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(54) **LINING AND COOLING ARRANGEMENT FOR A METALLURGICAL FURNACE**

AUSKLEIDUNG UND KÜHLANORDNUNG FÜR EINEN METALLURGISCHEN OFEN

AGENCEMENT DE REVÊTEMENT ET DE REFROIDISSEMENT POUR FOUR MÉTALLURGIQUE

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Description

BACKGROUND TO THE INVENTION

[0001] THIS invention relates to a lining and cooling arrangement for a metallurgical furnace, and more particularly but not exclusively to a containment ring forming part of a lining and cooling arrangement for a metallurgical furnace.

[0002] Cooling of the refractory lining of a metallurgical furnace is a critical aspect of successful and extended furnace operations. Lining life is often determined by abnormal operating events and extreme operating conditions. To improve lining life and guarantee extended performance, particular care must be given to design and installation of a sidewall cooling system. Various sidewall lining and cooling designs and configurations are known in industry, and it is for example common practice for a furnace to include a working lining comprising refractory bricks, with copper cooling elements located on top of the refractory brick lining.

[0003] In one example, a bottom zone of a furnace sidewall cooler of the stave or waffle type interfaces with a refractory brick lining of the furnace. As the brick lining expands upwards due to thermal expansion of the sidewall brick lining itself as well as radial thermal expansion of the furnace hearth brick lining, the coolers are lifted upwards. However, if the furnace is cooled down, the brick lining and coolers do not always move down by its own weight, and gaps can form between the bricks as well as between the brick lining and the coolers. A hold down mechanism is normally used to ensure the coolers are pushed down onto the brick lining in order to close the gaps. The hold down mechanism normally employs springs to ensure the coolers and brick lining can move upwards under expansion pressure, but will move downwards during cooling and shrinking of the refractory brick lining in the sidewall and hearth. If the gaps are not closed, it can fill up with dust, grit or molten material resulting in unwanted growth of the lining over time, also called "ratcheting".

[0004] Previously, hold down mechanisms were designed to hold down a complete cooler ring or row as a unit. Due to differential expansion from one side of the furnace to the other side, gaps could form during operation between the bottom of the coolers and the bricks as the cooler ring is lifted more on side of the furnace compared to the other. To solve this problem, coolers are now mostly equipped with individual hold down mechanisms. In other words, each cooler is held down on the brick lining below independently from the other coolers. It is believed this has been an improvement.

[0005] However, even with independent held down coolers, leakage of slag (could also be matte/metal) is known to occur from time to time. These leakages are most frequently experienced at the junction between the vertical interface between adjacent coolers and the horizontal interface between the coolers and refractory brick

lining below. It can be imagined that if a particular cooler lifts more than the adjacent cooler, an open channel between the furnace sidewall hot face and the furnace sidewall cold face can form at this interface junction. Molten material can then leak from the furnace bath through this channel to the furnace sidewall.

[0006] This problem is amplified by the fact that the refractory brick lining underneath the coolers expands more on the hot face compared to the cold face. As such, as the expanding brick lining lifts the coolers above, the contact between the brick lining and the coolers can be limited to a small area underneath the hot face "toe" of the cooler. The brick lining underneath the coolers may in fact tilt upwards on the hot face side whilst the cooler does not tilt as it is constrained vertically on the furnace shell or a similar support backing frame and structure. A tapering or flaring gap can therefore be formed directly behind the toe of the brick lining and the bottom surface of the cooling element. It is therefore foreseen that if molten material leak through a small gap on the hot face it will enter a larger cavity behind this gap, leaving a clear path to leak to the sidewall cold face.

[0007] The main solution proposed and implemented to date for this problem is the use of hold down mechanisms employing springs or hydraulics, both for a sidewall lining/cooling system as a unit, or independently held down coolers as described above. Although these mechanisms assist, they do not always manage fully to close the gaps between the cooling elements and the refractory bricks.

[0008] It is accordingly an object of the invention to provide a lining and cooling arrangement for a metallurgical furnace that will, at least partially, alleviate the above shortcomings.

[0009] It is also an object of the invention to provide a lining and cooling arrangement for a metallurgical furnace which will be a useful alternative to existing cooling arrangements for metallurgical furnaces.

[0010] US 2013/099430 A1 discloses an elastically interconnected cooler comprising a plurality of coolers cast as segments of a ring and interconnected with springs and bolts through flanges on their outer perimeter to form an elastic hoop.

SUMMARY OF THE INVENTION

[0011] According to a first aspect of the present invention, there is provided a sidewall lining and cooling arrangement for a metallurgical furnace including:

a layer of refractory bricks located adjacent a furnace shell of the furnace, the layer of refractory bricks having a hot side that is in use the side facing the inside of the furnace, and a cold side that is in use the side facing the furnace shell;

a cooling element located on top of the layer of refractory bricks, the cooling element having a hot side that is in use the side facing the inside of the furnace,

and a cold side that is in use the side facing the furnace shell; wherein a contact interface is defined between the top of the layer of refractory bricks and a bottom of the cooling element; and
a containment ring located adjacent the cold sides of the cooling element and the layer of refractory bricks, wherein the containment ring covers the contact interface between the top of the layer of refractory bricks and a bottom of the cooling element.

[0012] There is provided for the containment ring to have an operatively lower end and an operatively upper end, wherein the operatively lower end extends downwardly below the interface between the cooling element and the layer of refractory bricks, and wherein the operatively upper end extends upwardly above the interface between the cooling element and the layer of refractory bricks.

[0013] There is provided for the lower end of the containment ring to extend operatively downwardly at least one brick height of the layer of refractory bricks. Preferably, the lower end of the containment ring extends operatively downwardly at least two brick height of the layer of refractory bricks.

[0014] In preferred embodiment of the invention there is provided for the containment ring to be independent from the cooling element and not fixed to or part of the cooling element.

[0015] The containment ring may be in the form of a plurality of containment plates, blocks or bricks that are locatable adjacent one another so as to form a continuous containment ring.

[0016] There is provided for the plurality of containment plates, blocks or bricks to be configured to form lap joints when located adjacent one another.

[0017] There is provided for the containment ring to be made from copper, stainless steel or cast iron.

[0018] A further feature of the invention provides for the lining and cooling arrangement to include a bolting arrangement for use in urging the containment ring into contact with the cold faces of the cooling element and the layer of refractory bricks.

[0019] The bolting arrangement may extend through the furnace shell or cooling element support structure, and may include a biasing means for exerting an abutment bias onto the containment ring.

[0020] In one embodiment of the invention there is also provided for the lining and cooling arrangement to include an expansion layer located between the cold face of the layer of refractory bricks and the containment ring.

[0021] The expansion layer may be in the form of a refractory material type expansion board or a refractory ramming material.

[0022] According to a further aspect of the invention there is provided a furnace including the lining and cooling arrangement as described above.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] Embodiments of the invention are described by way of non-limiting examples, and with reference to the accompanying drawings in which:

Figure 1 is a cross-sectional reference illustration of an electric arc furnace showing the area of the furnace where a containment ring forming part of the lining and cooling arrangement of this invention will in use be located, without actually disclosing the specific design and configuration of the lining and cooling arrangement;

Figure 2 is a cross-sectional reference illustration of a top submerged lance furnace showing the area of the furnace where a containment ring forming part of the lining and cooling arrangement of this invention will in use be located, without actually disclosing the specific design and configuration of the lining and cooling arrangement;

Figure 3 shows a first embodiment of a lining and cooling arrangement in accordance with the invention;

Figure 4 shows a second embodiment of a lining and cooling arrangement in accordance with the invention;

Figure 5 shows a third embodiment of a lining and cooling arrangement in accordance with the invention;

Figure 6 shows a fourth embodiment of a lining and cooling arrangement in accordance with the invention;

Figure 7 shows a top plan view of two spaced apart components of a containment ring, showing one example of a lap joint formed between the two components;

Figure 8 is a schematic view of a lining and cooling arrangement in accordance with the invention, including an expansion layer, and a bolting arrangement; and

Figure 9 is a schematic view of a further lining and cooling arrangement in accordance with the invention, in this case including a biased bolting arrangement, but no expansion layer.

DETAILED DESCRIPTION OF INVENTION

[0024] Before any embodiments of the invention are

explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the following drawings. The invention is capable of other embodiments and of being practiced or of being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting. The use of "including," "comprising," or "having" and variations thereof herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items. Unless specified or limited otherwise, the terms "mounted," "connected," "supported," and "coupled" and variations thereof are used broadly and encompass both direct and indirect mountings, connections, supports, and couplings and are thus intended to include direct connections between two members without any other members interposed therebetween and indirect connections between members in which one or more other members are interposed therebetween. It is noted that, as used in this specification and the appended claims, the singular forms "a," "an," and "the," and any singular use of any word, include plural referents unless expressly and unequivocally limited to one referent. As used herein, the term "include" and its grammatical variants are intended to be non-limiting, such that recitation of items in a list is not to the exclusion of other like items that can be substituted or added to the listed items.

[0025] Referring to the drawings, in which like numerals indicate like features, a non-limiting and simplified example of a lining and cooling arrangement for a furnace in accordance with the invention is generally indicated by reference numeral 10.

[0026] The invention finds application in amongst others, electric furnaces, schematically illustrated in Figure 1, as well as top submerged lance furnaces, schematically illustrated in Figure 2. Note that Figure 1 and 2 merely serves to indicated where the lining and cooling arrangement 20 and hence the containment ring 25, are located, and does not serve to exemplify the detail design associated with the new lining and cooling arrangement of this invention.

[0027] With references to all the figures, a furnace 10 includes a furnace shell 11 which defines an internal volume 12 therein. A lining and cooling arrangement 20 is provided inside the furnace between the shell 11 and the internal volume 12, and this invention specifically focusses on a lining and cooling arrangement 20 located towards and operatively lower end of the furnace 10.

[0028] The lining and cooling arrangement 20 includes a layer of refractory bricks 21, comprising a plurality of independent bricks 22 stacked on top of one another. The layer of refractory bricks 21 has a hot face 21.1, being the side facing the internal volume 12, and a cold face 21.2, being the side facing the furnace shell 11.

[0029] Cooling elements 23 are located on top of the upper surface of the layer of refractory bricks 21. In this

example, the cooling elements are made from copper, but it will be appreciated that materials may suffice. Each cooling element also has a hot face 23.1, being the side facing the internal volume 12, and a cold face 23.2, being the side facing the furnace shell 11. A contact interface 30 is defined between the upper surface of the layer of refractory bricks 21, and the lower surface of the copper cooling elements 23. In use, this interface constitutes a potential leakage path between the cooling elements 23 and the layer of refractory bricks 21. The copper cooling element 23 does not extend the entire width of the layer of refractory bricks 21, but does include a lower extension 24 that protrudes from the rest of the cooling element, and which extends towards the furnace shell.

[0030] A containment ring 25 is provided adjacent the cold faces (21.2 and 23.2) of the layer of refractory bricks and the cooling element, and extends at least across the interface 30 between the layer of refractory bricks and the cooling element, so as to seal off one end of the potential leakage path defined by the interface 30.

[0031] The invention provides for the containment ring to be in the form of a plurality of plates or blocks or bricks that are located behind the potential gap formed on the horizontal interface 30 between the bottom of the cooler 23 and the brick lining 21 below. In the embodiments shown in Figures 3 to 5, the containment ring comprises a plurality of plates (shown in figure 7), with each plate being 50 mm in thickness, either cooled or uncooled, but preferably uncooled. The plates are made from a cast iron material such as Meehanite® HS that can withstand operating temperatures up to 900°C, has mechanical strength, and is independent from the cooler and the refractory brick lining. In the embodiment of Figure 6 the containment ring will be integrally formed with the cooling element 23.

[0032] In Figures 3 to 5 the containment ring 25 is installed during the brick lining installation. The containment ring 25 is positioned behind the cold face 21.2 of the layer of refractory bricks 21 directly below the cooling element 23. The containment ring 25 extends vertically downwardly at least one brick height (typically between 75 mm and 100 mm high) but preferably two brick heights. It is envisaged for the containment ring to extend at least 100 mm vertically upwards behind the cooling element 23.

[0033] In the embodiment shown in Figure 5, the bottom extension 24 of the cooling element 23 is configured to form a lap joint with an upper end of the containment ring 25. As mentioned above, in most embodiments (Figures 3 to 5) the containment ring 25 will be separate from the cooling element, but it is possible to have the containment ring combined with the cooling element, as is shown in Figure 6.

[0034] The embodiments shown in Figure 3 and 4 are very similar. However, in the embodiment in Figure 3 the bottom end of the containment ring 25 rests on a backing lining made from refractory brick or another refractory material and which is located adjacent the cold face of

the operatively lower refractory bricks 22 forming part of the layer of refractory bricks 21, whereas in the embodiment of Figure 4 the bottom end of the containment ring 25 rests on operatively lower bricks 22 of the layer of refractory bricks 21 that extend beyond the outer periphery of the uppermost bricks of the layer of refractory bricks 21 so as to define an landing for receiving the bottom end of the containment ring 25..

[0035] As is shown in Figures 8 and 9, there is also provided for the lining and cooling arrangement 20 to include a bolting arrangement 90 that can be used to push the containment ring 25 tight against the cold faces (21.2 and 23.2) of the cooling element 23 and the brick lining 21. The bolting arrangement will typically extend through the furnace shell 11. As a further option, the bolting arrangement may incorporate a spring arrangement 95 (seen in Figure 9) to ensure that contact is maintained between the containment ring 25 and the cooling element 23 and layer of refractory bricks 21, which will then also allow for radial expansion of the layer of refractory bricks 21 and the subsequent closing of the gap so formed during cooling periods.

[0036] As mentioned above, the containment ring takes the form of a plurality of containment plates, blocks or bricks that are locatable adjacent one another so as to form a continuous containment ring. As shown in the Figure 7, there is also provided for the plurality of containment plates, blocks or bricks to be configured to form lap joints 29 when located adjacent one another so as to seal of the vertical gaps between the adjacent plates, bricks or blocks that make up the containment ring 25.

[0037] Figure 8 shows an embodiment of the invention including an expansion layer 100. The expansion layer 100 is located between the cold face 21.2 of the layer of refractory bricks and the containment ring 25. The expansion layer is typically in the form of a refractory material type expansion board or a refractory ramming material. The expansion layer, if present, typically extends all the way up to the underside of the cooling element 23. In some cases, due to the cooling effect of the cooling element on the brick directly below it, the expansion layer may be omitted or at least of reduced thickness behind the top row of bricks. In TSL furnaces, because the overall diameter is less than electric furnaces, expansion allowance is normally in the form of expansion paper (2 mm thick) installed between every so often brick in a particular row. In other words, expansion is allowed for circumferentially versus radially behind the bricks.

[0038] It will be appreciated that the above are only some embodiments of the invention and that there may be many variations without departing from the scope of the claims. It is easily understood from the present application that the particular features of the present invention, as generally described and illustrated in the figures, can be arranged and designed according to a wide variety of different configurations. In this way, the description of the present invention and the related figures are not provided to limit the scope of the invention but simply rep-

resent selected embodiments.

[0039] The skilled person will understand that the technical characteristics of a given embodiment can in fact be combined with characteristics of another embodiment, unless otherwise expressed or it is evident that these characteristics are incompatible. Also, the technical characteristics described in a given embodiment can be isolated from the other characteristics of this embodiment unless otherwise expressed.

Claims

1. A sidewall lining and cooling arrangement (20) for a metallurgical furnace (10) including:

a layer of refractory bricks (21) located adjacent a furnace shell (11) of the furnace, the layer of refractory bricks having a hot side (21.1) that is in use the side facing the inside of the furnace, and a cold side (21.2) that is in use the side facing the furnace shell;

a cooling element (23) located on top of the layer of refractory bricks (21), the cooling element having a hot side (23.1) that is in use the side facing the inside of the furnace, and a cold side (23.2) that is in use the side facing the furnace shell (11); wherein a contact interface (30) is defined between the top of the layer of refractory bricks and a bottom of the cooling element; and a containment ring (25) located adjacent the cold sides (21.2, 23.2) of the cooling element (23) and the layer of refractory bricks (21), wherein the containment ring covers the contact interface (30) between the top of the layer of refractory bricks and a bottom of the cooling element.

2. The sidewall lining and cooling arrangement (20) according to claim 1, wherein the containment ring (25) has an operatively lower end and an operatively upper end, wherein the operatively lower end extends downwardly below the contact interface (30) between the cooling element (23) and the layer of refractory bricks (21), and wherein the operatively upper end extends upwardly above the contact interface between the cooling element and the layer of refractory bricks.
3. The sidewall lining and cooling arrangement (20) according to claim 2, wherein the lower end of the containment ring (25) extends operatively downwardly at least one brick (22) height of the layer of refractory bricks (21).
4. The sidewall lining and cooling arrangement (20) according to claim 2, wherein the lower end of the containment ring (25) extends operatively downwardly at least two brick (22) heights of the layer of refractory

bricks (21).

5. The sidewall lining and cooling arrangement (20) according to any one of the preceding claims, wherein the containment ring (25) is in the form of a plurality of containment plates, blocks or bricks that are locatable adjacent one another so as to form a continuous containment ring. 5
6. The sidewall lining and cooling arrangement (20) according to claim 5, wherein the adjacently located containment plates, blocks or bricks form lap joints (29) when located adjacent one another. 10
7. The sidewall lining and cooling arrangement (20) according to any one of the preceding claims, including a bolting arrangement (90) for use in urging the containment ring (25) into contact with the cold faces (21.2, 23.2) of the cooling element (23) and the layer of refractory bricks (21). 15 20
8. The sidewall lining and cooling arrangement (20) according to claim 7, wherein the bolting arrangement (90) extends through the furnace shell (11) or cooling element support structure. 25
9. The sidewall lining and cooling arrangement (20) according to claim 7 or 8, wherein the bolting arrangement (90) includes a biasing means (95) for exerting an abutment bias onto the containment ring (25). 30
10. The sidewall lining and cooling arrangement (20) according to any one of the preceding claims, further including an expansion layer (100) located between the cold face (21.2) of the layer of refractory bricks (21) and the containment ring (25). 35
11. The sidewall lining and cooling arrangement (20) according to claim 10, wherein the expansion layer (100) is in the form of a refractory material type expansion board or a refractory ramming material. 40
12. A furnace (10) including the lining and cooling arrangement (20) according to any one of claims 1 to 11. 45

Patentansprüche

1. Seitenwandauskleidungs- und Kühlanordnung (20) für einen metallurgischen Ofen (10), die Folgendes beinhaltet: 50

eine Schicht aus feuerfesten Steinen (21), die an einen Ofenmantel (11) des Ofens angrenzend liegt, wobei die Schicht aus feuerfesten Steinen eine heiße Seite (21.1) aufweist, die bei Verwendung die Seite ist, die dem Inneren des

Ofens zugewandt ist, und eine kalte Seite (21.2), die bei Verwendung die Seite ist, die dem Ofenmantel zugewandt ist;
 ein Kühlelement (23), das auf der Oberseite der Schicht aus feuerfesten Steinen (21) liegt, wobei das Kühlelement eine heiße Seite (23.1) aufweist, die bei Verwendung die Seite ist, die dem Inneren des Ofens zugewandt ist, und eine kalte Seite (23.2), die bei Verwendung die Seite ist, die dem Ofenmantel (11) zugewandt ist; wobei eine Kontaktschnittfläche (30) zwischen der Oberseite der Schicht aus feuerfesten Steinen und einem Boden des Kühlelements definiert ist; und
 einen Einschlussring (25), der an die kalten Seiten (21.2, 23.2) des Kühlelements (23) und die Schicht aus feuerfesten Steinen (21) angrenzend liegt, wobei der Einschlussring die Kontaktschnittfläche (30) zwischen der Oberseite der Schicht aus feuerfesten Steinen und einem Boden des Kühlelements abdeckt.

2. Seitenwandauskleidungs- und Kühlanordnung (20) nach Anspruch 1, wobei der Einschlussring (25) ein operativ unteres Ende und ein operativ oberes Ende aufweist, wobei sich das operativ untere Ende nach unten unter die Kontaktschnittfläche (30) zwischen dem Kühlelement (23) und der Schicht aus feuerfesten Steinen (21) erstreckt, und wobei sich das operativ obere Ende nach oben über die Kontaktschnittfläche zwischen dem Kühlelement und der Schicht aus feuerfesten Steinen erstreckt.
3. Seitenwandauskleidungs- und Kühlanordnung (20) nach Anspruch 2, wobei sich das untere Ende des Einschlussrings (25) operativ um mindestens die Höhe eines Steins (22) der Schicht aus feuerfesten Steinen (21) nach unten erstreckt.
4. Seitenwandauskleidungs- und Kühlanordnung (20) nach Anspruch 2, wobei sich das untere Ende des Einschlussrings (25) operativ um mindestens die Höhen von zwei Steinen (22) der Schicht aus feuerfesten Steinen (21) nach unten erstreckt.
5. Seitenwandauskleidungs- und Kühlanordnung (20) nach einem der vorstehenden Ansprüche, wobei der Einschlussring (25) die Form einer Vielzahl von Einschlussplatten, -blöcken oder -steinen aufweist, die aneinander angrenzend derart liegen können, dass sie einen durchgehenden Einschlussring bilden.
6. Seitenwandauskleidungs- und Kühlanordnung (20) nach Anspruch 5, wobei die aneinandergrenzend liegenden Einschlussplatten, -blöcke oder -steine Überlappungsverbindungen (29) bilden, wenn sie aneinander angrenzend liegen.

7. Seitenwandauskleidungs- und Kühlanordnung (20) nach einem der vorstehenden Ansprüche, die eine Verschraubungsanordnung (90) zur Verwendung beim Drücken des Einschlussrings (25) zum Kontakt mit den kalten Flächen (21.2, 23.2) des Kühlelements (23) und der Schicht aus feuerfesten Steinen (21) beinhaltet. 5
8. Seitenwandauskleidungs- und Kühlanordnung (20) nach Anspruch 7, wobei sich die Verschraubungsanordnung (90) durch den Ofenmantel (11) oder die Kühlelementtragstruktur erstreckt. 10
9. Seitenwandauskleidungs- und Kühlanordnung (20) nach Anspruch 7 oder 8, wobei die Verschraubungsanordnung (90) ein Vorspannmittel (95) zum Ausüben einer Anschlagvorspannung auf den Einschlussring (25) beinhaltet. 15
10. Seitenwandauskleidungs- und Kühlanordnung (20) nach einem der vorstehenden Ansprüche, die weiter eine Expansionsschicht (100) beinhaltet, die zwischen der kalten Fläche (21.2) der Schicht aus feuerfesten Steinen (21) und dem Einschlussring (25) liegt. 20
11. Seitenwandauskleidungs- und Kühlanordnung (20) nach Anspruch 10, wobei die Expansionsschicht (100) die Form eines feuerfesten Materials vom Typ Expansionsplatte oder eines feuerfesten Stampfmaterials aufweist. 30
12. Ofen (10), der die Seitenwandauskleidungs- und Kühlanordnung (20) nach einem der Ansprüche 1 bis 11 beinhaltet. 35

Revendications

1. Agencement de revêtement et de refroidissement de paroi latérale (20) pour un four métallurgique (10) incluant : 40
 - une couche de briques réfractaires (21) située adjacente à une carcasse de four (11) du four, la couche de briques réfractaires présentant un côté chaud (21.1) qui est en utilisation le côté faisant face à l'intérieur du four, et un côté froid (21.2) qui est en utilisation le côté faisant face à la carcasse de four ; 45
 - un élément de refroidissement (23) situé au-dessus de la couche de briques réfractaires (21), l'élément de refroidissement présentant un côté chaud (23.1) qui est, en utilisation, le côté faisant face à l'intérieur du four, et un côté froid (23.2) qui est, en utilisation, le côté faisant face à la carcasse de four (11) ; dans lequel une interface de contact (30) est définie entre le haut 50

de la couche de briques réfractaires et un bas de l'élément de refroidissement ; et une enceinte de confinement (25) située adjacente aux côtés froids (21.2, 23.2) de l'élément de refroidissement (23) et la couche de briques réfractaires (21), dans lequel l'enceinte de confinement recouvre l'interface de contact (30) entre le haut de la couche de briques réfractaires et un bas de l'élément de refroidissement.

2. Agencement de revêtement et de refroidissement de paroi latérale (20) selon la revendication 1, dans lequel l'enceinte de confinement (25) présente une extrémité opérationnellement inférieure et une extrémité opérationnellement supérieure, dans lequel l'extrémité opérationnellement inférieure s'étend vers le bas au-dessous de l'interface de contact (30) entre l'élément de refroidissement (23) et la couche de briques réfractaires (21), et dans lequel la couche opérationnellement supérieure s'étend vers le haut au-dessus de l'interface de contact entre l'élément de refroidissement et la couche de briques réfractaires. 25
3. Agencement de revêtement et de refroidissement de paroi latérale (20) selon la revendication 2, dans lequel l'extrémité inférieure de l'enceinte de confinement (25) s'étend opérationnellement vers le bas d'au moins une hauteur de brique (22) de la couche de briques réfractaires (21). 30
4. Agencement de revêtement et de refroidissement de paroi latérale (20) selon la revendication 2, dans lequel l'extrémité inférieure de l'enceinte de confinement (25) s'étend opérationnellement vers le bas d'au moins deux hauteurs de brique (22) de la couche de briques réfractaires (21). 35
5. Agencement de revêtement et de refroidissement de paroi latérale (20) selon l'une quelconque des revendications précédentes, dans lequel l'enceinte de confinement (25) est sous la forme d'une pluralité de plaques, blocs ou briques de confinement pouvant être situés adjacents les uns aux autres de manière à former une enceinte de confinement continue. 40
6. Agencement de revêtement et de refroidissement de paroi latérale (20) selon la revendication 5, dans lequel les plaques, blocs ou briques de confinement situés de manière adjacente forment des joints à recouvrement (29) lorsqu'ils sont situés adjacents les uns aux autres. 45
7. Agencement de revêtement et de refroidissement de paroi latérale (20) selon l'une quelconque des revendications précédentes, incluant un agencement de boulonnage (90) destiné à être utilisé pour 55

mettre l'enceinte de confinement (25) en contact avec les faces froides (21.2, 23.2) de l'élément de refroidissement (23) et la couche de briques réfractaires (21).

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8. Agencement de revêtement et de refroidissement de paroi latérale (20) selon la revendication 7, dans lequel l'agencement de boulonnage (90) s'étend à travers la carcasse de four (11) ou une structure de support d'élément de refroidissement. 10
9. Agencement de revêtement et de refroidissement de paroi latérale (20) selon la revendication 7 ou 8, dans lequel l'agencement de boulonnage (90) inclut un moyen de sollicitation (95) pour exercer une sollicitation de butée sur l'enceinte de confinement (25). 15
10. Agencement de revêtement et de refroidissement de paroi latérale (20) selon l'une quelconque des revendications précédentes, incluant en outre une couche d'expansion (100) située entre la face froide (21.2) de la couche de briques réfractaires (21) et l'enceinte de confinement (25). 20
11. Agencement de revêtement et de refroidissement de paroi latérale (20) selon la revendication 10, dans lequel la couche d'expansion (100) est sous la forme d'un panneau d'expansion de type à matériau réfractaire ou d'un matériau de battage réfractaire. 25
12. Four (10) incluant l'agencement de revêtement et de refroidissement (20) selon l'une quelconque des revendications 1 à 11. 30

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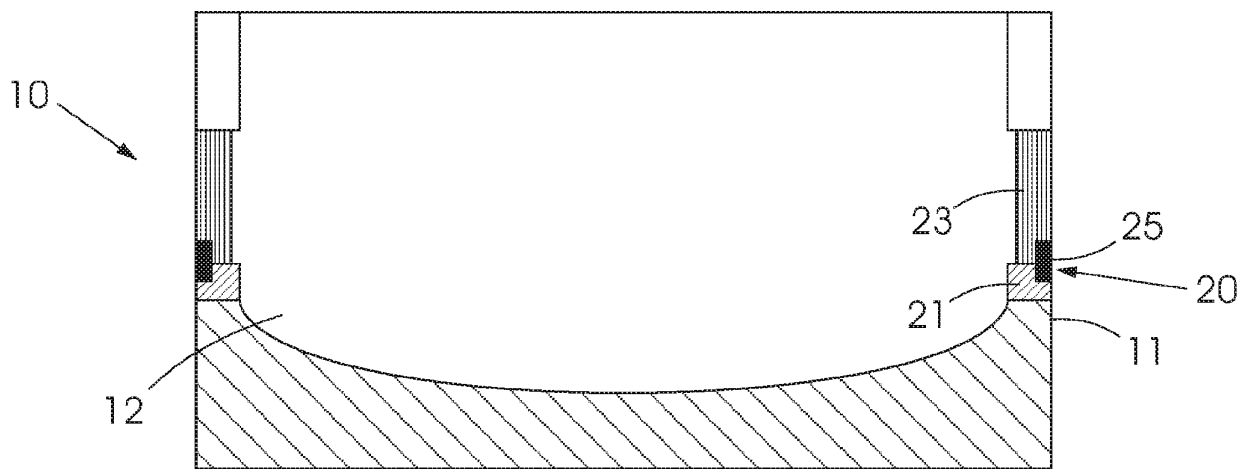


Fig. 1

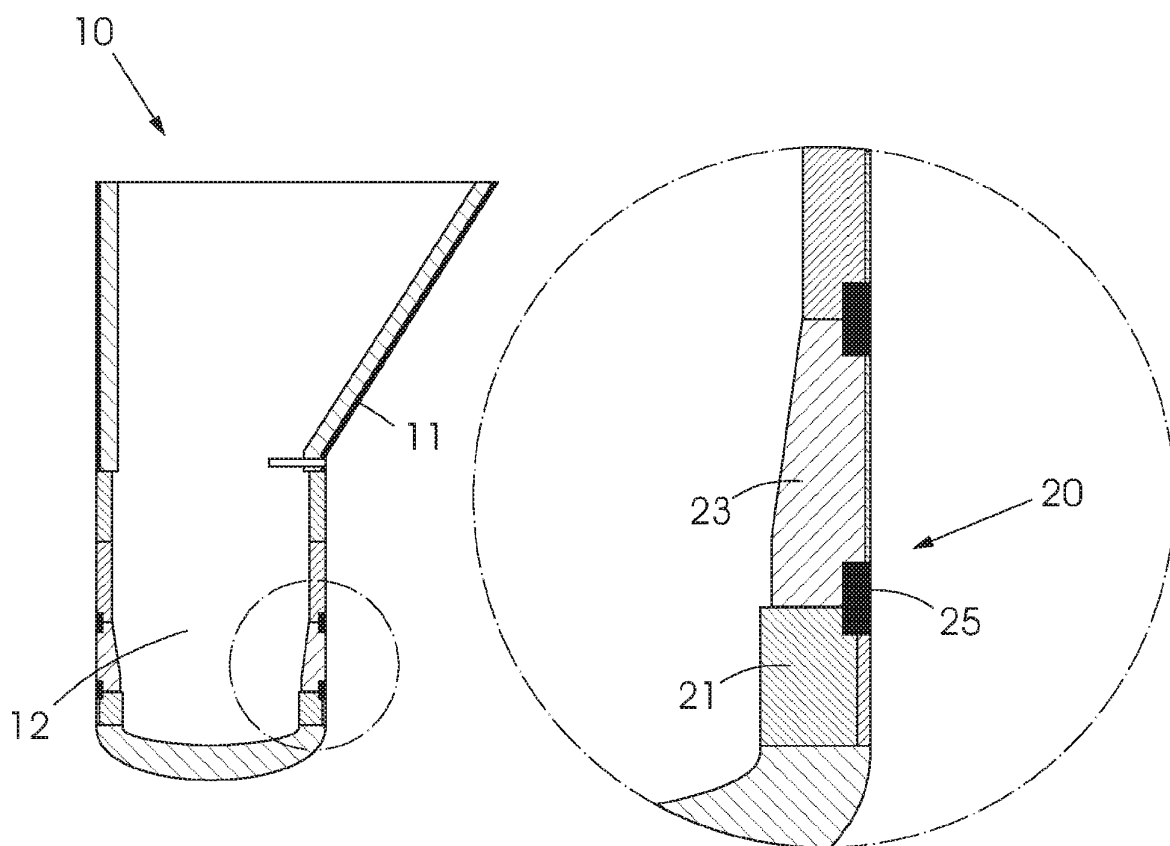
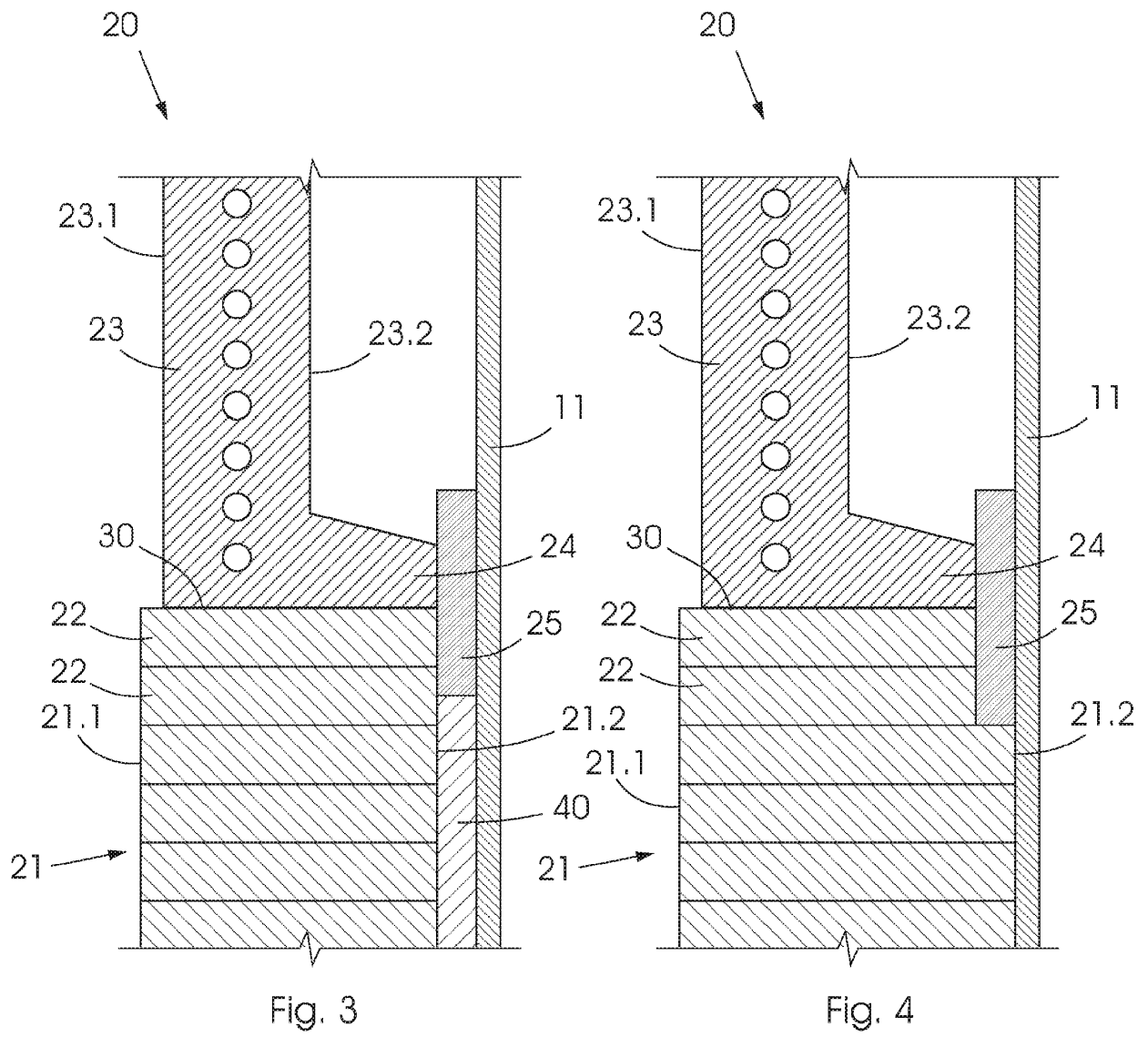
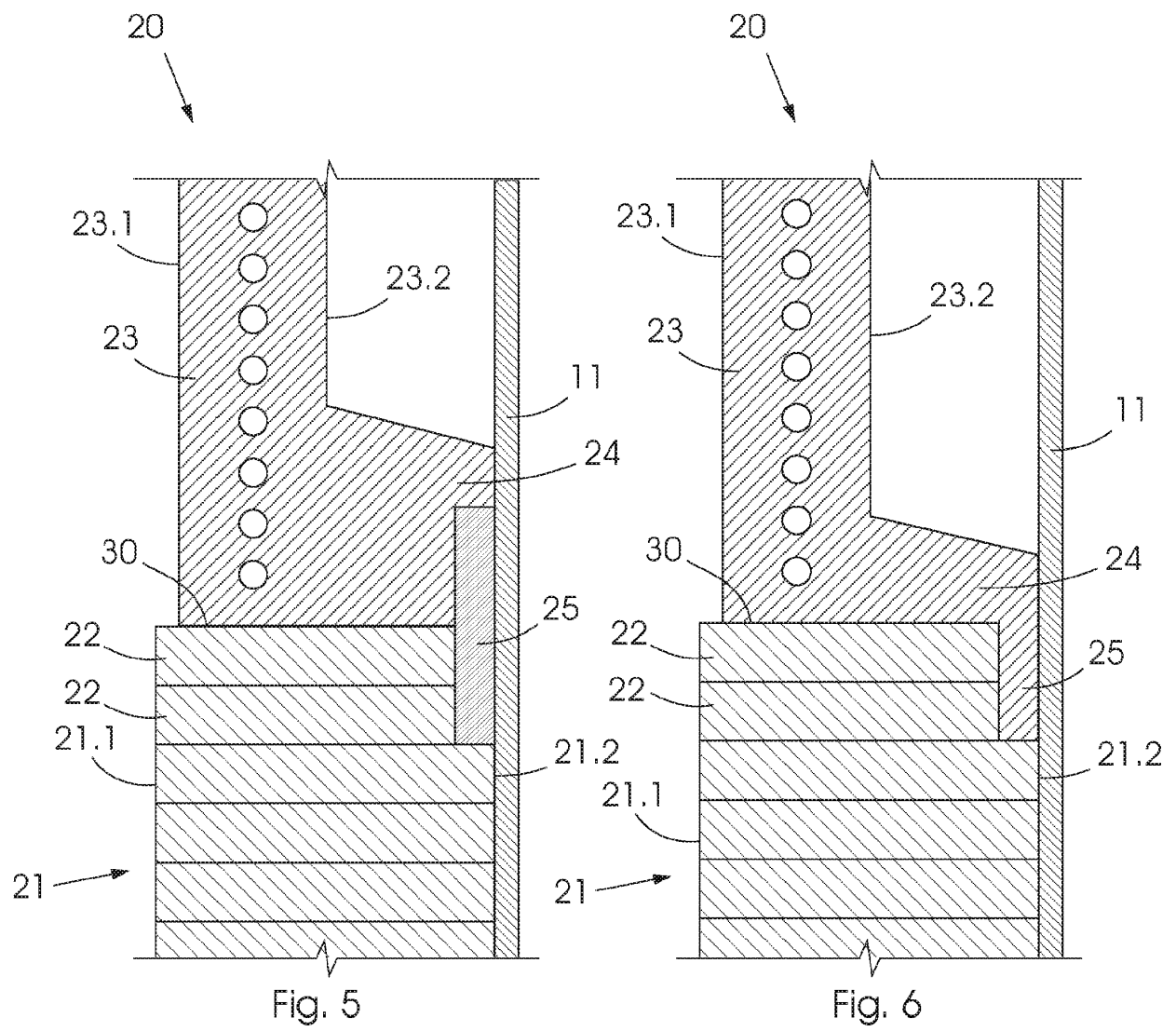


Fig. 2





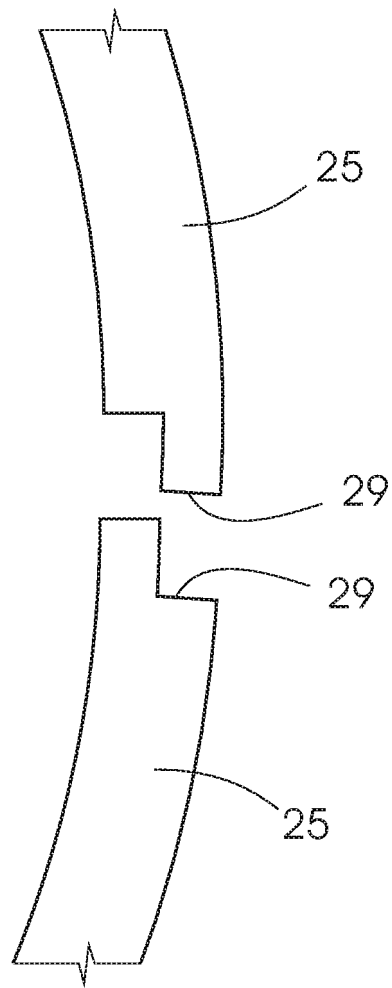
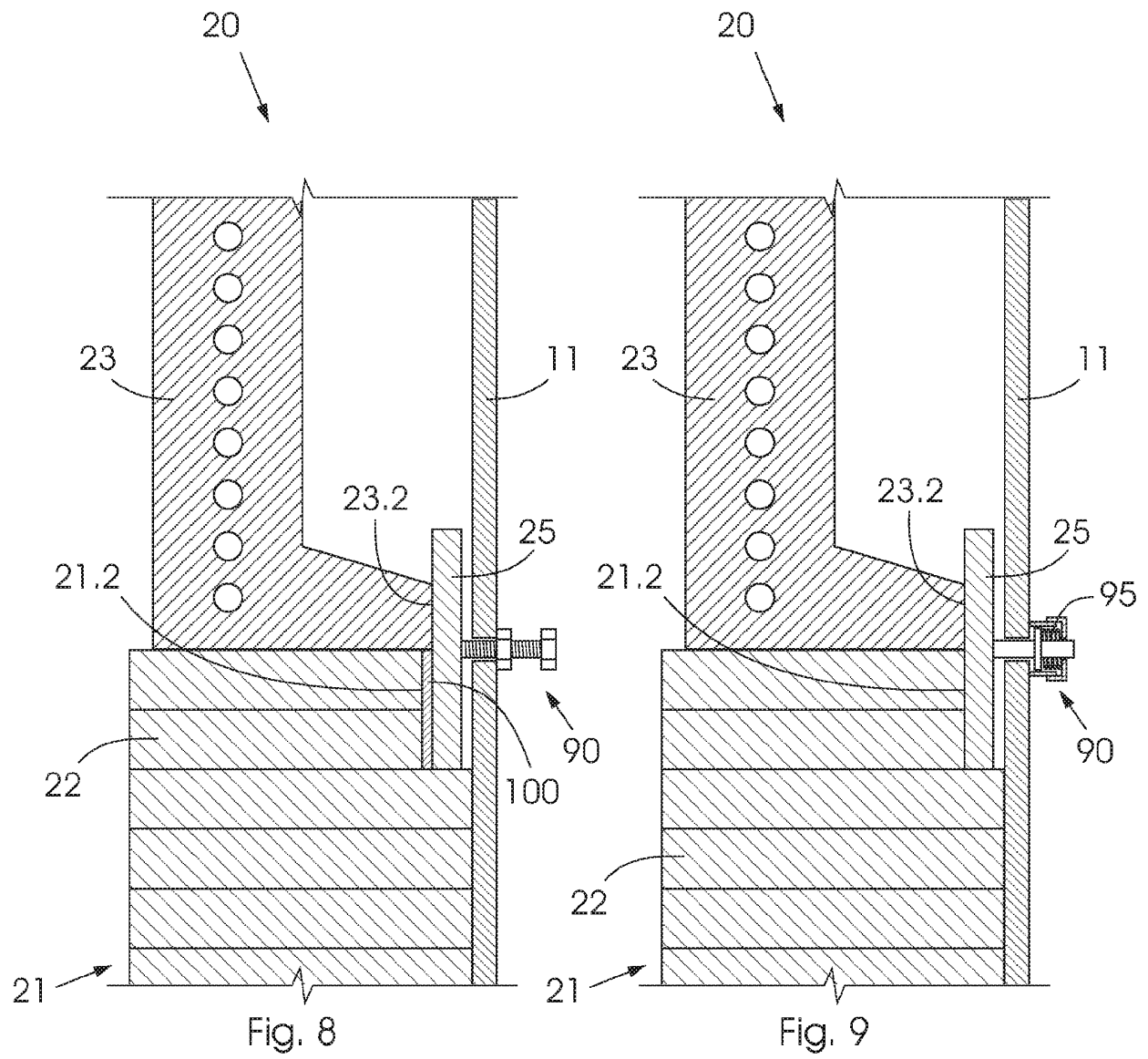


Fig. 7



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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