 or 33. The upper inner surface of hook 29 being at about the same level as the bottom edge of notch 19 or bottom edge 37 of notch 33, the supported blocks 21 assume the same level as each other and the same level as suspended blocks 12. As seen best in FIGURE 3, therefore, brackets 11 suspend blocks 12, but each block 12 supports at least one block 21, and in the preferred form, several blocks 21. In the illustrated embodiment, each suspended block 12 supports three blocks 21, the block 21 adjacent block 12 in turn supporting two of these blocks and the next block in turn supporting one of these blocks.

The assembly of suspended blocks 12 and supported blocks 21, however, does not fill the space beneath beams 5. Therefore, for this purpose, roof blocks 39 are provided that are comprised of brick 41 surrounded by a metal case or sheathing 43 having an upward extension 45 at one side thereof which terminates upward in a horizontal leg 47 extending toward but terminating short of the opposite side of block 39, as best seen in FIGURE 8. These blocks 39 are supported directly on the upper surfaces of lower flanges 8 of beams 5, in the manner shown in FIGURE 2, one block 39 being hung on beam 5 from each side thereof and meeting in the plane of the web of beam 5. From a study of FIGURES 8 and 2, it is seen that the transverse legs 47 overlie, are substantially parallel to, and are coextensive with a major part but less than 100% of the area of the tops of the bricks 41. In this way, a strong and secure fit is obtained.

The method of assembly, therefore, of a furnace roof according to FIGURE 1 is to place blocks 39 in confronting relationship on beam 5 and then to add bars 9 between beams 5, the ends of bars 9 resting directly on the upper surfaces of horizontal legs 47 of the blocks 39 disposed beneath the beams 5 and thus resting on the upper surfaces of flanges 8 beneath bars 10. The brackets 11 on bars 9 are spaced apart a distance equal to the width of a suspended block 12, which is the same width as that of a supported block 21. The brackets 11 nearest beams 5 are spaced from the edges of the lower flanges 8 of beams 5 and more particularly from upward extensions 45 of block 39 a distance equal to about half the width of a block 12. Hangers 15 of block 12 are then hooked on to brackets 11 through slots 16. Supported blocks 21 are then added progressively by hooking them one over the other until the desired number of blocks is achieved, whereupon another bar 9 is hung with a row of blocks 12 and the process is repeated, the direction of construction proceeding generally to the right, as seen in FIGURE 3, or upward from both ends as seen in FIGURE 1. Bars 9 are parallel to each other, and are spaced apart an even multiple of the depth of blocks 12 and 21, which preferably are all of equal depth. Thus, it is to be understood that there will be a plurality of bars 9 parallel to each other and spaced apart equal distances transversely of their lengths, each bar 9 having a plurality of brackets 11 thereon spaced apart lengthwise thereof.

During assembly of the arched roof of FIGURES 1-8, the blocks tend to rest and bear against skewback block 17 and against each other, this contact being automatically established and maintained by the sliding movement of bars 9 on the upper surfaces of legs 47 of blocks 39. At the same time, any tendency of bars 9 to ride up off legs 47 either during construction or in use is counteracted

by bars 10 that define, with lower flanges 8 and the webs of beams 5, laterally opening channels for the secure reception of the ends of bars 9.

Another embodiment of roof construction according to the present invention is shown in FIGURE 9, in which is shown a furnace roof including a plurality of parallel supporting beams 49, only one of which is shown. Beams 49 on their upper surfaces support a plurality of rods 51, only one of which is shown, which extend transversely of the length of beams 49. Contrary to the arrangement of FIGURE 1, it is the rods 51 that extend transversely of the furnace, not beams 49, so that beams 49 are horizontal. Thus, in an arched roof, it is the rods 51 that are arranged in an arched configuration. Each of rods 51, in turn supports a plurality of inverted U-shaped hangers 53 having downwardly extending legs from the lower end of each of which is suspended a furnace roof block 55 which is like block 21 except that hook 29 of block 21 is replaced by a hook 57 in the case of block 55, hook 57 being of a different configuration from hook 29 of block 21. Specifically, hook 57 is integral with a side wall of the metallic sheathing of block 55, but is disposed on the same side of the plane of that side wall as is the brick of block 55. Thus, hanger 53 can suspend a pair of blocks 55 on its free spaced ends and at the same time the confronting faces of the metallic sheathing of those two suspended blocks will be in area contact with each other.

Still another embodiment of roof construction according to the present invention is shown in FIGURE 10, in which the beams 5 and bars 9 or beams 49 and rods 51 are replaced by the ribs 59 disposed in a vertical plane which is viewed edgewise in FIGURE 10. Ribs 59 comprise the fixed supporting structure of the furnace roof. In this latter case, hanger 61 suspend blocks 55 from ribs 59 by means of hooks 63 at the upper ends of hangers 61. In an arched roof, the ribs 59 have arched configuration. At their lower ends, hangers 61 have the same slots as hangers 53, for the reception of hooks 57 of blocks 55. As also in the case of FIGURES 2 and 9, supported blocks 21 are hung on each suspended block 55, the ribs 59 being spaced apart distances that are multiples of the depth of blocks 55 and 21. For this purpose, as in the corresponding structure of the preceding embodiments, blocks 55 and 21 are of the same depth. Needless to say, hanger 61 of FIGURE 10 could be replaced by hanger 53 of FIGURE 9, in which case the roof would be built outward in both directions from each rib 59 and the number of ribs 59 would be reduced by half. Similarly, hanger 53 in FIGURE 9 could be replaced by hanger 61 in FIGURE 10, in which case the number of rods 51 in FIGURE 9 would be doubled and the blocks would be installed in one direction only.

To repair a furnace roof comprised of blocks according to the present invention, by replacement of an individual block, it is necessary only to remove those blocks that are supported by the block to be replaced, and then to remove the block to be replaced. Alternatively, of course, the block to be replaced can be removed at the same time as the blocks supported thereby, and the block to be replaced can thereafter be separated from the blocks it supports. In any event, a new or repaired block is then reinstalled simply by hanging one block on another as in the original construction of the roof, until the end of that group of blocks is reached. Thus, in no case of the replacement of an individual block is it necessary to remove more than several blocks; and the removal and replacement of these blocks are quite easy and can be performed without any supporting structure or scaffolding. A roof construction of blocks according to the present invention is thus self-supporting as installed and needs no special supports to hold it up until portions of metal sheathing of adjacent blocks in contact with each other have integrated by oxidation.

From a consideration of the foregoing disclosure, it will

be obvious that all of the initially recited objects of the present invention have been achieved.

Although the present invention has been described and illustrated in connection with preferred embodiments, it is to be understood that modifications and variations may be resorted to without departing from the spirit of the invention, as those skilled in this art will readily understand. Such modifications and variations are considered to be within the purview and scope of the present invention as defined by the appended claims.

What is claimed is:

1. Furnace roof construction comprising roof-supporting structure and a furnace roof comprised of a multiplicity of contiguous metal-sheathed refractory bricks, means interconnecting the metal sheathing of not more than half the bricks with the roof-supporting structure to suspend not more than half the bricks by their metal sheathing from the roof-supporting structure, and means supporting at least half the bricks on the metal sheathing of an immediately adjacent brick, the bricks that support other bricks being characterized in that those portions of the metal sheathing by which the supporting bricks are themselves supported are connected in unitary assembly by portions of the metal sheathing with those portions of the metal sheathing which support the supported bricks, so that the weight of the bricks which are supported by the supporting bricks is carried by the metal sheathing rather than by the refractory material of the bricks.

2. Furnace roof construction comprising roof-supporting structure and a furnace roof comprised of a multiplicity of contiguous metal-sheathed refractory bricks, means interconnecting the metal sheathing of not more than half the bricks with the roof-supporting structure to suspend not more than half the bricks by their metal sheathing from the roof-supporting structure, and means supporting at least half the bricks on the metal sheathing of said suspended bricks on the sides of the suspended bricks opposite the sides of the suspended bricks next to those portions of the sheathing by which said suspended bricks are suspended, the bricks that support other bricks being characterized in that those portions of the metal sheathing by which the supporting bricks are themselves supported are connected in unitary assembly by portions of the metal sheathing with those portions of the metal sheathing which support the supported bricks, so that the weight of the bricks which are supported by the supporting bricks is carried by the metal sheathing rather than by the refractory material of the bricks.

3. Furnace roof construction as claimed in claim 2, the number of bricks supported by immediately adjacent bricks being several times the number of said suspended bricks.

4. Furnace roof construction comprising roof-supporting structure and a furnace roof comprised of a multiplicity of contiguous metal-sheathed refractory bricks, means interconnecting a first upper side portion of the sheathing of not more than half the bricks with the roof-supporting structure to suspend not more than half the bricks from the roof-supporting structure, and means supporting at least half the bricks on a second upper side portion of the sheathing of said suspended bricks, said first and second upper side portions of the sheathing being on opposite sides of said suspended bricks, the bricks that support other bricks being characterized in that those portions of the metal sheathing by which the supporting bricks are themselves supported are connected in unitary assembly by portions of the metal sheathing with those portions of the metal sheathing which support the supported bricks, so that the weight of the bricks which are supported by the supporting bricks is carried by the metal sheathing rather than by the refractory material of the bricks.

5. Furnace roof construction as claimed in claim 4, the last-named means comprising hooks on said supported bricks engaging over the upper edges of said second upper side portions of the sheathing of said suspended bricks.

6. Furnace roof construction as claimed in claim 4, the number of bricks supported by immediately adjacent bricks being several times the number of said suspended bricks.

7. Furnace roof construction comprising a beam structure extending across the furnace and having a lower flange, a plurality of metal sheathed refractory bricks, said bricks having tops and bottoms, the metal sheathing of the bricks including legs that extend transversely of and are spaced above the tops of the bricks, the transverse legs overlying, being substantially parallel to, and being coextensive with a major part but less than 100% of the area of the tops of the bricks, the legs being supported from beneath by the flange of the beam structure with the tops of the bricks extending transversely underneath the flange.

8. Furnace roof construction as claimed in claim 7, the beam structure having oppositely outwardly extending lower flanges both of which support the legs of the metal sheathing of bricks, the bricks supported on the oppositely extending flanges of the beam structure being contiguous to each other beneath the beam structure.

9. Furnace roof construction as claimed in claim 7, there being a pair of parallel beam structures, and horizontal support members extending between the beam structures and resting at their ends on the legs of the metal sheathing, and refractory bricks depending from said support members.

10. Furnace roof construction comprising a plurality of parallel arched beam structures extending across the furnace, each beam structure having lower flanges, horizontal support members resting at their ends on and extending between said lower flanges of adjacent beam structures, and refractory bricks depending from said support members, said adjacent beam structures having opposed channel portions opening toward each other with the ends of the support members disposed in and closely vertically confined by said channel portions against substantial upward movement of the support members relative to the beam structures, the upper leg of each said channel portion being disposed a substantial distance below the upper edge of its associated beam structure.

11. Furnace roof construction comprising a plurality of parallel arched beam structures extending across the furnace, each beam structure having lower flanges, horizontal support members resting at their ends on and extending between said lower flanges of adjacent beam structures, and refractory bricks depending from said

support members, said adjacent beam structures having opposed channel portions opening toward each other with the ends of the support members disposed in and closely vertically confined by said channel portions against substantial upward movement of the support members relative to the beam structures, said beam structures being I-beams having upper flanges, the upper legs of the channel portions comprising members secured to the webs of the I-beams beneath the upper flanges of the I-beams.

12. Furnace roof construction comprising a pair of parallel beam structures extending across the furnace and having lower flanges, a plurality of metal sheathed refractory bricks, the metal sheathing of the bricks including legs that extend transversely of and are spaced above the bricks, the legs being supported from beneath by the lower flanges of the parallel beam structures with the bricks disposed beneath the flanges, and horizontal support members extending between the parallel beam structures and resting at their ends on the legs of the metal sheathing, and refractory bricks depending from said support members.

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