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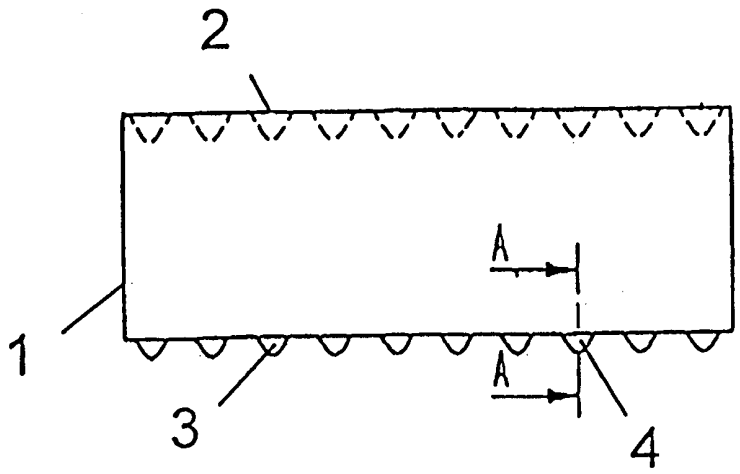
(54) Title: BRICK MADE OF REFRACTORY MATERIAL

(57) Abstract

Brick made of refractory material, preferably for use in a furnace for calcining carbon bodies, where at least one of the surfaces of the brick that is facing towards an adjacent brick is provided with mating elements such as recesses and projections. The mating elements are rotational symmetric about an axis that is perpendicular to said surface.



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Brick made of refractory material

Present invention relates to a brick made of refractory material. More particularly, the invention relates to formed bricks that can used as parts in construction elements in a furnace for calcining carbon bodies, where at least one of the surfaces of the bricks is provided with mating or interlocking elements. The mating elements co-operate with complementary mating elements in an adjacent brick.

WO 97/35150 relates to design of refractory bricks to be used in a ring chamber furnace where the upper surface of the brick is provided with an arrangement of mating elements shaped as an elongated groove extending lengthwise in the complete length of the brick, together with crosswise extending grooves terminating short of the sides of the brick. The lower surface of the brick is formed in a similar manner with complementary projections that co-operates with a similar, underlying brick.

The system as described above has a rather complicated geometry that involves high costs related to production/maintenance of production tools in the manufacture of such bricks. Further, a system of grooves/tongues extending in the complete length of the brick could possibly involve a risk of leakage of gas through the wall, as a result of gas leakage through the layers between adjacent bricks. Particularly in calcining furnaces, such leakages may generate problems with respect to burn-off in carbon bodies caused by air entering the chamber where the calcining process takes place. An other problem related to longitudinal grooves/tongues extending approximately in the complete length and width of the brick, is that such grooves/tongues may represent regions of tension concentration where weakening lines or crack formation may occur, which in worst cases may imply that the brick is cracking wholly or partly leading to leakages or weakening of the overall wall construction.

With the present invention there is achieved a novel design of a brick where the above mentioned disadvantages can be avoided. The brick in accordance with the invention can be manufactured at low costs, as the shaping tool used in the pressing of the brick before burning has a simple and rugged geometry. Further, the geometric shape of the brick makes possible that the number of different types of bricks that is included in a calcining

furnace can be reduced. The fact that this number can be reduced, imply that the logistics with respect to maintenance and repair work can be simplified, together with that the constructional drawings of the furnace can be simplified. Following this, the construction period for a furnace can be reduced.

In the following, the present invention will be further described by example and figures where:

Fig. 1 shows a formed brick in accordance with the invention, seen from above,

Fig. 2a shows a formed brick as shown in Fig. 1, seen from one side,

Fig. 2b shows a formed brick as shown in Fig. 1, seen in front,

Fig. 3a shows the cut through A-A, as shown in Fig. 2a,

Fig. 3b shows the cut through B-B, as shown in Fig. 2b.

The formed brick 1 as shown in figure 1 is provided with mating elements at its upper surface, where the mating elements are constituted by a plurality of recesses 2. In the embodiment shown in the figure, there is arranged ten circular or rotational symmetric recesses in each of five rows. It should be understood that the number of recesses and the arrangement of these in relation to the long side and the short side of the brick can deviate from that shown in figure 1.

Figure 2a shows in side view the formed brick as shown in figure 1, having recesses 2 at the upper surface of the brick. As seen from the figure, there is arranged mating elements at the lower surface of the brick, formed as projections 3. The number of projections can appropriately be the same as the number of recesses, and the projections have preferably the same position as the recesses, related to co-ordinates in the horizontal plane, i.e. the projections are respectively centrically arranged relative a vertical axis through each of the recesses. It should be understood that the brick may alternatively be arranged in such a manner that the projections are arranged at the upper surface of the brick, while the recesses are arranged at its lower surface.

Figure 3a shows an enlarged portion of the cut through A-A in figure 2a, and discloses a projection 4. The geometry of the projection is by preference rotational symmetric and has in this embodiment a rounded off cone shape where its top is rounded off.

Figure 3b shows an enlarged portion of the cut through B-B in figure 2b, and discloses a recess 5. The geometry of the recess is by preference rotational symmetric and has in this embodiment a rounded off cone shape where its bottom is rounded off.

It should be understood that other geometrical design of the projections and the recesses than shown here may be actual as well. For instance, the form of these mating elements can be dome-shaped or hemispherical. Meanwhile, it is of great importance that shape of the projections and recesses are of a mutual complementary shape, i.e. they engage each other with a little clearance, where the projections have a geometric extension that is a little bit smaller than that of the recesses.

The manufacture of production tools for producing bricks having rotational symmetric projections will be simple. The projections in the brick can for instance be provided by milling recesses in the surface of the mould, using a suitable milling tool (not shown). Appropriately, the recesses in the brick are manufactured by rotational symmetric projections in the surface of the mould. For instance, such projections may in a simple manner be fixed to the mould surface, for instance by screws or other fastening means(not shown). The projections themselves may be produced in a moulding process or the similar.

Bricks in accordance with the present invention make possible the construction of long and slender furnace walls, which results in that the net volume inside the furnace can be increased compared to previous furnaces with similar outer measures. In use, the bricks have shown to sustain a stable mutual locking to each other, which essentially reduces problems related to settle effects and bowing-out of the wall. Between the brick layers there is used mortar to even out possible small deviations and to provide an increased binding/sealing between the layers.

Bricks produced in accordance with the proposed geometry have shown to sustain a reduced deviation in its shape (tolerance deviation) in the pressing and burning processes, compared to previous manufacture. The fact that bricks now can be reproduced with small deviations renders great simplifications in the construction work, together with a reduction in mortar consume. Further, the improved accuracy in the shape of the bricks influence positively upon the stability and lifetime duration of the wall.

It should be understood that the brick may be provided with mating elements in more than one surface within the scope of the claims. For instance the top- and bottom surface of the brick can be provided with such elements, as well as one or more side surfaces. In the latter, the mating elements may be of the same type as described above.

Claims

1. Brick (1) made of refractory material, preferably for use in a furnace for calcining carbon bodies, where at least one of the surfaces of the brick that is arranged towards an adjacent brick is provided with mating elements such as recesses (2) or projections (3),
characterised in that
the mating elements are substantially rotational symmetric about an axis that is perpendicular to said surface.

2. Brick in accordance with claim 1,
characterised in that
the geometric shape of the mating elements is a rounded cone shape.

3. Brick in accordance with claim 1,
characterised in that
the geometric shape of the mating elements is substantially a hemispherical shape.

4. Brick in accordance with claim 1-3,
characterised in that
the recesses are arranged at the upper surface of the brick, while the projections are arranged at the lower surface of the brick.

5. Brick in accordance with claim 1-3,
characterised in that
the recesses are arranged at the lower surface of the brick, while the projections are arranged at the upper surface of the brick.

6. Brick in accordance with claim 1-5,
characterised in that
mating elements are arranged at one or more side surfaces of the brick.

7. Use of a brick as defined in claims 1-6 as formed brick in construction elements of a furnace for calcining carbon bodies.

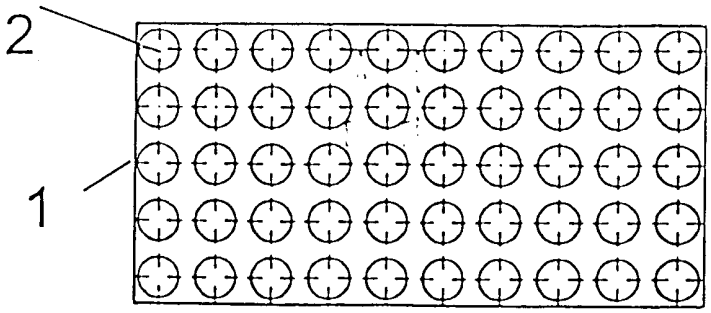

Fig. 1

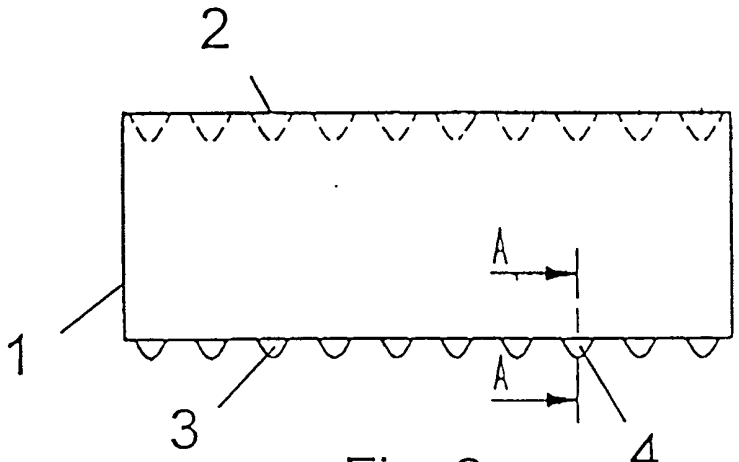

Fig. 2a

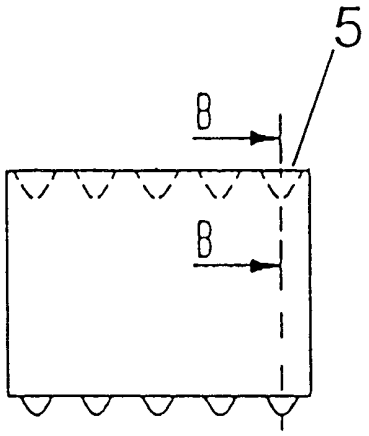

Fig. 2b

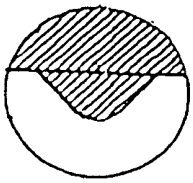

Fig. 3a

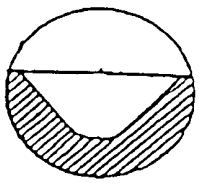

Fig. 3b

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 99/00370

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: E04B 2/08, E04C 1/00, F24D 1/04
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: E04B, E04C, F27D, F23M

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2415279 A1 (SOCIETE EUROPEENNE DES PRODUITS REFRACTAIRES), 17 August 1979 (17.08.79), page 2, line 1 - line 17, figures 3a-3b --	1-7
X	DE 3046403 A1 (NAAMLOZE VENNOTSCHAP GOUDA VUURAST), 22 October 1981 (22.10.81), page 5 - page 6, figures 1,2 --	1-7
X	US 5358031 A (J. HYDE), 25 October 1994 (25.10.94), column 3, line 53 - column 4, line 2, figures 1-3 --	1-7
X	US 4107894 A (W.L. MULLINS), 22 August 1978 (22.08.78), figure 4, abstract --	1-6

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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A	US 4026086 A (D.T. LANGLEY), 31 May 1977 (31.05.77), figures 3-6, abstract ---	1-7
A	DE 846452 C (H. GüTH ET AL), 14 August 1952 (14.08.52), page 2, line 72 - line 100, figures 1-4 ---	1-7
A	US 5277580 A (J. MISKOLCZI, JR.), 11 January 1994 (11.01.94), figure 1, abstract --- --------	1-7

INTERNATIONAL SEARCH REPORT

Information on patent family members

02/12/99

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR 2415279 A1	17/08/79	NONE	
DE 3046403 A1	22/10/81	BE 888401 A	14/10/81
		FR 2480420 A	16/10/81
		NL 8002195 A	16/11/81
US 5358031 A	25/10/94	US 5474726 A	12/12/95
		US 5531586 A	02/07/96
		US 5299629 A	05/04/94
US 4107894 A	22/08/78	NONE	
US 4026086 A	31/05/77	NONE	
DE 846452 C	14/08/52	NONE	
US 5277580 A	11/01/94	NONE	