(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 082 689 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
02.11.2022 Bulletin 2022/44

(21) Application number: **20905734.8**

(22) Date of filing: **22.12.2020**

(51) International Patent Classification (IPC):
B22D 1/00 *(2006.01)* ***B22D 41/00*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
B22D 1/00; B22D 41/00; Y02P 10/20

(86) International application number:
PCT/KR2020/018846

(87) International publication number:
WO 2021/133018 (01.07.2021 Gazette 2021/26)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **26.12.2019 KR 20190175095**

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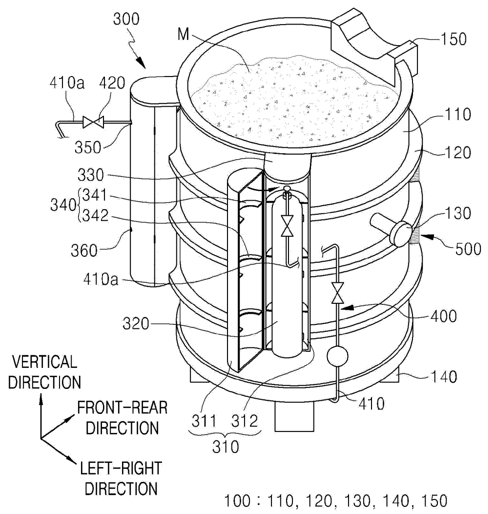
(54) **MOLTEN MATERIAL TREATMENT APPARATUS AND METHOD**

(57) The present invention relates to an apparatus for processing a melt including a container unit having an inner space to receive a melt; an injection unit mounted on a lower portion of the container unit to inject gas into the melt in the container unit; a storage unit mounted on the container unit and filled with gas; and a supply unit installed in the container unit to connect the injection unit and the storage unit and having a pressure regulator for regulating a supply pressure of the gas and a flow regulator for regulating a supply flow rate of the gas under the adjusted supply pressure, and a method for processing a melt using the apparatus. According to the present invention, an apparatus for processing a melt and a method for conveying a melt which are capable of preventing the melt from being penetrated into the injection unit over a long time.

FIG. 1



100 : 110, 120, 130, 140, 150
300 : 310, 320, 330, 340, 350, 360

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Description

TECHNICAL FIELD

[0001] The present invention relates to an apparatus and method for processing a melt, and more particularly, to an apparatus and method for processing a melt which is capable of effectively preventing the penetration of a melt into an injection unit over a long period of time.

BACKGROUND

[0002] In steelmaking and continuous casting processes, a ladle is used for receiving, refining and transporting molten steel. A purging plug is provided at a bottom of the ladle and is connected to an argon gas utility line. During the steelmaking process, argon gas may be supplied from the utility line to the purging plug, and hence a bubbling process of molten steel may be performed. In this bubbling process, it may be possible to stir the molten steel, adjust its components, float its inclusions, and control its temperature.

[0003] On the other hand, when the bubbling process of molten steel is completed, the purging plug is separated from the argon gas utility line, and the ladle is conveyed to the next process. At this time, the molten steel in the ladle penetrates into the purging plug and solidifies. Therefore, conventionally, a gas pipe having a detachable structure was installed on a trolley for carrying the ladle, and gas was supplied to the purging plug via the gas pipe while the ladle was being conveyed.

[0004] However, in such conventional structure, there is a problem in that argon gas is excessively supplied to the purging plug because argon gas is supplied under the same pressure as the pressure in the bubbling process from the argon gas utility line even during the movement of the trolley. And there is a problem in that it is difficult to supply argon gas to the purging plug after lifting the ladle from the trolley

[0005] The technology underlying the present invention is published in the following patent documents.

(Patent Document 1) KR10-2013-0101786 A
(Patent Document 2) KR10-2013-0107713 A

DISCLOSURE OF THE INVENTION

TECHNICAL PROBLEM

[0006] The present invention provides an apparatus and method for processing a melt which is capable of effectively preventing the penetration of a melt into an injection unit over a long period of time.

TECHNICAL SOLUTION

[0007] According to an embodiment of the present invention, an apparatus for processing a melt includes a container unit having an inner space to receive a melt; an injection unit mounted on a lower portion of the container unit to inject gas into the melt in the container unit; a storage unit mounted on the container unit and filled with gas; and a supply unit installed in the container unit to connect the injection unit and the storage unit and having a pressure regulator for regulating a supply pressure of the gas and a flow regulator for regulating a supply flow rate of the gas under the adjusted supply pressure.

[0008] The supply unit may include a pipe extending along an outer surface of the container unit and connecting the injection unit and the storage unit; and a safety valve mounted on the pipe, wherein the pressure regulator may be mounted on the pipe between the safety valve and the injection unit, and the flow regulator may be mounted on the pipe between the pressure regulator and the injection unit.

[0009] The supply unit may include a first blocking valve mounted on the pipe between the safety valve and the pressure regulator; a discharge valve mounted on the pipe between the first blocking valve and the safety valve; and a second blocking valve mounted on the pipe between the pressure regulator and the flow regulator.

[0010] A plurality of storage units may be provided, and a part of the pipe may be branched into a plurality of sub-pipes, and each of sub-pipes may be connected to each storage unit.

[0011] The storage unit may include a replaceable pressure container connected to the pipe and filled with gas; a partially openable protective container mounted on an outer surface of the container unit to receive the pressure container; an anti-shattering plate formed to cover an upper surface of the protective container; and a holding plate protruding from an inner surface of the protective container and being in contact with the pressure container.

[0012] The pressure container may have a convex upper portion, a plurality of holding plates may be provided, and at least one holding plate may be in contact with the convex upper portion of the pressure container to restrict the vertical movement of the pressure container.

[0013] The rest of the holding plates may be in contact with a side surface of the pressure container to restrict the horizontal movement of the pressure container.

[0014] At least one of a heat blocking member and a cooling channel may be provided on an inner surface of the protective container.

[0015] The apparatus may include a weight adjustment unit mounted on an outer surface of the container unit at a position opposite to the storage unit in a horizontal direction with the container unit interposed therebetween.

[0016] The weight adjustment unit may be installed to be at least partially movable in a horizontal direction along an outer surface of the container unit to adjust the center of gravity.

[0017] According to an embodiment of the present invention, a method for processing a melt includes the steps of providing a container unit that is movable together with a storage unit filled with gas; conveying the container unit containing the melt from a first position to a second position; supplying gas to an injection unit mounted on a lower portion of the container unit to inject the gas into the melt in the container unit; adjusting a supply pressure of the gas supplied to the injection unit; and adjusting a supply flow rate of the gas under the adjusted supply pressure.

[0018] Adjusting the pressure may include reducing the supply pressure to a reference pressure that is lower than an internal pressure of the utility line in at least one of the first and second positions and higher than the melt pressure.

[0019] Adjusting the pressure may include reducing the supply pressure to a reference pressure that is lower than a filling pressure of the storage unit and higher than the melt pressure.

[0020] The reference pressure may depend on a height of the melt in the container unit.

[0021] Adjusting the flow rate may include increasing or decreasing the supply flow rate such that the gas follows a preset reference flow rate while maintaining the supply pressure.

[0022] The method may include at least one of preventing a temperature from being transferred from the container unit to the storage unit; preventing shattering matters generated from the melt from contaminating the storage unit; and opening a portion of a pipe in which gas flows when the internal pressure of the storage unit rapidly increases to prevent a change in the supply pressure.

[0023] The method may include preventing the center of gravity of the container unit from being biased by applying a weight to a side opposite to the storage unit about the container unit.

[0024] The method may include moving the action point of the weight toward the storage unit depending on an amount of gas consumed.

[0025] The melt may include at least one of molten steel and slag.

ADVANTAGEOUS EFFECTS

[0026] According to the foregoing embodiments of the present invention, by using the storage unit separated from the utility line, gas can be supplied to the injection unit under a desired pressure and flow rate over a long time. In addition, when the pressure of the storage unit is lowered by consuming gas filled in the storage unit, the supply pressure and the supply flow rate of gas may be maintained at a desired reference value by using the pressure regulator and the flow regulator. In this manner, by first adjusting the supply pressure of gas and then adjusting the supply flow rate of gas under the adjusted pressure, the supply pressure and the supply flow rate of gas may be stably maintained over a long time. Thus, while the container unit repeats the entire process cycle of steelmaking and continuous casting processes several times, it is possible to effectively prevent the melt from penetrating into the spraying unit directly exposed to the melt over a long time. As a result, the service life of the gas injection unit may be increased, and the container unit may be smoothly operated, thereby improving the productivity of the steelmaking and continuous casting processes.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027]

Fig. 1 is a schematic diagram showing an apparatus for processing a melt according to an embodiment of the present invention.

Fig. 2 is a plan view of the apparatus for processing a melt according to an embodiment of the present invention.

Fig. 3 is a side view of the apparatus for processing a melt according to an embodiment of the present invention.

Fig. 4 is a rear view of the apparatus for processing a melt according to an embodiment of the present invention.

Fig. 5 is a conceptual diagram for explaining a supply unit according to an embodiment of the present invention.

Figs. 6 and 7 are conceptual diagrams showing a supply unit according to a first modified embodiment of the present invention.

Fig. 8 is a front view of an apparatus for processing a melt according to an embodiment of the present invention.

Fig. 9 is a schematic diagram showing a weight adjustment unit according to a second modified embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0028] Hereinafter, the embodiments of the present invention will be described in detail with reference to the accompanying drawings. However, the present invention is not limited to these embodiments disclosed below and will be implemented in a variety of different forms. Only the embodiments of the present invention are provided to complete the disclosure of the present invention and to completely inform those of ordinary skill in the art the scope of the invention. The drawings may be exaggerated to explain the embodiments of the present invention, and like reference numerals in the drawings refer to the same elements.

[0029] An apparatus and method for processing a melt according to the present invention may be applied to various melt processing processes in various industrial fields. Hereinafter, the present invention will be described in detail with respect to a ladle which is used for receiving, refining, and transporting molten steel in steelmaking and continuous casting processes of steel industry.

[0030] Fig. 1 is a schematic view showing an apparatus for processing a melt according to an embodiment of the present invention, and Figs. 2(a) and 2(b) are a plan view showing upper and lower portions of a container unit according to an embodiment of the present invention.

[0031] Referring to Figs. 1 and 2, an apparatus for processing a melt according to an embodiment of the present invention will be described in detail.

[0032] According to an embodiment of the present invention, an apparatus for processing a melt includes a container unit 100 having an inner space to receive a melt M; an injection unit 200 mounted on a lower portion of the container unit 100 to inject gas into the melt M in the container unit 100; a storage unit 300 mounted on the container unit 100 and filled with gas; and a supply unit 400 installed in the container unit 100 to connect the injection unit 200 and the storage unit 300 and having a pressure regulator 430 for regulating the supply pressure of the gas and a flow regulator 440 for regulating the supply flow rate of the gas under the adjusted supply pressure.

[0033] The melt M may include at least one of molten steel and molten slag, but is not limited to. Also, the gas may include an inert gas such as argon, but is not limited to.

[0034] The container unit 100 may receive the melt M therein. The container unit 100 may be used for receiving, refining, and transporting molten steel in steelmaking and continuous casting processes, and may be used for receiving and transporting slag. The container unit 100 may include a container body 110, a protrusion member 120, a locking member 130, a support member 140, and a discharge member 150.

[0035] The container body 110 may have a cylindrical shape, for example. The container body 110 may have an inner space and an openable upper portion. The melt M may be received in the inner space of the container body 110. The container body 110 may have a bottom plate and a side wall. The bottom plate may be any shape, for example a disk shape and may extend in a horizontal direction. In this case, the horizontal direction may include a left-right direction and a front-rear direction. The side wall may be a hollow cylindrical shape and may extend in a vertical direction. In addition, the side wall may be mounted around an upper surface edge of the bottom plate. The shape and structure of the container body 110 are not limited thereto; the container body 110 may have various shape and structure.

[0036] The protrusion member 120 may protrude from an outer circumferential surface of the side wall of the container body 110 and may extend along the perimeter of the outer circumferential surface. A pair of locking members 130 may be provided to be spaced apart from each other in a horizontal direction and may be mounted on both upper sides of the side wall of the container body 110. Also, the locking member 130 may be coupled to a main winding hook (not shown) of a crane (not shown). The container unit 100 may be supported and lifted on the main winding hook by the locking member 130. On the other hand, a tilting arm (not shown) may be provided on a lower surface of the bottom plate of the container body 110 and may be coupled to a slave winding hook (not shown) of the crane. The container unit 100 may be tilted by pulling the tilting arm upward with the slave winding hook.

[0037] A plurality of support members 140 may be provided to be spaced apart from each other in a horizontal direction and may be mounted on a lower surface edge of the bottom plate of the container body 110. When the container body 110 is seated on a trolley (not shown) and a ladle turret (not shown), a desired separation space can be obtained beneath the bottom plate of the container body 110 by the support member 140. The discharge member 150 may be mounted on an upper end of the side wall of the container body 110 between the pair of locking members 130. The discharge member 150 and the tilting arm may be spaced apart from each other in a front-rear direction. The discharge member 150 may be positioned in front of the locking members 130. The discharge member 150 may be provided with a discharge passage in a concave shape on an upper surface thereof. The discharge passage may extend in the front-rear direction. When the container unit 100 is tilted, the melt M may be discharged to the front of the container body 110 through the discharge passage. That is, the term front may refer to a direction in which the melt M is discharged from the container unit 100.

[0038] Fig. 3 is a side view of the apparatus for processing a melt according to an embodiment of the present invention, Fig. 4 is a rear view of the apparatus for processing a melt according to an embodiment of the present invention, and Fig. 5 is a conceptual diagram for explaining a supply unit according to an embodiment of the present invention.

[0039] Now, an injection unit, a storage unit, and a supply unit of an apparatus for processing a melt according to an embodiment of the present invention will be described with reference to Figs. 3 to 5.

[0040] Referring to Fig. 3, the injection unit 200 may be mounted on a lower portion of the container body 110 to inject gas into the container body 110. For example, the injection unit 200 may be mounted through the bottom plate of the container body 110 in a vertical direction. In addition, the injection unit 200 may have an upper surface exposed inside the container body 110. The injection unit 200 may include a porous refractory material. The injection unit 200 may be referred to as a purging plug or a bottom plug, for example. Also, the injection unit 200 may be referred to as a nozzle or a bottom blowing nozzle. The injection unit 200 may be connected to the storage unit 300 via the supply unit 400, and gas filled in the storage unit 300 may be supplied to the injection unit 200. The gas may be injected into the melt M in the container unit 100 from the injection unit 200. When the container unit 100 is used for refining the melt M, a relatively large amount of gas may be supplied to the injection unit 200. When the container unit 100 is used for receiving and transporting the melt M, a relatively small amount of gas may be supplied to the injection unit 200. A large amount of gas supplied to the injection unit 200 may bubble molten steel in the melt M. A small amount of gas supplied to the injection unit 200 serves to prevent the melt M from penetrating into the injection unit 200, so that it is suitable for clean bubbling that does not occur naked molten metal on an upper surface of the melt M. The supply of gas is performed by the storage unit 300 and the supply unit 400, and the operation of the supply unit 400 may be controlled by a controller (not shown).

[0041] The storage unit 300 may be supported by the container unit 100. The storage unit 300 may move together with the container unit 100. The storage unit 300 serves to continuously, for example constantly supply gas to the injection unit 200 while the container unit 100 repeats the entire process cycle of steelmaking and continuous casting processes several times. That is, the storage unit 300 serves to continuously supply gas to the injection unit 200 and prevent the melt M from penetrating into the injection unit 200 while the container unit 100 repeatedly performs a series of processes including converter steel tapping, bubbling, secondary refining, continuous casting, and slag exclusion. To this end, the storage unit 300 may be configured to store a sufficient amount of gas and to stably supply the stored gas to the injection unit 200 over a long time. Also, the storage unit 300 may be configured to safely protect the stored gas from a high temperature of the melt M and shattering matters. The storage unit 300 may include a protective container 310, a pressure container 320, an anti-shattering plate 330, and a holding plate 340.

[0042] Referring to Figs. 3 and 4, the protective container 310 may be spaced apart from the discharge member 150 in a front-rear direction. The protective container 310 may be spaced apart from the rear of the discharge member 150. In addition, the locking member 130 may be positioned between the protective container 310 and the discharge member 150. The protective container 310 may be formed, for example in a cylindrical shape with an empty interior to receive the pressure container 320. However, the protective container 310 may have various shapes depending on the shape of the pressure container 320. The pressure container 320 may also have various shapes as long as it does not interfere with surrounding equipment such as cranes and hooks. The protective container 310 may be formed to be larger than the pressure container 320 such that at least a portion of its inner surface may be spaced apart from the pressure container 320. The protective container 310 may be mounted on an outer surface of the container unit 100.

[0043] That is, the protective container 310 may be mounted on at least one of the side wall and the protrusion member 120 of the container body 110. Specifically, the protective container 310 may be mounted on the protrusion member 120 to be spaced rearward from the side wall of the container body 110. The protective container 310 may be mounted on the side wall of the container body 110 between the protrusion members 120 in a vertical direction. The protective container 310 serves to protect the pressure container 320 from a high temperature of the melt M and shattering.

[0044] The protective container 310 may be partially opened and closed to facilitate the receiving of the pressure container 320. To this end, the protective container 310 may have a plurality of detachable protective bodies. That is, the protective container 310 may be formed from separable first and second protective bodies 311 and 312. Each of the protective bodies 311 and 312 may have a shape in which a cylinder is cut in half in a vertical direction. Thus, one complete cylindrical shape can be obtained by combining these protective bodies 311 and 312. As the protective bodies 311 and 312 have a cylindrical shape, a structural interference between the protective bodies 311 and 312 and surrounding equipment can be minimized or prevented.

[0045] The protective bodies 311 and 312 may be arranged in a front-rear direction, any one of the protective bodies may be mounted on the container unit 100. Specifically, the second protection body 312 may be mounted on the protrusion member 120, and the first protection body 311 may be rotatably mounted on one side of the second protection body 312 in a left-right direction. In addition, the second protective body 312 may be mounted on the side wall of the container body 110 between the protrusion members 120, and the first protective body 311 may be rotatably mounted on one side of the second protective body 312 in a left-right direction. Alternatively, the first protective body 311 may be mounted on the protrusion member 120 or the container body 110, and the second protection body 312 may be rotatably mounted on the first protection body 311.

[0046] The first protective body 311 may be rotate the other side thereof about one side in a left-right direction to open and close the interior of the protective container 310. The other side of the first protection body 311 in the left-right direction may be provided with a desired fastening member (not shown) to couple the first protection body 311 to the second protection body 312. The fastening member may have various structures to facilitate the opening and closing of the protective container 310.

[0047] The pressure container 320 may be connected to a pipe 410 of the supply unit 400 and may be filled with high pressure gas. The pressure container 320 may be replaceable. Here, the term replaceable pressure container 320 means that the gas-consumed pressure vessel 320 may be replaced with a new pressure container 320 filled with high pressure gas 320 when gas filled in the pressure container 320 was consumed by a predetermined amount.

[0048] The pressure container 320 may be formed in a cylindrical shape that extends in a vertical direction and has a desired diameter in a horizontal direction. However, the pressure container 320 may have various extension directions and shapes. The pressure container 320 may be housed in the protective container 310. The pressure container 320 may be filled with high pressure gas. Here, the term high pressure may refer to a pressure higher than the pressure of the utility line as described below. The pressure container 320 may also be referred to as a gas storage container.

[0049] The pressure container 320 may be separated from a utility line provided in at least one of steelmaking and continuous casting facilities and may be independently used. That is, the pressure container 320 may be a component arranged separately from the utility line. The pressure container 320 may be filled with gas by using a separate filling means (not shown) under a pressure higher than the pressure inside the utility line. The supply pressure of gas supplied from the pressure container 320 through the supply unit 400 to the injection unit 200 may be lower than the pressure of the utility line. Here, the term pressure of the utility line may refer to a supply pressure of gas flowing inside the utility line.

[0050] The pressure container 320 may have the capacity of about 52 L. However, the capacity of the pressure container 320 may vary depending on the size of the container body 110, the total time during which a series of processes including converter steel tapping, bubbling, secondary refining, continuous casting and slag exclusion are performed, and the like. The gas filling pressure of the pressure container 320 may be 6 to 7 times, preferably 6.1 to 6.6 times higher than the gas supply pressure of the utility line. That is, the gas filling pressure of the pressure container 320 may be, for example in the range of 110 to 120 bar. Here, the term filling pressure means a pressure of gas supplied to the pressure container 320 when gas is filled in the pressure container 320. When the pressure container 320 is fully filled with gas, the pressure inside the pressure container 320 may be equal to the filling pressure. That is, the term filling pressure means the gas pressure of the pressure container 320 at the time when the filling of the pressure container 320 is completed. The gas pressure inside the pressure container 320 during the operation of the pressure container 320 is referred to as an internal pressure. The filling pressure of the pressure container 320 may be significantly higher than about 18 bar which is the gas supply pressure of the utility line provided in steelmaking and continuous casting facilities. Thus, the relatively high gas filling pressure of the pressure container 320 allows for a large amount of gas to be filled into the pressure container 320.

[0051] The internal pressure endured by the pressure container 320 may be higher than the filling pressure of the pressure container 320. Hence, when the pressure container 320 is filled with gas under the pressure of 120 bar, for example, the pressure container 320 may be stably used. Even when the pressure container 320 is exposed to high temperature radiant heat temporarily or for a long time and the temperature of the pressure container 320 is increased, the pressure container 320 may stably accommodate the volume expansion of gas due to the increased temperature. In this case, the internal pressure endured by the pressure container 320 may be referred to as, for example a maximum internal pressure or an acceptable pressure of the pressure container 320.

[0052] The pressure container 320 may be housed in the protective container 310 in a state that gas is filled under the filling pressure of 110 to 120 bar, and may be connected to the pipe 410 of the supply unit 400 inside the protective container 310. The pressure container 320 may supply gas to the injection unit 200 via the pipe 410. In this case, the supply pressure and flow rate of gas from the pressure container 320 to the injection unit 200 may be sequentially controlled by the pressure regulator 430 and the flow regulator 440 of the supply unit 400. When the pressure of gas filled in the pressure container 320, that is, the internal pressure of the pressure container 320 is close to the supply pressure of gas supplied to the injection unit 200, the pressure container 320 may be replaced with a new pressure container 320 having gas filled under the filling pressure of 110 to 120 bar, and the new pressure container 320 may be housed in the protective container 310.

[0053] The anti-shattering plate 330 may be formed to cover an upper surface of the protective container 310. Thus, high-temperature radiant heat and shattering matters generated by the melt M in the container body 310 may be blocked by the anti-shattering plate 330 before the protective container 310 is contaminated. The pressure container 320 may be primarily protected from heat and shattering matters by the anti-shattering plate 330, and secondarily protected by the protective container 310. As such, the storage unit 300 may safely and doubly protect the pressure container 320 using the anti-shattering plate 330 and the protective container 310.

[0054] For example, while the container unit 100 performs a series of processes from converter steel tapping to continuous casting and slag exclusion, the melt M may be discharged several times from the container unit 100. During these processes, a strong splash is generated and attached to the container unit 100, resulting in forming a fagot. The anti-shattering plate 330 may block the splash from reaching the protective container 310 from an upper side of the protective container 310 and may prevent the fagot from being attached to the protective container 310.

[0055] The anti-shattering plate 330 may be detachable. It may also be replaced earlier than the protective container 310. That is, the entire storage unit 300 can be maintained in a clean state without replacing the entire storage unit 300, only replacing the anti-shattering plate 330 as needed.

[0056] The holding plate 340 serves to stably support the pressure container 320 in the protective container 310. That is, in order to suppress or prevent heat transfer from the protective container 310 to the pressure container 320, the inner side and upper surfaces of the protective container 310 are spaced apart from the outer side and upper surfaces of the pressure container 320. At this time, the holding plate 340 in contact with the pressure container 320 may hold the pressure container 320 in the protection container 310. For example, the holding plate 340 may be formed in a ring shape such that an inner circumferential surface may be in contact with the pressure vessel 320 and an outer circumferential surface may be supported on an inner side surface of the protective container 310. In this case, the holding plate 340 may be formed of a plurality of separate members, for example two separate members wherein some may be supported on the first protection body 311 and the rest may be supported on the second protection body 312. When the first protection body 311 is coupled to the second protection body 312, said two separate members may be coupled to form one holding plate 340.

[0057] The holding plate 340 may protrude from an inner surface such as an inner side surface of the protective container 310 and may be in contact with an outer surface such as an outer side surface and the outer upper surface of the pressure container 320. The pressure container 320 may have an upper portion convex upward. Thus, an outer upper surface of the pressure container 320 may be formed to be convex upward. A plurality of holding plates 340 may be provided, and at least one holding plate, for example the first holding plate 341 may be in contact with the convex upper portion, that is, the outer upper surface of the pressure container 310 to restrict the vertical movement of the pressure container. As described above, the first holding plate 341 may be formed of two separate members wherein one may be supported on the first protection body 311 and the other may be supported on the second protection body 312.

[0058] Meanwhile, the remainder holding plates excluding the first holding plate 341 among the plurality of holding plates 340 is referred to as the second holding plate 342. The number of the second holding plate 342 may be at least one. The second holding plate 342 may be spaced apart from a lower side of the first holding plate 341 to be in contact with an inner side surface of the pressure container 320, thereby restricting the horizontal movement of the pressure container 320. The second holding plate 342 may also be formed of two separate members wherein one may be supported on the first protection body 311 and the other may be supported on the second protection body 312.

[0059] The holding plate 340 allows a separation space to be formed and maintained between the protective container 310 and the pressure container 320, and hence the pressure container 320 may be stably held in the protective container 310.

[0060] For example, the container unit 100 may be tilted from an upright state to 90 to 180° during slag exclusion. At this time, the holding plate 340 may prevent the pressure container 320 from moving in left-right and vertical directions inside the protective container 310. Thus, the pressure container 320 may be prevented from being damaged by colliding with the protection container 310.

[0061] The storage unit 300 may include a pipe installation hole 350 and a blowhole 360. The pipe installation hole 350 may be formed to pass through an upper or lower portion of the first protection body 311. Also, the pipe 410 of the supply unit 400 may be disposed to pass through the pipe installation hole 350.

[0062] The blowhole 360 may be formed to pass through a lower or upper portion of the first protection body 311. Air may be introduced from the outside of the protective container 310 to the inside through the blowhole 360. The number of the blowhole 360 may be at least one. Also, a blower (not shown) may be provided around the blowhole 360 for forced inflow of air. The blower may be supported by the protective container 310.

[0063] The protective container 310 may be provided with at least one of a heat blocking member and a cooling channel (both not shown) on the inner surface thereof. In this case, the separation space formed between the protective container 310 and the pressure container 320 may be used as an installation space for at least one of the heat blocking member and the cooling channel.

[0064] The heat blocking member may include a refractory heat insulating material having a heat shielding function even at a temperature of about 1000°C or higher. The heat blocking member may be manufactured by melting and fiberizing a refractory material including silica and alumina, followed by forming or weaving the resulting substance into a desired shape. Such heat blocking member may be referred to as, for example Cerakwool. The heat blocking member may be formed to encase at least one of the inner surface of the protective container 310 and the outer surface of the pressure container 320. Thus, radiant heat transferred from the melt M in the container unit 100 to the protective container 310 may be slowly transferred to the pressure container 320, or such heat transfer may be blocked. The heat blocking member may suppress or prevent an increase in the temperature of the pressure container 320, thereby suppressing or preventing an increase in the internal pressure of the pressure container 320.

[0065] Also, the cooling channel may be installed between the protective container 310 and the pressure container 320 to be at least partially in contact with or exposed to the pressure container 320. The cooling channel may be connected to the blowhole 360 or a utility line (not shown) for supplying a refrigerant. Alternatively, the separation space between the protective container 310 and the pressure container 320 may be used as a cooling channel as it is. It is possible to suppress or prevent an increase in the temperature of the pressure container 320 by the air or refrigerant supplied to the cooling channel. As a result, an increase in the internal pressure of the pressure container 320 may be suppressed or prevented.

[0066] A plurality of storage units 300 may be provided at the rear of the container body 110. For example, two storage units 300 may be provided to be spaced apart from each other in a left-right direction, and may be supported by the protrusion member 120 at the rear of the locking member 130, or on the side wall of the container body 110 between the protrusion members 120. However, the number of the storage unit 300 may vary. The plurality of storage units 300 allows gas to be supplied to the injection unit 200 over a long time, and hence the integrity of the injection unit 200 can be maintained over a long time. The integrity may be determined depending on the degree of penetration of the melt M into the injection unit 200. That is, the integrity may be considered to be maintained in a state that the melt M does not penetrate into the injection unit 200 or a state that a small amount of the melt M penetrates the injection unit 200 enough to operate the injection unit 200 smoothly.

[0067] As such, by using the plurality of storage units 300, for example, even while the container unit 100 waits for a long time after slag exclusion, the integrity of the injection unit 200 may be maintained. Alternatively, a single storage unit 300 may be provided at the rear of the container body 100.

[0068] Referring to Figs. 3 and 5, it is shown the supply unit 400 extending along an outer surface of the container unit 100. The supply unit 400 may include a pipe 410 with an end being connected to the injection unit 200 and the other end being connected to the storage unit 300, a safety valve 420 mounted on the other end of the pipe 410, a pressure regulator 430 mounted on the pipe 410 between the safety valve 420 and the injection unit 200, and a pressure regulator 430, and a flow regulator 440 mounted on the pipe 410 between the pressure regulator 430 and the injection unit 200. A part of the pipe 410 may be branched into a plurality of sub-pipes 410a, and each of sub-pipes 410a may be connected to each storage unit 300. Specifically, the other end of the pipe 410 may be branched into a plurality of sub-pipes 410a. Also, the plurality of sub-pipes 410a may be respectively connected to the plurality of storage units 300 on a one-to-one basis.

[0069] The pipe 410 may have one end extending along a lower surface of the bottom plate of the container body 110 to connect the injection unit 200 and the storage unit 300, and may be connected to a lower portion of the injection unit 200. Each of sub-pipes 410a formed at the other end of the pipe 410 may be installed to pass through the protective container 310, and may be connected to the pressure container 320.

[0070] On the other hand, when a single storage unit 300 is provided, the other end of the pipe 310 may not be branched. That is, the other end of the pipe 310 may be installed to pass through the protective container 310 and may be directly connected to the pressure container 320.

[0071] A connection pipe may extend along a side wall of the container body 110 to connect one end of the pipe 410 and the other end. The pressure regulator 430 and the flow regulator 440 may be respectively mounted on the connection pipe.

[0072] The safety valve 420 may be mounted on the pipe 410. Specifically, the safety valve 420 may be mounted on the sub-pipes 410a at the outside of the protective container 310. The safety valve 420 may automatically be opened to discharge gas to the outside when the internal pressure of the pressure container 320 increase to a desired pressure that is smaller than the internal pressure endured by the pressure container 320, that is, an acceptable pressure. The safety valve 420 may be blocked after a desired amount of gas is discharged over a period of time. When a single storage unit 300 is used, the safety valve 320 may be mounted on the other end of the pipe 410 at the outside of the protective container 310.

[0073] The pressure regulator 430 may be located upstream the flow regulator 440 in a direction of gas flow from the pressure container 320 to the injection unit 200. The flow regulator 440 may be located downstream the pressure regulator 430 in the direction of gas flow. Here, the term upstream means a region over which gas relatively first passes, and the term downstream means a region over which the gas relatively later passes.

[0074] The pressure regulator 430 may include a pressure reducing valve. The pressure regulator 430 may constantly maintain an output pressure at a desired pressure smaller than an input pressure. The input pressure refers to a gas pressure input to the pressure regulator 430 which is led from the pressure container 320 to the pipe 410. The output pressure refers to a gas pressure output to the inside of the pipe 410 which passes through the pressure regulator 430. The output pressure may be the supply pressure of gas from the pressure container 320 to the injection unit 200.

[0075] The pressure regulator 430 may maintain constantly the output pressure even when the pressure decreases due to a decrease in the gas filling capacity of the pressure container 310. For example, the input pressure may be greater than 3 bar and less than or equal to 120 bar, and the output pressure may be 3 bar. The output pressure may be determined by the height of the melt such as molten steel. A constant amount of gas may be stably supplied to the injection unit 200 by the pressure regulator 430.

[0076] Meanwhile, when the pressure is adjusted by the pressure regulator 430, the flow rate of gas is rapidly changed. In addition, it is difficult to control the supply flow rate of gas when gas is supplied to the injection unit 200 while maintaining the adjusted supply pressure of gas. The flow regulator 440 is mounted downstream the pressure regulator 430 to adjust the flow rate of gas under the adjusted pressure to a desired supply flow rate. That is, the flow regulator 440 may adjust the supply flow rate of gas supplied to the injection unit 200. In this manner, even when the internal pressure of gas in the storage unit 300 is reduced, the flow rate of gas supplied to the injection unit 200 may be stably maintained.

[0077] The flow regulator 440 may receive the pressure-adjusted gas passing through the pressure regulator 430, adjust its flow rate to a desired supply flow rate, and output it to the inside of the pipe 410. Thus, gas may be supplied to the injection unit 200 at a constant supply pressure and flow rate.

[0078] Even if the pressure-adjusted gas passing through the pressure regulator 430 is supplied to the flow regulator 440 at an irregular flow rate as the internal pressure of the pressure container 320 is lowered, the flow rate may be adjusted at a desired supply flow rate, for example of about 20 L/min by passing through the flow regulator 440. Thus, gas may be supplied from the flow regulator 440 to the injection unit 200 at the flow rate of 20 L/min under the pressure of 3 bar. The flow regulator 440 may include various types of flow meters capable of automatically adjusting a flow rate while constantly maintaining the gas pressure as an isostatic pressure.

[0079] The pressure regulator 430 and flow regulator 440 may be controlled by a control unit (not shown). They may be mechanically operated under the control of the control unit to sequentially adjust the supply pressure and flow rate of gas. In addition, the pressure regulator 430 and flow regulator 440 may adjust the magnitude of preset supply pressure and flow rate under the control of the control unit. That is, if it is desired to reduce the supply pressure as needed, the control unit may control the pressure regulator 430 to reduce the outlet pressure of the pressure regulator 430. If it is desired to reduce the supply flow rate as needed, the control unit may control the flow regulator 440 to reduce the outlet flow rate of the flow regulator 440.

[0080] For example, when the height of the melt M is lowered, the pressure of the melt M, for example iron static pressure is lowered, so a pressure applied to the injection unit 200 by the melt M is also reduced, resulting in reducing the supply pressure. When the temperature of the melt M is changed, the properties such as fluidity and viscosity of the melt M are also changed, and the supply flow rate may be correspondingly changed.

[0081] The supply unit 400 may not be connected to the utility lines used in the steelmaking and continuous casting processes. That is, during the entire process using the container unit 100, it is sufficient if only the gas filled in the storage unit 300 is supplied to the injection unit 200 to prevent clogging of the injection unit 200.

[0082] Fig. 8 is a front view of the apparatus for processing a melt according to an embodiment of the present invention.

[0083] Referring to Figs. 2 and 8, the apparatus for processing a melt according to an embodiment of the present invention may further include a weight adjustment unit 500. The weight adjustment unit 500 may be mounted on an outer surface of the container unit 100 at a position opposite to the storage unit 300 in a front-rear direction with the container unit 100 interposed therebetween. The weight adjustment unit 500 may prevent the eccentricity of the center of gravity of the container unit 100 by the storage unit 300. The weight adjustment unit 500 may extend in a vertical direction, and may include a holding bar 510 supported by the protrusion member 120 and a weight 520. The weight 520 may be formed to be curved along a shape of an outer circumferential surface of the container body 110, be seated on an upper surface of the protrusion member 120, and be fitted to the holding bar 510. The weight adjustment unit 500 may be located in front of the container body 110. The weight adjustment unit 500 may adjust the number of weights 520 to position the center of gravity of the container body 110 between a pair of locking members 130. Thus, even if the storage unit 300 is large and a large amount of gas is filled in the storage unit 300, the center of gravity of the container unit 100 may not be biased toward the storage unit 300.

[0084] A plurality of holding bars 510 may be provided. The plurality of holding bars 510 may be spaced apart from each other in at least one direction of a left-right and vertical directions. Each of upper and lower ends of the holding bar may be fitted respectively to surfaces facing each other of the protrusion member 120 arranged in the vertical direction.

[0085] The weight 520 may be a member of a bow shape and may have an area that may be seated on the upper surface of the protrusion member 120. A plurality of weights 520 may be stacked on the top of each other. In this case, irregularities and adhesive members may be provided on upper and lower surfaces of the weight 520. Thus, when the plurality of weights 520 are stacked on the top of each other, they may be coupled to each other to prevent movement. The weight 520 may have a fitting groove (h) formed on its side. The holding bar 510 may be fitted into the fitting groove (h). The fitting groove (h) may be formed on a front side of the weight 520. Thereby, the weight 520 may be stably protected between the container body 110 and the holding bar 510. Here, term front side refers to a side toward the front of the container body 110. The rear side may be a side facing the container body 110.

[0086] According to the foregoing embodiment of the present invention, even if the pressure of gas filled in the pressure container 320, for example the internal pressure of the pressure container 320 is varied, the gas may be stably supplied to the injection unit 200 at constant supply pressure and flow rate over a long time. In addition, the exposure of the pressure container 320 to radiant heat from the melt M can be minimized. As a result, it is possible to suppress or prevent the penetration of the melt M into the injection unit 200 over a long time.

[0087] Figs. 6 and 7 are conceptual views showing a supply unit according to a first modified embodiment of the present invention. Specifically, Fig, 6 is a conceptual diagram illustrating a connection structure of a supply unit according to the first modified embodiment of the present invention when a plurality of storage units, for example two storage units are used, and Fig. 7 is a conceptual diagram showing a connection structure of a supply unit according to the first modified embodiment of the present invention when a single storage unit is used.

[0088] Referring to Fig. 6, according to the first modified embodiment of the present invention, the supply unit 400 may include a first blocking valve 450 mounted on the pipe 410 between the safety valve 420 and the pressure regulator 430, a discharge valve 460 mounted on the pipe 410 between the first blocking valve 450 and the safety valve 420, and a second blocking valve 470 mounted on the pipe 410 between the pressure regulator 430 and the flow regulator 440.

[0089] The first blocking valve 450 may include a manual needle valve. The first blocking valve 450 may manually block a gas supply from the storage unit 300 to the supply unit 400 when the container unit 100 is not operated. The discharge valve 460 may include a manual ball valve. When the container unit 100 starts to operate again, the discharge valve 460 may discharge high-pressure gas accumulated in the pipe 410 between the first blocking valve 450 and the storage unit 300 to reduce pressure between the first blocking valve 450 and the storage unit 300. Thereby, the pressure regulator 430 may be protected from damage when the container unit 100 is operated again. The discharge valve 460 may discharge high pressure gas to a ventilation line L. The second blocking valve 470 may include a manual needle valve, and may be used to block a gas flow between the pressure regulator 430 and the flow regulator 440 as needed.

[0090] The supply unit 400 may further include a pressure gauge 490 mounted on the pipe 410 downstream the flow regulator 440 and a switching valve 480 mounted on the pipe 410 between the pressure gauge 490 and the injection unit 200.

[0091] The pressure gauge 490 may measure the pressure of gas output from the flow regulator 440. The measurement result from the pressure gauge 490 is transmitted to the control unit. When an actual pressure measured by the pressure gauge 490 is different from an output pressure set in the pressure regulator 430, the control unit may promptly notify a user of such situation.

[0092] The switching valve 480 may be a three-way valve, for example. The switching valve 480 may be selectively detached from the utility line U. When the switching valve 480 is mounted on the utility line U, the switching valve 480 may block a gas flow from the flow regulator 440 to the injection unit 200 and open a gas flow from the utility line U to the injection unit 200. When the switching valve 480 is disconnected from the utility line U, the switching valve 480 may open the gas flow from the flow regulator 440 to the injection unit 200.

[0093] Fig. 9 is a schematic diagram showing a weight adjustment unit according to a second modified embodiment of the present invention.

[0094] Referring to Figs. 8 and 9, according to the second modified embodiment of the present invention, the weight adjusting unit 500 may be installed to be at least partially movable in a horizontal direction along an outer surface of the container unit such that the center of gravity of the container unit 100 may be adjusted depending on a change in weight by the consumption of gas in the storage unit 300. To this end, the weight adjustment unit 500 may include a holding bar 510, a weight 520, an actuator 530, and a guide rail 540.

[0095] The holding bar 510 may extend in a vertical direction in front of the container body 110. A plurality of holding bars 510 may be provided to be spaced apart from each other in a left-right direction, and may be disposed between the protrusion members 120. Also, a plurality of weights 520 may be provided. The plurality of weights 520 may be arranged in the left-right direction, and may be stacked on the top of each other. A left group of weights 520 and a right group of weights 520 may be fitted into different holding bars 510.

[0096] The actuator 530 may be adjusted in length in the left-right direction, be supported on an outer surface of the container body 110, and be connected to the holding bar 510 on a one-to-one basis. The guide rail 540 may be respectively formed on surfaces facing each other in the protrusion members 120 arranged in a vertical direction and extend in a circumferential direction of the container body 110 along the protrusion members 120. Each of upper and lower ends of the holding bar 510 may be mounted on the guide rail 540.

[0097] The actuator 530 may be controlled by the control unit. The actuator 530 may move the holding bars 510 toward the front of the container body 110 so that they get closer to each other when an amount of gas filled in the storage unit 300 is relatively large. To the contrary, when the gas amount is relatively small, the actuator 530 may pull the holding bars 510 toward the locking members 130 so that they move away from each other in a left-right direction. A position of the weight 520 may be adjusted in a front-rear direction depending on the movement of the holding bars 510, thereby adjusting the center of gravity.

[0098] Hereinafter, a method for processing a melt according to an embodiment of the present invention will be described in detail with reference to Figs. 1 to 9.

[0099] According to an embodiment of the present invention, a method for processing a melt includes the steps of providing a container unit 100 that is movable together with a storage unit 300 filled with gas; conveying the container unit 100 containing the melt M from a first position to a second position; supplying gas to an injection unit 200 mounted on a lower portion of the container unit 100 to inject the gas into the melt M in the container unit 100; adjusting the supply pressure of gas supplied to the injection unit 200; and adjusting the supply flow rate of gas under the adjusted supply pressure.

[0100] First, the storage unit 300 filled with gas and the container unit 100 which are movable together are provided. The storage unit 300 may be in a state that gas is filled under the pressure of about 110 to 120 bar. However, a filling pressure may have any pressure range which is higher or lower than the above-mentioned pressure. At this time, the container unit 100 may contain the melt M. The melt M may be at least one of molten steel and slag.

[0101] Then, the container unit 100 containing the melt M is conveyed from the first position to the second position. The first position may be a place where the container unit 100 is currently located, and the second position may be a predetermined place where the container unit 100 is to be moved. For example, when the container unit 100 transports molten steel for which converter steel tapping has been completed to a subsequent process, a place where a converter process facility is located may be the first position, and a place where a subsequent process facility for subsequent processes such as a bubbling, secondary refining, or continuous casting process is located may be the second position.

[0102] During the foregoing processes, gas is supplied to the injection unit 200 such that the gas may be injected into the melt M in the container unit 100. Specifically, gas filled in the storage unit 300 may be supplied to the injection unit 200 using the supply unit 400. At this time, when an amount of gas filled in the storage unit 300 is reduced, the flow rate and pressure of gas supplied to the injection unit 200 may be irregularly varied. As a result, a molten metal surface of the melt M becomes unstable, so that the quality may be deteriorated. To prevent such situation, during said process, the supply pressure of gas supplied to the injection unit 200 is adjusted and subsequently the supply flow rate of gas under the adjusted pressure is also adjusted.

[0103] In this context, the reason for first adjusting the gas supply pressure is as follows; after adjusting the pressure of gas, typically the flow rate of gas is significantly fluctuated. So, to supply gas to the injection unit 200 at a stable flow rate, the pressure of gas is first adjusted by the pressure regulator 430 and then the flow rate of gas is adjusted by the flow regulator 430 and the gas is supplied to the injection unit 200.

[0104] The step of adjusting the pressure may include reducing the supply pressure to a reference pressure that is lower than the filling pressure of the storage unit 300 and higher than the pressure of the melt M. Alternatively, the step of adjusting the pressure may include reducing the supply pressure to a reference pressure that is lower than the internal pressure of the utility line in at least one of the first position and the second position and higher than the pressure of the melt M. The pressure of the melt may be a pressure at the bottom of the melt, that is, a pressure applied to an upper surface of the bottom plate of the container unit 100 by the melt.

[0105] At this time, the pressure of the melt M may be a pressure which is applied to the injection unit 200 by the melt M, for example an iron static pressure. The reference pressure may be a desired pressure at which the gas may be injected into the melt M via the injection unit 200 while preventing the melt M from entering the injection unit 200. Alternatively, the reference pressure may be a desired pressure which prevents naked molten metal surface from being formed on a molten metal surface of molten steel when the melt M contains molten steel and slag.

[0106] As such, since gas is supplied to the injection unit 200 under the supply pressure reduced to the reference pressure, a small amount of gas may be used. Also, it is possible to prevent the melt M from entering the injection unit 200 and to prevent naked molten metal from being formed on a molten metal surface of the melt M. The reference pressure may be about 3 bar. For example, the reference pressure may be 6 times lower than the supply pressure of the utility line as described above.

[0107] Meanwhile, as a height of the melt m increases, the pressure of the melt M, for example an iron static pressure is also increased, so the supply pressure must be correspondingly increased. For example, when the density of the melt is 7020 kg/m3, if a height of the melt m increases by about 1 m, the supply pressure must be increased by about 0.68 bar. Thereby, even if a height of the melt m is altered, it is possible to supply gas under an appropriate pressure to the injection unit 200. As such, the reference pressure may be determined depending on a height of the melt M in the container unit 100.

[0108] Then, the supply flow rate of the pressure-adjusted gas is adjusted. Specifically, the supply flow rate may be increased or decreased to follow a preset reference flow rate while maintaining a constant level of the supply pressure. Thereby, even if the flow rate of gas is irregularly varied in the pressure regulator 430, the gas may be supplied to the injection unit 200 at a constant supply flow rate by adjusting the flow rate by the flow regulator 440. The reference flow rate may be a flow rate which may not cause naked molten metal on a molten metal surface of the melt M or a flow rate which may prevent a rapid stirring of the melt M. However, the reference flow rate may be defined in various ways.

[0109] When the foregoing processes are performed, it is possible to prevent a high temperature from being transferred from the container unit 100 to the pressure container 320 of the storage unit 300 by using the protective container 310 and the anti-shattering plate 330. It is also possible to prevent shattering matters generated from the melt M from contaminating the pressure container 320.

[0110] Also, when the foregoing processes are performed, if the internal pressure of the storage unit 300 is rapidly increased exceeding a specific pressure due to a temperature increase in the storage unit 300, the supply pressure of gas led from the pressure container 320 to the pressure regulator 430 is rapidly increased. In this case, a part of the pipe 400 through which gas flows, for example sub-pipes 410a may be opened using the safety valve 420 of the supply unit 400 to reduce the pressure of gas supplied to pressure regulator 430. Thereby, it is possible to prevent damage to the pressure regulator 430 and to prevent fluctuations in the supply pressure. Here, said specific pressure may be any pressure in a pressure range that is higher than the filling pressure of the storage unit 300 and lower than an acceptable pressure which is an internal pressure endured by the pressure container 320 of the storage unit 300.

[0111] While supplying gas to the injection unit 200 under the adjusted supply pressure and flow rate, the steps of preventing a temperature from being transferred to the pressure container 320, preventing the pressure container 320 from being contaminated and preventing the supply pressure from being fluctuated may be optionally performed. For example, when gas is supplied to the injection unit 200 with the supply pressure and flow rate adjusted, at least one of these steps may be performed.

[0112] In addition, when the foregoing processes are performed, it is possible to prevent the center of gravity of the container unit 100 from being biased by applying a weight to the container unit 100 using the weight adjustment unit 500 from a side opposite to the storage unit 300 about the container unit 100. In this manner, depending on an amount of gas consumed in the storage unit 300, an action point to which a weight is applied by the weight adjustment unit 500 may be moved toward the storage unit 300 to stably maintain the center of gravity.

[0113] As such, even if the internal pressure of the pressure container 320 of the storage unit 300 is altered, since gas is supplied to the injection unit 200 under a constant flow rate and pressure over a long time, it is possible to prevent the melt M from penetrating into the injection unit 200 and to prevent the injection unit from being damaged.

[0114] The foregoing embodiments of the present invention are intended to illustrate the present invention, not to limit the present invention. It should be noted that the configurations disclosed in the embodiments of the present invention and their modifications may be combined and varied in various forms by combining or crossing each other, and their modifications may also be considered within the scope of the present invention. That is, the present invention will be embodied in a variety of different forms within the scope of the appended claims and equivalent technical spirits, and it should be understood by those skilled in the art to which the present invention pertains that the present invention can be implemented in various embodiments within the scope of the technical spirit of the present invention.

(Description of the Symbols)

[0115]

100: container unit
200: injection unit
300: storage unit
320: pressure container
400: supply unit
430: pressure regulator
440: flow regulator

Claims

1. An apparatus for processing a melt including:

    a container unit having an inner space to receive a melt;
    an injection unit mounted on a lower portion of the container unit to inject gas into the melt in the container unit;
    a storage unit mounted on the container unit and filled with gas; and
    a supply unit installed in the container unit to connect the injection unit and the storage unit and having a pressure regulator for regulating a supply pressure of the gas and a flow regulator for regulating a supply flow rate of the gas under the adjusted supply pressure.

2. The apparatus according to claim 1 wherein the supply unit includes a pipe extending along an outer surface of the container unit and connecting the injection unit and the storage unit; and a safety valve mounted on the pipe, wherein the pressure regulator is mounted on the pipe between the safety valve and the injection unit, and the flow regulator is mounted on the pipe between the pressure regulator and the injection unit.

3. The apparatus according to claim 2 wherein the supply unit includes a first blocking valve mounted on the pipe between the safety valve and the pressure regulator; a discharge valve mounted on the pipe between the first blocking valve and the safety valve; and a second blocking valve mounted on the pipe between the pressure regulator and the flow regulator.

4. The apparatus according to claim 2 wherein a plurality of storage units is provided, and a part of the pipe is branched into a plurality of sub-pipes, and each of sub-pipes is connected to each storage unit.

5. The apparatus according to claim 2 wherein the storage unit includes a replaceable pressure container connected to the pipe and filled with gas; a partially openable protective container mounted on an outer surface of the container unit to receive the pressure container; an anti-shattering plate formed to cover an upper surface of the protective container; and a holding plate protruding from an inner surface of the protective container and being in contact with the pressure container.

6. The apparatus according to claim 5 wherein the pressure container has a convex upper portion, a plurality of holding plates is provided, and at least one holding plate is in contact with the convex upper portion of the pressure container to restrict the vertical movement of the pressure container.

7. The apparatus according to claim 6 wherein the rest of the holding plates is in contact with a side surface of the pressure container to restrict the horizontal

movement of the pressure container.

8. The apparatus according to claim 5 wherein at least one of a heat blocking member and a cooling channel is provided on an inner surface of the protective container.

9. The apparatus according to claim 1 including a weight adjustment unit mounted on an outer surface of the container unit at a position opposite to the storage unit in a horizontal direction with the container unit interposed therebetween.

10. The apparatus according to claim 9 wherein the weight adjustment unit is installed to be at least partially movable in a horizontal direction along an outer surface of the container unit to adjust the center of gravity.

11. A method for processing a melt, the method including:

providing a container unit that is movable together with a storage unit filled with gas;
conveying the container unit containing the melt from a first position to a second position;
supplying gas to an injection unit mounted on a lower portion of the container unit to inject the gas into the melt in the container unit;
adjusting a supply pressure of gas supplied to the injection unit; and
adjusting a supply flow rate of gas under the adjusted supply pressure.

12. The method according to claim 11 wherein adjusting the pressure includes reducing the supply pressure to a reference pressure that is lower than an internal pressure of the utility line in at least one of the first and second positions and higher than the melt pressure.

13. The method according to claim 11 wherein adjusting the pressure includes reducing the supply pressure to a reference pressure that is lower than a filling pressure of the storage unit and higher than the melt pressure.

14. The method according to claim 12 or 13 wherein the reference pressure is determined depending on a height of the melt in the container unit.

15. The method according to claim 12 or 13 wherein adjusting the flow rate includes increasing or decreasing the supply flow rate such that the gas follows a preset reference flow rate while maintaining the supply pressure.

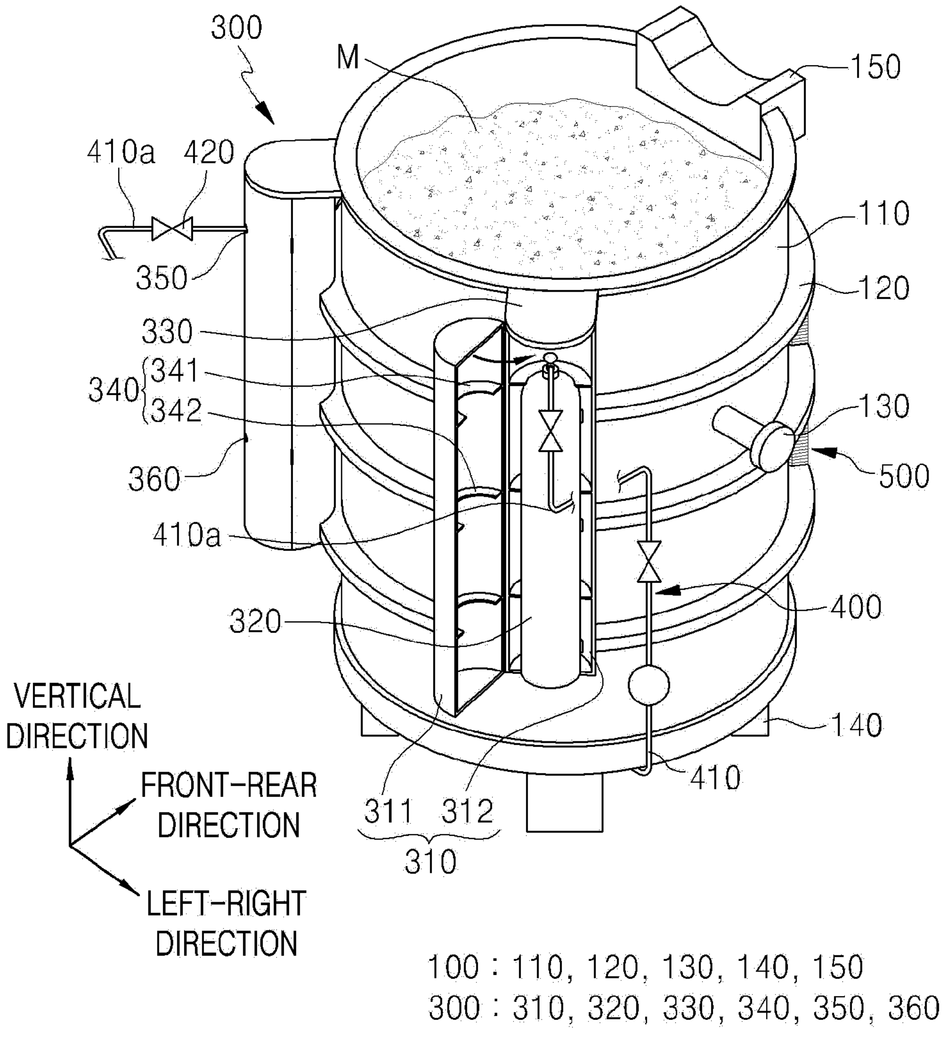
16. The method according to claim 11 wherein the method includes at least one of preventing a temperature from being transferred from the container unit to the storage unit; preventing shattering matters generated from the melt from contaminating the storage unit; and opening a portion of a pipe through which gas flows when the internal pressure of the storage unit rapidly increases to prevent a change in the supply pressure.

17. The method according to claim 11 wherein the method includes preventing the center of gravity of the container unit from being biased by applying a weight to a side opposite to the storage unit about the container unit.

18. The method according to claim 17 wherein the method includes moving the action point of the weight toward the storage unit depending on an amount of gas consumed.

19. The method according to claim 11 wherein the melt includes at least one of molten steel and slag.

FIG. 1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341
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140
410
FRONT-REAR DIRECTION
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312
310
LEFT-RIGHT DIRECTION
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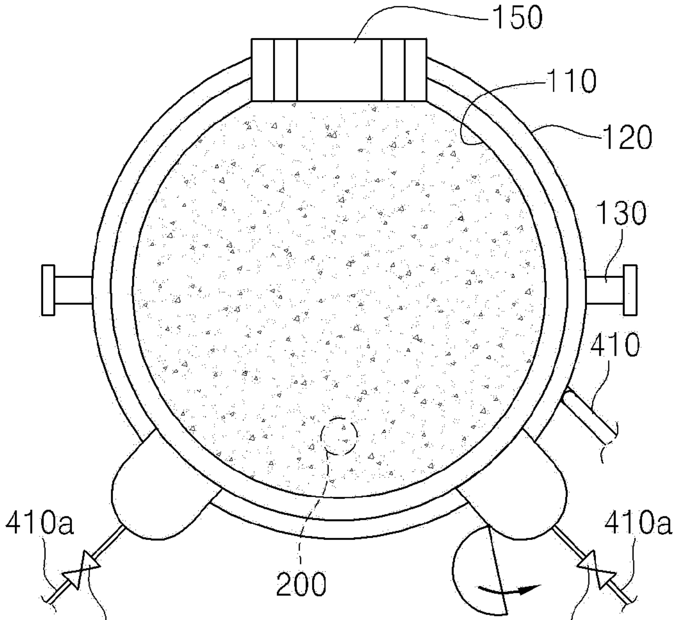
300 : 310, 320, 330, 340, 350, 360

FIG. 2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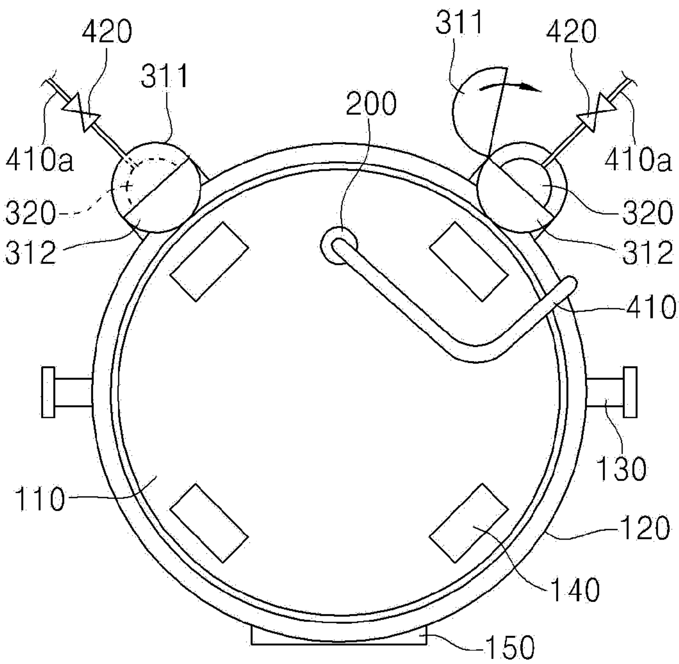
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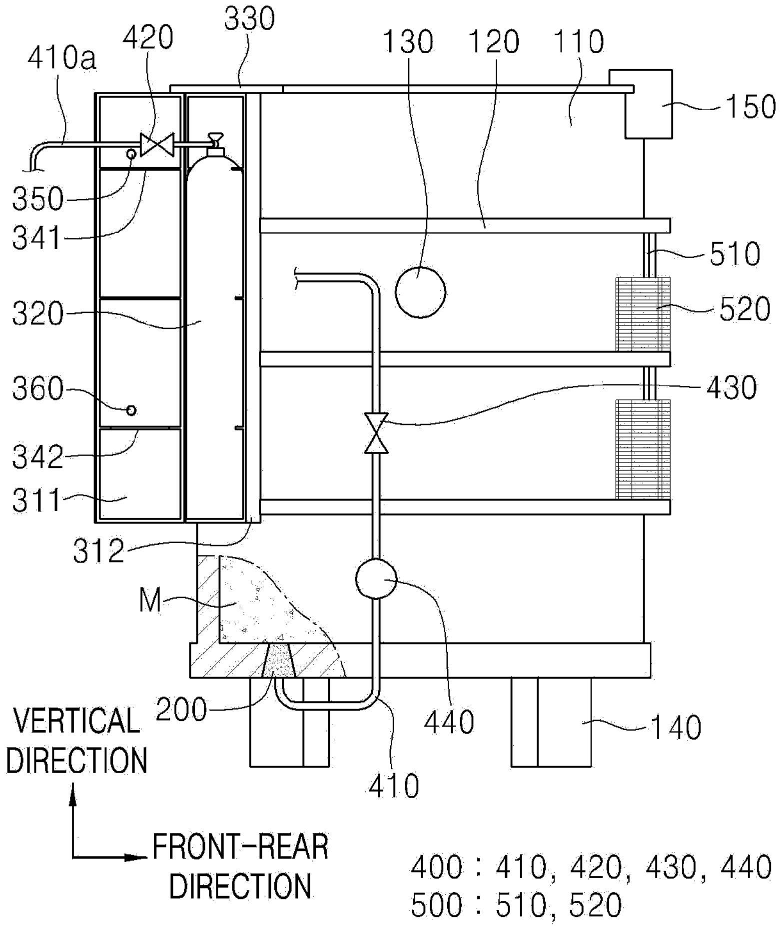
(b)

FIG. 3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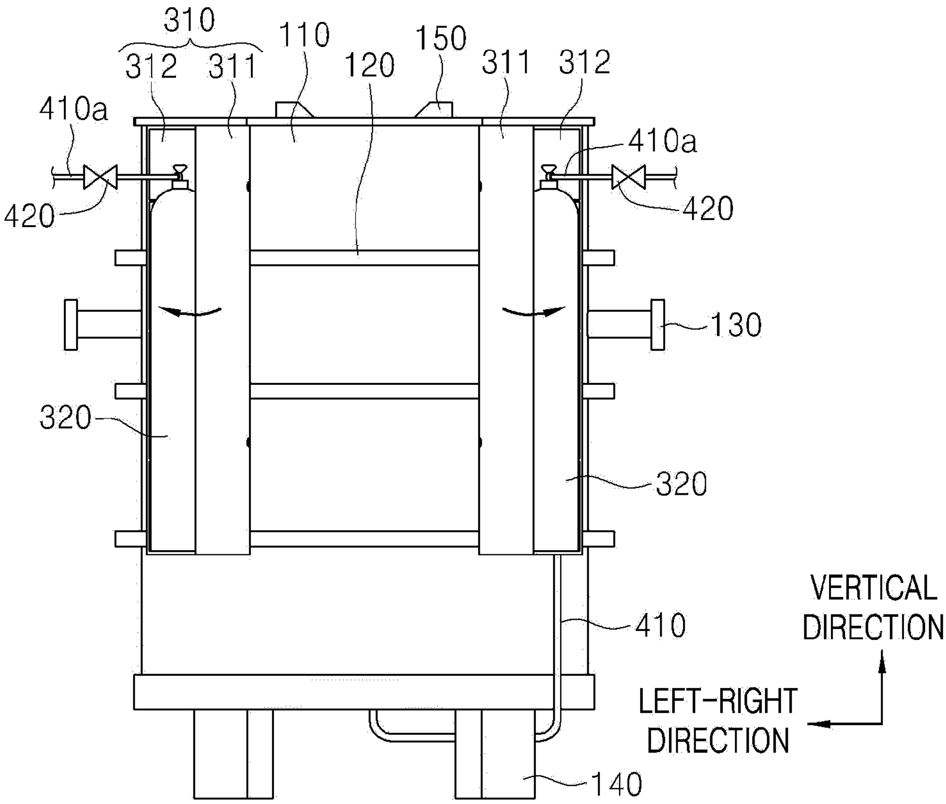
150
350
341
510
320
520
360
430
342
311
312
M
440
VERTICAL DIRECTION
200
140
410
FRONT-REAR DIRECTION
400 : 410, 420, 430, 440
500 : 510, 520

FIG. 4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420
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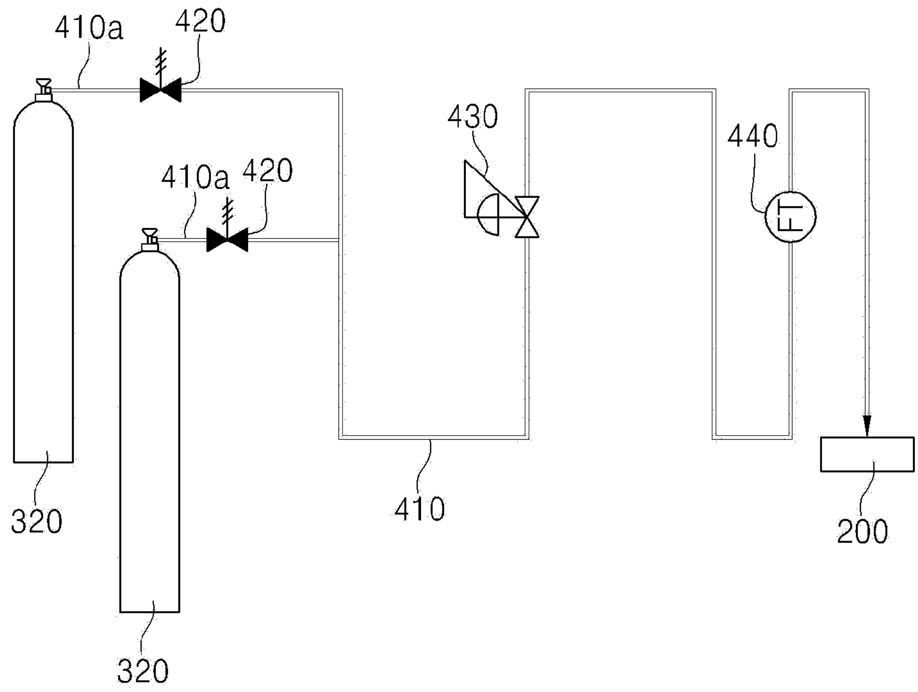
130
320
320
410
VERTICAL DIRECTION
LEFT-RIGHT DIRECTION
140

FIG. 5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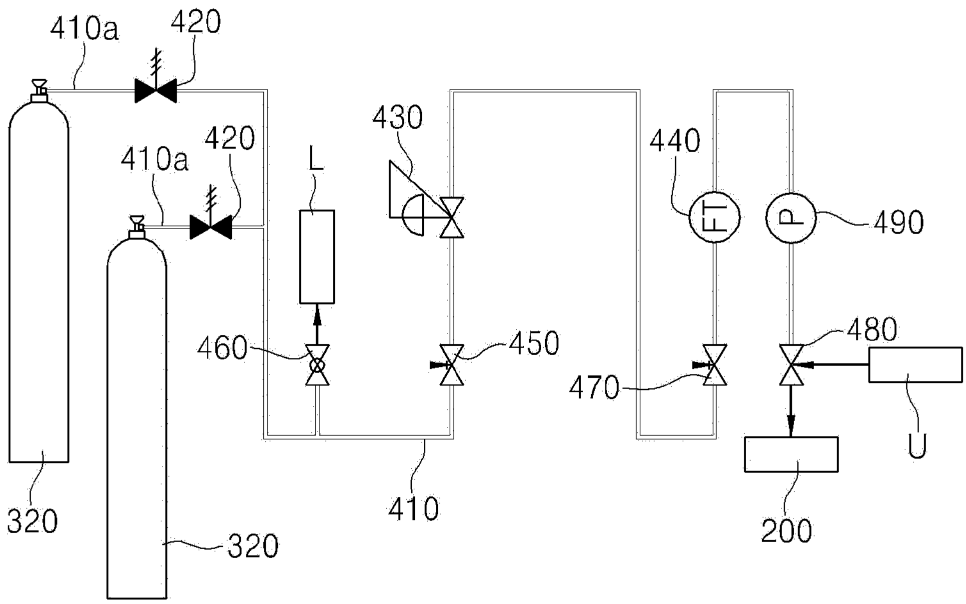
410
200

FIG. 6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320
410
200

FIG. 7

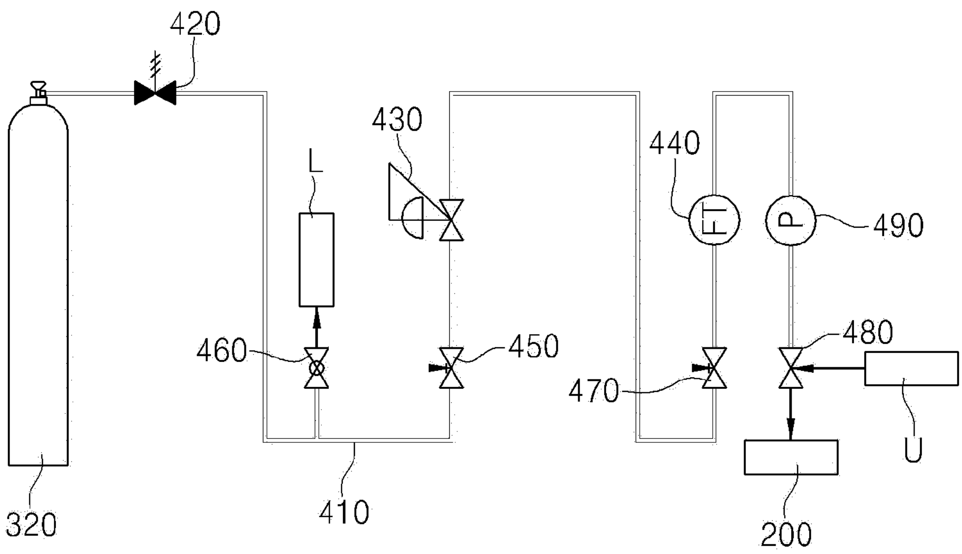


FIG. 8

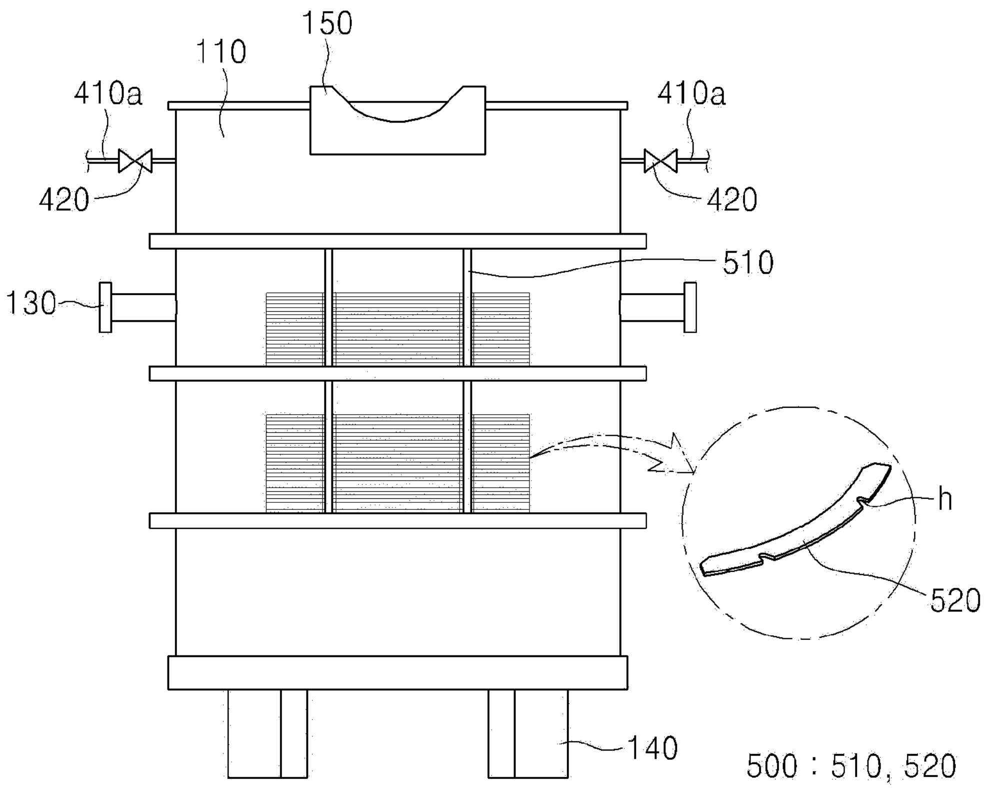
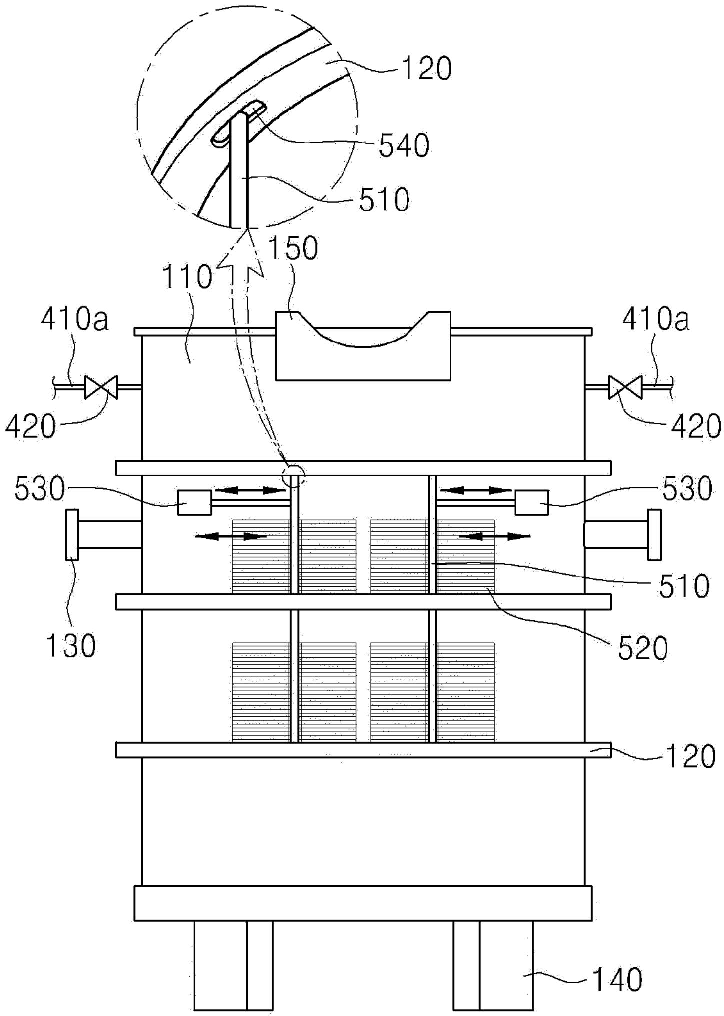


FIG. 9


120
540
510
110
150
410a
410a
420
420
530
530
130
510
520
120
140

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2020/018846

A. CLASSIFICATION OF SUBJECT MATTER

B22D 1/00(2006.01)i; **B22D 41/00**(2006.01)i

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)

B22D 1/00(2006.01); B22D 41/00(2006.01); B22D 41/42(2006.01); B22D 41/46(2006.01); B22D 41/58(2006.01); C21C 7/00(2006.01)

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

Korean utility models and applications for utility models: IPC as above
Japanese utility models and applications for utility models: IPC as above

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

eKOMPASS (KIPO internal) & keywords: 용융물(melt), 용기(container), 분사(spray), 저장(storage), 압력 조절(pressure adjustment), 유량(flux), 배관(piping), 밸브(valve)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2014-237161 A (TOKYO YOGYO CO., LTD. et al.) 18 December 2014 (2014-12-18) See paragraphs [0012] and [0016]-[0029] and figures 1-2.	1-4,11,19
Y		5-8,12-16
A		9-10,17-18
Y	KR 10-2018-0070952 A (POSCO) 27 June 2018 (2018-06-27) See paragraphs [0033]-[0035] and figures 1-2.	5-8,16
Y	KR 10-2003-0069033 A (TOKYO YOGYO KABUSHIKI KAISHA) 25 August 2003 (2003-08-25) See pages 3-4 and figure 2.	12-15
A	JP 2001-198667 A (TOKYO YOGYO CO., LTD.) 24 July 2001 (2001-07-24) See paragraphs [0012]-[0049] and figures 1-4.	1-19

☑ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 March 2021	**18 March 2021**
Name and mailing address of the ISA/KR	Authorized officer
Korean Intellectual Property Office **Government Complex-Daejeon Building 4, 189 Cheongsa-ro, Seo-gu, Daejeon 35208**	
Facsimile No. **+82-42-481-8578**	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2020/018846

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2014-237158 A (TOKYO YOGYO CO., LTD.) 18 December 2014 (2014-12-18) See paragraphs [0017]-[0035] and figures 1-3.	1-19

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2020/018846

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2014-237161 A	18 December 2014	JP 6175287 B2	02 August 2017
KR 10-2018-0070952 A	27 June 2018	None	
KR 10-2003-0069033 A	25 August 2003	AT 359138 T	15 May 2007
		AU 2002-300920 A1	04 September 2003
		AU 2002-300920 B2	07 October 2004
		BR 0204002 A	18 May 2004
		BR 0204002 B1	07 February 2012
		EG 23352 A	31 January 2005
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		ES 2286340 T3	01 December 2007
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JP 2014-237158 A	18 December 2014	JP 6175286 B2	02 August 2017

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- KR 1020130107713 A **[0005]**