United States Patent [19]

Wilce

[11] **3,854,256**

[45] **Dec. 17, 1974**

[54] **FABRICATION OF FURNACE LININGS WITH SUPPORT FRAME**

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[22] Filed: **Jan. 7, 1974**

[21] Appl. No.: **431,213**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 255,188, May 19, 1972, abandoned.

[52] **U.S. Cl.** ..... **52/122,** 52/127, 52/227, 52/561, 52/608, 52/747, 294/61 R, 294/81 R

[51] **Int. Cl.** **E04c 3/22**

[58] **Field of Search** ..... 52/122, 743, 127, 745, 52/566, 747, 143, 227, 561, 228, 608; 110/1 A; 294/61 R, 81 R, 81 SF, 67 R

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927,182	5/1963	Great Britain	52/227

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[57] **ABSTRACT**

A unit including part of a refractory lining of a furnace, suitable for assembly off-site and transportation to its intended location. The unit includes a support frame from which a cluster of refractory blocks is suspended by vertical load bearing rods.

6 Claims, 5 Drawing Figures

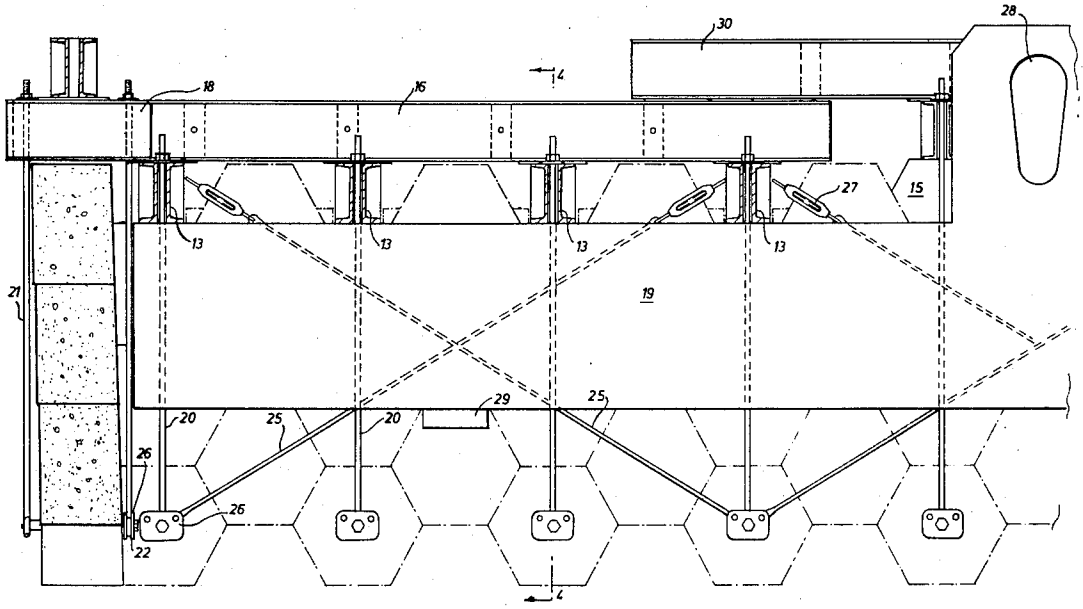
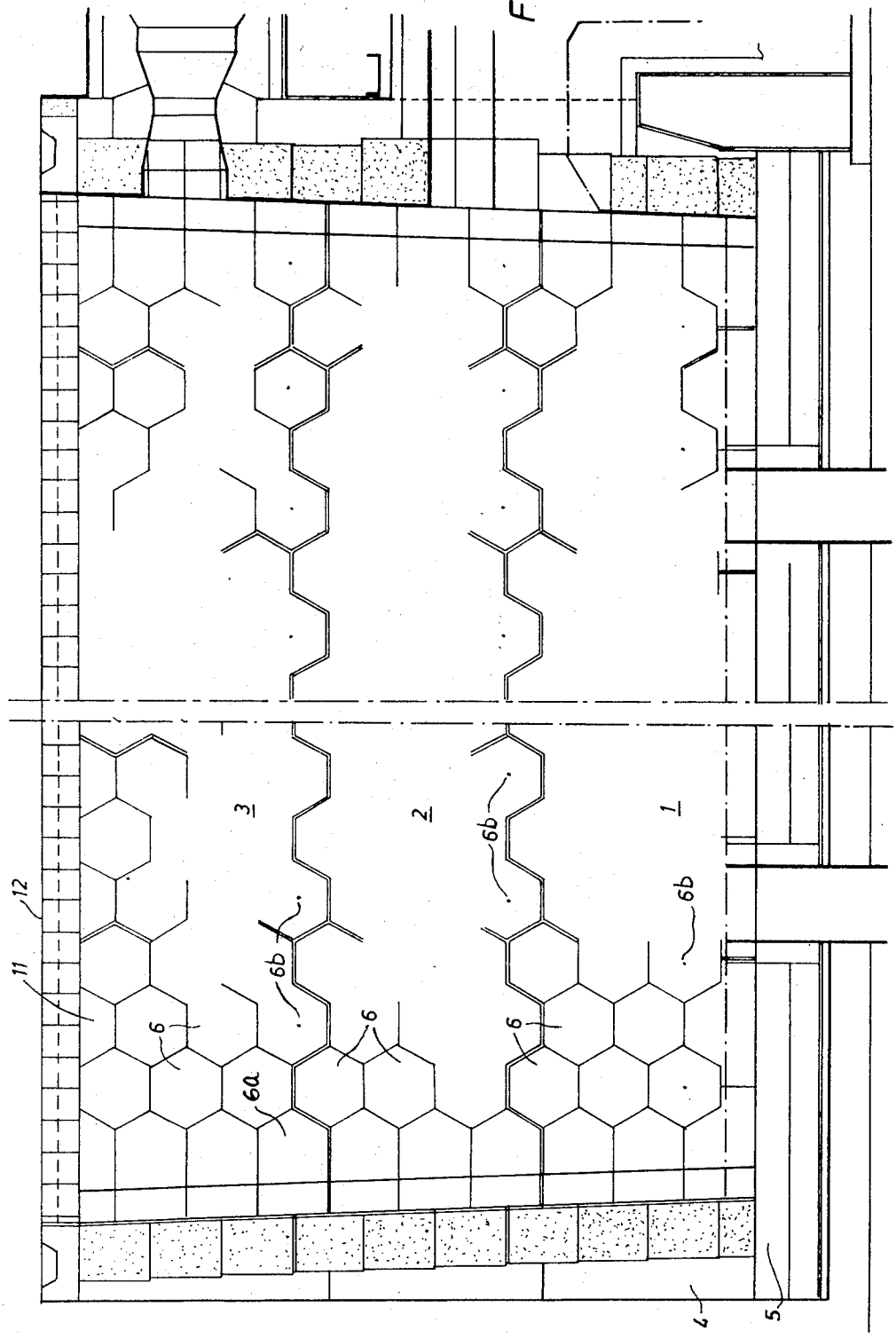


FIG.1.



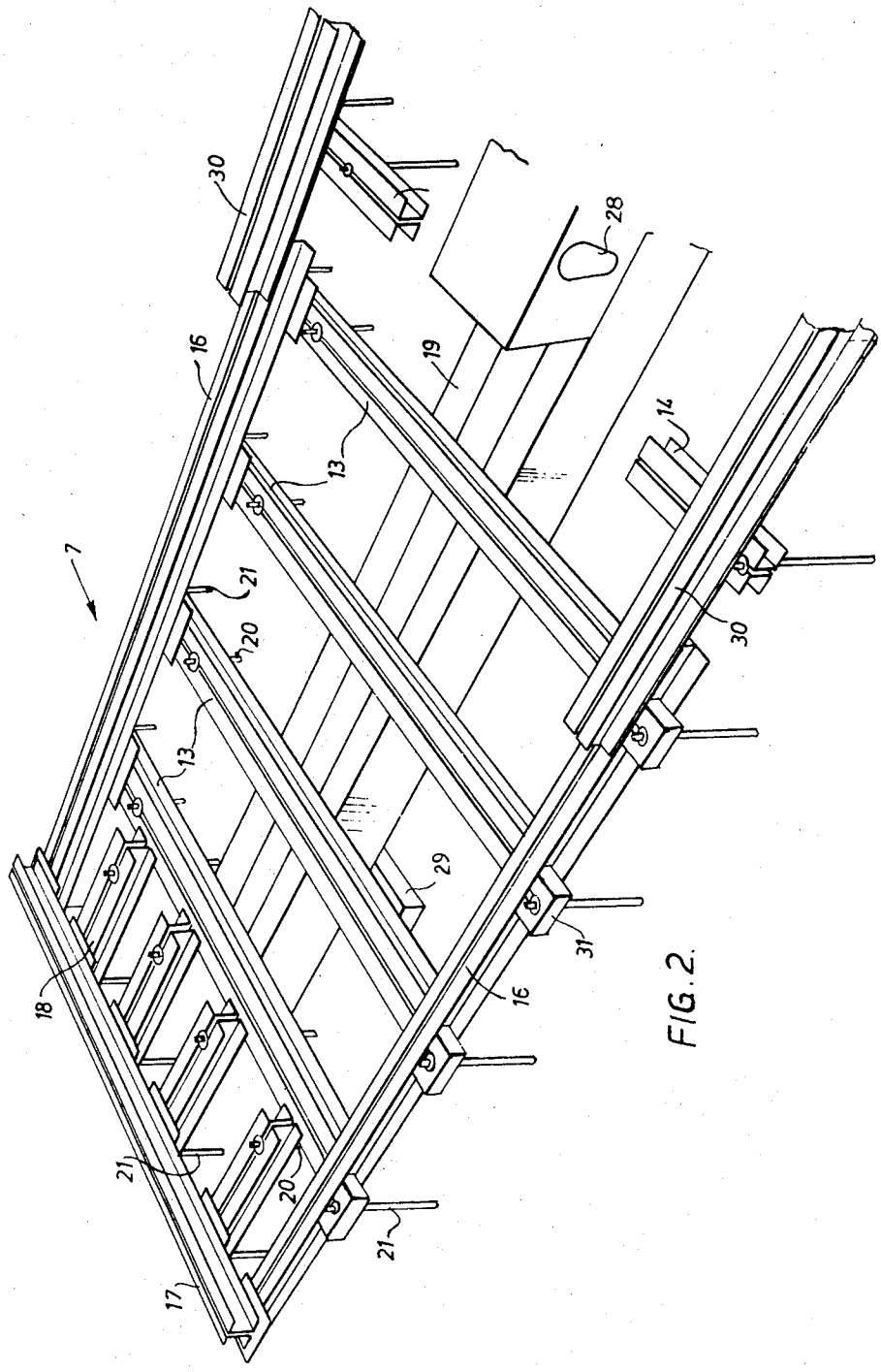


FIG. 2.

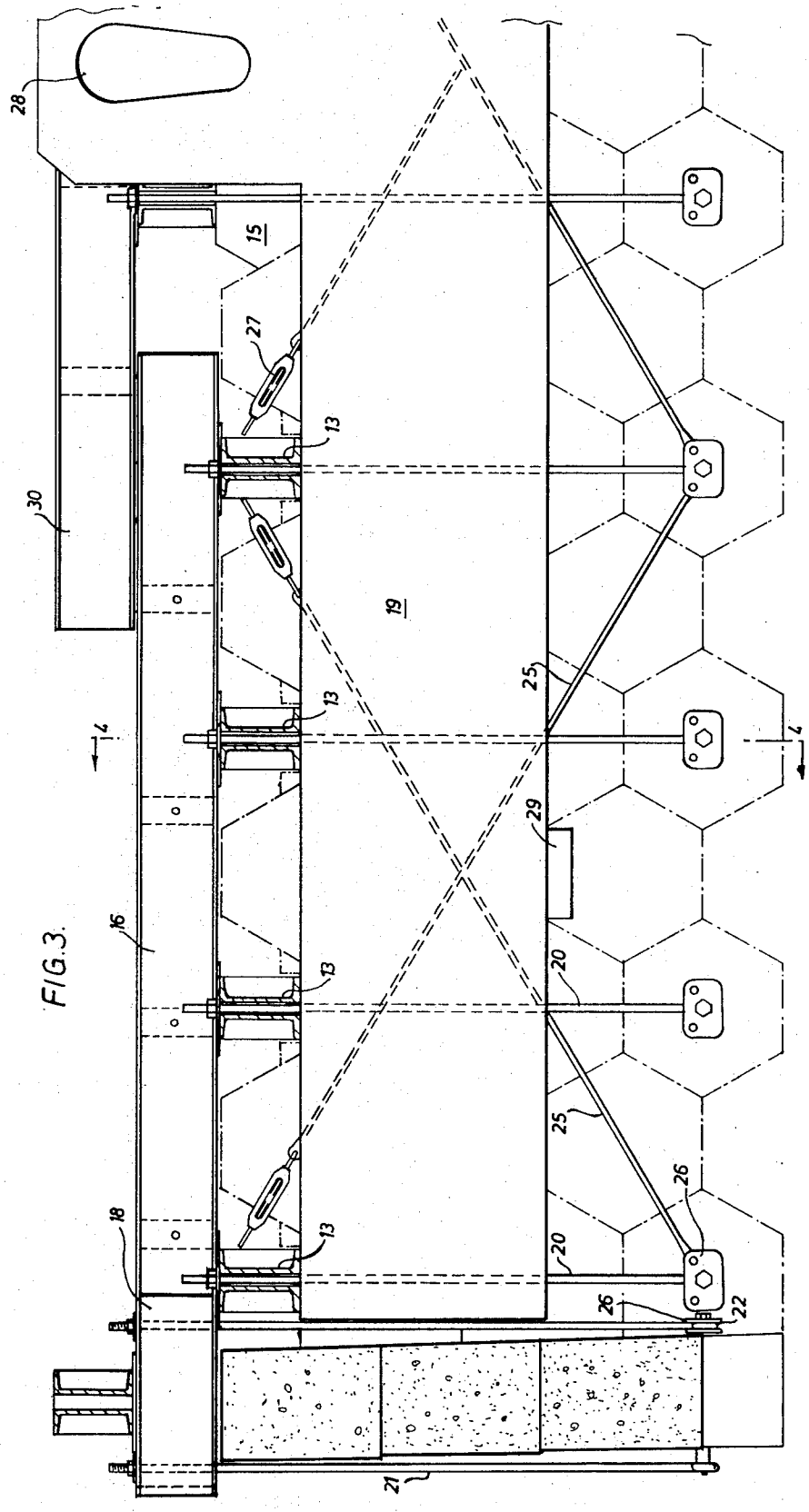


FIG.3.

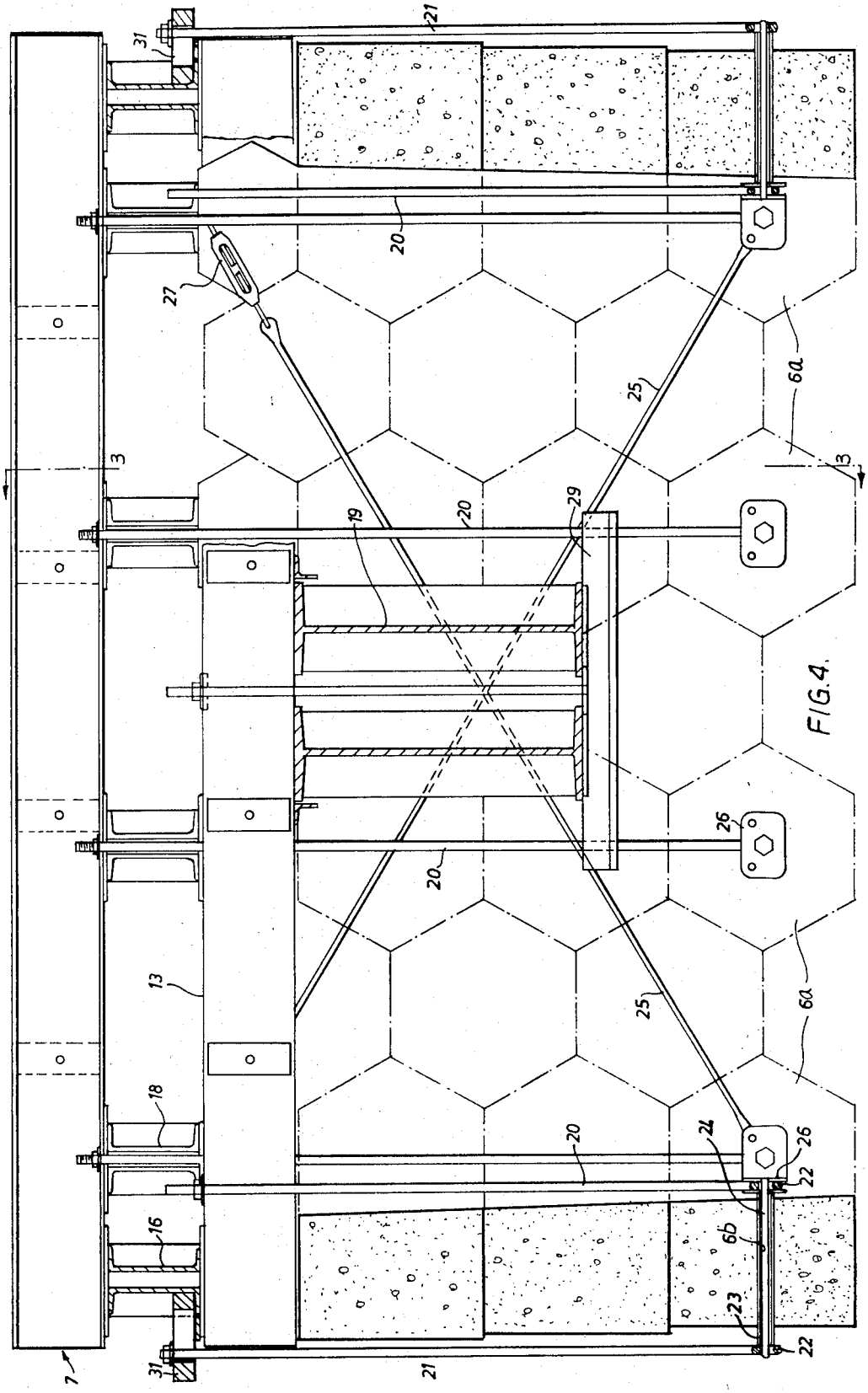


FIG.4.

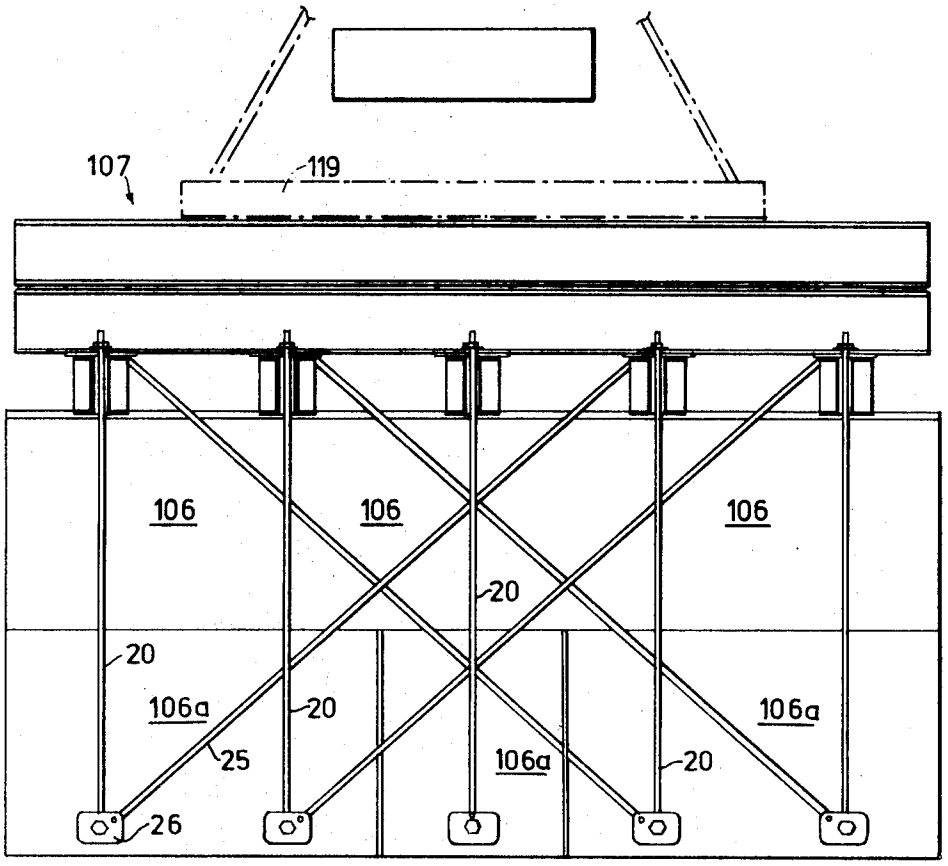


FIG.5.

FABRICATION OF FURNACE LININGS WITH SUPPORT FRAME

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part application of my application Ser. No. 255,188 filed May 19, 1972 and now abandoned.

BACKGROUND OF THE INVENTION

The linings of certain industrial furnaces consists of separate refractory blocks which, conventionally, are laid individually in place within the furnace casing. This time consuming procedure inevitably results in long periods during which a furnnace must be taken out of commission while renovation work is carried out. Proposals have been made to speed-up the fabrication of various structures, including furnace linings, by handling groups of bricks in the form of pre-assembled units. One such proposal is contained in British Pat. No. 927,182 (General Refrectories) in which some of the pre-assembled bricks are pierced with vertically extending bores through which pass tie bars. The tie bars emerge in longitudinally recessed edges of the bricks in the outermost courses and have their ends received within metal bonding strips located in the recesses. This form of pre-assembly leads to a number of problems. In the first place, metal inserts must be provided beneath the lowest course of bricks in order to provide support for the assembly. This arrangement becomes impracticable if, as in accordance with the present invention, it is desired to build up the lining by depositing a number of pre-assembled units upon one another — especially if hexagonal blocks are to be used instead of rectangular bricks. Secondly, the arrangement as disclosed in British Pat. No. 927,182 is only practicable with relatively light units formed from interlocking refractory bricks. If a unit is to be assembled from substantially heavier, non-interlocking refractory blocks, each and every vertical row or blocks must have at least one tie bar to support it so that as a result every block in the assembly is pierced by one or more vertical bores. Experience gained while attempting to assemble furnace linings using blocks with such vertical bores has taught that these bores seriously weaken the blocks. In consequence, the blocks may crack after repeated exposure to temperature fluctuations. This problem is aggravated if attempts are made to increase the stability of the assembly by tensioning the assembly diagonally, because further bores must be formed in at least some of the blocks. In my British Pat. No. 1,121,991 I propose that hexagonal blocks should have three bores arranged in a vertical plane so that a tensioned assembly might be produced, although not with the intention of lifting the assembly. Blocks of this design were found to crack in use.

In British Pat. No. 985,915 (Hinse), there is a proposal to support a pre-assembled unit by means of a support bar which extends beneath the unit, longitudinally thereof, and which is supported at each end by ropes. At first sight, this proposal may seem to offer a solution to the problem. However, the arrangement of the supporting ropes cannot provide the unit with adequate support when the unit is assembled from refractory blocks, it is impossible to tension the unit adequately in the longitudinal direction so as to prevent it breaking up should one of the ropes break, the unit cannot be lowered into position satisfactorily within a furnace and, finally, it is impossible to make use of blocks having a standard external shape.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a pre-assembled unit including a plurality or cluster of refractory blocks and which enables furnace lining fabrication to be speeded-up, but which allows blocks to be used which have not been weakened to an undesirable extent by bores passing through them.

A further object of the invention is to provide a unit of this type which forms a rigid structure so that the blocks do not work loose during transportation and so that there is no risk of the unit falling apart should one of the ropes suspending the unit snap during transportation.

A further object of the invention is to provide a unit which may be of considerable weight and which is adapted to be lowered into place upon a cluster of blocks previously placed in position.

A further object of the invention is to provide a unit from which the parts used to support the blocks may be removed without difficulty, to leave in place the cluster of blocks alone.

According to the invention, at least some of the lowest blocks of the cluster have horizontal bores which pass through from their front to their back faces. This disposition of the bores is in contradistinction to the known constructions in which the bores extend vertically or inclinedly through the blocks. This novel arrangement of the bores does not result in serious weaknesses within the blocks, and furthermore, it is only the lowest blocks which need to be formed with bores in this way.

If rectangular blocks are employed, each of the lowest blocks has at least one bore, but, if hexagonal blocks are used, it is necessary only for every other lowest block to have a bore.

Through each of the bores extends a pin which is connected at each end to the lower ends of a pair of vertically extending load-bearing members. The upper ends of these members are secured to a support member or frame. The assembly is tensioned horizontally by wire ropes strung between the lower ends of the load-bearing members and the support member or frame.

To instal the cluster of blocks, lifting means are engaged with the support member or frame and raise the unit with the load-bearing members in tension. The unit is transported to its intended location and place in position, whereafter the load-bearing members, pins and wire ropes are removed to leave the cluster of blocks in position.

The cluster of blocks may form substantially the whole of the structure to be fabricated or part thereof. In the latter case, the cluster may form one or more walls of the structure or a part of a wall. Alternatively, and more preferably, the cluster forms a section of the structure of part of the structure considered in a vertical sense, so that the structure is assembled by stacking a number of clusters one on top of another.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a diagrammatically vertical section through a soaking pit having a lining constructed using units in accordance with the invention;

FIG. 2 is a perspective overhead view of one half of a lifting bridle showing the upper end of the lifting rods,

FIG. 3 is a section on the line 3—3 of FIG. 4 of a unit according to the invention;

FIG. 4 is a section on the line 4—4 of FIG. 3; and

FIG. 5 is an elevation of a different embodiment of unit.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring to FIG. 1 of the drawings, the lining of a soaking pit furnace is supported within a casing 4 and is supported upon a prepared base 5. The lining is made up from separate, hexagonal blocks 6 and can be regarded as being divided into three superposed sections 1, 2 and 3, each section being made up from a number of rows of blocks that have horizontally extending centre lines. Each of the blocks 6*a* in the lowest horizontal row of hexagonal blocks in each section has a horizontal bore 6*b* which extends through the block from its front surface to its back surface and is generally perpendicular to the centre line of the lowest row of blocks.

To construct the lining, the sections are assembled separately as cluster of blocks, with or without mortar, one after the other on a site some distance from the furnace. When the first unit (that is, the unit which will form Section 1 of the lining) has been made ready, a lifting bridle is positioned upon the upper row of blocks as shown in FIGS. 3 and 4.

The arrangement of the lifting bridle is shown more clearly in FIG. 2 where it can be seen to consist of a plurality of beams of I section each constituted by two channel sections bolted together at a small distance apart. More specifically, each half of the overall frame consists of four long transverse beams 13 which rest on the opposite longitudinal walls on the upper sides of the blocks in the second highest row of hexagonal blocks (FIG. 3). A pair of long beams 16 extend longitudinally one above each longitudinal wall, and are bolted to the transverse beams 13. A long transverse beam 17 at the end of the bridle is bolted to the beams 16. Short longitudinal beams 18 are bolted onto the underside of the transverse beam 17. A pair of main longitudinal beams 30 extend parallel to and above the beams 16 and have bolted beneath them two aligned short transverse beams 14 which are on the same level as the beams 16 and bear on dummy blocks 15 (FIG. 3). A lifting frame 19 is disposed within the unit and is connected to the transverse beams 13.

A number of mild steel lifting rods 20, 21 which are threaded at their upper ends and receive units so as to secure them to the lifting bridle one on each side of each vertical row of blocks in which is to be found one of the lowest blocks 6*a*. The rods 20 are positioned within the unit and pass through the space between the channels sections making up the beams 13, 14 and 18. The rods 21 are positioned outside the unit and, in the case of the short beams 14 and 18, are secured to the beams in the same manner as the rods 20. In the case of the long beams 13, however, the rods 21 are secured not to the beams themselves but to extension pieces 31 secured to the beams seen more clearly in FIG. 4. In other embodiments in which the blocks do not have the stepped relationship shown in FIG. 4, the rods 21 may, like the rods 20, be secured to the beams 13. The rods have eyes 22 at their lower ends, which eyes are brought into alignment with the bores 6*b* by adjusting the nuts at the upper ends of the rods. Spacers 23 are inserted in the bores and hold the lower ends of the rods at a desired distance apart and bolts 24 are passed through the eyes and spacers to secure the rods to the blocks 6*a*. Wire ropes 25 are strung between the lifting bridle and certain of the blocks 6*a*, the inner rods 20 having attachment plates 26 to which the wire ropes are connected. Turnbuckles 27 allow the tension in the wire ropes to be adjusted.

Each unit may weigh in the region of 60 tons and after assembly and connection to its bridle is raised by means of a crane which is connnected at 28 and 29 to the lifting frame.

Those skilled in the art will appreciate that when the bridle is suspended from a crane, the tendency of the beams to deflect will result in variations in the forces applied by the cluster of blocks to the various lifting rods. To ensure that the cluster of blocks is held tightly together during transportation and, in particular, to prevent the cluster braking up should one of the several ropes suspensing the unit from the crane snap, the lifting rods are pre-tensioned by tightening the nuts at their upper ends. A torque spanner is used for this purpose to ensure that the tension appplied to the rods is great enough for there to be sufficient residual tension in all of the rods when the unit is suspended. When the rods have been tensioned, the wire ropes are tensioned so as to apply forces holding the cluster together laterally.

Each unit is built up in turn, lifting and transported to the furnace bay and lowered into the casing. The connection bolts, rods, wire ropes, lifting frame and bridle are removed and returned to the pre-assembly site where another unit is being made ready. The design used for the connection bolts and lifting rods makes possible the easy and complete removal of all ancillary equipment.

Meanwhile, certain blocks in the cluster just placed in position are anchored back to the casing and the whole section back-filled between the casing and the back faces of the blocks with insulating concrete. When the upper cluster has been positioned, the half hexagon blocks 11 and sand seal blocks 12 are laid individually.

The unit described above has the advantage that it can be introduced into the furnace casing and form a complete section of the lining. To make use of this unit, space must be reserved for the assembly of the unit relatively near the furnace in question. This space may not always be available and, accordingly, the invention may instead be performed using a cluster of blocks which make up one wall or part of one wall of the furnace lining. FIG. 5 shows an embodiment of this type in which rectangular blocks 106 are employed. The blocks 106*a* in the lower row have bores to permit the application of spacers 23, bolts 24, rods 20, 21 and wire ropes 25 in accordance with the first embodiment. It will be noticed that the lower horizontal row of blocks consists of three blocks, namely a narrow block flanked by two wider blocks to each of which two pairs of lifting rods are applied. The upper row also consists of three blocks, namely a wide block flanked by two three quarter size blocks.

The rods and wire ropes are connected up to a bridle 107 to which a lifting frame 119 can be applied from above. The lifting frame is adapted to be suspended

from a crane. The lifting frame is adapted to be suspended from a crane. The bridle is, of course, much simpler than that shown in FIGS. **2** to **4** since the cluster of blocks makes up but a single wall of the furnace lining.

The unit shown in FIG. **5** may weigh up to 13 tons and may be constructed at a considerable distance from the furnace. When it has been constructed, it is raised by a crane onto a vehicle, such as a low loader, and transported in this way to the vicinity of the furnace, there it is raised from the low loader and lowered into the furnace casing as described in connection with the first embodiment.

I claim:

1. A unit for use in the fabrication of furnaces, comprising in combination:

a. a cluster of refractory blocks, said cluster comprising a lower row of blocks having a generally horizontal centre line and an upper row of blocks located above the lower row of blocks, each of at least some of the blocks in the lower row having therein at least one bore that extends through the block from the front to the back face of the block in a horizontal direction generally perpendicular to the centre line of the lower row of blocks,

b. a support frame resting upon the upper row of blocks,

c. a connecting element extending through each of said bores, each said element having a first portion, projecting beyond the front face and a second portion projecting beyond the back face of the block through which said bore passes,

d. a pair of vertically extending load bearing members associated with each connecting element, one of said members being connected to said first portion and the other being connected to the second portion of the element, the upper ends of the members being secured to the support frame,

e. wire ropes strung obliquely from the support frame to the points of connection of at least some of the load bearing members and connecting elements, the wire ropes being under sufficient tension to apply a force to hold the cluster of blocks together laterally.

2. A unit as claimed in claim **1,** wherein the lifting members are constituted by rods having upper ends provided with screw threads, the support frame having openings therein through which the said upper ends of the rods pass, and nuts screwed onto the said upper ends of the rods so as to apply to the rods a predetermined tension.

3. A unit as claimed in claim **1,** wherein each of said connecting members is in the form of a bolt which passes through a spacer member disposed in said bore, and the lifting members are in the form of rods having at their lower end eyes through which the bolt passes.

4. A unit as claimed in claim **3,** wherein the bolts pass through plates adjacent the front faces of the blocks, to which plates the wire ropes are connected.

5. A unit as claimed in claim **1,** wherein between the upper and lower rows of blocks there is at least one intermediate row of blocks.

6. A unit as claimed in claim **5,** wherein the blocks are hexagonal blocks, every other one of which blocks in the lower row has a bore therethrough.

* * * * *