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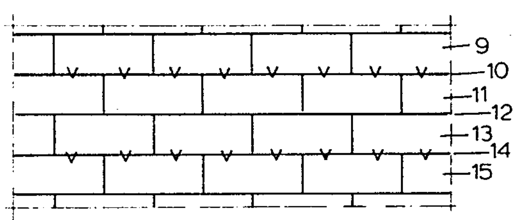
(54) Coke oven battery.

(57) A coke oven battery has coking chambers 1, combustion chambers 3, oven roof 4, regenerator roof 5 and regenerator walls 8. To achieve resistance to crack and hole formation during heating up due to differences of thermal expansion, the refractory brickwork of at least one of said regenerator walls, said regenerator roof and said oven roof comprises a region which is formed substantially of bricks of one material and in which a plurality of vertically adjacent strengthened brickwork sections, each comprising at least two layers of bricks, are provided by connecting together the bricks of the said layers of the strengthened section so that the layers are prevented from relative movement in the direction transverse to said longitudinal direction of the battery, each adjacent pair of said strengthened sections being separated from each other by a joint permitting their relative movement in said transverse direction.



EP 0 090 449 A1

"Coke oven battery"

This invention relates to a coke oven battery having refractory brickwork comprising horizontal layers of bricks, and is especially applicable to the brickwork of the regenerator walls, the regenerator roof and the oven roof.

A coke oven battery comprises a number of coking chambers for the coal being coked arranged side by side in the longitudinal direction of the battery and separated by combustion chambers for the gas being burned. The coking chambers are narrow in that longitudinal direction, which direction is thus transverse to the longitudinal direction of each coking chamber. Access to the coking chambers is via doors at the two longitudinal sides of the battery, called the coking side and the machine side. The oven roof is located above the coking and combustion chambers. Below the coking and combustion chambers is the regenerator roof and below that are regenerators for heating the combustion air. The regenerators are separated by regenerator walls.

When demolishing an old coke-oven battery, the present applicant company has found vertical open joints and cracks in the brickwork of the regenerator walls, regenerator roof and oven roof. Undesirable leaks occur through these openings between the ducts carrying combustion air, flue gas and combustion gas, as a result of which the combustion is incomplete causing the gas outlet stack of the battery to emit sooty smoke Premature combustion occurs in the regenerators or in the ducts in the regenerator roof, resulting in damage to the refractory brickwork there. These two undesirable combustion processes reduce the thermal efficiency of the battery. It is difficult to achieve optimum operation of the battery, as the leaks vary from place to place.

The open joints and cracks are produced, at least in part, during heating up of the battery as a result of vertical differences in temperature in the brickwork. This phenomenon can be summarized by saying that a layer of bricks which is already hot expands and pulls open a lower layer which is still cold, and in so doing, creates permanent vertical open joints and cracks because of movements in the joint between the two layers. When the lower colder layer then heats up, it in turn pulls open the higher already hot layer and creates permanent vertical open joints and cracks in it.

This phenomenon occurs extensively when silica material is used for the brickwork, because this material has a 1.2 to 1.5% thermal expansion up to 600^{o}C and in particular a large expansion of about 1.1% in the temperature range of 100^{o} to 300^{o}C, and because of the great length of the brickwork.

The creation of open joints and cracks is in practice counteracted as far as possible by supporting the brickwork structure of the battery on the outside. In the longitudinal direction of the battry, the brickwork is supported on the outside by buttresses in conjunction with longitudinal ties. Across the battery, corresponding to the longitudinal direction of the coking chambers, the brickwork is supported by pillars and cross-ties. From the discovery of the open joints and cracks in the old battery, we have concluded that the transverse support of the brickwork is not sufficient to prevent open joints and cracks.

Silica is an expensive material. It has been the practice to build the battery up to the level of the bottom of the regenerator roof of the cheaper chamotte bricks. Because of the difference of thermal expansion of silica and chamotte, a so-called sliding zone or slip joint has been arranged at the junction of the two materials. DE-OLS 1,571,692 discloses an arrangement to resist tension forces arising in the top chamotte layers immediately below the sliding zone. This consists of interlocking of the bricks of at least two chamotte layers so as to prevent relative movement of the layers. The interlocking results from the shapes of the bricks.

The object of the invention is to provide brickwork for a coke oven battery in which the occurrence of vertical open joints and/or cracks at right angles to the longitudinal direction of the battery, corresponding to the longitudinal direction of the coking chambers, is completely or at least partly prevented.

Another object of the invention is to provide a battery which causes little pollution of the atmosphere.

A further object of the invention is to provide a battery having a high thermal efficiency.

According to the invention the brickwork of the battery has a plurality of vertically neighbouring strengthened sections, each consisting of a plurality of adjacent horizontal layers in which the bricks are joined in the longitudinal direction of the coking chamber so that they cannot move in relation to one another, and there being a horizontal sliding zone adjacent each such strengthened section, which allows the section to move relative to adjacent brickwork in the longitudinal direction of the brickwork.

Instead of increasing the support of the brickwork at the outside, which might result in an unacceptably great load on the supporting pillars, while the depth over which such support would have any effect in the brickwork, is probably limited, a leakproof bond between the brickwork is sought by the invention in the brickwork itself. The neighbouring strengthened sections of brickwork in which the bricks cannot move in relation to one another in the transverse direction of the battery, can move when there is differential thermal expansion along their common horizontal joints, without any vertical open joints or cracks being produced within each section of the brickwork. Without these sliding joints between the brickwork sections, i.e. when all the bricks in the brickwork are joined and cannot move in relation to one another in the transverse direction of the battery, upon differential thermal expansion the layers of brickwork would be pulled to pieces. The invention thus provides a brickwork structure with a long technical and environmental life.

The inventors have in fact realised that the structure of interlocked layers shown in DE-OLS 1,571,692 is applicable at other parts of the battery than the junction between silica and chamotte and that a plurality of such structures should be provided adjacent each other in brickwork consisting substantially all of the same material.

The danger of the courses being pulled to pieces in a section of the brickwork as a result of differential thermal expansion increases with the difference in the degree of thermal expansion and the greater the number of layers in a section of brickwork. For this reason, in particular where there is large differential thermal expansion, such as for example in the regenerator walls, the strengthened brickwork sections preferably consist of two adjacent horizontal layers.

Many arrangements are possible in order to achieve connections between the bricks of adjacent layers of a section of brickwork so that the bricks are unable to move in relation to one another and also many arrangements are possible for the sliding joints between adjoining sections of brickwork. The desired condition is that the resistance to relative movement of adjacent layers within such a section is much greater than that of the adjacent sections of brickwork. Firmly stuck joints between the layers and good slip joints between the sections of the brickwork can be used.

The connection between adjacent horizontal layers which are unable to move relative to one another is preferably achieved by interfitting projections and recesses in the top and bottom surfaces of the bricks of the respective layers. Three particular possibilities are (1) tongue and groove structures extending at right angles to the longitudinal direction of the coking chamber (i.e. parallel to the longitudinal direction of the battery), (2) the bricks of adjacent layers have thick ends and narrow middle portions, the two ends of a pair of bricks of one layer being located against the narrow middle portion of a brick in the adjacent layer to provide an interlocked structure and (3) the bricks of adjacent layers are connected together by dowels located in opposed holes in the adjacent top and bottom surfaces of the bricks, the dowel being fitted into two adjacent bricks while the brickwork is being built.

The joints between the strengthened sections of brickwork should preferably be made with mortar. It is then preferable to incorporate in the mortar joint a zone of relative weakness, e.g. a friction reducing or fracture-surface forming means, such as oiled paper.

The regenerator walls have a temperature of about 200^{o}C at their lower ends. In practice the section of the regenerator walls containing the checker work (heat exchanging mass) is made of chamotte. Those experts in this field have generally rejected the idea of forming the bottom section of the regenerator walls of silica because of the risk that these walls may reach temperatures lower than 300^{o}C. According to a preferred feature of the invention however the regenerator walls to be largely made of silica at the checker work region. This has the advantage that during normal cyclical operation of the regenerators these sections of the walls are no longer subject to thermal expansion as silica undergoes virtually no expansion above 300°C. The brickwork in accordance with the invention can withstand a drop in temperature to below 300°C without damage. Thus preferably at least 30% of the height of the regenerator walls is formed of silica bricks, with a plurality of adjacent strengthened sections as proposed by this invention.

Preferred embodiments of the invention will now be described by way of non-limitative example with reference to the accompanying drawings, in which:-

Fig. 1 is a vertical section through a coke-oven battery,

Fig. 2 is a sectional view of a regenerator wall on the line II-II in Fig. 1, in a prior art battery,

Fig. 3 illustrates the principle of the invention applied to the regenerator wall portion shown in Fig. 2.

Figs. 4, 5 and 6 show respective preferred embodiments of brickwork used in the invention.

Figs. 7, 8 and 9 show the bricks used in the respective brickwork embodiments of Figs. 4, 5 and 6, according to arrows VII-VII, IIX-IIX and IX-IX in Figs. 4,5 and 6 respectively.

Fig. 1 is a section in the longitudinal direction of the coke-oven battery and shows the coking chambers 1 which are separated from one another by combustion walls 2, each containing a number of combustion chambers 3, and are bounded at the top by the oven roof 4 and at the bottom by oven sole or regenerator roof 5. The combustion chambers communicate via ducts 6 in the regenerator roof 6 with the regenerators 7, which are separated from one another by regenerator walls 8. The regenerators 7 are filled with checker work 18. The approximate boundaries of the various portions of the battery are indicated on Fig. 1. Thus I gives the height of the oven roof, II the height of the combustion walls, III the height of the regenerator roof and IV the height of the regenerator walls. The design shown in Fig. 1 is well-known to the expert and does not need any further explanation.

The battery is heated up before operation by means of burners located near the regenerator roof in the coking chambers 1. The route taken by the hot gases during heating up is shown by arrows in Fig. 1. The gases are conducted into the combustion chambers 3 via temporary openings at the top of the coking chambers 1, and removed via the passages 6 and the regenerators 7 to the waste gas duct and the chimney stack which are not shown. During this heating up a vertical difference in temperature is created particularly at the regenerator roof 5, the regenerator walls 8 and the oven roof 4.

In the part of the regenerator wall shown in Fig. 2 the brickwork undergoes expansion during heating up. At any given time the higher layers of bricks have expanded more than the lower layers. An already hot layer 9 pulls open a layer 11 which is still colder and as a result of movements in the joint 10 between the layers 9 and 11 vertical open joints and cracks are produced in the layer 11. When the cold layer 11 later heats up, it in turn as a result of movements in the joint 10 pulls open the already hot layer 9 and produces vertical open joints and cracks in this. The vertical open joints and cracks in layer 11 remain, at least in part. In addition the vertical open joints and cracks in layer 11 increase further in size and/or number as a result of movements in joint 12, when layer 11 is in turn pulled open by layer 13, as layer 13 warms up. To sum up it can be stated that the vertical open joints and cracks left in the brickwork are created by differential thermal expansion, where movements occur in the horizontal joints.

These vertical open joints and cracks also occur in the regenerator roof 5 and the oven roof 4. The external support structure provided in practice for the brickwork by means of pillars and cross-ties is not sufficient to prevent such open joints and cracks.

Fig. 3 shows schematically that, according to the invention, the joint 10 is prevented from moving by vertical connections between the bricks in layers 9 and 11. This produces a rigid or strengthened section in the brickwork, comprising two layers 9 and 11, which can no longer pull one another open. In effect in the two layers, none of the bricks can move horizontally relative to each other, longitudinally in the coking chambers. If however all the horizontal joints in the brickwork were blocked against movement in this way, upon differential thermal expansion as a result of vertical differences in temperature such very large cracks would be produced in the brickwork that it would be broken to pieces. The brickwork is therefore made in a plurality of adjacent strengthened sections of two layers each and between the strengthened sections of the brickwork with blocked joints 10 and 14, comprising layers 9,11 and 13, 15 an unblocked joint 12 is present at which the sections of brickwork can move relative to one another in the longitudinal direction of the coking chambers. This joint 12 may take the form of a mortar joint with preferably a weakened zone formed by a friction-reducing or fracture-surface forming agent, such as oiled paper.

The number of layers in a brickwork section with blocked joints is a minimum of two, and is chosen depending on, among other things, the expansion characteristics of the brickwork, the speed of heating up or temperature changes in the brickwork during operation and the extent of the difference in temperature arising.

Figs. 4, 5 and 6 show particular embodiments of blocked joints in the brickwork to produce the strengthened sections.

Fig. 4 shows the blocked joints 10 and 14 provided by means of tongue and groove structures 19. A top view of the brick used in layer 11 (and 15) is given in Fig. 7, and there is used a brick of the corresponding opposite shape for layers 9 and 13. The tongues and grooves extend transversely at right angles to the longitudinal direction of the coking chambers.

Fig. 5 shows the blocked joints 10 and 14 provided by dowels 16 located in opposed holes in the opposed faces of the two adjacent layers. The brick to be used here with for example four holes 17 is shown in Fig. 8.

Fig. 6 shows the blocked joints 10 and 14 obtained with interfitting shaped bricks each with thick ends 20 and a narrow centre 21, which are fitted into one another as the brickwork is built up. The two adjacent ends 20 of a pair of bricks in one layer project into the recess provided by the narrow centre portion 21 of the adjacent brick of the other layer. The brick used here is shown in Fig. 9.

Where the brickwork is built up with sections with more than one blocked joint, then an extra brick design is necessary for each of the embodiments described, e.g. for the embodiment of Fig. 4 a brick with a tongue and groove on each of its top and bottom surfaces, for the embodiment of Fig. 5 a brick with holes on each of the top and bottom surfaces and for the embodiment of Fig. 6 a brick with a recess in each of its top and bottom surfaces.

In Fig. 1, broken line 25 indicates the vertical location of the sliding joint between silica and chamotte preferred in the invention. Thus about 60% of the height of the regenerator walls above this line 25 is made of silica bricks. In both the silica and chamotte regions of the regenerator walls, the bricks are arranged in a plurality of the strengthened sections, each comprising two layers having one blocked joint between them. Such strengthened sections are also provided in the regenerator roof 5 above the regenerator walls 8, and in the oven roof 4.

CLAIMS:

1. A coke-oven battery having refractory brickwork comprising horizontal layers of bricks, there being a strengthened section of said brickwork consisting of at least two of said layers in which the bricks are connected together in a manner preventing relative horizontal movement of the bricks in the direction transverse to the longitudinal direction of the battery, which section is adjacent a sliding zone permitting relative sliding in said transverse direction of the section and the next adjacent layer of bricks characterized in that the brickwork has a plurality of such strengthened sections neighbouring each other vertically and formed within a region of the brickwork in which the bricks are substantially all of the same material, each neighbouring pair of strengthened sections having between them a said sliding zone.

2. A battery according to claim 1 wherein a plurality of said neighbouring strengthened sections each consists of two layers of bricks.

3. A battery according to claim 1 or claim 2 wherein said plurality of sections include at least part of the height of the regenerator roof.

4. A battery according to claim 1 or claim 2 wherein

said plurality of sections include at least part of the height of the regenerator walls.

5. A battery according to claim 1 or claim 2 wherein said plurality of sections include at least part of the height of the regenerator roof and at least an upper part of the regenerator walls adjacent said roof.

6. A battery according to any one of the preceding claims wherein the regenerator walls comprise an upper region formed of brick layers of a first material and a lower region formed of brick layers of a second material, and each of said upper and lower regions has a plurality of said neighbouring strengthened sections.

7. A battery according to claim 6 wherein said first material is silica and said second material is chamotte.

8. A battery according to any one of the preceding claims wherein the oven roof comprises a plurality of said neighbouring strengthened sections.

9. A battery according to any one of the preceding claims wherein the bricks of adjacent layers within a said strengthened section are joined together by projections and recesses in the adjacent top and bottom surfaces of the bricks.

10. A battery according to claim 9 wherein the bricks in the adjacent layers within a said strengthened section are joined together by tongue and groove connections

extending at right angles to the said transverse direction.

11. A battery according to claim 9 wherein the bricks in adjacent layers within a said strengthened section are of an interlocking shape comprising relatively thick ends and a relatively thin middle portion whereby the two adjacent ends of a pair of adjacent bricks in one layer are located against the narrow middle portion of a brick in the adjacent layer.

12. A battery according to claim 9 wherein bricks of adjacent layers within a said strengthened section are joined together by dowels located in opposed holes in the respective top and bottom surfaces of the bricks.

13. A battery according to any one of the preceding claims wherein said sliding zone consists of a mortar joint between adjacent layers of bricks, the mortar joint not preventing the relative sliding of the layers.

14. A battery according to claim 13 wherein said mortar joint includes a horizontally extending zone of weak resistance to the relative sliding of the layers.

15. A battery according to any one of the preceding claims wherein a region comprising at least 30% of the height of the regenerator walls is of silica bricks, which region consists of a plurality of said neighbouring strengthened sections.

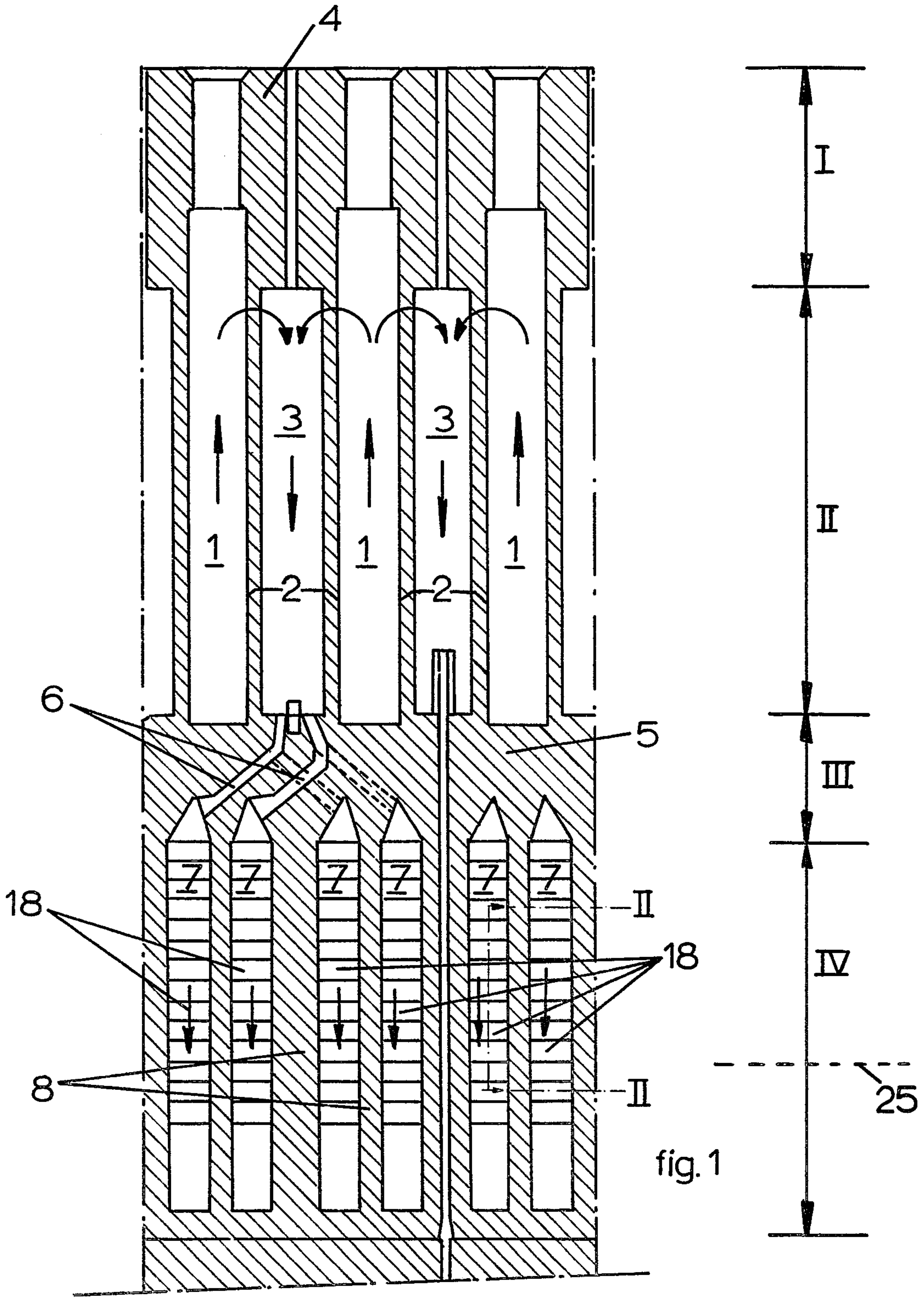


fig. 1

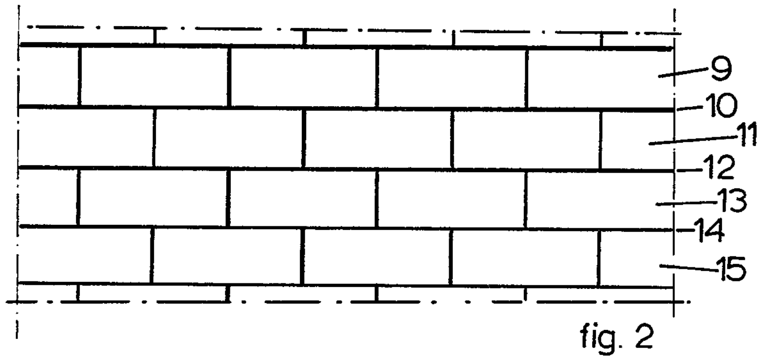


fig. 2

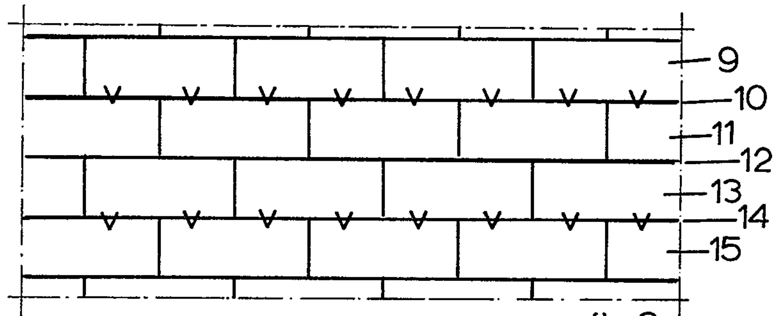


fig. 3

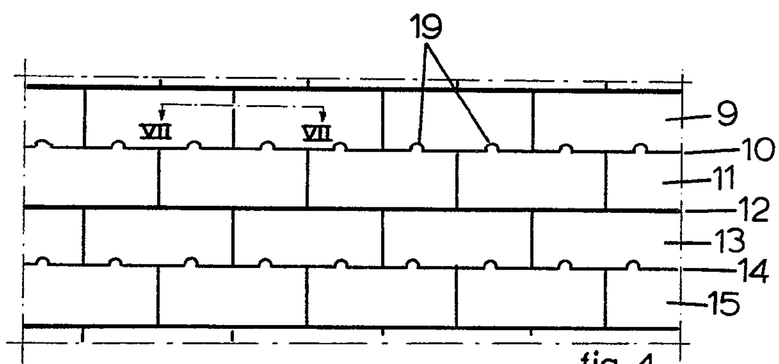


fig. 4

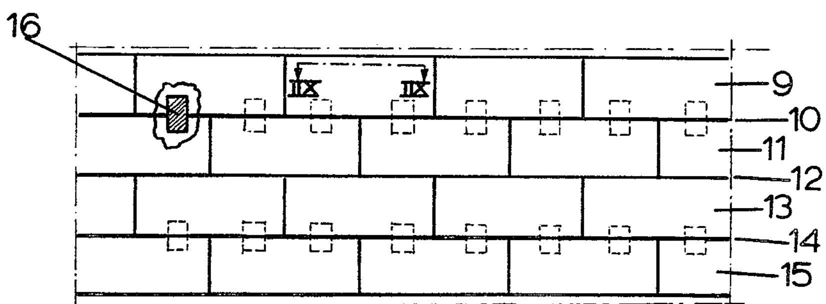


fig. 5

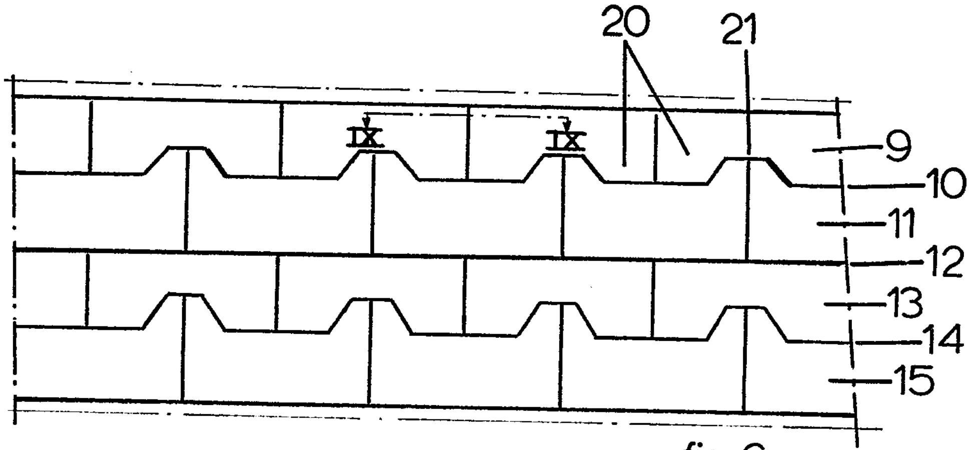


fig. 6

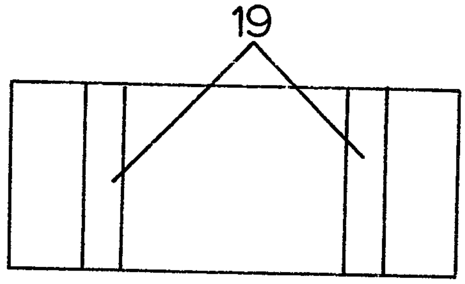


fig. 7

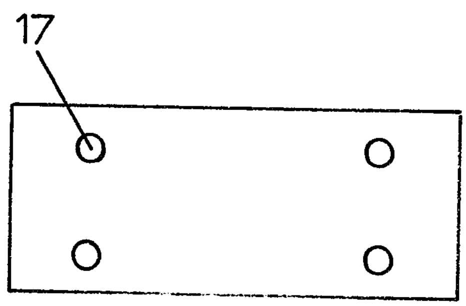


fig. 8

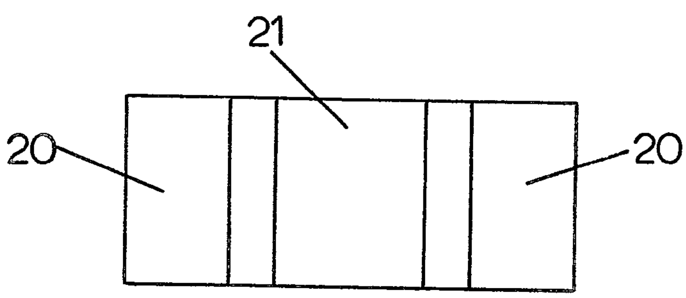


fig. 9

European Patent Office

EUROPEAN SEARCH REPORT

0090449

Application number

EP 83 20 0364

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
Y	DE-A-1 571 692 (VEB) * Claim 1; figures 1,2 * ---	1-15	C 10 B 29/02
Y	GB-A-1 509 083 (CERAMTEC) * Claim 1; figures 2,3 * ---	1-15	
A	DE-C- 916 415 (SCHWARTZ) -----		
			TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
			C 10 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	04-07-1983	MEERTENS J.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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