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[33] **Great Britain**
[31] **13,857/69**

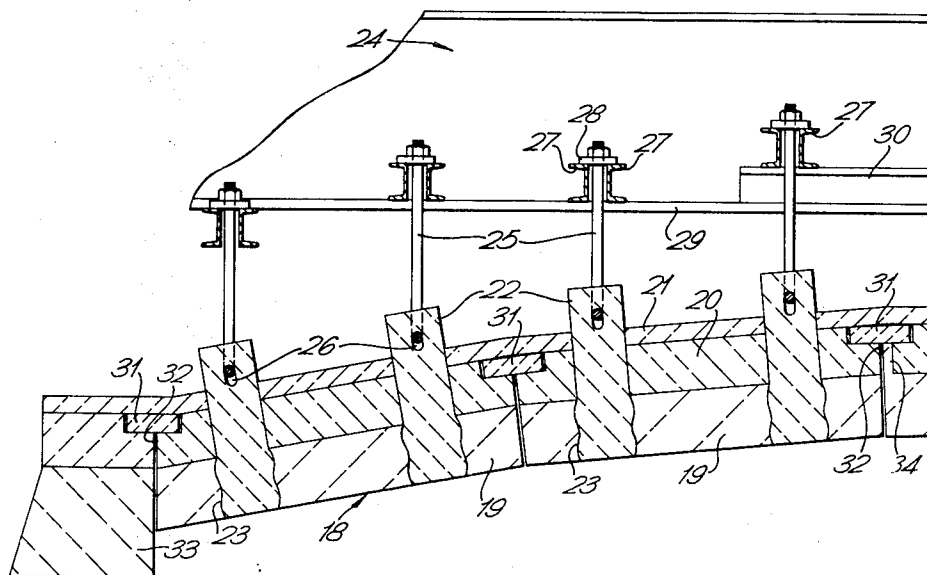
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[54] **SUSPENDED ROOF FOR HIGH-TEMPERATURE INDUSTRIAL FURNACES**
8 Claims, 10 Drawing Figs.

[52] U.S. Cl. **110/99 R**
[51] Int. Cl. **F23m 5/02**
[50] Field of Search **110/1 A, 99 R**

ABSTRACT: A roof structure primarily for a regenerative glass furnace comprising a plurality of monolithic facing blocks suspended from a support structure via ceramic anchor tiles formed integral with said facing blocks, said facing blocks being backed up by high and low temperature layers of insulating material. Expansion gaps are provided between said facing blocks and these are closed by filler tiles positioned in one of said insulation layers.



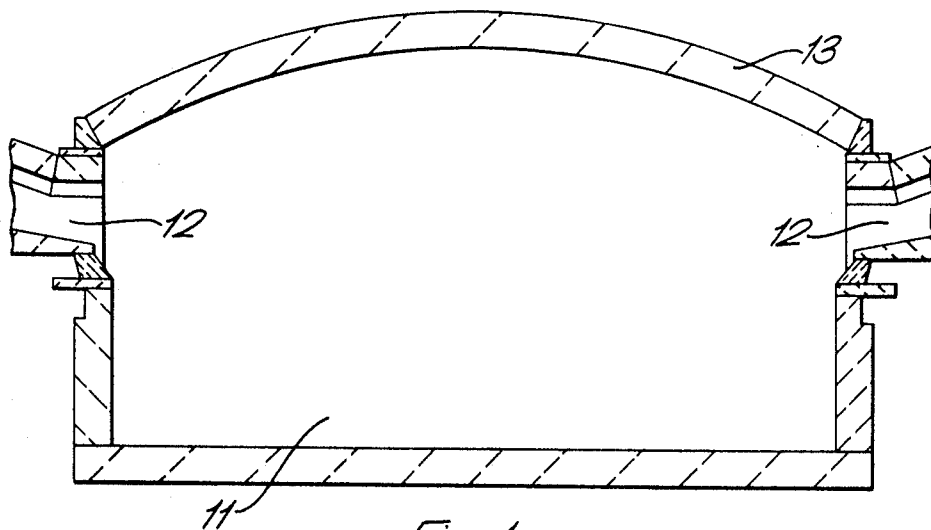


Fig. 1.

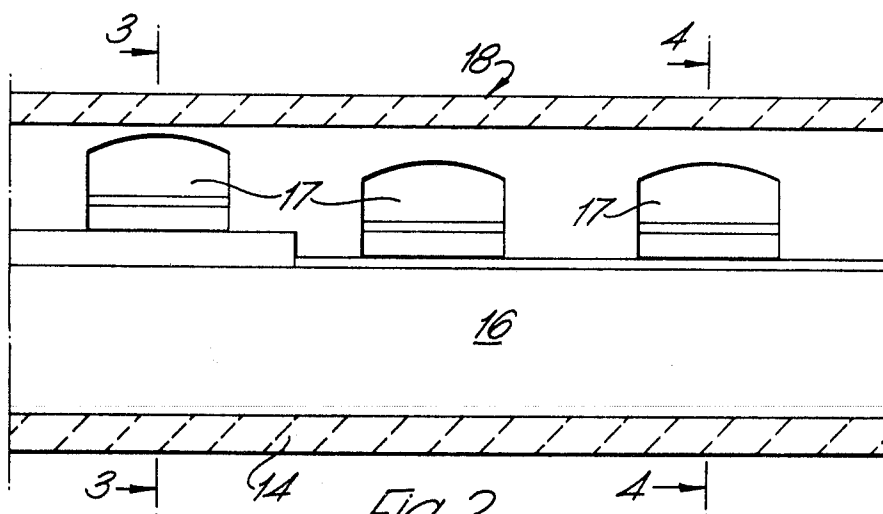


Fig. 2.

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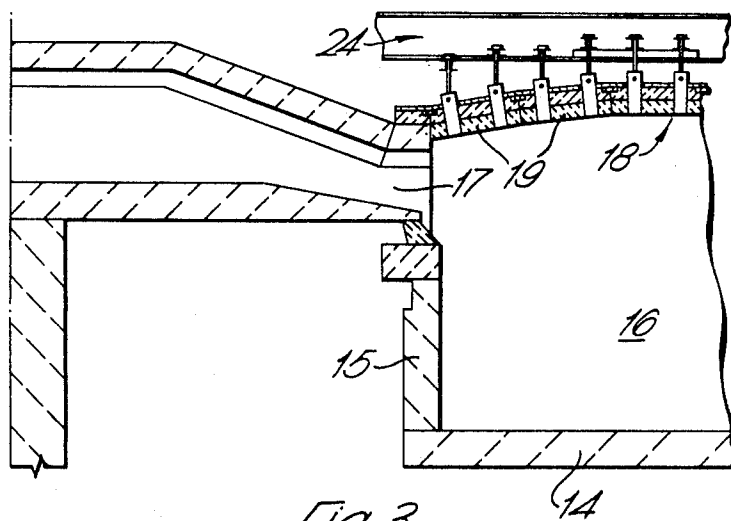


FIG. 3.

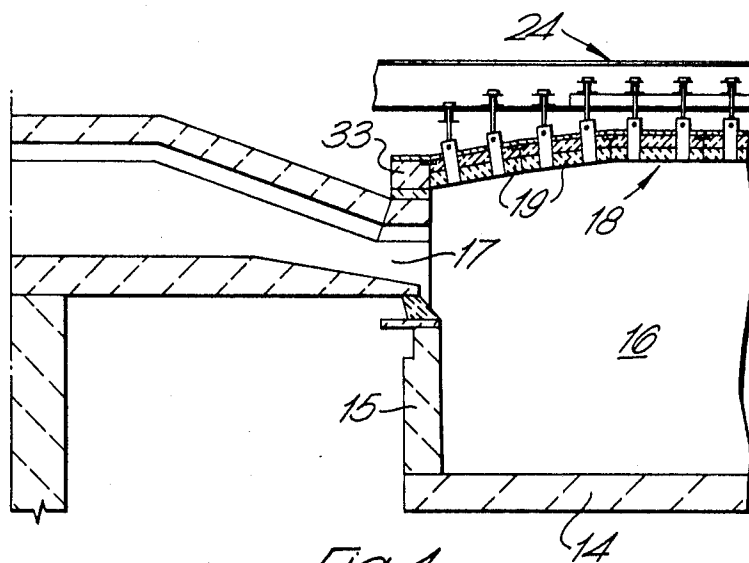


FIG. 4.

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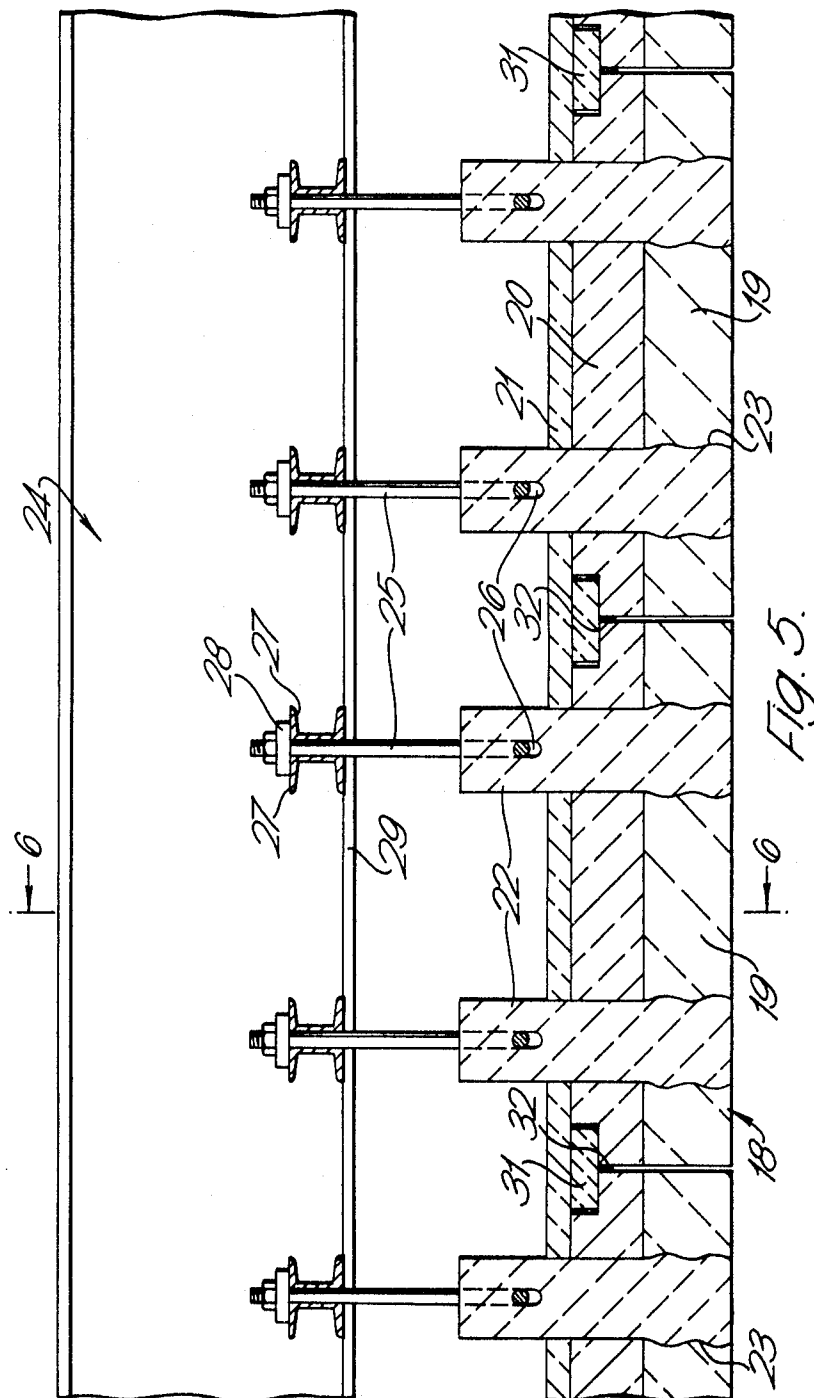


FIG. 5.

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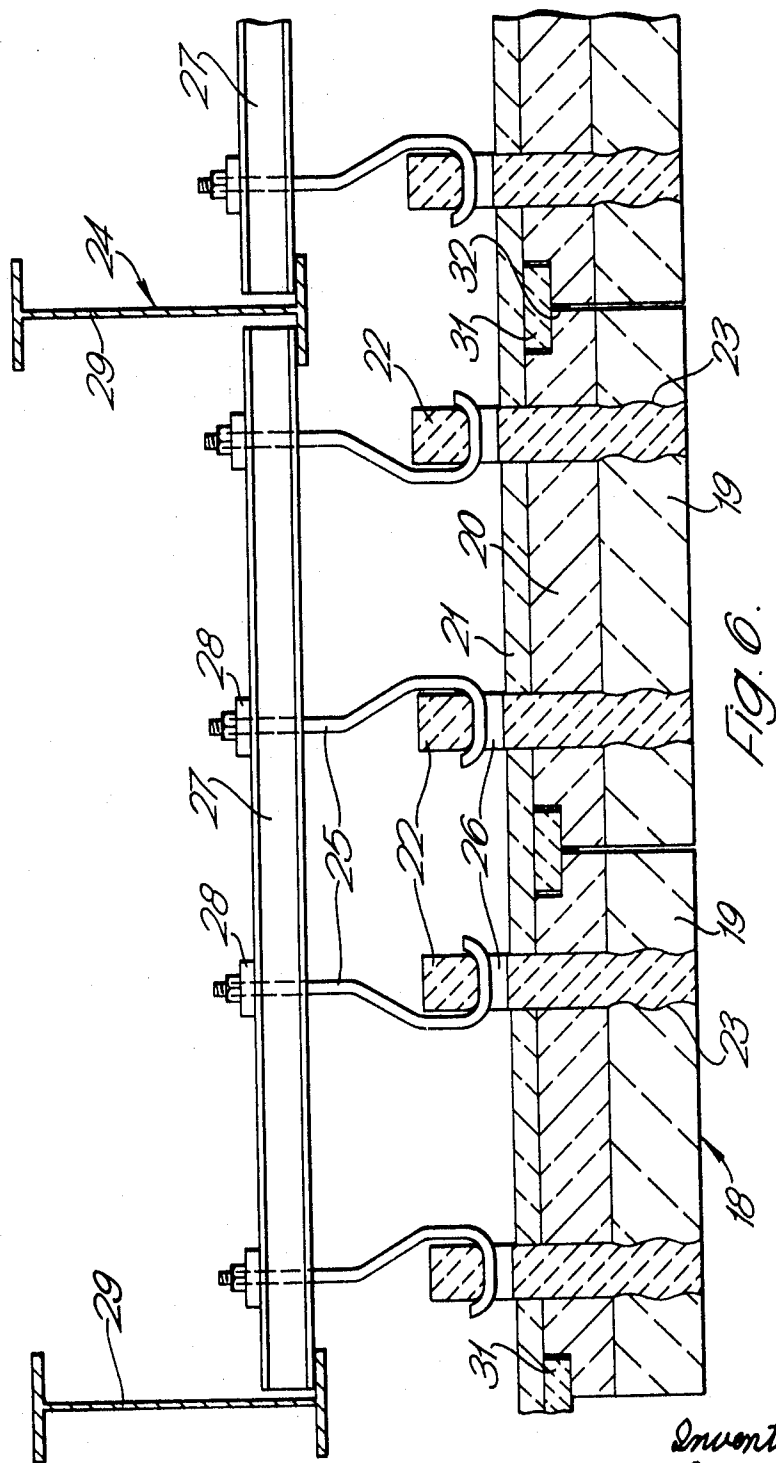
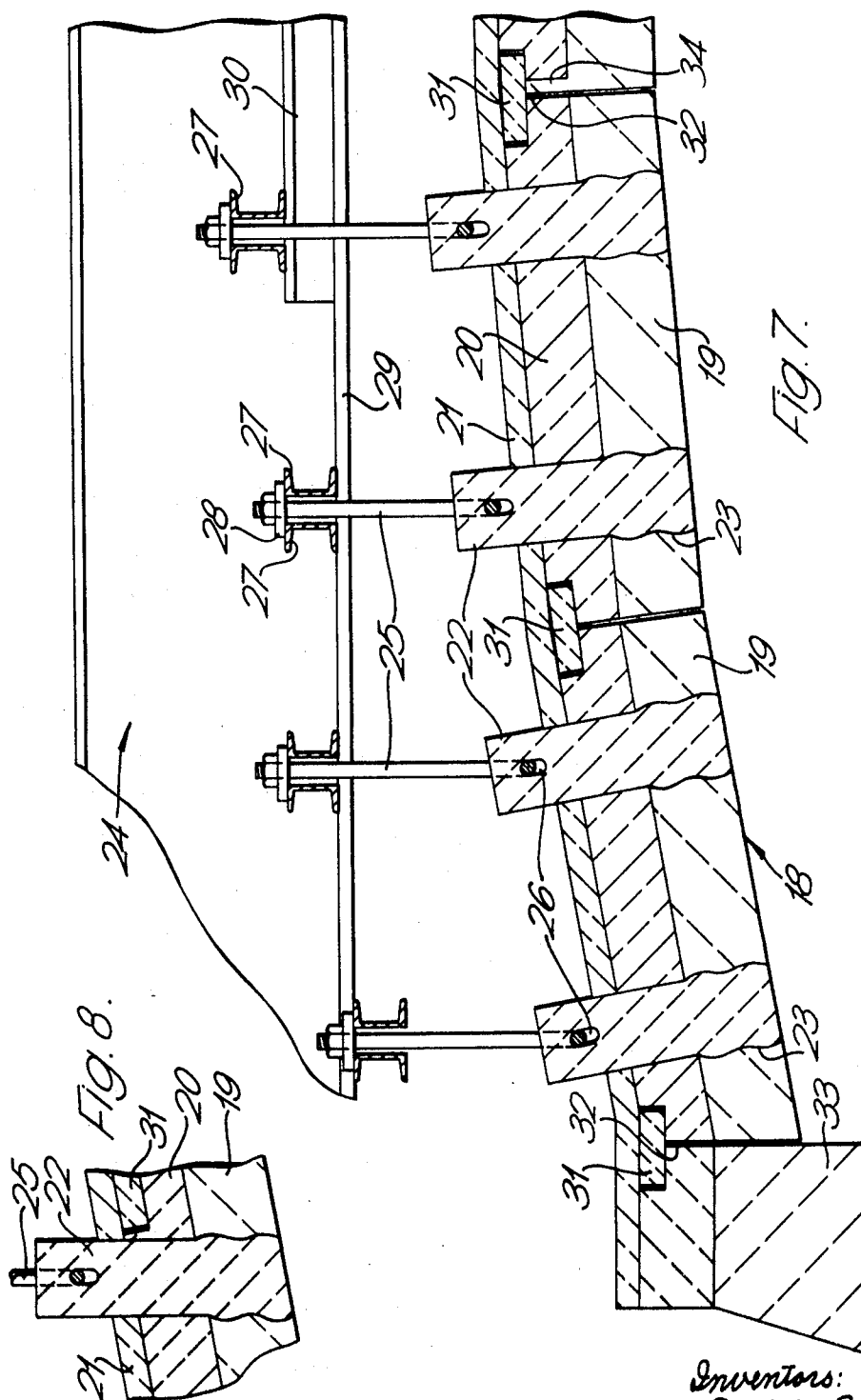


FIG. 6.

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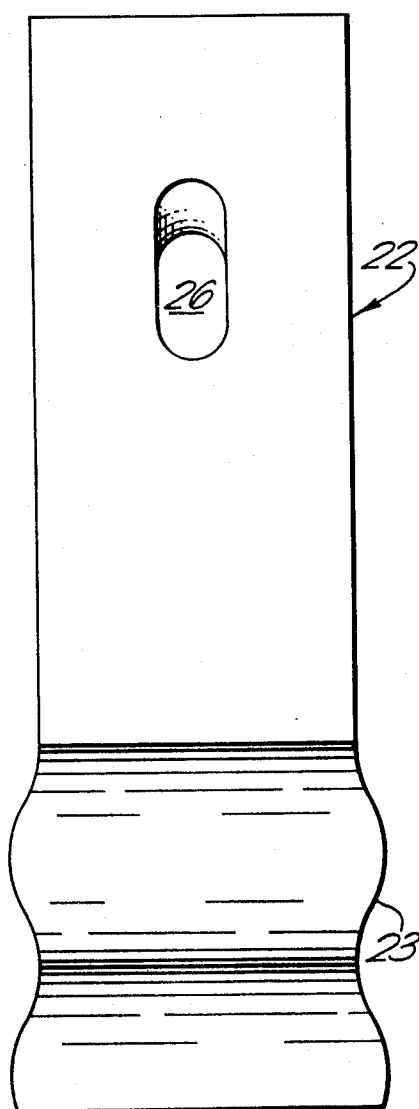


Fig. 9.

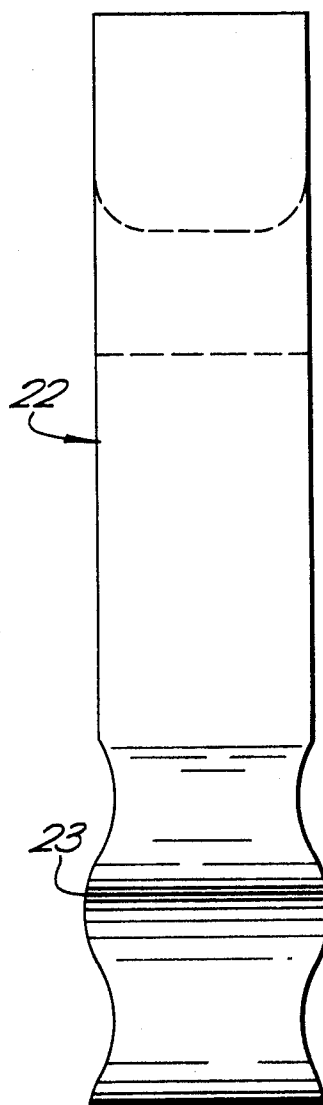


Fig. 10.

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SUSPENDED ROOF FOR HIGH-TEMPERATURE INDUSTRIAL FURNACES

This invention relates to a suspended roof for high temperature industrial furnaces.

It is among the objects of the present invention to provide a roof structure for a high-temperature industrial furnace, and particularly a regenerative glass furnace, which provides a high degree of insulation compared with known structures, is robust, and has lasting qualities and therefore requires less maintenance than known structures.

According to the present invention, there is provided a roof for a high-temperature industrial furnace, comprising a plurality of monolithic facing blocks of a refractory material disposed side-by-side over the area of the furnace chamber, and means for suspending said blocks individually from a supporting framework, said blocks being backed up by high-temperature and low-temperature layers of insulating material whereby, in use, the heat losses from furnace are kept to a minimum.

Preferably, the facing blocks are suspended from a steel-work support structure by hanger bolts which engage holes formed in ceramic anchor tiles attached to, or formed integral with, the facing blocks.

The invention is illustrated by way of example, as applied to a regenerative glass furnace, in the accompanying drawing in which:

FIG. 1 is a cross section through a known type of glass furnace,

FIG. 2 is a longitudinal section through a furnace according to the present invention,

FIG. 3 is a part section on the line 3—3 of FIG. 2,

FIG. 4 is a part section on the line 4—4 of FIG. 2,

FIG. 5 is an enlarged section of part of FIG. 4,

FIG. 6 is a part section on the line 6—6 of FIG. 5,

FIG. 7 is an enlarged section of part of FIG. 3,

FIG. 8 is a detail showing a modification of FIG. 7,

FIG. 9 is an elevation, on an enlarged scale, of an anchor tile, and

FIG. 10 is a side elevation corresponding to FIG. 9.

Referring to FIG. 1 of the drawings, there is shown a standard type of glass furnace which consists of furnace chamber 11 having combustion air ports 12 and a solid arcuate roof 13. It has been found that, particularly in larger melting unit, the geometry of solid arcuate roofs is not compatible with the geometry required to obtain good combustion conditions within the furnace. This results in furnaces provided with arcuate roofs having, either high refractory wear rates, or lower outputs that would normally be expected. Furthermore, in these known glass furnaces, difficulties are experienced in varying the heights of the combustion air ports 12 in order to suit the aerodynamic requirements for good combustion within the furnace. This arises out of the fact that the roof height is normally determined by the height of the highest air port and the roof runs at this level throughout the entire length of the furnace.

Turning now to the remaining figures of the drawings, a furnace according to the present invention comprises a base and sidewalls 14, 15 defining a furnace chamber 16, the walls 15 having combustion air ports 17, and the roof being in the form of a suspended structure indicated generally at 18.

The roof 18 comprises a plurality of monolithic facing blocks 19 of a refractory material, for example of polymer bonded silica or mullite and/or other materials, or of a bonded silica, mullite and/or other materials. The blocks 19 are preferably but not essentially approximately 30 inch square and are arranged side-by-side with a space, for example of one-quarter of an inch, therebetween to allow the blocks to expand on being heated.

The blocks 19 are backed up with a layer 20 of high-temperature insulation material and this layer is in turn backed up with a layer 21 of low-temperature insulation material, the two insulation layers serving to reduce heat losses from the furnace chamber to a minimum. The layers 20, 21 are preferably mullite but other materials could be used.

The facing blocks 19 are each provided with two or more anchor tiles 22 which are preferably molded into the block at the time of manufacture. In this respect, as can be seen particularly in FIGS. 9 and 10 of the drawings, one end 23 of the tile is of corrugated formation to provide a key with the block.

The blocks 19 are supported individually from a steel framework 24 by means of hook-shaped hanger bolts 25 which engage openings 26 formed in the anchor tiles 22. The framework 24 consists of pairs of steel channels 27 between which the hanger bolts 25 are supported by bearing plates 28, the channels 27 being mounted between main roof supporting beams 29. Intermediate beams 30 may be provided where necessary to assist in shaping of the roof.

As hereinbefore stated, an expansion gap is provided between adjacent facing blocks 19 and these gaps are closed by filler tiles 31 which span the gaps and are arranged in recesses provided in the high-temperature insulation layer 20. As will be appreciated, the filler tiles 31 serve to reduce the escape of heat through the expansion gaps. In furnaces where the roof is under high pressure, it may additionally be necessary to provide further sealing of the expansion gaps and this may be effected by caulking the gaps with ceramic fiber as indicated at 32.

According to requirements, the roof structure 18 may be flat or arcuate or, as is shown in the drawings, it may be flat in the center over a major portion of its span and be curved adjacent the ends of its span.

Where the roof is arcuate, or in the arcuate portions of a roof, the anchor tiles 22 may be disposed perpendicular to the plane of their respective facing blocks 19 as is shown in FIG. 7. Alternatively, as is shown in FIG. 8, the anchor tiles 22 may be arranged obliquely with respect to the plane of their respective facing blocks so that, when in their position of use, the anchor tiles are vertical thereby reducing any bending stresses in the tiles which might otherwise occur.

FIGS. 3 and 8 also show one manner in which the curved roof can be fitted to a glass tank port arch block 33. This manner of fitting has the advantage that the distance between the underside of the roof structure 18 and the underside of the arch block 33 can be reduced to, for example 4 inch, as compared with 12 inch which is the usual figure necessary in present day furnace constructions. This further permits, as shown in FIGS. 2, 3 and 4, the combustion air ports 17 to be arranged at different vertical levels to suit combustion requirements without the attendant disadvantages of known furnace constructions.

In a further modification which is partly illustrated on the right-hand side of FIG. 7, the facing blocks 19 may be formed with an upstanding peripheral flange 34 which extends round the whole of the periphery of the block to present a boxlike structure in which the high-temperature insulation 20 is contained. This has the advantage that it protects the high-temperature insulation against direct attack by furnace vapors.

Although the invention has been described specifically with reference to glass furnaces, it will be appreciated that it could, without modification, be applied to other types of furnace.

Thus, it will be understood that the roof structure of the present invention is of simple and robust construction and, by virtue of the use of large monolithic blocks, is such as to reduce heat losses as compared with known types of suspended roof constructions. In the latter respect, it is the normal practice to use small refractory units, roughly the size of a common building brick, each unit having to be individually hung on a separate hanger. This results in a roof which has a very large number of joints which cannot easily be sealed, and a very large number of metal hangers around which it is impossible to fit insulation. It has been estimated that, with this known type of roof construction, it is only possible to insulate some 40 percent of the total roof area whereas, with the construction of the invention, this figure is increased to at least 80 percent.

Furthermore, the ability to arrange the combustion air ports at different levels results in better combustion conditions within the furnace.

Finally, the construction of the invention enables the correct roof shape to be provided to satisfy the aerodynamic requirements of the furnace under consideration.

We Claim:

1. A roof structure comprising a supporting framework, a plurality of facing blocks disposed side-by-side with expansion gaps therebetween, at least one anchor block associated with each facing block, hanger bolts connected between said supporting framework and said anchor blocks for supporting said facing blocks, filler blocks positioned over said expansion gaps between said facing blocks, said roof at least in part being of an arcuate formation, and said anchor blocks being disposed obliquely with respect to the planes of their respective facing blocks.
2. The roof structure as defined in claim 1 wherein recessed insulating material is disposed between said filler blocks and facing blocks, and said filler blocks are received in said recesses.
3. The roof structure as defined in claim 1 wherein an uppermost surface of each said facing blocks is formed with an upstanding peripheral flange.
4. The roof structure as defined in claim 1 wherein said fac-

ing blocks are composed of monolithic refractory material and said anchor blocks are of ceramic material thereby adapting said roof structure for use in a high-temperature industrial furnace.

5. The roof structure as defined in claim 1 including a first backing layer of high-temperature insulating material extending over said facing blocks, and a second backing layer of low-temperature insulating material extending over said first backing layer.

6. The roof structure as defined in claim 2 wherein said expansion gaps are additionally sealed by caulking.

7. The roof structure as defined in claim 4 including a first backing layer of high-temperature insulating material extending over said facing blocks, and a second backing layer of low-temperature insulating material extending over said first backing layer.

8. The roof structure as defined in claim 7 wherein recessed insulating material is disposed between said filler blocks and facing blocks, and said filler blocks are received in said recesses.

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