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(54) COMBINATION OF A PYROMETALLURGICAL FURNACE AND A WEIR MODULE

KOMBINATION EINES PYROMETALLURGISCHEN OFENS MIT EINEM WEHRMODUL

COMBINAISON D'UN FOUR PYROMÉTALLURGIQUE AVEC UN MODULE DE DÉVERSOIR

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(73) Proprietor: **Outotec (Finland) Oy**
02230 Espoo (FI)

(72) Inventor: **WOOD, Jacob**
Oakleigh, Victoria 3166 (AU)

(74) Representative: **Boco IP Oy Ab**
Itämerenkatu 5
00180 Helsinki (FI)

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Description

PRIORITY CROSS-REFERENCE

[0001] The present invention claims priority from Australian Provisional Patent application No. 2014904057 filed 10 October 2014.

TECHNICAL FIELD

[0002] The present invention generally relates to a combination of a pyrometallurgical furnace and an interchangeable weir module for a pyrometallurgical furnace. The invention is particularly applicable to top submerged lancing (TSL) furnaces and it will be convenient to hereinafter disclose the invention in relation to that exemplary application. However, it is to be appreciated that the invention is not limited to that application and could be applied to any continuously operating furnace that utilises a weir for collecting and removing molten material.

BACKGROUND OF THE INVENTION

[0003] The following discussion of the background to the invention is intended to facilitate an understanding of the invention. However, it should be appreciated that the discussion is not an acknowledgement or admission that any of the material referred to was published, known or part of the common general knowledge as at the priority date of the application.

[0004] A weir may be incorporated into the design of a continuously operating pyrometallurgical furnace to remove molten material such as metal, matte and/or slag from the furnace. Examples of pyrometallurgical furnaces which use a weir include electric furnaces, Outotec Flash Furnace, top blowing lance injection furnaces and the like. Top blowing lance injection furnaces utilises a lance to provide either top blowing or submerged injection of gases above or into a molten bath. An example of a top blowing lance injection is the Mitsubishi copper process, in which injection lances cause jets of gas, such as air or oxygen-enriched air, to impinge on and penetrate the top surface of the bath, respectively to produce and to convert copper matte. In the case of submerged lance injection, the lower end of the lance is submerged so that injection occurs within rather than from above a slag layer of the bath, to provide top submerged lancing (TSL) injection. A well-known TSL furnace configuration is the Outotec Ausmelt TSL technology of the applicant that is applied to a wide range of metals processing. Combinations between a smelting furnace and a weir module are disclosed in each one of US-A 5 375 818 and US-A 4 444 378.

[0005] Weirs can provide a number of production, operation and occupational health and safety related advantages including:

- Improved furnace operational stability arising from a

relatively constant bath depth and continuous operation;

- Decreased operating costs owing to lower consumables, such as tapping clay, taphole inserts, oxygen lances, usage and maintenance expenses such as drill and mud-gun, other tapping equipment;
- Increased furnace availability compared with a furnace employing conventional tapholes due to there being no need for taphole insert replacement; and
- Reduced labour requirements due to there being no need for furnace tapping operations, clearing of launders etc. This provides flow-on OPEX savings and a reduced likelihood of personnel injury (burns) and/or adverse health effects such as heat stress, exhaustion, dehydration etc.

[0006] Nevertheless, periodic weir inspections and maintenance activities are still required to ensure safe and optimal operation of the weir, as is the case for all pyrometallurgical furnace components.

[0007] Present furnace designs for at least TSL furnaces incorporate the weir as an integral part of the overall furnace structural design. In such a structure, the refractories of the weir are incorporated within the overall furnace refractory lining, in particular refractories in and surrounding the passage that extends between the furnace and the interior of the weir, through which molten material passes. Other cooperative elements between the weir and the furnace, such as cooling panels are also incorporated into the structure of the body of the furnace.

[0008] Whilst the integral design of the weir and furnace creates a desirably strong structure, this integration can create difficulties when access is required to the weir for inspections and/or maintenance activities while the furnace is still 'online' (i.e. in operation and/or on standby). Some maintenance may be carried out by removing one or more roof portions of the weir. However, integration of the weir refractories within the overall furnace refractory lining precludes the weir from being easily separated from the furnace. Thus, substantial inspection and maintenance activities require partial or complete shut-down of the furnace.

[0009] It would therefore be desirable to provide a weir and furnace configuration which better facilitates inspections and/or maintenance activities whilst the furnace is online.

[0010] Furthermore, it may also be desirable to provide a weir arrangement that can be retro-fitted to an existing furnace to provide for increased capacity/throughput. This can provide a scalable solution in which a furnace using a taphole(s) for the batch tapping of molten materials could be retro-fitted with a weir for increased throughput and more stable operability.

SUMMARY OF THE INVENTION

[0011] The present invention provides a combination of a pyrometallurgical furnace and a weir module for re-

leasable attachment to an pyrometallurgical furnace, the furnace including at least one weir attachment section, wherein the weir module comprises a discrete structure to the furnace, and the weir module includes at least one furnace engagement section which is releasably engageable to at least one weir attachment section of the furnace, as according to claim 1.

[0012] The weir module of the present invention is releasably attachable to a cooperating furnace. The use of a discrete weir module provides a structurally separate unit which can be attached and detached from the cooperating furnace when required. The weir can therefore be removed for inspections and maintenance activities, and in some embodiments can be replaced by a further weir module eliminating the need for a full furnace shutdown and allowing for ongoing furnace operations. The use of a detachable weir module configuration of the present invention enables simple and rapid weir removal for inspections and maintenance activities without the need for complete furnace shutdown. Furthermore, simple and rapid installation of a replacement weir module maximises furnace availability and feed processing capacity.

[0013] A releasably attachable weir module can also introduce flexibility in molten material (slag, matte and/or metal) tapping operations for various furnaces. For example, a molten material can be removed by batchwise tapping using a tapping opening or hole formed in the side of a furnace. When it is desirable to increase production, a weir module of the present invention could be fitted or retrofitted to that furnace to increase production. The weir module could use the tapping hole as the weir opening fluidly connecting the molten material within the furnace to the weir module. Alternatively, the tapping hole may be replaced with a suitable opening/ passage attachable to the weir module.

[0014] Weir designs for pyrometallurgical furnaces typically include a cooling panel which effects cooling of a selected area of and around the connection between the furnace and the weir. The weir module of the present invention includes at least one cooling panel. The furnace engagement section of each weir module includes at least one weir cooling panel configured to cool a selected area of and around the connection between the furnace and the weir module, and more specifically to cool the region around which molten material flows between the furnace and weir. Similarly, each weir attachment section of the furnace includes a furnace cooling panel having a complementary configuration to a cooperative weir cooling panel. In use each furnace cooling panel is configured to cooperate with the weir cooling panel to cool a selected area of and around the connection between the furnace and the weir module, and more specifically to cool the region around which molten material flows between the furnace and weir. The use of cooling panels of this type are used to minimise the rate at which refractory materials in this region are worn/eroded

[0015] The use of separate weir cooling panel and fur-

nace cooling panel allows these separate panels to be independently incorporated into the respective structures of the weir module and the furnace. The cooling panels can then be joined or otherwise engaged when the weir module is attached to the furnace. In some embodiments, each cooperating weir cooling panel and furnace cooling panel are, in use, configured to releasably engage to cooperatively attach the weir module to the furnace. The releasable attachment function of each weir module therefore utilises the separate cooling panels in the weir module and the furnace to form an engagement point, preferably a connection point between the structure of the weir module and the separate structure of the furnace.

[0016] The releasable engagement between the furnace engagement section(s) of each weir module and the attachment section of the furnace can have any suitable form or arrangement. In some embodiments, the two structures are abuttingly engaged. In other embodiments, the structures are physically joined or interconnected at or around the weir cooling panel and the furnace cooling panel. The weir cooling panel and furnace cooling panel preferably have cooperating configuration to facilitate releasable attachment between the furnace and the weir module.

[0017] The cooperative configuration at or around the weir cooling panel and the furnace cooling panel can have any suitable configuration. In some embodiments, each of the furnace engagement section and the weir attachment section include a cooperative attachment structure on or around the respective weir cooling panel and furnace cooling panel which facilitate releasable attachment between the furnace and the weir module. This cooperative attachment structure can comprise a mounting bracket, mounting platform, attachment framework or combinations thereof. The cooperative attachment structure may be releasably attachable using attachment arrangements which utilize at least one fastener and cooperating receiving feature, hook and cooperating mount, clamping arrangement, clipping arrangement, rod and hole configuration or the like and combinations thereof.

[0018] In some embodiments, the cooperative attachment structure includes a weir attachment framework extending from the furnace and a cooperative furnace attachment framework extending from the weir module which is releasably attachable to the weir attachment framework. It should be appreciated that fasteners, for example interlocking nuts and bolts, received within cooperating openings within the attachment framework can be used to facilitate attachment. In some embodiments, a clamping arrangement, for example a C-shaped or U-shaped plate or cap can be engaged over an abutting edge or edges of the furnace cooling panel and the weir cooling panel or other parts of the cooperative attachment structure to retain the respective abutting edge or edges together. This engagement may be provided by a clamping force from the C or U-shape plate having a biasing means which provide a clamping force, through

the insertion of one or more fasteners such as cooperative bolts and nuts through the plate or cap or other similar means.

[0019] The weir attachment section of the furnace can include a mounting structure, such as a frame or ledge, attached to, or fixedly located next to or around the furnace onto which, in use, the weir module is mounted. For example, the mounting structure could be formed as a ledge or platform on which the weir module can be seated. In some forms, the mounting structure includes a translation arrangement which allows the weir module to be moved away from the furnace, preferably to a position in which the weir module can be more easily moved/removed for example using a crane. For example, the mounting structure may include a jig, moveable frame or rail arrangement which enables the weir module to be moved laterally away from the side of the furnace. In some embodiments, the furnace engagement section of the weir includes a section of the translation arrangement such as a jig, rollers or similar which cooperates or otherwise interacts with the mounting structure to facilitate movement of the weir module on the mounting structure. It should be appreciated that the mounting structure can also form a part of the cooperative attachment structure between the weir module and the furnace.

[0020] The weir cooling panels and the furnace cooling panels have cooperative configurations to assist engagement, preferably abutting engagement, between the respective cooling panels. The weir cooling panels and furnace cooling panels can therefore include cooperating engagement surfaces which substantially abut and/or engage when the weir module is attached to the furnace. In some embodiments, the weir cooling panel comprises a conductive metal block having a planar face extending from a rear side of the weir module. Similarly, the furnace cooling panel comprises a conductive metal block having a planar face extending from a side of the furnace, preferably near the base of the furnace. Whilst the cooling panels can be made from any suitable heat conductive material, in preferred embodiments the cooling panels are made from copper. The copper cooling panels are preferably cooled by means of a cooling fluid, such as water, flowing through internal heat exchange conduits or lines within each cooling panel.

[0021] The furnace engagement section of each weir module may also include a molten material opening which is fluidly sealable to a cooperating molten material opening in the furnace. The molten material opening comprises an opening of a molten material passage of the weir module which is configured to cooperate and seal with a molten material passage of the furnace. The molten material opening can have any suitable configuration. Preferably, the molten material passage of the weir module has a cooperative and complementary configuration to the molten material passage of the furnace which facilitates a fluid seal therebetween. In some embodiments, the molten material opening of the weir module is configured to fit into or around molten material

opening of the furnace. A mortar, cement, or tight fitting refractories may be used in some embodiments to assist fluid seal between the molten material opening of the weir and the molten material opening of the furnace.

[0022] In those embodiments, where refractories are used for the molten material passage, any refractories around the molten material opening of the weir module and furnace are likely to be sealed and/or fused together through the use and high temperature conditions of the furnace and weir module. These refractories may therefore be damaged when the weir module is detached/removed from the furnace, for example through physical action by chipping or other separation actions which assist detachment of the molten material opening of the weir module and the molten material opening of the furnace during a weir module - furnace separation process. In some embodiments, each of the molten material opening of the weir module and the molten material opening of the furnace therefore include replaceable refractories around said openings. This allows any damaged refractories to be selectively replaced.

[0023] Each weir module is constructed as a discrete module which can be individually attached or detached from the cooperating weir attachment section of the furnace. Each weir module may therefore be formed as a discrete structure of interconnected materials. This can be achieved in some embodiments by forming the weir module from an interconnected structure of refractory material, structural members, and support members. The structural members can include one or more frameworks, support structure(s) or the like. For example, the structural members may include at least one metal structure, preferably steel structure. The steel structure preferably includes a steel shell, for example a cylindrical steel shell.

[0024] It should be appreciated, that the weir cooling panel can form an integral section of the interconnected structure of the weir module. In such embodiments, the weir cooling panel comprises a rear structural member of the support structure of the weir module. Preferably, the weir cooling panel can be attached or otherwise integrated into the steel shell structure of the weir module.

[0025] The weir module of the present invention can be used with any suitable pyrometallurgical furnace. Suitable pyrometallurgical furnaces include electric furnaces, top submerged lancing (TSL) furnaces or the like.

[0026] The present invention provides a pyrometallurgical furnace in combination with at least one weir module as previously described. In some embodiments, the furnace comprises a top submerged lancing (TSL) furnace.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] The present invention will now be described with reference to the figures of the accompanying drawings, which illustrate particular preferred embodiments of the present invention, wherein:

Figure 1 is a schematic perspective view, depicting

a top submerged lancing (TSL) injection furnace with a weir module according to one embodiment of the present invention attached around the base of the reactor.

Figure 2 provides an isometric view of a weir module of the present invention separated from a furnace cooling panel and the furnace of Figure 1.

Figure 3 provides a cross-sectional plan view of a weir module of the present invention attached to the furnace of Figure 1 along line A-A shown in Figure 4.

Figure 4 provides a cross-sectional side view of a weir module of the present invention attached to the furnace of Figure 1 along line B-B shown in Figure 3.

DETAILED DESCRIPTION

[0028] Figure 1 illustrates a furnace of a top submerged lancing (TSL) furnace 10 which includes a weir module 100 according to the present invention. It should be appreciated that the TSL furnace 10 is shown and described in the following detailed description for illustrative purposes only. A similarly structured weir module 100 could equally be attached to other types of pyrometallurgical furnaces.

[0029] Turning firstly to Figure 1, there is shown a TSL reactor or furnace 10 suitable for use in conducting a pyro-metallurgical operation, using top submerged lancing (TSL) injection with a TSL lance having a weir module 100 according to the present invention. A cut out section of the furnace 10 is also shown in Figure 4. The furnace 10 has a tall cylindrical base section 12 for containing a molten bath 14 (see Figure 4) comprising, or having an upper layer, of slag. The base section 12 and roof 16 of furnace 10 typically have an outer shell 20 of steel that is internally lined with suitable refractory 22 (Figure 4).

[0030] The operation of this type of TSL furnace is well understood, and can be found in the other patent publications of the application, for example international patent publication no. WO2013000017A₁. As should be appreciated, furnace operation involves use of a vertically suspended lance (not illustrated) which is lowered into the bath through which an oxygen-containing gas and a suitable fuel can be injected into the bath 14.

[0031] As best shown in Figure 4, molten material produced in the furnace 10 collects as a molten bath 14 in the bottom 60 of the furnace 10. This bath 14 is fluidly connected to a weir module 100, (and in some embodiments, where applicable, two weir modules 100) attached around the base 90 of the furnace 10. The fluid connection between the weir 100 and bath 14 is in the form of channel or conduit 110 formed through the refractories 22 of the furnace wall 94.

[0032] The structure of the weir module 100 is best illustrated in Figures 2 to 4 which provide an isometric view and two cross-sectional views of a weir module 100

according to one embodiment of the present invention for releasable attachment to the TSL furnace 10. Again, it should be appreciated that a similarly structured weir module 100 could also be attached to other types of pyrometallurgical furnaces, and that the TSL furnace 10 is shown for illustrative purposes only.

[0033] Referring firstly to the furnace 10, it can be seen that the furnace wall 94 includes a weir attachment section 120, comprising a furnace cooling panel 122 (Figures 2, 3 and 4), a molten material passage 110 (Figures 2 and 4) formed through one or more cooperating refractories 124, and a weir attachment framework 125 (Figure 3) built around and configured to house the furnace cooling panel 122. The refractories 124 around the molten material passage 110 are formed and extend through a corresponding opening in the metal shell of the furnace 10 and a corresponding opening in the furnace cooling panel 122.

[0034] The furnace cooling panel 122 comprises a block of material, having a planar weir attachment side 122A and a curved furnace abutment side 122B configured to conform to the outer curve of the furnace outer shell 20. The furnace cooling panel 122 fits into a section (cutout) of the furnace outer shell 20. The refractory lining 22 of the furnace 10 abuts against that panel 122. The furnace cooling panel 122 is typically formed from copper or another heat conductive metal configured to cool a selected area proximate the cooling panel 122 of and around the molten material connection 110A and 110B between the weir module 100 and the furnace 10. The cooling panel 122 can be cooled by various means. In the illustrated embodiment, cooling fluid such as water is used to cool the panel 122 using a series of cooling conduits extending through the panel 122. A supporting lintel 123 extends from the furnace shell 20 to support and seat the base of the furnace cooling panel 122.

[0035] The weir attachment framework 125 comprises a steel welded frame extending outwardly from the furnace shell 20 each side of the furnace cooling panel 122. The weir attachment framework 125 provides a planar coupling face 125A onto which a corresponding furnace attachment framework 135 can abut and be attached using cooperating fasteners such as bolts or the like. In addition, the furnace 10 includes a platform mounting structure 150 fixed to the outer shell 20 of the furnace 10 onto which, in use, the weir module 100 is seated. As shown in Figures 2 and 4, the platform 150 comprises two spaced apart rails 150A and 150B, on which the base of the weir module 100 is seated. The rails 150A and 150B provide support to the weir module 100 from below allowing module 100 to be easily moved laterally into and out of position/ attachment to the furnace 10. Such a design can aid in ensuring correct vertical positioning of the weir module 100 (relative to the furnace 10) when reinstalling the weir module 100.

[0036] The illustrated weir module 100 comprises an underflow type weir. In this arrangement, the connective molten material passage 110 comprises an underflow

passage connecting to a corresponding underflow opening at the base of the furnace 10, allowing both metal, matte and slag to flow into the weir module 100. Whilst not illustrated, it should be appreciated that the present invention could also be configured as an overflow weir.

[0037] The illustrated weir module 100 comprises a discrete structure to the furnace 10. As such, the weir module 100 comprises a structurally separate unit which is which is releasably engageable to at least one weir attachment section 120 of the furnace 10 through a furnace engagement section 130. The engagement section 130 has a complementary configuration to the weir attachment section 120 of the furnace 10, comprising a weir cooling panel 132, a molten material passage 110 formed through one or more cooperating refractories 134 in the weir module 100 and a furnace attachment framework 135 (Figure 3) built around and configured to house the furnace cooling panel 122. The refractories 134 around the molten material passage 110 are formed and extend through a corresponding opening in the weir cooling panel 132.

[0038] The weir cooling panel 132 comprises a block of material, having a planar furnace attachment side 132A and a curved weir abutment side 132B (see for example Figure 3) configured to form a curved inner surface of the weir against which refractories 144 can be laid. The weir cooling panel 132 is typically formed from copper or another heat conductive metal configured to cool a selected area proximate the cooling panel 132 of and around the molten material connection 110A and 110B between the weir module 100 and the furnace 10. The cooling panel 132 can be cooled by various means. In the illustrated embodiment, cooling fluid such as water is used to cool the panel 132 using a series of cooling conduits extending through the panel 132. Cooling of this region ensures a protective coating of slag and metal form over the refractories, reducing refractory wear in this area from the flow of molten material through and around the molten material passages 110A and 110B.

[0039] The furnace attachment framework 135 comprises a steel frame/ bracket structure connected around the outside of the steel shell 141 of the weir module 10 and extending each side of the weir cooling panel 132. The furnace attachment framework 135 provides a cooperating planar coupling face 135A onto which a corresponding weir attachment framework 125 can abut and be attached using cooperating fasteners such as bolts or the like inserted through connection apertures 135B. Attachment of the furnace attachment framework 135 to the corresponding weir attachment framework 125 of the furnace 10 prevents independent movement of the weir module 100 which could lead to refractory damage.

[0040] Each weir module 100 is constructed as a discrete structure/ module which can be individually attached or detached from the cooperating weir attachment section 120 of the furnace 10. The illustrated weir module 100 comprises a generally cylindrical steel shell 141 defining a base 136, sides 138 and roof structure 140. The

weir cooling panel 132 forms one part of the structural rear side 142 of the weir module 100. A refractory lining 144 is laid within that structure to contain the molten material which flows from the metal bath 14 within the furnace 10. A copper tapping block or valve 148 is included in the front side 138A of the weir module 100 to enable removal of molten material from inside the weir module 100. A molten material underflow tap conduit 150 is formed between refractories 144 in the front side 142A of the weir module 100 which fluidly links the interior of the weir module 100 to the tapping block/ valve 148. An overflow spout 151 is provided where molten material is typically removed from the weir 100.

[0041] The releasable attachment between the furnace 10 and weir module 100 is provided by a cooperative engagement structure formed around the weir cooling panel 132 and furnace cooling panel 122. In this respect, the separate cooling panels 122, 132 in the weir module 100 and the furnace 10 form a connection point between the structure of the weir module 100 and the separate structure of the furnace 10.

[0042] Firstly, the weir cooling panel 132 and furnace cooling panel 122 have a complementary configuration which includes cooperating engagement surfaces which substantially abut when the weir module 100 is attached to the furnace 10 to assist abutting engagement between the cooling panels 122, 132.

[0043] Secondly, the cooperative attachment between each weir module 100 and the furnace 10 can take the form of any suitable arrangement. In some embodiments, the two structures are abuttingly engaged. However, as shown in the illustrated embodiments, the structures are preferably physically joined or interconnected when the weir is attached to the furnace. This cooperative configuration is provided by two main connection points:

[0044] Firstly, as noted previously the furnace attachment framework 135 is attached to the corresponding weir attachment framework 125 of the furnace using fasteners such as a series of spaced apart cooperating nut and bolts inserted through suitably positioned and coaxial apertures in the abutting coupling faces 125A, 135A of the each of the weir attachment framework 125 and the furnace attachment framework 135. However, it should be appreciated that other fastening and/or clamping arrangements could equally be used.

[0045] Secondly, the furnace includes a platform mounting structure 150 fixed to the furnace 10, or otherwise fixedly located next to or around the furnace 10 onto which, in use, the weir module 100 is seated. The platform 150 comprises two spaced apart rails 150A and 150B which enable the weir module 100 to be moved laterally relative to the side of the furnace 10 in order to laterally attach (move toward) or detach (move away from) the weir module 100 to the furnace 10. Whilst not illustrated, in some embodiments the base of the weir module 100 may include a jig, rollers or similar which enables the weir module 100 to be moved laterally towards and away from the side of the furnace 10 when it is desired to attach or

detach the weir module 100 from the furnace 10.

[0046] A fluid seal is preferred between the molten material passage 110B of the weir module 100 and the molten material passage 110A of the furnace 10. Preferably, the molten material passage 110B of the weir module 100 has a cooperative and complementary configuration to the molten material passage 110A of the furnace 10 which facilitates a fluid seal therebetween. For example, the two channels 110A, 100B may be configured to have an interference, step or other seal fit in which the opening of one channel 110A, 100B is configured to fit into or around the opening of the other channel 110A, 100B. A mortar or other sealant may be used in some embodiments to assist fluid seal therebetween. Furthermore, the refractories around the molten material opening of the channels 110A, 100B are configured as replaceable refractories. This allows any damaged refractories to be selectively replaced.

[0047] The weir module 100 can therefore be releasably attached and detached from a selected furnace 10 about the above described attachment structures surrounding the furnace cooling panel 122 and weir cooling panel 132. This enables the weir module 100 to be inspected and serviced away from the furnace 10, and if desired a replacement weir module 100 to be attached to the furnace 10 to enable the furnace 10 to re-enter operation.

[0048] The illustrated weir module 100 can be also used as an interchangeable module, enabling:

- relatively simple and rapid weir removal to allow for offline weir inspection and maintenance activities;
- installation of a replacement weir module to eliminate the need for a complete furnace shutdown and maximise operating time;
- ability to easily remove/replace weir without damaging furnace refractory structure;
- rapid replacement compared to convention weir configurations, and thus a reduction of downtime compared to conventional weir configurations if the weir module of the present invention needs to be changed; and
- Scope for replacement of existing copper tapping block(s) with a weir module in a number of pyrometallurgical furnace designs, including TSL furnaces, allowing for increased throughput (at some point in the future), without significant modification of the furnace design.

[0049] Top submerged lancing (TSL) injection has found wide application in pyro-metallurgical processes because of the advantages it brings other pyrometallurgical operations. The advance provided in the present invention further increases the advantages of TSL technology in improving efficiency in current practices, and also in increasing the range of application of the technology, such as in flexibility of operations in scaled processing.

[0050] Those skilled in the art will appreciate that the invention described herein is susceptible to variations and modifications other than those specifically described. It is understood that the invention includes all such variations and modifications which fall within the spirit and scope of the present invention.

[0051] Where the terms "comprise", "comprises", "comprised" or "comprising" are used in this specification (including the claims) they are to be interpreted as specifying the presence of the stated features, integers, steps or components, but not precluding the presence of one or more other feature, integer, step, component or group thereof.

Claims

1. A combination of a pyrometallurgical furnace (10) and a weir module (100) for releasable attachment to the pyrometallurgical furnace (10), wherein the pyrometallurgical furnace (10) including at least one weir attachment section (120), **characterized in that** the weir module (100) comprises a discrete structure releasable attachable to the pyrometallurgical furnace (10), **in that** the weir module (100) includes at least one furnace engagement section (130) which is releasably engageable to at least one weir attachment section (120) of the pyrometallurgical furnace (10), **in that** the furnace engagement section (130) of each weir module (100) includes at least one weir cooling panel (132) configured to cool a selected area of and around the connection between the weir module (100) and the pyrometallurgical furnace (10), **in that** each weir attachment section (120) of the pyrometallurgical furnace (10) includes a furnace cooling panel (122) having a complementary configuration to a cooperative weir cooling panel (132), and in use, is configured to cooperate with the weir cooling panel (132) to cool a selected area of and around the connection between the weir module (100) and the pyrometallurgical furnace (10).
2. A combination of a pyrometallurgical furnace (10) and a weir module (100) according to claim 1, wherein each cooperating weir cooling panel (132) and furnace cooling panel (122) are, in use, configured to releasably engage to cooperatively attach the weir module (100) to the pyrometallurgical furnace (10).
3. A combination of a pyrometallurgical furnace (10) and a weir module (100) according to claim 1 or 2, wherein each of the furnace engagement section (130) and the weir attachment section (120) include a cooperative attachment structure on or around the respective weir cooling panel (132) and furnace cooling panel (122) which facilitate releasable attachment between the pyrometallurgical furnace (10)

and the weir module (100).

4. A combination of a pyrometallurgical furnace (10) and a weir module (100) according to claim 3, wherein the cooperative attachment structure comprises a mounting bracket, mounting platform, attachment framework or a combination thereof.
5. A combination of a pyrometallurgical furnace (10) and a weir module (100) according to claim 3 or 4, wherein the cooperative attachment structure includes a weir attachment framework (125) extending from the pyrometallurgical furnace (10) and a cooperative furnace attachment framework extending from the weir module (100) which is releasably attachable to the weir attachment framework (125).
6. A combination of a pyrometallurgical furnace (10) and a weir module (100) according to any preceding claim, wherein the weir attachment section (120) of the pyrometallurgical furnace (10) includes a mounting structure attached to or fixedly located next to or around the pyrometallurgical furnace (10) onto which, in use, the weir module (100) is mounted.
7. A combination of a pyrometallurgical furnace (10) and a weir module (100) according to claim 6, wherein the mounting structure comprises a frame, ledge or platform on which the weir module (100) can be seated.
8. A combination of a pyrometallurgical furnace (10) and a weir module (100) according to claim 6 or 7, wherein the mounting structure includes a translation arrangement which allows the weir module (100) to be moved away from the pyrometallurgical furnace (10), preferably laterally away from the side of the pyrometallurgical furnace (10).
9. A combination of a pyrometallurgical furnace (10) and a weir module (100) according to claim 8, wherein the furnace engagement section (130) of the weir includes a section of the translation arrangement which cooperates or otherwise interacts with the mounting structure to facilitate movement of the weir module (100) on the mounting structure.
10. A combination of a pyrometallurgical furnace (10) and a weir module (100) according to claim 9, wherein the furnace engagement section (130) includes a roller or jig arrangement which cooperates with the mounting structure to facilitate movement of the weir module (100) on the mounting structure.
11. A combination of a pyrometallurgical furnace (10) and a weir module (100) according to any one of claims 1 to 10, wherein the weir cooling panels (132) and furnace cooling panels (122) include cooperating engagement surfaces which substantially abut when the weir is attached to the pyrometallurgical furnace (10).
12. A combination of a pyrometallurgical furnace (10) and a weir module (100) according to any one of claims 1 to 11, wherein the weir cooling panel (132) comprises a conductive metal block having a planar face extending from a rear side of the weir module (100).
13. A combination of a pyrometallurgical furnace (10) and a weir module (100) according to any preceding claim, wherein the furnace engagement section (130) includes a molten material opening being fluidly sealable to a cooperating molten material opening in the pyrometallurgical furnace (10).
14. A combination of a pyrometallurgical furnace (10) and a weir module (100) according to claim 13, wherein the molten material opening of the weir module (100) has a cooperative and complementary configuration to the molten material opening of the pyrometallurgical furnace (10) which facilitates a fluid seal therebetween.
15. A combination of a pyrometallurgical furnace (10) and a weir module (100) according to claim 14, wherein the molten material opening of the weir module (100) is configured to fit into or around the molten material opening of the pyrometallurgical furnace (10).
16. A combination of a pyrometallurgical furnace (10) and a weir module (100) according to any one of claims 13 to 15, wherein each of the molten material opening of the weir module (100) and the molten material opening of the pyrometallurgical furnace (10) include replaceable refractories around said openings.
17. A combination of a pyrometallurgical furnace (10) and a weir module (100) according to any preceding claim, wherein each weir module (100) is formed as a discrete structure of interconnected materials.
18. A combination of a pyrometallurgical furnace (10) and a weir module (100) according to claim 17, wherein the weir cooling panel (132) forms an integral section of the interconnected structure of the weir module (100).
19. A combination of a pyrometallurgical furnace (10) and a weir module (100) according to any preceding claim, wherein the pyrometallurgical furnace (10) is a top submerged lancing (TSL) furnace.

Patentansprüche

1. Kombination eines pyrometallurgischen Ofens (10) und eines Wehrmoduls (100) zur lösbaren Anbringung am pyrometallurgischen Ofen (10), wobei der pyrometallurgische Ofen (10) mindestens einen Wehranbringungsabschnitt (120) umfasst, **dadurch gekennzeichnet,**
dass das Wehrmodul (100) eine diskrete Struktur umfasst, die am pyrometallurgischen Ofen (10) lösbar angebracht werden kann,
dass das Wehrmodul (100) mindestens einen Ofen-Eingriffsabschnitt (130) aufweist, der in mindestens einen Wehranbringungsabschnitt (120) des pyrometallurgischen Ofens (10) lösbar eingreifen kann,
dass der Ofen-Eingriffsabschnitt (130) jedes Wehrmoduls (100) mindestens eine Wehrkühlplatte (132) aufweist, die eingerichtet ist, um einen ausgewählten Bereich der, und rund um die, Verbindung zwischen dem Wehrmodul (100) und dem pyrometallurgischen Ofen (10) zu kühlen,
dass jeder Wehranbringungsabschnitt (120) des pyrometallurgischen Ofens (10) eine Ofenkühlplatte (122) aufweist, die komplementär zu einer mitwirkenden Wehrkühlplatte (132) ausgestaltet ist und so ausgestaltet ist, dass sie im Gebrauch mit der Wehrkühlplatte (132) zusammenwirkt, um einen ausgewählten Bereich der, und rund um die, Verbindung zwischen dem Wehrmodul (100) und dem pyrometallurgischen Ofen (10) zu kühlen.
2. Kombination eines pyrometallurgischen Ofens (10) und eines Wehrmoduls (100) nach Anspruch 1, wobei jede zusammenwirkende Wehrkühlplatte (132) und Ofenkühlplatte (122) so ausgestaltet sind, dass sie im Gebrauch lösbar ineinander eingreifen, um zusammenwirkend das Wehrmodul (100) am pyrometallurgischen Ofen (10) anzubringen.
3. Kombination eines pyrometallurgischen Ofens (10) und eines Wehrmoduls (100) nach Anspruch 1 oder 2, wobei der Ofen-Eingriffsabschnitt (130) und der Wehranbringungsabschnitt (120) jeweils eine zusammenwirkende Befestigungsstruktur an der oder rund um die jeweilige Wehrkühlplatte (132) und Ofenkühlplatte (122) aufweisen, die eine lösbare Anbringung zwischen dem pyrometallurgischen Ofen (10) und dem Wehrmodul (100) erleichtern.
4. Kombination eines pyrometallurgischen Ofens (10) und eines Wehrmoduls (100) nach Anspruch 3, wobei die zusammenwirkende Befestigungsstruktur eine Montagehalterung, eine Montageplattform, einen Befestigungsrahmen oder eine Kombination derselben umfasst.
5. Kombination eines pyrometallurgischen Ofens (10) und eines Wehrmoduls (100) nach Anspruch 3 oder 4, wobei die zusammenwirkende Befestigungsstruktur einen aus dem pyrometallurgischen Ofen (10) ragenden Wehranbringungsrahmen (125) und einen aus dem Wehrmodul (100) ragenden zusammenwirkenden Ofenanbringungsrahmen, der am Wehranbringungsrahmen (125) lösbar angebracht werden kann, umfasst.
6. Kombination eines pyrometallurgischen Ofens (10) und eines Wehrmoduls (100) nach einem vorhergehenden Anspruch, wobei der Wehranbringungsabschnitt (120) des pyrometallurgischen Ofens (10) eine am pyrometallurgischen Ofen (10) angebrachte oder neben dem oder rund um den pyrometallurgischen Ofen (10) fest angeordnete Montagestruktur aufweist, an welcher im Gebrauch das Wehrmodul (100) montiert wird.
7. Kombination eines pyrometallurgischen Ofens (10) und eines Wehrmoduls (100) nach Anspruch 6, wobei die Montagestruktur einen Rahmen, eine Leiste oder eine Plattform umfasst, auf welchem/welcher das Wehrmodul (100) aufgelagert werden kann.
8. Kombination eines pyrometallurgischen Ofens (10) und eines Wehrmoduls (100) nach Anspruch 6 oder 7, wobei die Montagestruktur eine Verfahrenanordnung aufweist, die es ermöglicht, das Wehrmodul (100) vom pyrometallurgischen Ofen (10) weg, vorzugsweise von der Seite des pyrometallurgischen Ofens (10) seitlich weg, zu bewegen.
9. Kombination eines pyrometallurgischen Ofens (10) und eines Wehrmoduls (100) nach Anspruch 8, wobei der Ofen-Eingriffsabschnitt (130) des Wehrs einen Abschnitt der Verfahrenanordnung aufweist, der mit der Montagestruktur zusammenwirkt oder anderweitig in Wechselwirkung steht, um die Bewegung des Wehrmoduls (100) an der Montagestruktur zu begünstigen.
10. Kombination eines pyrometallurgischen Ofens (10) und eines Wehrmoduls (100) nach Anspruch 9, wobei der Ofen-Eingriffsabschnitt (130) eine Rollen- oder Gestellanordnung aufweist, die mit der Montagestruktur zusammenwirkt, um die Bewegung des Wehrmoduls (100) an der Montagestruktur zu begünstigen.
11. Kombination eines pyrometallurgischen Ofens (10) und eines Wehrmoduls (100) nach einem der Ansprüche 1 bis 10, wobei die Wehrkühlplatten (132) und Ofenkühlplatten (122) zusammenwirkende Eingriffsflächen aufweisen, die im Wesentlichen aneinander stoßen, wenn das Wehr am pyrometallurgischen Ofen (10) angebracht ist.
12. Kombination eines pyrometallurgischen Ofens (10)

und eines Wehrmoduls (100) nach einem der Ansprüche 1 bis 11, wobei die Wehrkühlplatte (132) einen leitfähigen Metallblock mit einer planen Fläche aufweist, der sich von einer Rückseite des Wehrmoduls (100) aus erstreckt.

13. Kombination eines pyrometallurgischen Ofens (10) und eines Wehrmoduls (100) nach einem vorhergehenden Anspruch, wobei der Ofen-Eingriffsabschnitt (130) eine Schmelzmaterialöffnung aufweist, die gegenüber einer zusammenwirkenden Schmelzmaterialöffnung im pyrometallurgischen Ofen (10) fluidtechnisch abdichtbar ist. 10
14. Kombination eines pyrometallurgischen Ofens (10) und eines Wehrmoduls (100) nach Anspruch 13, wobei die Schmelzmaterialöffnung des Wehrmoduls (100) eine zusammenwirkende und komplementäre Ausgestaltung in Bezug zur Schmelzmaterialöffnung des pyrometallurgischen Ofens (10) aufweist, was eine dazwischen liegende Fluid-Abdichtung begünstigt. 15 20
15. Kombination eines pyrometallurgischen Ofens (10) und eines Wehrmoduls (100) nach Anspruch 14, wobei die Schmelzmaterialöffnung des Wehrmoduls (100) so ausgestaltet ist, dass sie in die oder rund um die Schmelzmaterialöffnung des pyrometallurgischen Ofens (10) passt. 25 30
16. Kombination eines pyrometallurgischen Ofens (10) und eines Wehrmoduls (100) nach einem der Ansprüche 13 bis 15, wobei die Schmelzmaterialöffnung des Wehrmoduls (100) und die Schmelzmaterialöffnung des pyrometallurgischen Ofens (10) jeweils austauschbare Feuerfestmaterialien um die Öffnungen herum aufweisen. 35
17. Kombination eines pyrometallurgischen Ofens (10) und eines Wehrmoduls (100) nach einem vorhergehenden Anspruch, wobei jedes Wehrmodul (100) als eine diskrete Struktur von miteinander verbundenen Materialien ausgebildet ist. 40
18. Kombination eines pyrometallurgischen Ofens (10) und eines Wehrmoduls (100) nach Anspruch 17, wobei die Wehrkühlplatte (132) einen integralen Abschnitt der verbundenen Struktur des Wehrmoduls (100) ausbildet. 45 50
19. Kombination eines pyrometallurgischen Ofens (10) und eines Wehrmoduls (100) nach einem vorhergehenden Anspruch, wobei der pyrometallurgische Ofen (10) ein Ofen mit von oben eingetauchter Lanze (TSL-Ofen) ist. 55

Revendications

1. Combinaison d'un four pyrometallurgique (10) et d'un module déversoir (100) pour l'attachement amovible au four pyrometallurgique (10), dans laquelle le four pyrometallurgique (10) comprend au moins une section d'attachement de déversoir (120), **caractérisée en ce**
que le module déversoir (100) comprend une structure discrète amoviblement attachable au four pyrometallurgique (10),
que le module déversoir (100) comprend au moins une section d'engagement de four (130) pouvant être engagée de manière détachable dans au moins une section d'attachement de déversoir (120) du four pyrometallurgique (10),
que la section d'engagement de four (130) de chaque module déversoir (100) comprend au moins un panneau de refroidissement de déversoir (132) configuré pour refroidir une zone choisie de, et autour de, la liaison entre le module déversoir (100) et le four pyrometallurgique (10),
que chaque section d'attachement de déversoir (120) du four pyrometallurgique (10) comprend un panneau de refroidissement de four (122) ayant une configuration complémentaire à un panneau de refroidissement de déversoir (132) coopératif et configurée pour coopérer, pendant l'utilisation, avec le panneau de refroidissement de déversoir (132) afin de refroidir une zone choisie de, et autour de, la liaison entre le module déversoir (100) et le four pyrometallurgique (10).
2. Combinaison d'un four pyrometallurgique (10) et d'un module déversoir (100) selon la revendication 1, dans laquelle chaque panneau de refroidissement de déversoir (132) et panneau de refroidissement de four (122) coopératifs sont configurés pour s'engager entre eux de manière détachable afin d'attacher de manière coopérative le module déversoir (100) au four pyrometallurgique (10).
3. Combinaison d'un four pyrometallurgique (10) et d'un module déversoir (100) selon la revendication 1 ou 2, dans laquelle chacune des section d'engagement de four (130) et section d'attachement de déversoir (120) comprend une structure d'attachement coopérative sur les, ou autour des, panneau de refroidissement de déversoir (132) et panneau de refroidissement de four (122) qui facilitent l'attachement amovible entre le four pyrometallurgique (10) et le module déversoir (100).
4. Combinaison d'un four pyrometallurgique (10) et d'un module déversoir (100) selon la revendication 3, dans laquelle la structure d'attachement coopérative comprend un support de montage, une plate-forme de montage, un cadre d'attachement ou leur

combinaison.

5. Combinaison d'un four pyrométallurgique (10) et d'un module déversoir (100) selon la revendication 3 ou 4, dans laquelle la structure d'attachement coopérative comprend un cadre d'attachement de déversoir (125) s'étendant à partir du four pyrométallurgique (10) et un cadre d'attachement de four coopératif s'étendant à partir du module déversoir (100) qui se prête à l'attachement amovible au cadre d'attachement de déversoir (125). 5 10
6. Combinaison d'un four pyrométallurgique (10) et d'un module déversoir (100) selon une revendication précédente, dans laquelle la section d'attachement de déversoir (120) du four pyrométallurgique (10) comprend une structure de montage attachée au, ou située en position fixe à proximité ou autour du, four pyrométallurgique (10), sur laquelle le module déversoir (100) est monté, pendant l'utilisation. 15 20
7. Combinaison d'un four pyrométallurgique (10) et d'un module déversoir (100) selon la revendication 6, dans laquelle la structure de montage comprend un cadre, un rebord ou une plate-forme sur lequel/laquelle le module déversoir (100) peut être logé. 25
8. Combinaison d'un four pyrométallurgique (10) et d'un module déversoir (100) selon la revendication 6 ou 7, dans laquelle la structure de montage comprend un ensemble de translation qui permet au module déversoir (100) d'être éloigné du four pyrométallurgique (10), préférablement d'être éloigné latéralement du côté du four pyrométallurgique (10). 30
9. Combinaison d'un four pyrométallurgique (10) et d'un module déversoir (100) selon la revendication 8, dans laquelle la section d'engagement de four (130) du déversoir comprend une section de l'ensemble de translation qui coopère ou interagit autrement avec la structure de montage pour faciliter le déplacement du module déversoir (100) sur la structure de montage. 35 40
10. Combinaison d'un four pyrométallurgique (10) et d'un module déversoir (100) selon la revendication 9, dans laquelle la section d'engagement de four (130) comprend un agencement de rouleaux ou de bâti qui coopère avec la structure de montage pour faciliter le déplacement du module déversoir (100) sur la structure de montage. 45 50
11. Combinaison d'un four pyrométallurgique (10) et d'un module déversoir (100) selon l'une des revendications 1 à 10, dans laquelle les panneaux de refroidissement de déversoir (132) et les panneaux de refroidissement de four (122) comprennent des surfaces d'engagement coopératives qui se rencontrent 55

essentiellement quand le déversoir est attaché au four pyrométallurgique (10).

12. Combinaison d'un four pyrométallurgique (10) et d'un module déversoir (100) selon l'une des revendications 1 à 11, dans laquelle le panneau de refroidissement de déversoir (132) comprend un bloc de métal conducteur ayant une face plane s'étendant à partir d'un côté arrière du module déversoir (100).
13. Combinaison d'un four pyrométallurgique (10) et d'un module déversoir (100) selon une revendication précédente, dans laquelle la section d'engagement de four (130) comprend une ouverture à matériau en fusion pouvant être rendue étanche fluidiquement par rapport à une ouverture à matériau en fusion coopérative dans le four pyrométallurgique (10).
14. Combinaison d'un four pyrométallurgique (10) et d'un module déversoir (100) selon la revendication 13, dans laquelle l'ouverture à matériau en fusion du module déversoir (100) a une configuration coopérative et complémentaire à l'ouverture à matériau en fusion du four pyrométallurgique (10) ce qui facilite une étanchéité fluide entre elles.
15. Combinaison d'un four pyrométallurgique (10) et d'un module déversoir (100) selon la revendication 14, dans laquelle l'ouverture à matériau en fusion du module déversoir (100) est configurée de manière à s'ajuster dans ou autour de l'ouverture à matériau en fusion du four pyrométallurgique (10).
16. Combinaison d'un four pyrométallurgique (10) et d'un module déversoir (100) selon l'une des revendications 13 à 15, dans laquelle chacune des ouvertures à matériau en fusion du module déversoir (100) et ouverture à matériau en fusion du four pyrométallurgique (10) comprend des réfractaires remplaçables autour desdites ouvertures.
17. Combinaison d'un four pyrométallurgique (10) et d'un module déversoir (100) selon une revendication précédente, dans laquelle chaque module déversoir (100) est formé en une structure discrète de matériaux interconnectés.
18. Combinaison d'un four pyrométallurgique (10) et d'un module déversoir (100) selon la revendication 17, dans laquelle le panneau de refroidissement de déversoir (132) forme une section intégrale de la structure interconnectée du module déversoir (100).
19. Combinaison d'un four pyrométallurgique (10) et d'un module déversoir (100) selon une revendication précédente, dans laquelle le four pyrométallurgique (10) est un four à lance immergée par le haut (TSL).

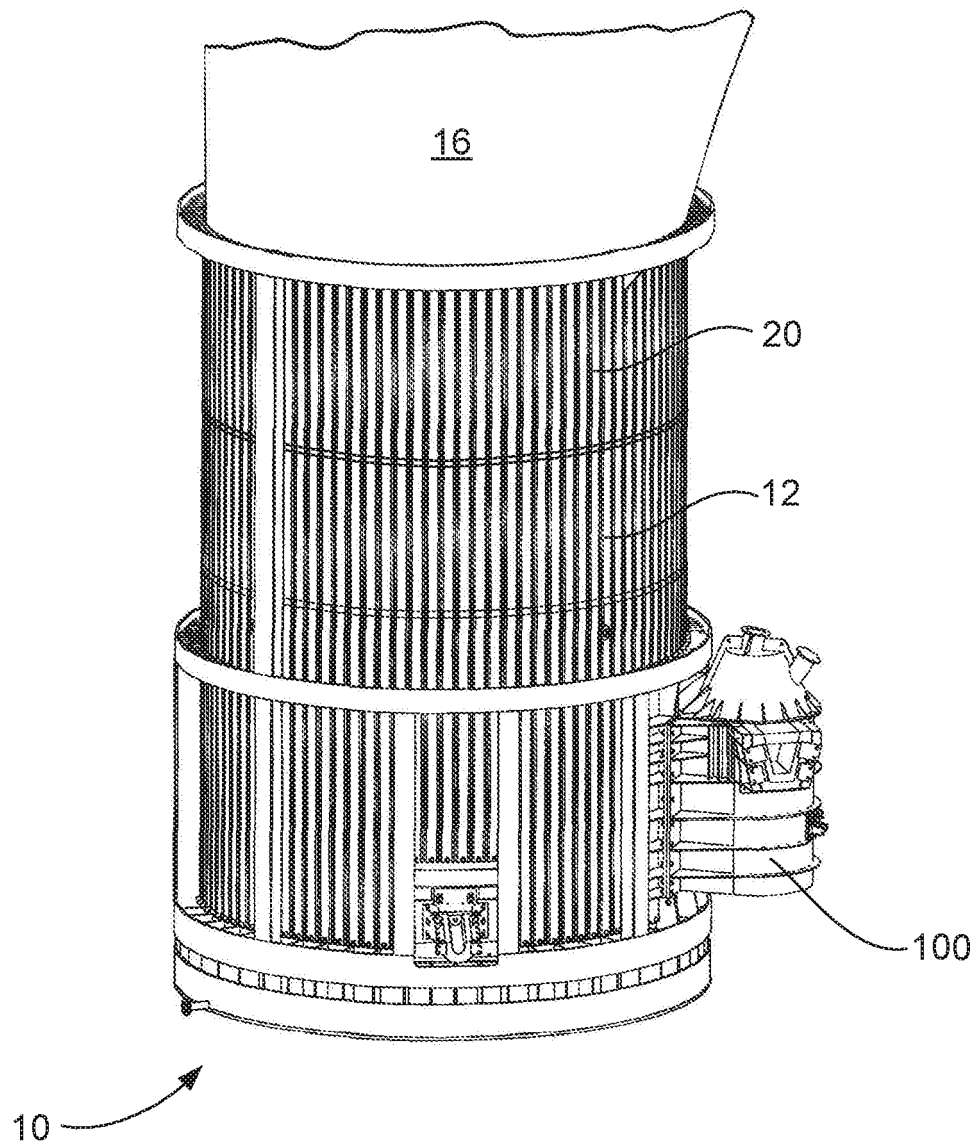
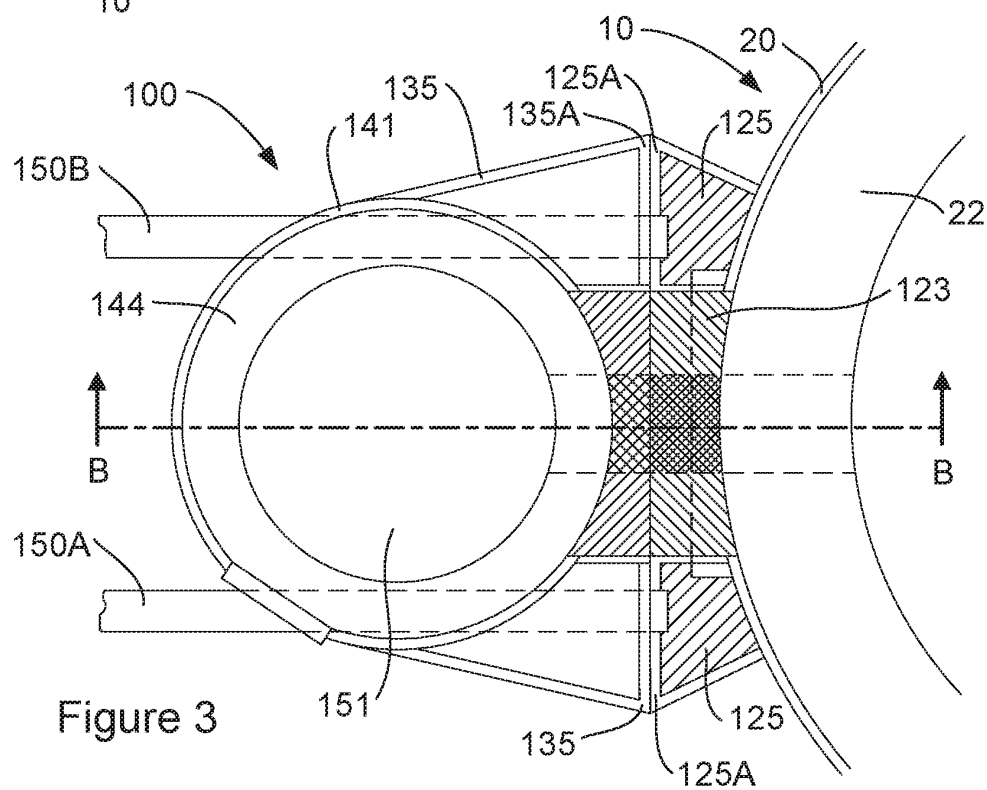
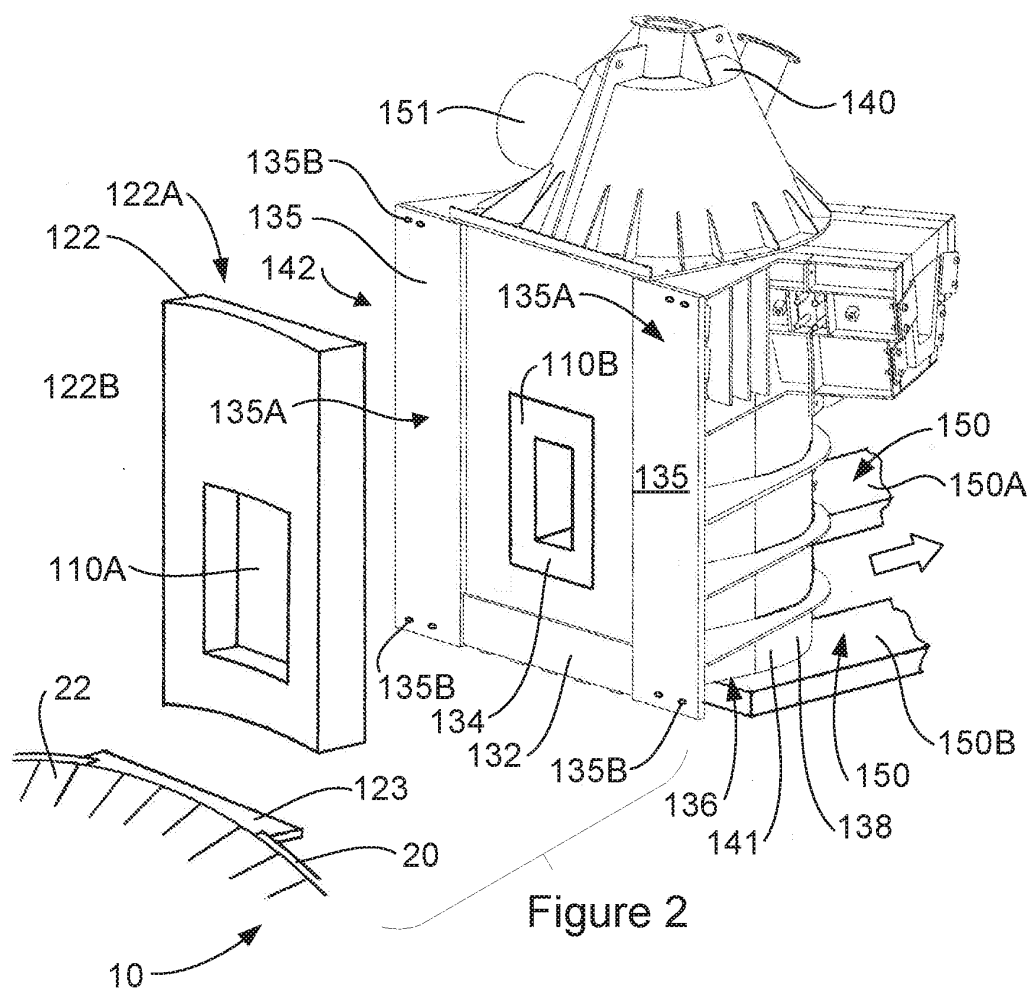


Figure 1



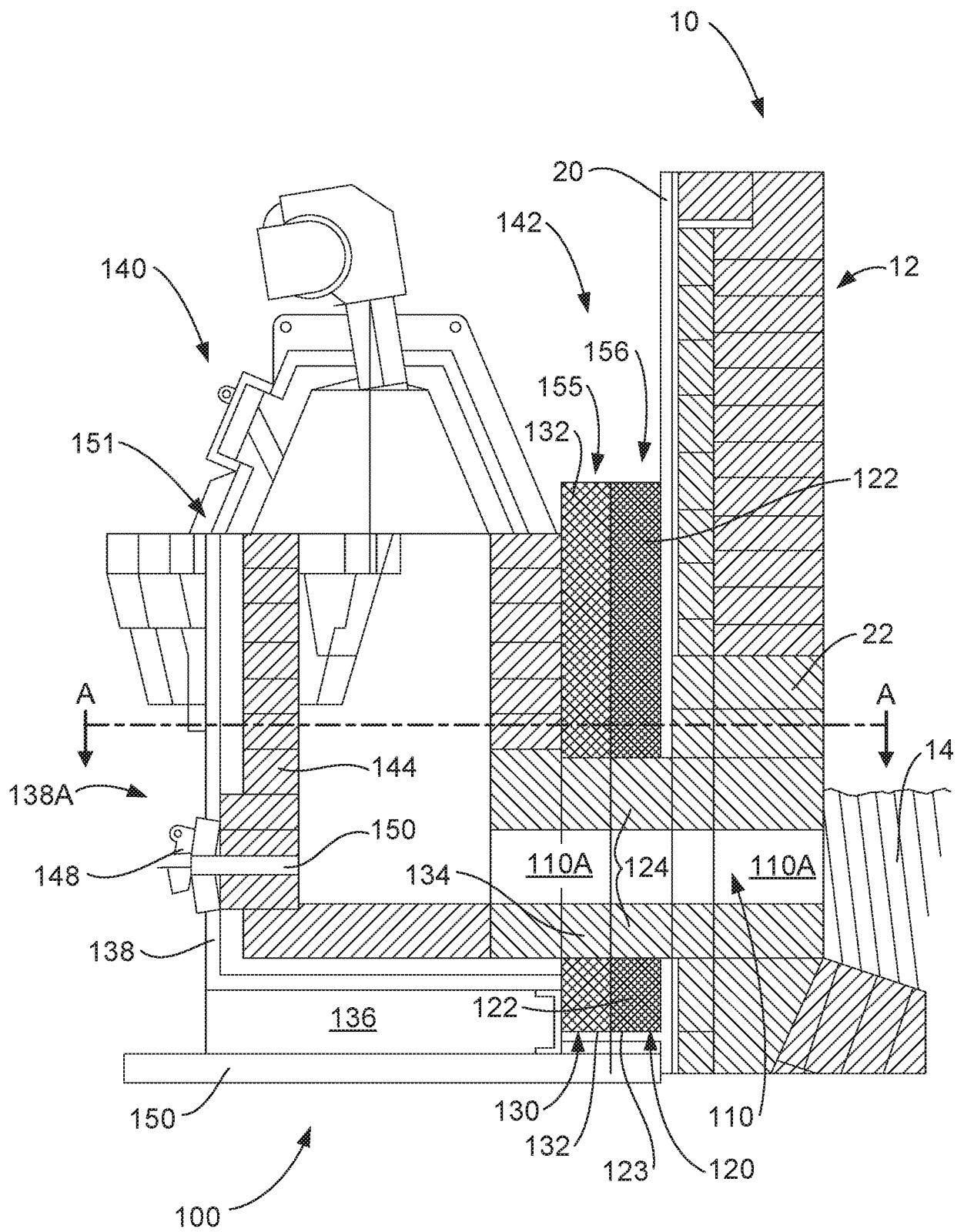


Figure 4

REFERENCES CITED IN THE DESCRIPTION

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