Nov. 15, 1960 W. F. GARRETTS 2,960,048

REFRACTORY ARTICLE

Filed Feb. 21, 1957 3 Sheets-Sheet 1

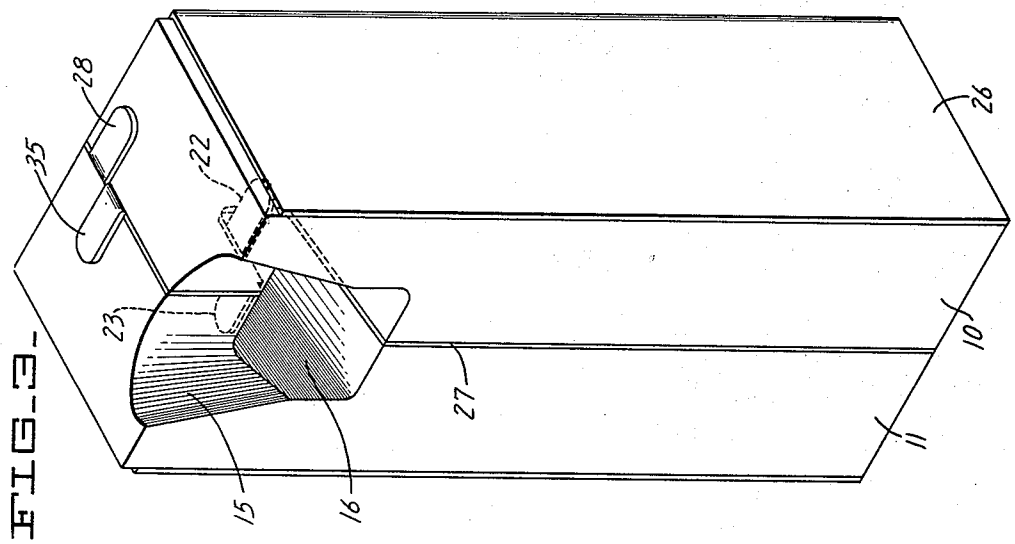


FIG_3_

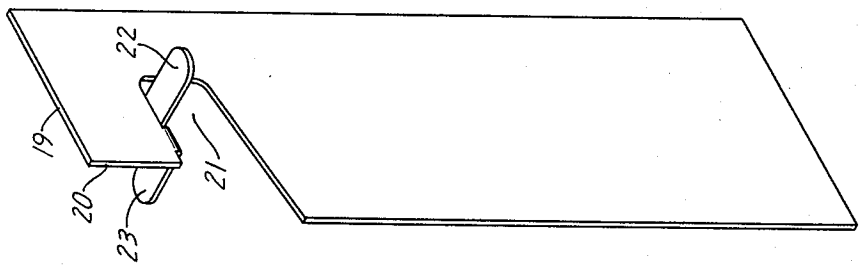


FIG_2_

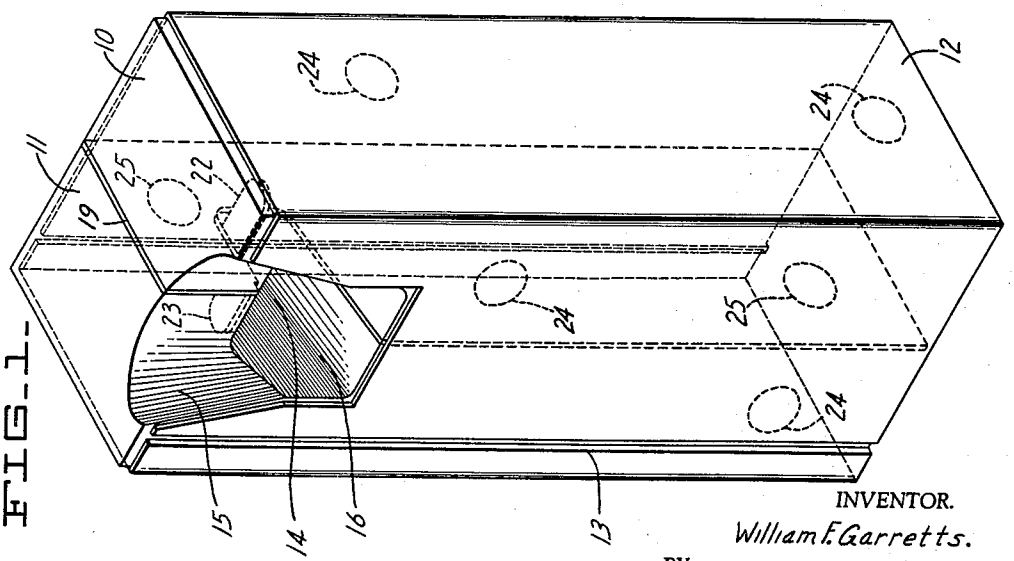


FIG_1_

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Nov. 15, 1960 W. F. GARRETTS 2,960,048

REFRACTORY ARTICLE

Filed Feb. 21, 1957 3 Sheets-Sheet 2

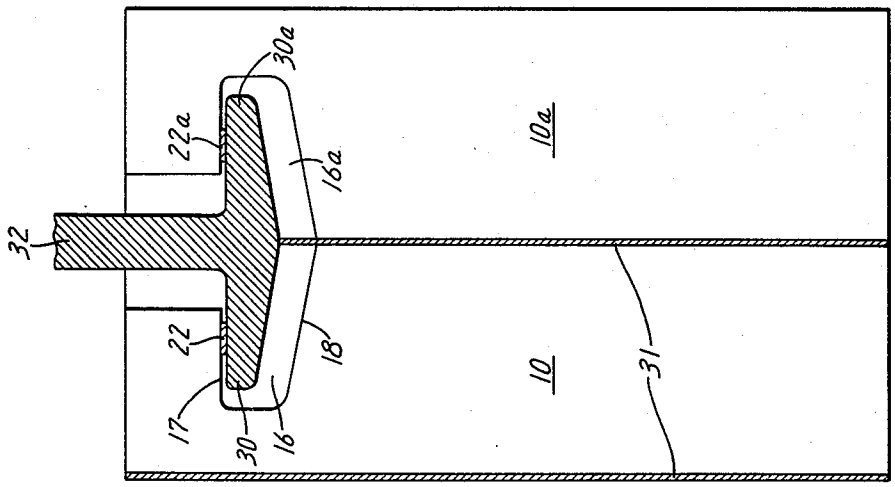


FIG-6-

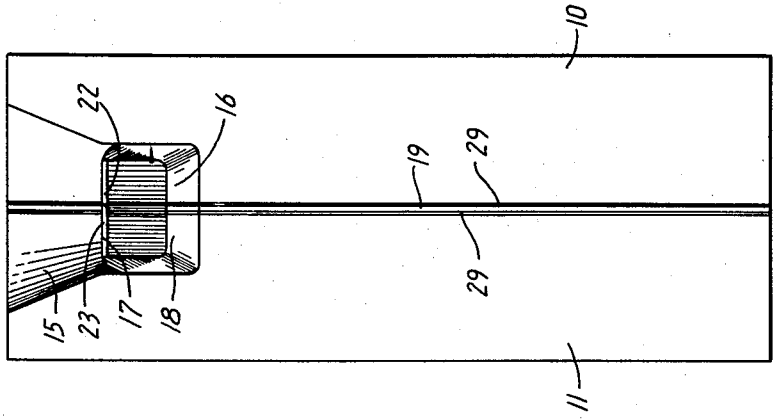


FIG-5-

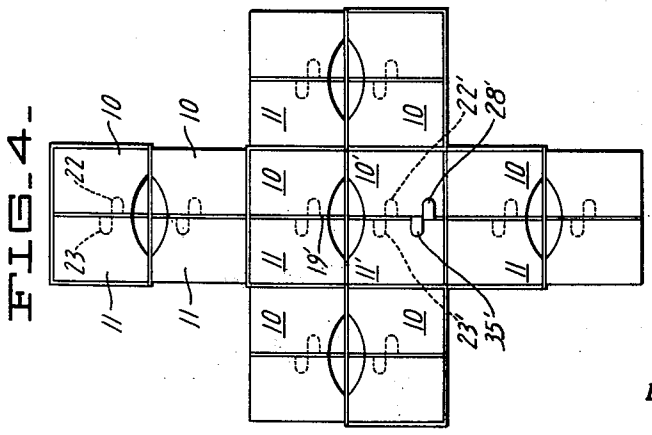


FIG-4-

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Nov. 15, 1960 W. F. GARRETTS 2,960,048

REFRACTORY ARTICLE

Filed Feb. 21, 1957 3 Sheets-Sheet 3

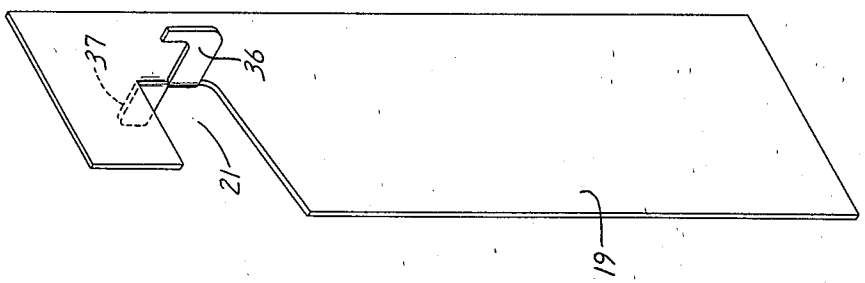


FIG-9-

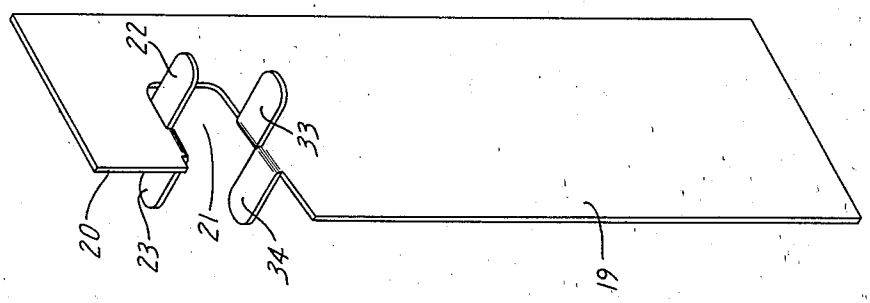


FIG-8-

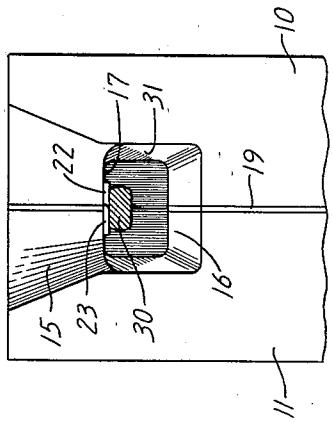


FIG-7-

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United States Patent Office 2,960,048
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2,960,048

REFRACTORY ARTICLE

William F. Garretts, Peoria, Ill., assignor to Kaiser Aluminum & Chemical Corporation, Oakland, Calif., a corporation of Delaware

Filed Feb. 21, 1957, Ser. No. 641,599

4 Claims. (Cl. 110—99)

This invention relates to a suspended roof structure and to a refractory block assembly for use in suspended roofs in industrial furnaces; and more particularly, it relates to a refractory assembly having a reinforced suspension means.

Refractory blocks, especially metal encased blocks, of various sizes and shapes have heretofore been made for use in forming what are known in the art as suspended roofs of industrial furnaces, e.q., open hearth furnaces. Various means have been suggested for making blocks for such use, whereby the blocks will be of extended useful life and will resist spalling, that is, will be more resistant to sudden changes of temperature, and whereby also the blocks can be safely handled. In particular, it has been previously known to assemble refractory bricks into a suspended roof structure with metal plates disposed between the blocks; and to form two refractory blocks into one unit, with a metal plate between the blocks, or to press a metal plate with the brick, and in both types of the latter block assemblies, to encase the whole in metal, which is applied on four or less of the sides of the block. However, the problems have still existed of producing bricks of high density and of firmly affixing or suspending the bricks within the roof or the blocks within the casings so that when they are hung in a roof structure and during the period before completion of firing and formation of a fired bond between the brick faces and the metal, the bricks will not fall out of the roofs or the cases. The foot of a hanger device will sometimes engage only one of such blocks and the other may then fall, resulting in an impairment of the roof structure and sometimes in serious injury to workers. Furthermore, some hanger brick or block assemblies are made with large sockets, and others with small sockets, and, correspondingly, there are large diameter and small diameter hangers or hanger feet. It is desirable, for instance, to sell a paired block assembly wihch can be used with either size hanger, but in the articles as heretofore known, the likelihood of successful use of a large socket assembly with a small diameter hanger foot has not been adequate because such small hanger often catches only one of such pair, leaving the other free to slip from the case.

It is an object of the present invention to provide a roof brick suspension article or unit wherein the bricks are firmly suspended within the casings. It is a further object to provide an improved metal dividing plate for a suspension roof refractory article which reinforces the suspension means. It is a still further object of the invention to provide such a dividing plate which will anchor the suspended brick and prevent slippage thereof out of the case or out of the roof structure. It is another object to provide a more stable furnace roof construction. Another object is to provide an improved furnace roof block assembly which can be pre-formed, shipped and installed as a unit; or which can, if desired, be assembled and installed at the site of use.

According to the present invention, there is provided

a suspended roof refractory article or unit or assembly which comprises a pair of abutting refractory bricks having a hanger-receiving recess, and a metal divider plate which is disposed between the bricks and conforms to the plane abutting faces of the bricks and which is provided with at least two lugs or ears lying adjacent the upper surface of the hanger-receiving recess. The metal divider plate is provided with an aperture or recess at one edge which conforms to or registers with the hanger-receiving recess, which is located at the upper portion of one face of the article or assembly.

According to the invention there is also provided a particularly advantageous metal divider plate for use in a refractory block assembly or in a suspended roof to maintain the refractory bricks or blocks in stable suspension. The metal plate has an aperture or cut-out portion conforming or registering with the suspension or hanger means opening in the block; and the plate is provided with lugs or ears integral therewith and extending outwardly from the main plane of the plate. These lugs underlie the upper surface of the socket opening or are contiguous with that surface, and ensure thereby that the bricks will not slip out of the case or roof structure, as will be further explained. Preferably, the lugs or projections underlie at least a major portion of the width of such upper surface.

In an especially advantageous embodiment of this invention there is provided a composite block for use in a suspended furnace roof which comprises a pair of refractory bricks disposed vertically and encased on at least three sides by a plate or plates of an oxidizable metal, preferably ferrous metal, and being provided with a hanger socket. Between the adjacent surfaces of the brick is disposed a metal plate as described above, the aperture of the plate registering with the refractory socket opening, and the lugs lie adjacent the top surface of that opening and fit snugly against it. The outer metal casing is affixed to the bricks in any desired manner, for example, by springing the sides of a U-shaped channel against the bricks when a 3-sided casing is employed, or by affixing the casings to the bricks by placing an adhesive between the casings and the bricks, by welding the parts of the cases together, or by molding the brick mix and internal plate, and, if desired, the outer casing, in a single pressing operation in the known manner.

In assembling a pair of bricks with the metal plate disposed therebetween, the plate is glued or adhesively attached to one brick or, if desired, for example in a unit cased article as described above, to both brick faces. Alternatively, the metal plate is provided with top flanges which rest upon the upper surface of each brick when the plate is in position and holds it in place until a fired bond is formed. In another mode of carrying out the invention the internal plate or diaphragm can be molded in place while pressing or casting the refractory block or bricks, and in such operation the main body of the plate is advantageously provided with ears or apertures to assist in fixing the plate to the refractory mix. The internal plate extends over a major portion of the abutting faces of the bricks or brick portions and, in a preferred embodiment, over substantially the entire surfaces of such faces. The plate can be disposed between two hanger brick in a suspended roof, neither brick being metal cased or only one of the brick being metal cased, and the advantages of the invention are also obtained. The metal plate in such roof construction prevents the brick from slipping and falling out of the roof because an adjacent brick cooperates to prevent the brick from tilting away from the lugs. Thus, it is sometimes advantageous to hang an uncased article adjacent a cased article and so on throughout the roof, in order to have only one thickness of metal between articles.

Some embodiments of this invention are shown in the accompanying drawings wherein:

Fig. 1 is a perspective view of a refractory block article comprising a pair of non-acid refractory bricks, metal-encased on four sides and having a metal divider plate according to the invention disposed between the bricks;

Fig. 2 is a perspective view of a metal divider plate according to the invention;

Fig. 3 is a perspective view of another refractory block article of this invention, wherein the metal divider plate is sustained by two flanges resting upon the top surfaces of each refractory brick;

Fig. 4 is a top view showing an embodiment wherein a suspended furnace roof structure is composed of alternate metal cased units and uncased units;

Fig. 5 is a front view of an assembly according to the invention, the bricks being not metal-encased;

Fig. 6 is a cross-sectional view of a pair of block assemblies or articles according to this invention and showing the supplement of a hanger therebetween in forming a suspended roof;

Fig. 7 is a front view of a brick assembly showing a section of the hanger foot as in place in use in a suspended furnace roof;

Fig. 8 is a perspective view of another embodiment of a metal plate according to the invention;

Fig. 9 is a perspective view of a further embodiment of a metal plate according to the invention.

Referring to Figure 1 of the drawings, **10** and **11** are in this embodiment basic bricks, and **12** and **13** are steel plates enclosing the pair of bricks on the four sides. The steel faces are composed of two channels or U-shaped plates, one plate being plate **12**, the web of which is parallel to the abutting faces of the bricks and the arms of which extend over parallel faces of brick **10** and partly over parallel faces of brick **11**. The other channel plate, **13**, is so disposed that its web is parallel also to the abutting faces of the bricks, and its arms extend a short distance across parallel faces of brick **11** toward U-plate **12** arms in such manner as to provide a substantially continuous metal case for the sides of the bricks, although it will be understood that a small opening is generally provided between the plate arms to allow for variations in size during applications of the plates to the bricks, or for expansion during heating, or the like. The bricks are so formed as to provide a common socket opening **14** to receive the hanger when the brick assembly is placed in a furnace roof.

The socket opening comprises an upper recessed portion **15** to accommodate the leg or stem of a suspension device, and lower recessed portion **16** to receive the foot of the suspension device, a suitable hanger device being illustrated in section in Figure 6. The lower recessed portion **16** is provided with upper surfaces **17** and lower surface **18**.

Between the abutting or facing surfaces of bricks **10** and **11** is disposed divider plate **19**, which is more clearly shown in Figure 2. The top of plate **19** is recessed at **20** to conform to upper recessed portion **15** of the block assembly and is recessed at **21** to conform to the lower recess or hanger foot-receiving portion **16** of the block assembly. At the upper edge of the recess **21** are disposed two projections or lugs **22** and **23** which extend perpendicularly to the main plane of the plate and oppositely from each other. As shown more clearly in Figure 5, these lugs underlie or are adjacent to the upper surface **17** of recess **16**. Most advantageously, the projections extend across substantially the whole width of the surface **17**, but are also effective when they extend over at least about one-third of this width. The projections ensure that a small hanger foot, for example, one whereof the diameter is equal to one-half or less than one-half the width of the upper surface of recess **16**, will support both bricks, and this occurs even if the hanger foot is displaced to the side of the opening, i.e. away from the center line of the plate or of the recess, because the weight of the brick is distributed over the projections **22** and **23**.

In the embodiment of Figure 1, the block assembly or article also includes a metal case as described above, and in this embodiment the portions of the case are attached or affixed to the bricks by means of a rubbery adhesive disposed between the bricks and the metal, as at **24**. Also, plate **19** is affixed or attached to at least one and preferably both plates by a like adhesive or by an animal glue, as at **25**. The metal cases are alternatively attached to the bricks in any other desired manner, for example, by springing U-cases on to the bricks, i.e. in a method wherein the side arms are deflected slightly inwardly and then the bricks are placed therein and the arms press against the bricks. Such an article is shown in Figure 3. Also, in still another embodiment, the case comprises a U-shaped channel whereof the web is disposed parallel to the interior plate or diaphragm and the arms extend over the sides of the bricks extending in the same plane, and a plane plate affixed to the fourth side of the article, the channel and plate being attached also by means of an adhesive of any desired type.

In the article of Figure 3, there are provided two basic brick **10** and **11** which are encased by U-shaped or channel casing **26** held by springing engagement with the sides of the bricks. Between the facing surfaces of the bricks is disposed metal plate or diaphragm **27** having projections **22** and **23** adjacent the upper surface of a socket opening **16**. The plate **27** is provided with flanges **28** and **35** which rest upon the upper surfaces of each brick and maintain the plate in position between the bricks so that it does not slip down in handling or suspending the article. The projections prevent movement of the plate upwardly if it is up-ended or inverted in handling or for any reason.

Figure 5 shows a front view of an article according to the invention. In the article of this example, the interior plate or diaphragm **19** is like that of Figure 1 and is attached to both bricks by interposition of an adhesive **29**. The cross-sections of the plate and adhesive are exaggerated to show the structure more clearly. In this example, the adhesive is disposed over the entire face at each side of the plate, but less coverage is employed, if desired. No outer casing is provided with the article of this example.

Figure 4 shows a top view of a suspended furnace roof structure arrangement according to the invention, wherein there are alternately disposed articles not having metal cases, whereby the roof structure exhibits only one layer of metal between refractory bricks or blocks, the hanger devices not being shown. The uncased blocks in this structure are suitably made as described with reference to Figure 5. Alternatively, however, there are employed cased or uncased single bricks of suitable shape, and these are placed in the roof with simultaneous placement of a plate according to the invention, the plate being disposed between paired blocks or bricks. Thus, in Figure 4 there are shown paired bricks **10'** and **11'** which are not encased in metal and which are placed in the furnace roof independently with plate **19'** disposed between them, the plate being provided with flanges **28'** and **35'** which rests in this instance on the top surfaces of bricks **10'** and **11'**. In the completed structure, bricks **10'** and **11'** are in stable suspension in the roof being supported by the projections **22'** and **23'** of plate **19'** and laterally by adjacent brick assemblies or articles as shown.

Figure 6 demonstrates the placement of block articles upon a suitable hanger comprising stem **32** and foot portions **30** and **30*a***; and shows further the supporting of the blocks by the hanger by way of projections **22** and **22*a***, the plate **19** shown in the other figures being cut away in this view. Bricks **10** and **10*a*** are provided with hanger foot-receiving recesses **16** and **16*a***; and projections **22** and **22*a*** underlie the upper surfaces of these recesses, respectively. Hanger foot portions **30** and **30*a*** in turn lie beneath and adjacent the projections, respec-

tively, and support the respective bricks and projections. Brick 10 also carries metal case 31.

Figure 7 is a front view of a block composed of bricks 10 and 11, and plate 19 disposed therebetween and having projections 22 and 23, lying adjacent upper surface 17 of recess 16 as previously described. Hanger foot 30 is disposed in recess 16, the stem of the hanger being cut away in this view. As here shown, foot 30 supports the block at substantially the center of upper surface 17, the recess being located suitably at the central portion of the upper side face of the block. In this illustrated example, foot 30 is of diameter slightly less than one-half the width of upper surface 17, or of the distance from the center line of plate 19 to side wall 31 of recess 16. In the event that the block articles slide to one side or the other in hanging or that the hanger twists or becomes displaced from one side to the other, the block is still firmly held by projections 22 or 23.

Figures 2, 8 and 9 show some embodiments of the metal plate or diaphragm according to this invention. In these illustrations a plate 19, which is made of any oxidizable metal such as iron, nickel, aluminum or other metal, but preferably of a ferrous metal such as iron or steel, is cut away or recessed as at 20 and 21 to conform to the shape of a hanger-receiving socket in a refractory article. In Figures 2 and 8, projections or lugs 22 and 23 are provided at an edge of recess 21 and extend oppositely from each other, that is, on opposite sides of the plate and preferably, substantially perpendicularly to the plate. In Figs. 2 and 8 the lugs extend outwardly from the top edge of the aperture in the plate and, when in place, lie with their upper faces adjacent to the upper surface of the hanger-receiving socket in the bricks. In Fig. 9, the lugs or projections 36 and 37 extend outwardly at the rear edge of the plate aperture, and the upper edge of each projection is adjacent the upper surface of the brick socket, projection 37 being made in a simple fashion by cutting the metal to form a rectangular piece attached to the plate at the rear of the aperture and the remaining L-shaped portion 36 of the metal piece forming the other projection. In this embodiment, especially, the projections may, if desired, extend at an angle less than a right angle to the main plane of the plate. The projections 22 and 23 are preferably made by suitably cutting and bending a small portion of the plate to form a right angle with the main plane of the plate. Alternatively, metal projections are welded on, riveted or fixedly attached to the plate by any other desired means. In an alternative embodiment, projections are also provided at the lower edge of recess 21, and these latter projections 33, 34 act in cooperation with upper projections 22, 23 to prevent relative up or down motion of the bricks with which the plate is assembled, according to the invention. As shown in Fig. 3, relative motion of the bricks is also prevented by providing the plate 19 alternatively with a flange 28, and flange 35.

It is an advantage of this invention that the block article is maintained in stable suspension in a roof structure. It is a further advantage that an improved roof structure is provided. It is a still further advantage that pre-formed brick of desired high pressed density can be employed in making the block article herein defined. It is another advantage that a strong, stable block article can be made, shipped, handled and installed with minimum danger of failure by slippage of either the plate or a brick. It is a still further advantage that in use in a furnace roof and after the fired bond is formed in the known way between the plate and the bricks toward the hot face of the block, the block is still firmly supported by means of projections, such as 22, 23, even though there occurs a cracking or failure of the refractory material lying above the socket. Basic or neutral refractory bricks, for example, of periclase, periclase-chrome, chrome-periclase, chromite or of other basic or neutral refractory composition are particularly useful in this article. In applying the glue or rubbery adhesive between the casing or the metal plate and a brick face, it is usually sufficient to apply adhesive material to a small area only. However, if desired, the adhesive can be applied over the whole of the abutting areas of the metal and the brick. In a preferred embodiment, the lugs or projections extend over or are adjacent to or contiguous with at least one-half portion of the width of the upper surface of the hanger-receiving recess; and still more advantageously, they extend over substantially the entire width of such upper surface. The bricks employed can be burned or unburned, that is, chemically bonded. The articles are arranged lengthwise and side by side when in place in a roof and two bricks are similarly disposed in a metal case. The upper or cold end is that end closest to the furnace roof and farthest from the furnace chamber, while the lower end conversely is toward the furnace chamber and during operation is likewise termed the hot end.

The composite article can be cased on four or fewer sides, for example, on two sides; or if desired, a metal plate can be applied to one side only. The two-sided casing is sometimes advantageous in installing the article in a furnace roof to provide a single layer of metal between refractory pieces.

Having now described the invention, what is claimed is:

1. A composite block for use in a suspended furnace roof and having a common hanger-receiving socket at an upper side face thereof, comprising a pair of basic refractory bricks, each of said bricks having a recess adjacent an upper corner thereof whereby when said bricks are assembled said recesses form said common socket adapted to receive one foot of a hanger means, a metal dividing plate extending the length of said bricks and disposed therebetween, said plate having an aperture registering with said socket, a pair of lugs integral with said plate and extending perpendicularly therefrom and oppositely to each other at the upper edge of said aperture to reinforce said socket and to maintain said bricks on said hanger foot, each one of said lugs extending across substantially the whole width of the upper surface of each said recess and engaging said upper surface, a metal case substantially encasing the four side faces of said composite block, and a rubbery adhesive disposed between said metal plate and said bricks and between said metal case and said block.

2. A composite block for use in a suspended furnace roof and having a common hanger-receiivng socket at an upper side face thereof, comprising a pair of basic refractory bricks, each of said bricks having a recess adjacent an upper corner thereof whereby when said bricks are assembled said recesses form said common socket adapted to receive one foot of hanger means, a metal dividing plate extending the length of said bricks and disposed therebetween, said plate having an aperture registering with said socket, a pair of lugs integral with said plate and extending perpendicularly therefrom oppositely to each other, each one of said lugs extending across at least one-third of the width of the upper surface of one said recess and engaging said upper surface, to reinforce said socket and maintain said block on said hanger foot, and a metal case substantially encasing the four side faces of said block.

3. A composite block for use in a suspended furnace roof and having a common hanger-receiving socket at an upper side face thereof, comprising a pair of basic refractory bricks, each of said bricks having a recess adjacent an upper corner thereof whereby when said bricks are assembled said recesses form said common socket adapted to receive one foot of a hanger means, a metal dividing plate extending the length of said bricks and disposed therebetween, said plate having an aperture registering with said socket, a pair of lugs integral with said plate and extending perpendicularly therefrom and oppositely to each other at the upper edge of said aperture to reinforce said socket and to maintain said bricks on

said hanger foot, each one of said lugs extending across at least one-third of the width of the upper surface of one said recess and engaging said upper surface, and a metal case substantially encasing the four side faces of said block and holding said block together.

4. A composite block for use in suspended furnace roofs and having a common hanger-receiving socket at an upper side face thereof, comprising a pair of basic refractory bricks, each of said bricks having a recess adjacent an upper corner thereof whereby when said pair of bricks is assembled said recesses form said common socket adapted to receive one foot of a hanger means, a metal dividing plate extending a major portion of the length of the bricks and disposed therebetween and having an aperture registering with said socket, a first pair of lugs integral with said plate and extending perpendicularly therefrom oppositely to each other at the upper edge of said aperture to reinforce said socket and to maintain said bricks on said hanger foot, each one of said lugs extending across at least one-third of the whole width of the upper surface of said recess and engaging said upper surface, a second pair of lugs integral with said plate, and extending perpendicularly therefrom oppositely to each other, one of each said second pair of lugs extending across the lower surface of each said recess to prevent relative up and down motion of the bricks when assembled, and a metal case substantially encasing the four side faces of said composite block.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,960,048 November 15, 1960

William F. Garretts

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 23, for "e.q." read -- e.g. --; line 51, for "wihch" read -- which --; column 3, line 20, for "supplement" read -- placement --; line 32, for "faces" read -- plates --; column 6, line 47, for "receiivng" read -- receiving --.

Signed and sealed this 12th day of September 1961.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents

USCOMM-DC