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(54) Title: REFRACTORY SNORKEL

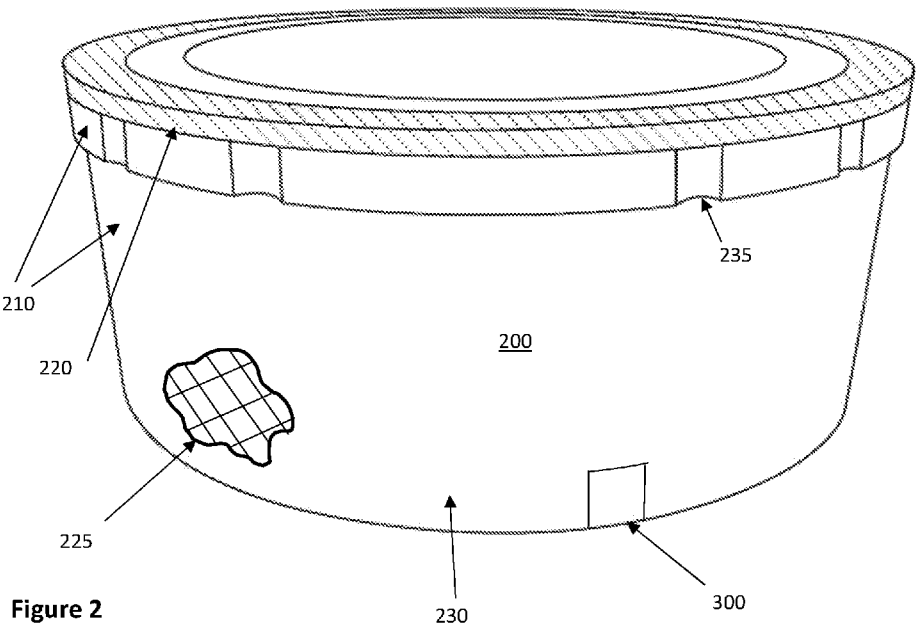


Figure 2

(57) Abstract: A refractory snorkel (200) having a tubular body having an upper portion defined by a first annular steel support (220), and a lower portion defined by a second annular ring (230) including refractory bricks (300) secured to the lowermost portion of the second annular ring (230).



Refractory snorkel

Field of the invention

[0001] The present invention relates to a refractory snorkel, a refractory brick and a method of forming the refractory snorkel for use in secondary steel production. However, it will be appreciated by those skilled in the art that the refractory snorkel and refractory brick may have applications in other fields of use.

Background

[0002] Any reference herein to known prior art does not, unless the contrary indication appears, constitute an admission that such prior art is commonly known by those skilled in the art to which the invention relates, at the priority date of this application.

[0003] Primary steel is manufactured in a primary furnace, such as a Basic Oxygen Furnace (BOF) or Electric Arc Furnace (EAF) using a process in which iron is converted into steel by an oxidation process which assists with the removal of carbon and other impurities like silicon, manganese and phosphorous to minimal required levels. However, primary steel generally requires a subsequent 'secondary' refinement.

[0004] In secondary steel making, primary steel is subjected to further refining using processes collectively known as "ladle metallurgy". In these secondary processes the steel produced in the primary furnace is refined to reduce impurities like sulphur, and its composition may optionally be altered through the addition of other alloy metals to produce a desired and consistent steel specification.

[0005] The main difference between primary and secondary steel relates to the dissolved oxygen content, noting that primary steel is not deoxidised. Also, sulphur cannot be removed in primary steel making. In secondary steel making, ferrosilicon (Fe-Si) and ferro aluminium (Fe-Al) are added to deoxidise, while iron manganese (Fe-Mn) is added to reduce sulphur. Thus, secondary steel is much cleaner than primary steel.

[0006] CAS-OB (Composition Adjustment by Sealed Argon Bubbling – Oxygen Blowing) is a secondary metallurgical ladle treatment process.

[0007] CAS-OB enables adjustment of the temperature to an optimum level and the accurate addition of alloying elements.

[0008] Liquid steel from a primary steelmaking process (basic oxygen furnace or electric arc furnace) is poured into a ladle. The ladle consists of a steel casing with a refractory brick or castable layer on the inside. The refractory layer provides insulation and is resistant to the corrosive environment of the steel bath, which is at a high temperature typically between 1,650 - 1,680 degrees C. Steel reacts with oxygen to form a surface slag phase. Oxides also dissolve into the slag phase. Typical slag components are FeO, SiO₂, MgO, Al₂O₃, and CaO.

[0009] The slag phase protects the liquid steel from the atmosphere and works as an insulating layer.

[0010] The CAS-OB process is designed to create an inert atmosphere above the liquid steel to allow the addition of alloys without contact with atmospheric oxygen or an oxide slag. This is achieved by first creating a slag free area at the surface of the liquid steel by the introduction of argon into the steel through a porous plug at the bottom of the ladle. The slag free area is known as “the eye”. Argon bubbles reaching the surface of the steel push aside the slag layer on top of the ladle, creating the slag free eye.

[0011] Once the eye is created, a snorkel can be lowered into the slag free area, and partially submerged below the surface of the liquid steel. The snorkel is typically defined by a cylindrical tube of precast refractory castable. The snorkel has an upper cover or bell which seals the snorkel. The bell has inputs for entry of alloy materials and oxygen, and ducts to vent off-gasses.

[0012] The bell and snorkel are used to contain an inert atmosphere of argon. The snorkel also provides a protected environment for adding alloying materials, where the steel surface is open, but still protected from contact with the surrounding atmosphere. This ensures that the amount of absorbed nitrogen can be kept at a low

level. The argon bubbling also provides stirring for homogenising temperature and composition of the steel.

[0013] The secondary heat treatment unit typically consists of two parts. The upper part (Bell) is normally lined only from the inside, while bottom (snorkel) is normally lined both inside and outside. Lining of the snorkel is generally done with high-alumina castable.

[0014] The service life of the lining of the top of the snorkel is normally significantly longer than the service life of the snorkel. This is primarily due to two factors. Firstly, the snorkel is affected by thermal shock when it is lowered into the molten steel, noting that the lower end of the snorkel must be immersed into the liquid steel by at least 200 mm.

[0015] Secondly the slag contains various impurities that corrosively attack the lining of the snorkel.

[0016] Furthermore, the location of highest wear of the snorkel lining may be affected by the position within the ladle where the argon gas is released. For example, it is common for the argon gas to be released off-centre in one specific quadrant of the snorkel, and wear on the snorkel lining may be more pronounced in that quadrant.

[0017] The combination of thermal shock and high corrosion results in a significantly reduced working life of the snorkel.

[0018] Snorkels are also used in the IRUT (Injection Refining Up Temperature) process which is a different secondary steel making process to the CAS-OB process, however, the IRUT snorkel is subjected to similar operating conditions to the CAS-OB snorkel and similar refractory linings are normally used.

Object of the Invention

[0019] It is an object of the invention to overcome or at least ameliorate one or more of the above disadvantages, or at least to provide a useful alternative.

Summary of the invention

[0020] In a first aspect, the present invention provides a refractory snorkel comprising:

a generally tubular body having an upper portion defined by a first annular steel support ring; and

a lower portion defined by a second annular ring, wherein refractory bricks are secured to a lowermost portion of the second annular ring.

[0021] Preferably the refractory bricks each have:

a body defining a brick upper surface and an opposing brick lower surface,
a mounting plate located at or near the brick upper surface,
at least one primary anchor secured to the mounting plate and extending into the brick body; and

at least one secondary anchor secured to the mounting plate and extending away from the brick upper surface, the secondary anchor extending into the refractory castable.

[0022] Preferably the height of the refractory brick between the brick upper surface and brick lower surface is between about 50 mm and 300 mm.

[0023] A layer of refractory castable is preferably located on a radially inner surface of the embodied bricks cast into the second annular ring.

[0024] A layer of refractory castable is preferably located on a radially outer surface of the embodied bricks cast into the second annular ring.

[0025] The refractory bricks are preferably made from magnesia/carbon or alumina/carbon or alumina/magnesia/carbon.

[0026] The second annular ring preferably includes refractory bricks arranged around a portion of the circumference of the second annular ring.

[0027] The refractory bricks are preferably arranged around about a quarter of the circumference of the second annular ring.

[0028] The second annular ring preferably includes refractory bricks arranged evenly and continuously around the circumference of the second annular ring.

[0029] In a second aspect, the present invention provides a refractory brick having a body defining a brick upper surface and an opposing brick lower surface, the refractory brick including:

 a mounting plate located at or near the brick upper surface,
 at least one primary anchor secured to the mounting plate and extending into the brick body; and
 at least one secondary anchor secured to the mounting plate and extending away from the brick upper surface.

[0030] The mounting plate is preferably formed from stainless steel.

[0031] The primary anchor is preferably formed from stainless steel and/or the secondary anchor is formed from stainless steel.

[0032] The secondary anchor is preferably defined by two arms having generally a Y or V-shaped profile.

[0033] The two arms are each preferably bent so that they extend in a non-linear manner.

[0034] The refractory brick preferably has a distal end of the secondary anchor capped with a plastic tip.

[0035] When viewed from either of the upper or lower surfaces, the brick preferably has a profile that tapers in width between longitudinally opposing ends.

[0036] Preferably when viewed from either of the upper or lower surfaces, the brick has the profile of a truncated isosceles triangle.

[0037] The mounting plate is preferably pressed into the brick upper surface prior to baking.

[0038] In a third aspect, the present invention provides a method of forming a refractory snorkel, the method including the steps of:

 moulding a plurality of refractory bricks each having a brick body defining a brick upper surface and an opposing brick lower surface,

 pressing a mounting plate into each brick upper surface so that at least one primary anchor secured to the mounting plate extends into each brick body;

 securing at least one secondary anchor to the mounting plate, the secondary anchor extending away from the brick upper surface,

casting a first annular ring from refractory castable seated on a steel support structure; and

forming a lower portion defined by a second annular ring whereby the secondary anchors of the refractory bricks are cast into the lower portion of the second annular ring.

[0039] Preferably the step of securing at least one secondary anchor to the mounting plate may be performed before or after the step of baking the bricks.

[0040] The method of forming a refractory snorkel further preferably includes the step of applying a layer of refractory castable to a radially inner and/or outer surface of the installed bricks around the lower portion of the second ring.

Brief description of the drawings

[0041] The invention will now be described, by way of non-limiting example, with reference to the accompanying drawings, in which:

[0042] Figure 1 is a schematic view of a conventional refractory snorkel and ladle; Figure 2 is a perspective side view of the refractory snorkel of the invention;

[0043] Figure 3 is a cross-sectional side view of a refractory brick according to the invention;

[0044] Figure 4 is a top view of the brick of Figure 2;

[0045] Figure 5 is an end view of the brick of Figure 2;

[0046] Figure 6 is a top view of the refractory brick of Figure 2 including secondary anchors;

[0047] Figure 7 is a side view of the brick of Figure 5;

[0048] Figure 8 is an end view of the brick of Figure 5; and

[0049] Figure 9 is a bottom view of a refractory snorkel according to the invention.

Detailed description

[0050] Figure 1 schematically depicts a conventional snorkel 100 and ladle 120 for secondary steel production. The snorkel 100 is inserted into an open eye on the steel surface, the eye being formed in the slag 130 by bubbling argon gas injected through a nozzle 140 in the base of the ladle 120, into the liquid steel 150. The snorkel 100 includes an oxygen lance 160 and ports for the entry of alloy metals and other additives, as well as a flue for the exhausting off-gasses.

[0051] The invention relates to an improved refractory snorkel 200, depicted schematically in Figure 2. As shown in Figure 2 the refractory snorkel 200 has a generally tubular body having an upper portion defined by a first annular ring 210 formed from refractory castable which is seated on a steel support structure 220, such as an annular steel ring. The steel structure also includes a castable support structure 225, schematically depicted partially exposed in Figure 2. The snorkel 200 has a second annular ring 230 formed at least partially from refractory bricks 300, which will be described below.

[0052] Refractory castable is premixed combinations of refractory aggregates, matrix components or modifiers, bonding agents, and admixtures which can be used to form monolithic refractories.

[0053] The upper portion of the snorkel has a steel or other such supporting structure 220 for holding the castable, and clamping to a bell. The notches 235 are used for clamping to the bell, so that the steel support structure 220 is accessible and provides multiple clamp points.

[0054] The castable support structure 225 can be provided in different ways. In one embodiment, the castable support structure 225 may be provided by an internal stainless steel or mild steel cylinder having stainless steel refractory anchors welded or otherwise attached to it. The refractory anchors are embedded in the castable and bond the castable to the supporting structure 225. In another embodiment, the supporting structure 225 may be provided by a mesh or perforated cylinder. The perforations provide a bonding mechanism to secure the castable to the supporting structure 225, as the castable extends between both sides of the supporting

structure through the mesh. It will be appreciated that other supporting structures 225 may be employed, which facilitate the snorkel 200 to be supported and secure to the upper bell.

[0055] An upper portion of the support structure steel ring 220 is clamped to the bottom of the bell.

[0056] Referring to Figure 2, the second annular ring 230 is formed at least partially from refractory bricks 300. In a preferred embodiment, the bricks 300 are arranged in a row defining the bottom of the second annular ring 230.

[0057] In the embodiment depicted in that figure, the outer diameter of the snorkel 200 steps radially inwardly between the first annular ring 210 and the second annular ring 230. In an alternative embodiment, the outer diameter may be generally constant with notches for clamping to the bell.

[0058] In the embodiment shown in Figure 2, the second annular ring 230 has a surface coating layer of castable which covers the bricks 300. However, it will be appreciated that in alternative embodiments, the bricks 300 may define all or most of the thickness of the second annular ring 230. Whilst the bricks of the preferred embodiment are arranged in one ring, as shown in Figure 9., alternatively, the bricks 300 may be arranged in two or more concentric rings.

[0059] Referring to figure 3, the refractory brick 300 has a body 305 defining a brick upper surface 310 and an opposing brick lower surface 320. The refractory brick 300 includes a mounting plate 330 located at or near the brick upper surface 310. The mounting plate 330 may be pressed so it is flush with the brick upper surface 310.

[0060] At least one primary anchor 350 is secured to the mounting plate 330 and extends into the brick body 305.

[0061] The bricks 300 each include at least one secondary anchor 360, best seen in figures 6 to 8. The secondary anchors 360 are secured to the mounting plate 330 and extend away from the brick upper surface 310, the secondary anchor 360 extends into the refractory castable of the upper portion, as will be described later.

[0062] The refractory bricks 300 may be manufactured with different dimensions. For example, the height may be between about 50mm and 300mm between the brick upper surface 310 and brick lower surface 320. In one embodiment, the brick 300 has a height of about 100mm.

[0063] In one embodiment, the bricks 300 have a length of about 225mm and a width of 87 mm at one end and 115 mm at a longitudinally opposing end. The brick taper may be varied to turn the diameter of the snorkel or alternatively a 2-taper system utilising sharp and slow tapered bricks can be used.

[0064] The second annular ring 230 may include a surface layer of refractory castable located on a radially inner surface of the second annular ring. A surface layer of refractory castable may also be located on a radially outer surface of the second annular ring 230.

[0065] The refractory bricks 300 are made from magnesia/carbon or alumina/carbon or alumina/magnesia/carbon, or another refractory material which allows them to operate in proximity to the liquid steel, including partially or fully immersed.

[0066] In some arrangements, the second annular ring 230 includes refractory bricks 300 arranged around a portion of the circumference of the second annular ring 230. For example, the refractory bricks 300 may be arranged around about a quarter of the circumference of the second annular ring 230 (Figure 9). In such an arrangement, the portion of the second annular ring 230 having the refractory bricks 300 may be aligned with the quadrant of the snorkel 200 circumference closest to the submerged argon gas inlet.

[0067] In contrast, in some embodiments, the refractory bricks 300 may be arranged continuously around the full circumference of the second annular ring 230.

[0068] The mounting plate 330 is formed from 310 grade stainless steel, or another suitable stainless steel. Similarly, the primary anchors 350 are also made from stainless steel, and may be welded, cast, or otherwise attached to the mounting plate 330. During manufacture of the brick 300, the mounting plate 330 is pushed

into the upper surface 310 of the brick 300, prior to low temperature baking process in a dryer or furnace.

[0069] The mounting plate in one embodiment has dimensions of around 100mm in length, 25mm in width and 5mm in thickness.

[0070] In the embodiment depicted in the drawings, each brick has two primary anchors 350, which are longitudinally spaced. However, it will be appreciated that more than two primary anchors 350 may be deployed, or a single primary anchor 350.

[0071] Each primary anchor 350 has two arms 355 which extend into the refractory material to bond the brick body 305 to the plate 330. The primary anchors 350 project about 25 mm into the body 305 of the refractory brick 300. The arms are depicted in a V shaped formation. It will be appreciated that other arm formations may be chosen that prevent, or at least inhibit, the separation of the brick 300 relative to the mounting plate 330.

[0072] The secondary anchors 360 are also formed from stainless steel, such as 8mm diameter rod. The secondary anchors 360 are each defined by two arms 365 having a generally V-shaped profile and separated by about 60 degrees. Furthermore, in the embodiment depicted, for example in figure 7, the two arms 365 are each also bent so that they extend in a curved, non-linear manner. A distal end of each secondary anchor 360 is capped with a plastic tip.

[0073] When viewed from either of the upper or lower surfaces 310, 320, the brick 300 has a profile that tapers in width between longitudinally opposing ends. Accordingly, the bricks 300 each have the profile of a truncated isosceles triangle. This tapering profile enables the bricks 300 to be arranged around the circumference of the second annular ring 230, whilst maintaining a relationship whereby adjacent edges of adjacent bricks remain in proximity to each other. This accommodates laying the bricks around a circle without excessive or uneven spacing. Alternatively, a 2 taper system utilising sharp and slow tapered bricks can be used.

[0074] The secondary anchors 360 are each secured to the mounting plate 330 by welding, casting or suitable fasteners. In the embodiment depicted in the drawings, each brick has two secondary anchors 360, which are longitudinally spaced. However, it will be appreciated that more than two secondary anchors 360 may be deployed, or a single secondary anchor 360. Each secondary anchor 360 extends about 100mm away from the upper surface 310 of the refractory brick 300.

[0075] The snorkel 200 is manufactured as follows. The snorkel 200 is manufactured upside down with steel support structure 220, in the form of a ring located at the bottom. Initially a mould is formed having inner and outer walls, defining a central annular void. A castable support structure 225 in the form of a steel cylinder 225 with stainless steel anchors welded to the inside and outside surfaces, or a steel mesh cage 225 is typically installed inside the void to support the castable, and the castable support structure 225 is secured to the steel support structure 220.

[0076] A plurality of the refractory bricks 300 are fabricated and baked at low temperatures. The secondary anchors 360 may be attached to the mounting plate 330 before or after the refractory bricks 300 have been baked.

[0077] Refractory castable is poured into the void, to produce the tubular upper portion or first annular ring 210 of the refractory snorkel 200. The castable bonds with the stainless-steel anchors or mesh perforations of the steel support structure 225.

Prior to baking or drying of the poured castable, the secondary anchors 360 of a plurality of the refractory bricks 300 are inserted into the lower section of the castable to define the second annular ring 230. However, as the snorkel is upside down, this will be at or near the top of the mould. The refractory bricks 300 can be installed either partially or fully around the circumference of the snorkel. A layer of refractory castable may be cast or otherwise applied to a radially inner surface of the second annular ring 230 and/or a radially outer surface of the second annular ring 230.

[0078] After the castable is cured or dried, the secondary anchor 360 become bonded, so that they cannot be removed from the solid castable first annular ring 210.

[0079] On completion, the snorkel 200 is subsequently turned upside down so that the bricks 300 define the lowermost portion of the snorkel 200

[0080] The refractory bricks 300 define the lowermost portion of the snorkel 200 which is closest to and in contact with the liquid steel. This is advantageous because refractory bricks such as magnesia/carbon and alumina/carbon and alumina/magnesia/carbon have improved corrosion and thermal shock resistance compared to the refractory castable that defines the upper portion of the snorkel 200.

[0081] The bell is clamped or secured to an upper portion of the snorkel 200, defined by an uppermost part of the first annular ring 210.

[0082] The refractory brick 300 thickness may vary at different locations around the circumference of the snorkel 200. For example, the bricks 300 may be thicker or longer in regions corresponding to greatest wear, typically closest to the argon source.

[0083] Advantageously, the snorkel 200 life is improved by increasing the resistance of the refractory lining to the severe operating conditions, in particular the corrosion resistance and thermal shock resistance.

[0084] Wherever it is used, the word “comprising” is to be understood in its “open” sense, that is, in the sense of “including”, and thus not limited to its “closed” sense, that is the sense of “consisting only of”. A corresponding meaning is to be attributed to the corresponding words “comprise”, “comprised” and “comprises” where they appear.

Claims:

1. A refractory snorkel comprising:

a generally tubular body having an upper portion defined by a first annular steel support ring; and

a lower portion defined by a second annular ring, wherein refractory bricks are secured to a lowermost portion of the second annular ring.
2. The refractory snorkel of claim 1, wherein the refractory bricks each have:

a body defining a brick upper surface and an opposing brick lower surface,

a mounting plate located at or near the brick upper surface,

at least one primary anchor secured to the mounting plate and extending into the brick body; and

at least one secondary anchor secured to the mounting plate and extending away from the brick upper surface, the secondary anchor extending into the refractory castable.
3. The refractory snorkel of claim 2, wherein the height of the refractory brick between the brick upper surface and brick lower surface is between about 50 mm and 300 mm.
4. The refractory snorkel of any one of the preceding claims, wherein a layer of refractory castable is located on a radially inner surface of the embodied bricks cast into the second annular ring.

5. The refractory snorkel of any one of the preceding claims, wherein a layer of refractory castable is located on a radially outer surface of the embodied bricks cast into the second annular ring.
6. The refractory snorkel of any one of the preceding claims, wherein the refractory bricks are made from magnesia/carbon or alumina/carbon or alumina/magnesia/carbon.
7. The refractory snorkel of any one of the preceding claims, wherein the second annular ring includes refractory bricks arranged around a portion of the circumference of the second annular ring.
8. The refractory snorkel of claim 7, wherein the refractory bricks are arranged around about a quarter of the circumference of the second annular ring.
9. The refractory snorkel of any one of the preceding claims, wherein the second annular ring includes refractory bricks arranged evenly and continuously around the circumference of the second annular ring.
10. A refractory brick having a body defining a brick upper surface and an opposing brick lower surface, the refractory brick including:
 - a mounting plate located at or near the brick upper surface,
 - at least one primary anchor secured to the mounting plate and extending into the brick body; and

at least one secondary anchor secured to the mounting plate and extending away from the brick upper surface.

11. The refractory brick of any one of the preceding claims wherein the mounting plate is formed from stainless steel.

12. The refractory brick of claim 10 wherein the primary anchor is formed from stainless steel and/or the secondary anchor is formed from stainless steel.

13. The refractory brick of claim 12, wherein the secondary anchor is defined by two arms having generally a Y or V-shaped profile.

14. The refractory brick of claim 13, wherein the two arms are each bent so that they extend in a non-linear manner.

15. The refractory brick of one of claims 13 or 14, wherein a distal end of the secondary anchor is capped with a plastic tip.

16. The brick of any one of claims 10 to 15, wherein when viewed from either of the upper or lower surfaces, the brick has a profile that tapers in width between longitudinally opposing ends.

17. The brick of claim 16, wherein when viewed from either of the upper or lower surfaces, the brick has the profile of a truncated isosceles triangle.

18. The brick of any one of claims 10 to 17, wherein the mounting plate is pressed into the brick upper surface prior to baking.

19. A method of forming a refractory snorkel, the method including the steps of:
- moulding a plurality of refractory bricks each having a brick body defining a brick upper surface and an opposing brick lower surface,
 - pressing a mounting plate into each brick upper surface so that at least one primary anchor secured to the mounting plate extends into each brick body;
 - securing at least one secondary anchor to the mounting plate, the secondary anchor extending away from the brick upper surface,
 - casting a first annular ring from refractory castable seated on a steel support structure; and
 - forming a lower portion defined by a second annular ring whereby the secondary anchors of the refractory bricks are cast to the lower portion of the second annular ring.
20. The method of forming a refractory snorkel of claim 19, wherein the step of securing at least one secondary anchor to the mounting plate may be performed before or after the step of baking the bricks.
21. The method of forming a refractory snorkel of claim 19 or 20, further including the step of applying a layer of refractory castable to a radially inner and /or outer surface of the installed bricks around the lower portion of the second ring.

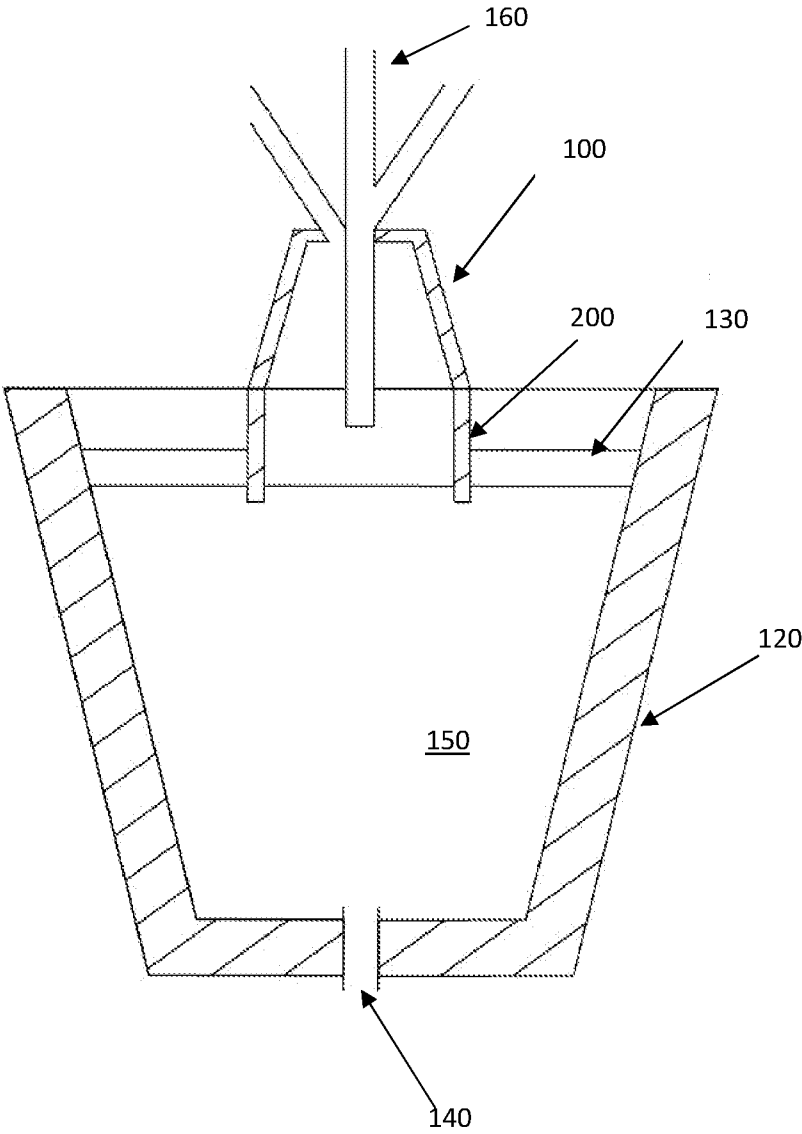


Figure 1

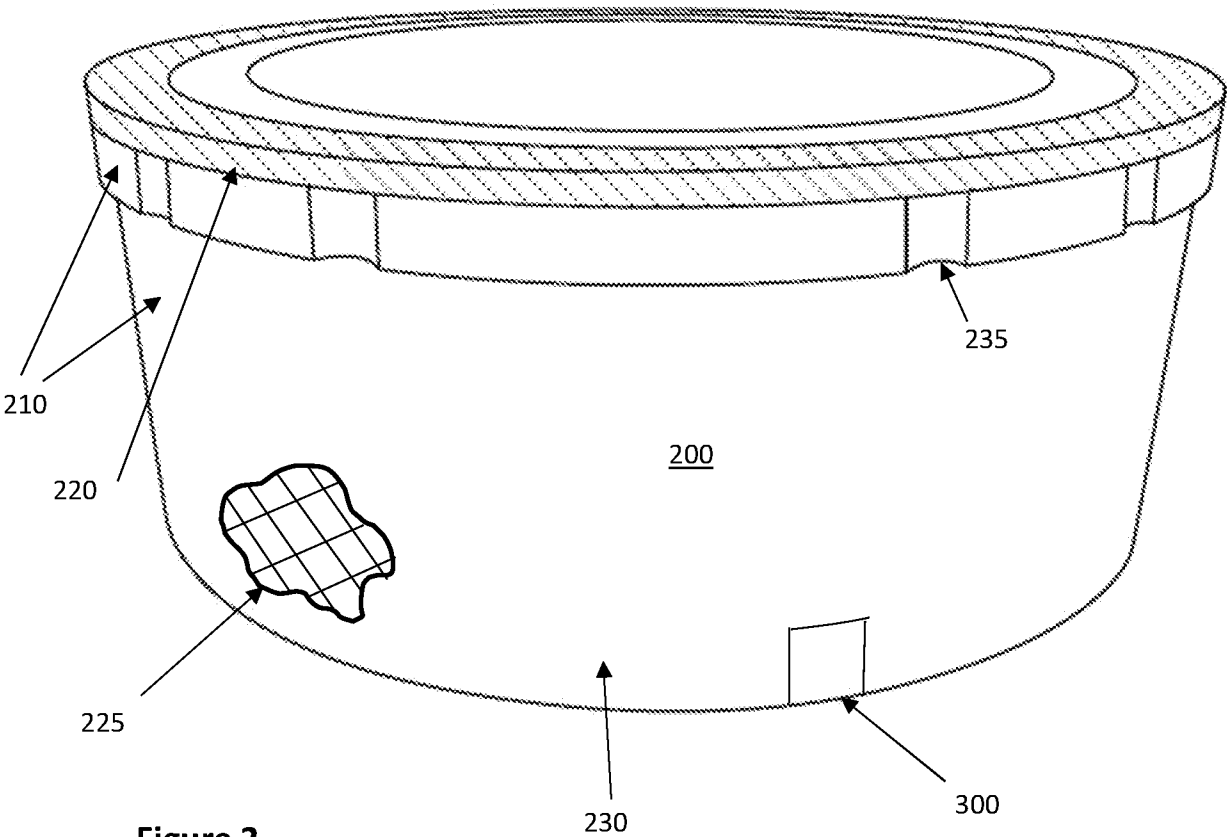


Figure 2

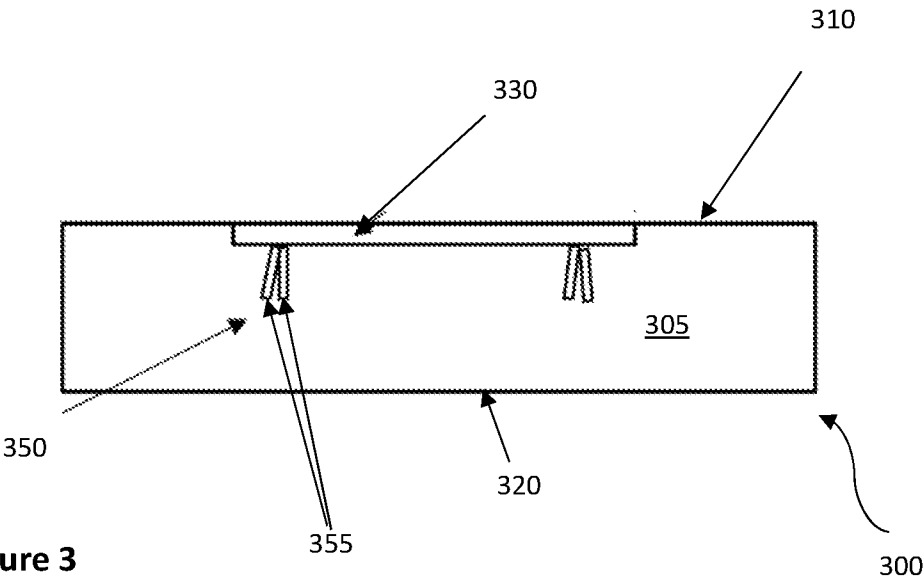


Figure 3

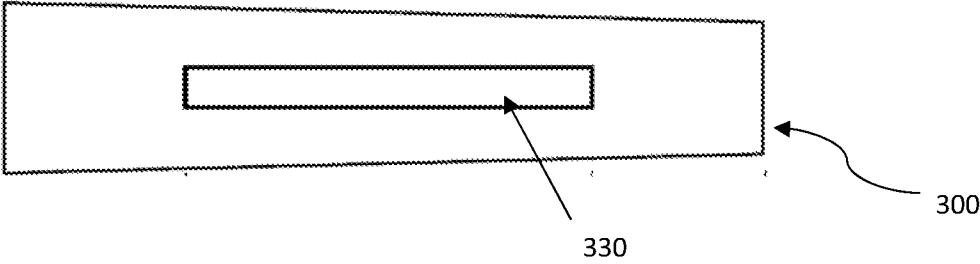


Figure 4

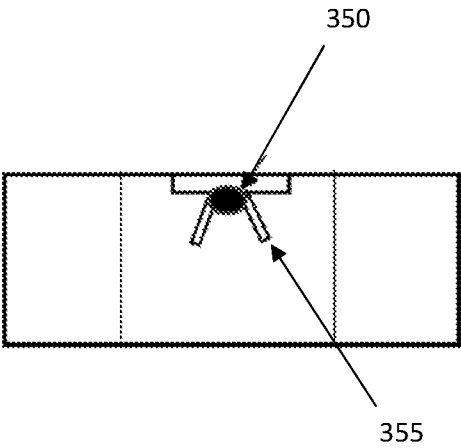


Figure 5

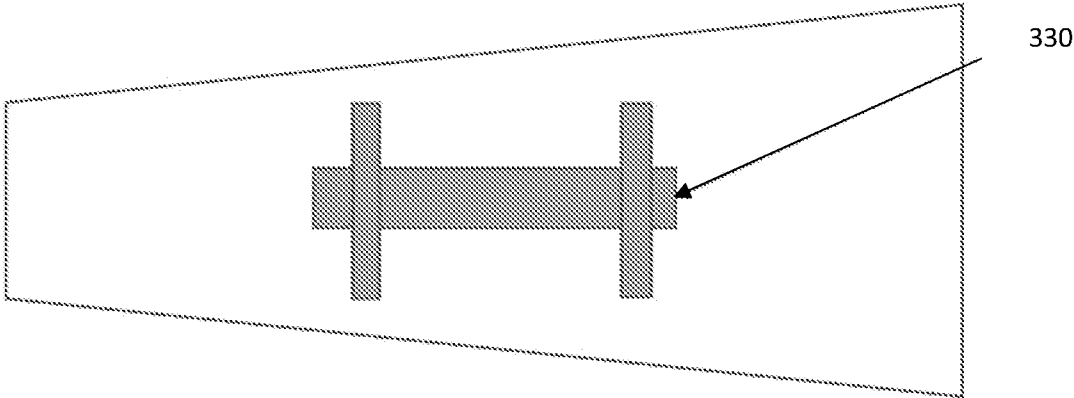


Figure 6

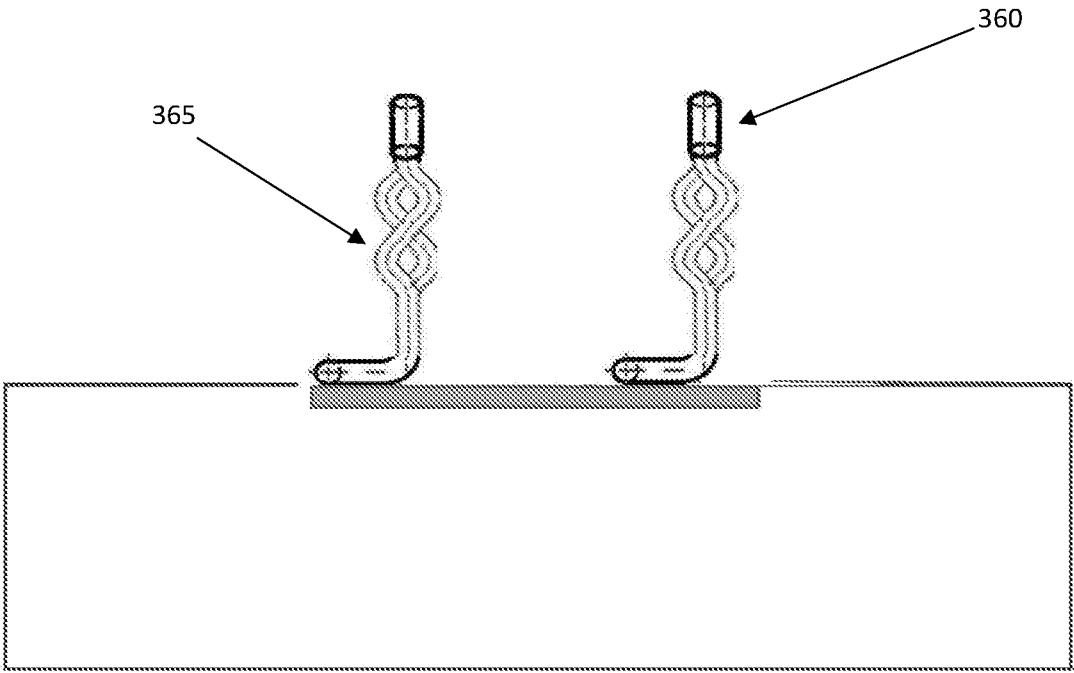


Figure 7

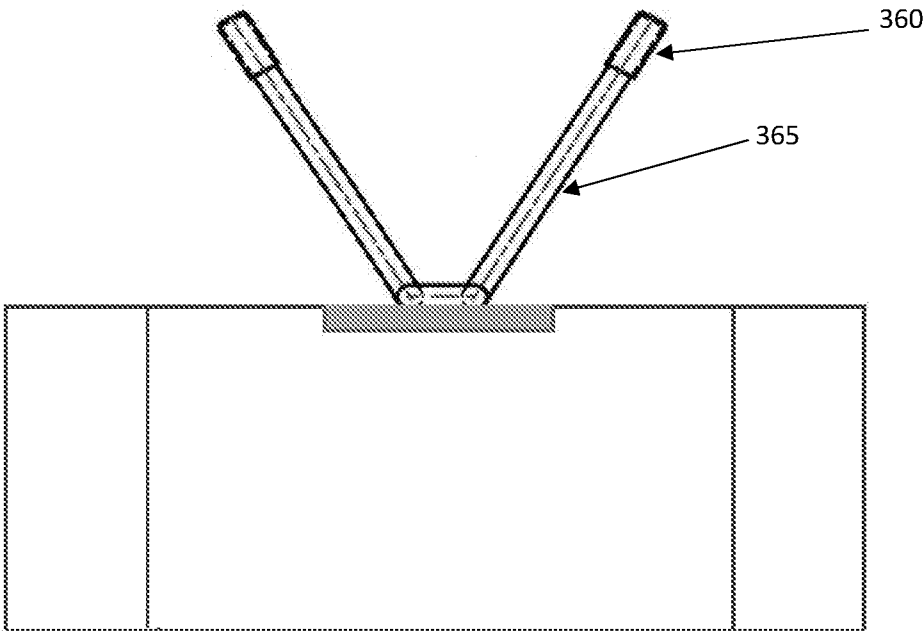


Figure 8

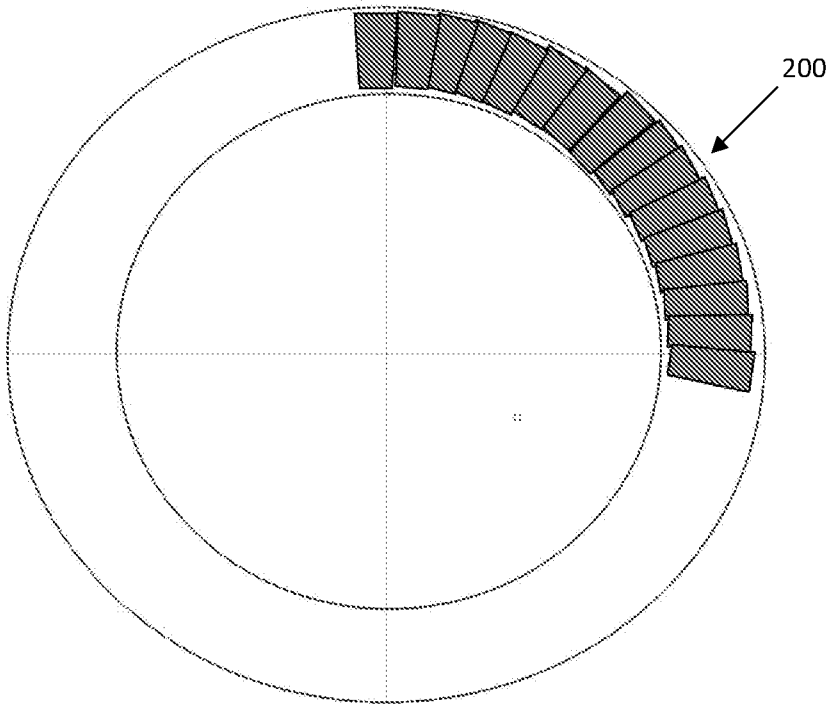


Figure 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2023/050540

A. CLASSIFICATION OF SUBJECT MATTER

F27D 1/00 (2006.01) B22D 1/00 (2006.01) C21C 5/44 (2006.01) C21C 7/00 (2006.01) F27B 3/14 (2006.01) F27D 1/04 (2006.01) F27D 1/06 (2006.01) F27D 1/14 (2006.01)

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)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PATENW: IPC,CPC: F27D1/0006/LOW,F27D1/004, F27D1/08, F27D1/14/LOW, B22D1/002/LOW, B22D41/00/LOW, C21C5/42/LOW, C21C7/0075, C21C7/0087, C21C7/06, C21C3/00, C21C5/00, F27B3/12/LOW with keywords: brick, refractory, base, anchor, cylindrical, steel (with similar keywords) Google Patents, Espacenet, The Lens, AusPat, Google Scholar: brick, refractory, anchor, tubular, kiln, base, cast, steel (with similar keywords). Applicant/Inventor searched in internal databases provided by IP Australia, Espacenet, AusPat.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	



Further documents are listed in the continuation of Box C



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* Special categories of cited documents:	
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INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/AU2023/050540
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 208155061 U (BEIJING GOODGATHER ENERGY SCIENCE AND TECH CO LTD) 27 November 2018, English translation retrieved from Espacenet paragraphs [0009-0066] Figs 1-4	1,2,4,6-8, 10-12, 16-18
X	CN 217715871 U (WUHAN JINGDING TECH COMPANY LIMITED) 01 November 2022, English translation retrieved from Espacenet Figs 1-6, paragraph [0004-0027]	1-7, 9-14, 16-18
X	CN 201463566 U (HENAN HONGDA FURNACE INDUSTRY CO LTD) 12 May 2010, English translation retrieved from Espacenet Fig. 1-1, 1-2, 1-3, 2-1, 2-2, 2-3, [0007-0030]	10, 18-21

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