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(54) **THERMALLY COMPENSATED STRUCTURAL ELEMENT FOR A FURNACE**

WÄRMEKOMPENSIERTES STRUKTURELEMENT FÜR EINEN OFEN

ELEMENT STRUCTUREL THERMIQUEMENT COMPENSE POUR UN FOUR

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Description

[0001] The present invention concerns a thermally compensated structural element and its application. The application of structural elements in accordance with the present invention is particularly advantageous as support for covers/lids for use in industrial processes. An example may be in connection with furnaces for calcining of carbon bodies. Such furnaces are usually created with a row of sections which can be closed at the top and which are also designed for the insertion of carbon bodies. Flue gas flows through the sections during the calcining process and so-called closed furnaces are equipped with section covers, which allows the operation of a closed process. During calcining, the carbon bodies remain stationary in their respective sections while the firing cycle is moved successively in relation to the sections, which means cyclical thermal loads on the sections and consequently also on their section covers.

[0002] Section covers exist for the above application in which an external, continuous, rigid frame of cast iron forms the bearing structure for an arch of one or more layers of refractory material i.e. bricks. One disadvantage of this structure is that the expansion of the metal as a consequence of heating results in distortion and geometric changes, which results in the cover no longer lying in sealing contact with its base. Moreover, the cover may damage the brick work at the top of the section, which will result in increased maintenance. One consequence of these factors will be that the process will no longer be closed in relation to the surroundings on account of leakages.

[0003] DE-A-27 13 766 discloses a cover for a furnace wherein T- and L-shaped profiles are rigidly connected.

[0004] The invention avoids the disadvantages mentioned above by the structural element according to claim 1 and by use thereof for a cover for use in a thermal process as mentioned in claim 8. Optional features of the element are set out in the dependent claims.

[0005] The above disadvantages may be avoided with the present invention as the structural elements in the cover remain stable in critical directions, even under high thermal loads. Section cover in accordance with the present invention have proved to lie in stable, sealing contact with the base during all stages of the firing cycles through which the furnace passes. Consequently, the process may be operated without disturbances caused by leakages to the surroundings.

[0006] The present invention will be described in further detail in the following by means of examples and figures, where:

Figures 1 a-b show drawings of a section of a structural element in accordance with the present invention, seen in perspective, partly from below in Fig. 1a and partly from above in Fig. 1b.

Figure 2

shows a section of a cover, seen in perspective, using structural elements in accordance with the present invention.

[0007] Figure 1b shows a drawing of a section of a structural element 1 comprising an upper element 2 and one or more lower elements 3, 3', 3". The upper element may consist of an angle section with 90° between a mainly horizontal part 15 and a mainly vertical part 16, which constitute the main parts of the section. The element may also comprise a second vertical part 16' for further reinforcement. The lower element 3 may be designed as an inverted T section with a base part 17 and a vertical part 18. The upper element 2 and the lower element 3 are both connected to a first connection element 5, which, in the figure, consists of a plate with a relatively large cross-section. The connection element 5 is permanently fixed, at its upper end, to the upper element 2 and, at its lower end, to the lower element 3. The connection element may also be permanently connected to the vertical parts 16, 16'. Such connections preferably consist of welded connections. The connection element is expediently mounted in the centre area between the ends of the lower element 3 and is also designed to support part of a vertical load which is transferred to the structural element 1 via a structural element 4. Such a load may consist of parts of the weight supported by the structural element, but may also consist of vertical load in the opposite direction, for example in connection with lifting the structure. Moreover, the vertical part 16 of the upper element 2 is designed to lie against the base part 17 in the underlying T section so that vertical loads may be transferred between the upper element 2 and the lower element 3 along the full length of the structural element 1.

[0008] Moreover, the structural element comprises connection elements 6, 7, 8, 9, which consist of plates with a much smaller cross-section than the connection element 5. Like the connection element 5, the plates are permanently fixed, at their upper and lower ends, to the upper element 2 and the lower element 3 respectively. The purpose of the plates is both to transfer forces between the upper element 2 and the lower element 3 and to compensate for mutual movements between the elements 2, 3 in their longitudinal direction.

[0009] The figure also shows torsion-stabilising elements 10, 11, 12, 13, which are permanently connected, at their tops, to the upper element 2 and possibly also, in part of their vertical extent, to the vertical part(s) 16, 16'. At their lower ends, they are suspended above the base part 17 but have lateral contact with the vertical part 18 of the T section. In this way, a gap is formed between the vertical part 16 of the upper element 2 and the torsion-stabilising elements, which will allow mutual longitudinal changes between the upper element 2 and the lower element 3 and will also counteract mutual torsion and distortion between the elements.

[0010] The vertical part 18 of the T section may have

through cutouts (not shown) in the area above where the torsion-stabilising elements are in contact with it. They may expediently be U-shaped without sharp corners which may initiate crack formation. The purpose of the cutouts is for the contact surface between the torsion-stabilising elements and the vertical part 18 to be reduced to allow greater elasticity in the connection between them.

[0011] Moreover, Figure 1a shows through cutouts 20, 21, 22, 23, 24, 25, 26, 27 which extend some way in from the side of the base part 17 in the lower element 3. These cutouts may consist of slots. The purpose of the cutouts is for thermally induced changes in length in the base part to be partially isolated to the parts between the cutouts, thus contributing to stabilisation of the T section in relation to torsion and distortion.

[0012] As shown in the figure, the upper element 2 is continuous throughout the section, while three lower elements 3, 3', 3'' are shown in part with openings 30, 31 between them. The purpose of this is to isolate longitudinal expansion in the lower part of the structural element 1, which, when in contact with the top of a furnace chamber, will be most exposed to thermal load. The size of the openings 30, 31 must, therefore, be dimensioned on the basis of knowledge of the relevant application so that the elements 3, 3', 3'' may expand freely.

[0013] As shown in the figure, the upper element 2 may be equipped with holes 14 to ensure that ambient air flows through, which will contribute to cooling the structure. In particular, the connection elements 5, 6, 7, 8, 9 will, when cooled, contribute to the lower element 3, which lies on the hot top of the furnace, being cooled advantageously. Accordingly, the torsion-stabilising elements will also function as cooling ribs in the structural element 1. The figure also shows part of brick work 19, which is designed to rest against the structural element 1. This will be described further under Figure 2.

[0014] Figure 2 shows a section of a cover 50, seen in perspective, using structural elements in accordance with the present invention. As shown, the cover comprises an arch 51, which may consist of one or more layers of refractory material. The arch (only partially shown) is built inside a frame structure 53 and rests, at its lower ends, against two longitudinal side members 54, 55 in a base frame 69. The cover also comprises two end walls. Only a section of one wall 56 is shown in the figure. Accordingly, the end walls rest against two cross members 57 (only one is shown in the figure) which constitute part of the base frame. The frame structure 53 may comprise fixings (not shown) for connection to a lifting device when the cover needs to be moved.

[0015] Both the longitudinal side members and the cross members may comprise structural elements 1 of the type mentioned above. All the members are designed to rest against a base, which may consist of the upper part of a furnace chamber for insertion of carbon bodies (not shown).

[0016] The figure shows that a leg 67 of the frame

structure 53 is fixed at the centre of a lower element 60, equivalent to that shown in Figure 1. Accordingly, the other legs of the frame structure are fixed in the same way in the other lower elements 58, 59. The upper element 61 extends continuously along the full length of the side member. The stated lower elements 58, 59, 60, which thus constitute part of the longitudinal side member 54 in the base frame 69, are mounted so that a small opening is formed between them. In the figure, the reference 70 indicates the opening between the structural elements 60 and 59.

[0017] On the transverse end of the cover, the figure shows a leg 68 which is fixed to a lower element 63 at its centre. Accordingly, other legs (not shown) are fixed to equivalent lower elements and a small opening is formed between the elements. A principal element of the transverse end of the cover is the wall itself 56, which may consist of a steel plate. In the cross member 57, which consists of a structural element as mentioned above under Figure 1, the steel plate may constitute the equivalent vertical part to that indicated by reference 16 in Figure 1b. Moreover, the torsion-stabilising elements may consist of small pieces of plate 71 which are welded onto the base part and the vertical part to reinforce the T section. The cross member may also be designed using the same principles for thermal compensation as stated for structural element 1.

Claims

1. A thermally compensated structural element (1) comprising an upper element (2) and one or more lower elements (3, 3', 3''), wherein
the upper element consists of an angle section with a mainly horizontal part (15) and a mainly vertical part (16) thus having a L- or U- shape, the lower element (3) is designed with a base part (17) and a vertical part (18), thus having a T- shape, whereby the upper element (2) and the lower element (3) are interconnected by means of a first connection element (5) centrally mounted in relation to the extent of each lower element (3, 3', 3''), and further by means of connection elements (6, 7, 8, 9) designed to be able to compensate for mutual movement between the upper element (2) and the lower element (3) in the longitudinal direction of the structural element (1).
2. A thermally compensated structural element in accordance with claim 1,
characterised in that
the connection elements (5, 6, 7, 8, 9) are plate-shaped and permanently connected, at their upper ends, to the upper element (2) and, at their lower ends, to the lower element (3).

3. A thermally compensated structural element in accordance with claim 1,
characterised in that
the vertical part (16), at its lower end, is in contact with one side surface of the vertical part (18), and that torsion-stabilising elements (10, 11, 12, 13) are in contact with the other side surface of the part (18) so that the latter is located in a gap formed between the vertical part 16 and the elements (10, 11, 12, 13).
4. A thermally compensated structural element in accordance with claim 3,
characterised in that
there are cutouts in the vertical part (18) over the areas where the torsion-stabilising elements (10, 11, 12, 13) are in contact with it.
5. A thermally compensated structural element in accordance with claim 3,
characterised in that
the torsion-stabilising elements (10, 11, 12, 13) are plate-shaped and are also permanently connected to the element (2) at their upper ends and possibly partially at their vertical sides.
6. A thermally compensated structural element in accordance with claim 1,
characterised in that
several lower elements (3, 3', 3'') form part of the structural element (1) and are also mounted so that a gap (70) is formed between them.
7. A thermally compensated structural element in accordance with claim 1,
characterised in that
the base part (17) is equipped with through cutouts (20, 21, 22, 23, 24, 25, 26, 27) which extend some way in from one side of it.
8. Use of a thermally compensated structural element as defined in accordance with claims 1-7,
characterised in that
one or more thermally compensated structural elements form part of a base frame for a cover for use in a thermal process such as calcining of carbon bodies.

Patentansprüche

1. Ein thermisch ausgeglichenes Konstruktionselement (1), das ein oberes Element (2) und eines oder mehrere untere Elemente (3, 3', 3'') umfasst, wobei das obere Element aus einem Winkelprofil mit einem hauptsächlich horizontalen Teil (15) und einem hauptsächlich vertikalen Teil (16) besteht und somit eine L- oder U-Form aufweist, das untere Element

(3) mit einem Basisteil (17) und einem vertikalen Teil (18) konzipiert ist und somit eine T-Form aufweist, wobei das obere Element (2) und das untere Element (3) mittels eines ersten Verbindungselements (5) verbunden sind, das gegenüber der Ausdehnung jedes unteren Elements (3, 3', 3'') mittig montiert ist, und weiterhin anhand von Verbindungselementen (6, 7, 8, 9), die so gestaltet sind, dass sie wechselseitige Bewegungen zwischen dem oberen Element (2) und dem unteren Element (3) in der Längsrichtung des Konstruktionselements (1) ausgleichen können.

2. Ein thermisch ausgeglichenes Konstruktionselement gemäß Behauptung 1, **gekennzeichnet dadurch, dass** die Verbindungselemente (5, 6, 7, 8, 9) plattenförmig und an ihren oberen Enden fest mit dem oberen Element (2) und an ihren unteren Enden mit dem unteren Element (3) verbunden sind.
3. Ein thermisch ausgeglichenes Konstruktionselement gemäß Behauptung 1, **gekennzeichnet dadurch, dass** der vertikale Teil (16) an seinem oberen Ende eine der Seitenflächen des vertikalen Teils (16) berührt und dass die torsionsstabilisierenden Elemente (10, 11, 12, 13) die andere Seitenfläche des Teils (18) berühren, so dass sich letzteres in einer Lücke zwischen dem vertikalen Teil 16 und den Elementen (10, 11, 12, 13) befindet.
4. Ein thermisch ausgeglichenes Konstruktionselement gemäß Behauptung 3, **gekennzeichnet dadurch, dass** es Durchstiche im vertikalen Teil (18) über den Bereichen gibt, in denen die torsionsstabilisierenden Elemente (10, 11, 12, 13) diesen berühren.
5. Ein thermisch ausgeglichenes Konstruktionselement gemäß Behauptung 3, **gekennzeichnet dadurch, dass** die torsionsstabilisierenden Elemente (10, 11, 12, 13) plattenförmig und an ihren oberen Enden und möglicherweise teilweise an ihren vertikalen Seiten fest mit dem Element (2) verbunden sind.
6. Ein thermisch ausgeglichenes Konstruktionselement gemäß Behauptung 1, **gekennzeichnet dadurch, dass** mehrere untere Elemente (3, 3', 3'') einen Teil des Konstruktionselements (1) bilden und zudem so montiert sind, dass zwischen ihnen eine Lücke (70) gebildet wird.
7. Ein thermisch ausgeglichenes Konstruktionselement gemäß Behauptung 1, **gekennzeichnet dadurch, dass** der Basisteil (17) mit Durchstichen (20, 21, 22, 23, 24, 25, 26, 27) versehen ist, die an einer Seite davon ein wenig hineinreichen.

8. Verwendung eines thermisch ausgeglichenen Konstruktionselements in der Definition gemäß den Behauptungen 1-7, **gekennzeichnet dadurch, dass** eines oder mehrere thermisch ausgeglichene Konstruktionselemente einen Teil eines Basisrahmens für eine Abdeckung zum Einsatz in einem thermischen Prozess wie der Kalzinierung von Carbonkörpern bilden.

Revendications

1. Élément structural à compensation thermique (1) comprenant un élément supérieur (2) et un ou plusieurs éléments inférieurs (3, 3', 3''), dans lequel l'élément supérieur consiste en une cornière comportant une pièce essentiellement horizontale (15) et une pièce essentiellement verticale (16), ayant donc une forme en L ou en U, l'élément inférieur (3) est conçu avec une pièce formant base (17) et une pièce verticale (18), ayant donc une forme en T, l'élément supérieur (2) et l'élément inférieur (3) étant reliés au moyen d'un premier élément de liaison (5) monté centralement par rapport à l'éten due de chaque élément inférieur (3, 3', 3''), et par ailleurs au moyen d'éléments de liaison (6, 7, 8, 9) conçus pour être capables de compenser un mouvement mutuel entre l'élément supérieur (2) et l'élément inférieur (3) dans le sens longitudinal de l'élément structural (1).
2. Élément structural à compensation thermique selon la revendication 1, **caractérisé en ce que** les éléments de liaison (5, 6, 7, 8, 9) sont en forme de plaque et reliés en permanence, par leurs extrémités supérieures, à l'élément supérieur (2) et, par leurs extrémités inférieures, à l'élément inférieur (3).
3. Élément structural à compensation thermique selon la revendication 1, **caractérisé en ce que** la pièce verticale (16), à son extrémité inférieure, est en contact avec une surface latérale de la pièce verticale (18), et **en ce que** des éléments de stabilisation en torsion (10, 11, 12, 13) sont en contact avec l'autre surface latérale de la pièce (18) de telle sorte que cette dernière est située dans un espace vide formé entre la pièce verticale (16) et les éléments (10, 11, 12, 13).
4. Élément structural à compensation thermique selon la revendication 3, **caractérisé en ce que** il y a des encoches dans la pièce verticale (18) sur les zones où les éléments de stabilisation en torsion

(10, 11, 12, 13) sont en contact avec elle.

5. Élément structural à compensation thermique selon la revendication 3, **caractérisé en ce que** les éléments de stabilisation en torsion (10, 11, 12, 13) sont en forme de plaque et sont aussi reliés en permanence à l'élément (2) par leurs extrémités supérieures et peut-être partiellement par leurs côtés verticaux.
6. Élément structural à compensation thermique selon la revendication 1, **caractérisé en ce que** plusieurs éléments inférieurs (3, 3', 3'') font partie de l'élément structural (1) et sont aussi montés de telle sorte qu'un espace vide (70) est formé entre eux.
7. Élément structural à compensation thermique selon la revendication 1, **caractérisé en ce que** la pièce formant base (17) est équipée d'encoches traversantes (20, 21, 22, 23, 24, 25, 26, 27) qui s'étendent sur une certaine distance depuis l'un de ses côtés.
8. Utilisation d'un élément structural à compensation thermique tel que défini selon les revendications 1-7, **caractérisé en ce que** un ou plusieurs éléments structuraux à compensation thermique font partie d'un cadre de base pour un couvercle à utiliser dans un processus thermique tel que la calcination de corps en carbone.

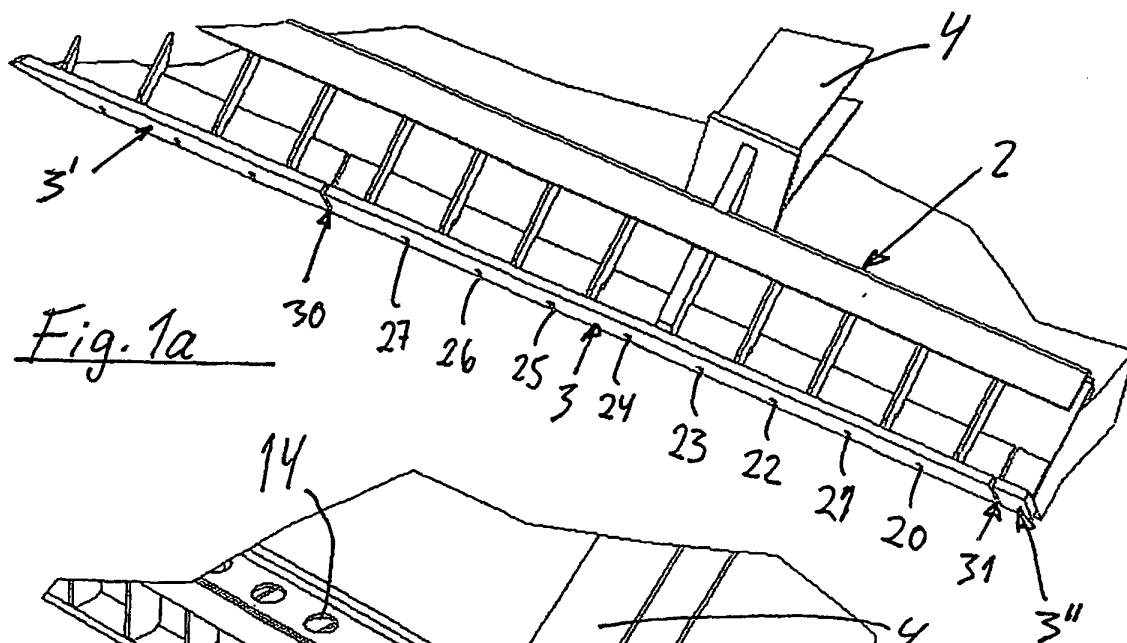


Fig. 1a

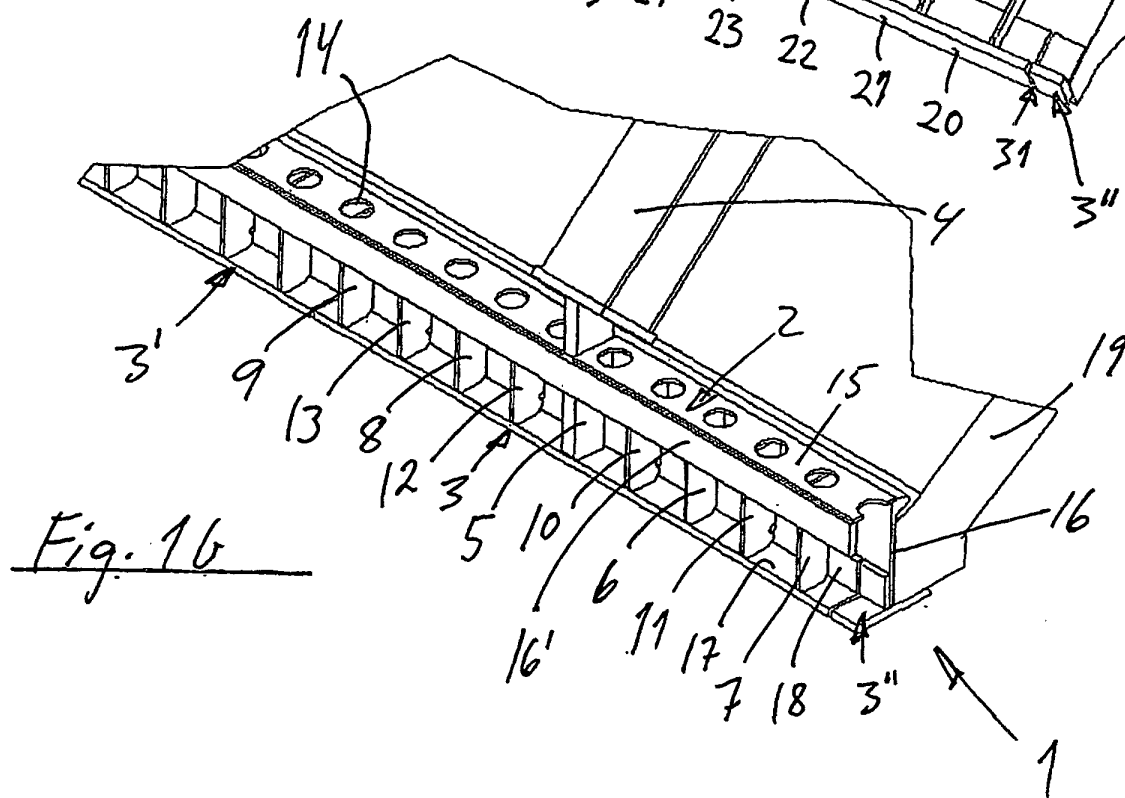


Fig. 16

