



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

(43) Date of publication:
12.09.2018 Bulletin 2018/37

(51) Int Cl.:
B22D 11/118 (2006.01)

(21) Application number: **16862352.8**

(86) International application number:
PCT/KR2016/012307

(22) Date of filing: **28.10.2016**

(87) International publication number:
WO 2017/078336 (11.05.2017 Gazette 2017/19)

(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:
MA MD

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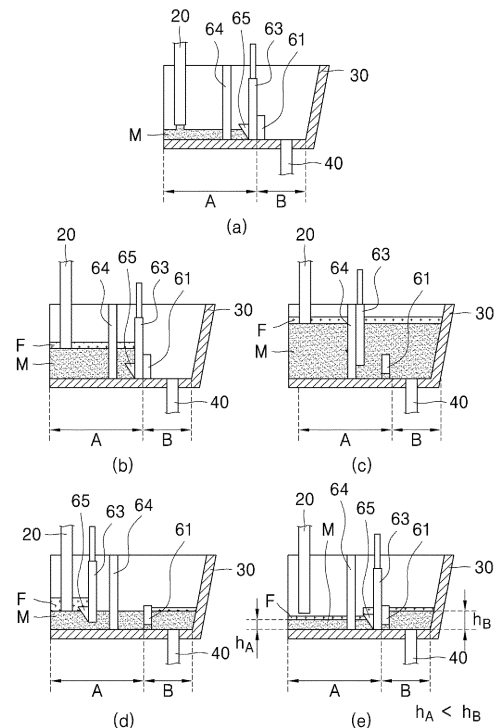
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(30) Priority: **02.11.2015 KR 20150153386**

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

(57) The present disclosure provides a molten steel treatment apparatus including a main body having an inner space, an open top and a bottom having a tap hole defined therein; a fixed dam extending in a width-direction of the main body and installed in contact with both the bottom and length-direction both side walls of the main body; a control dam extending in the width-direction of the main body; and a driving part for supporting the control dam in a movable and rotatable manner. The present disclosure provides a molten steel treatment method using the apparatus. In this way, in the initial stage, middle stage and late stage of the process, the level of the molten steel contained in the main body may be controlled based on each region.

[FIG. 6]



Description

Patent Document 4: KR10-2013-0047136 A

TECHNICAL FIELD

[0001] The present disclosure relates to a molten steel treatment apparatus and method. More particularly, the present disclosure relates to a molten steel treatment apparatus and method capable of controlling a level of a molten steel contained in a main body in an initial stage, a middle stage and a late stage of a process in each region.

RELATED ART

[0002] A tundish of a continuous casting plant is a device for continuously injecting steel, for example, molten steel from a ladle into a mold. The tundish has the function of storing the molten steel for a certain period of time, maintaining the temperature and lengthening the residence time of the molten steel to help floating and separation of inclusions therein. Further, the tundish has the ability to continuously supply molten steel to the mold while continuously performing the continuous casting process while continuously replacing the ladle.

[0003] Meanwhile, conventionally, as disclosed in the following patent documents, in order that the inclusions are floated up and separated from the molten steel contained in the tundish, a gas is injected into the tundish, or a magnetic field is applied into the tundish to induce an upward flow of molten steel, or the molten steel is passed through a slag in a form of droplets, or the shape of a dam and weir installed inside the tundish is improved to increase the retention time of the molten steel.

[0004] However, in the above-described conventional methods, the inclusions may be floated up and separated from the molten steel inside the tundish only when the molten steel level inside the tundish is kept at a certain level. For example, in the initial stage and middle stage and late stage of the process, in which the molten steel level inside the tundish is relatively low, it is difficult to separate the inclusions from the molten steel contained in the tundish in the conventional manners described above.

[0005] Therefore, inclusions are still incorporated in the slabs produced in the initial stage of the process, where molten steel begins to be fed into the tundish, in the slabs produced in the middle stage of the process, where ladle is exchanged and new molten steel begins to be supplied to the tundish, and in the slabs produced in the late stage of the process finishing the process using the remaining molten steel in the tundish. As a result, the slabs produced in the initial stage, the middle stage and the late stage of the process may not have the desired quality and may be scrapped.

Patent Document 1: KR10-2014-0085127 A
 Patent Document 2: KR10-2013-0076187 A
 Patent Document 3: KR10-2013-0127247 A

DISCLOSURE OF PRESENT DISCLOSURE**TECHNICAL PURPOSES**

[0006] The present disclosure provides a molten steel treatment apparatus and method that can control the level of the molten steel inside the main body on a region basis.

[0007] The present disclosure provides a molten steel treatment apparatus and method that can locally raise a molten steel level in the initial, middle, and late stages of the process.

[0008] The present disclosure provides a molten steel treatment apparatus and method that can quickly increase the molten steel level on the shroud nozzle side in the initial stage of the process and thereby advance the injection time of the flux.

[0009] The present disclosure provides a molten steel treatment apparatus and method capable of moving the remaining molten steel to the tap hole side in the middle stage and late stage of the process to secure the amount of remained molten steel near the tap hole.

[0010] The present disclosure provides a molten steel treatment apparatus and method that can reduce the index of inclusions in slabs produced in the initial, middle, and late stages of the process.

TECHNICAL SOLUTIONS

[0011] A molten steel treatment apparatus in accordance with an embodiment of the present disclosure includes a main body having an inner space, an open top and a bottom having a tap hole defined therein; a fixed dam extending in a width-direction of the main body and installed in contact with both the bottom and length-direction both side walls of the main body; a control dam extending in the width-direction of the main body; and a driving part for supporting the control dam in a movable and rotatable manner.

[0012] The molten steel treatment apparatus may include stoppers installed respectively on the length-direction both side walls of the main body, wherein the fixed dam is disposed between the stoppers and the tap hole.

[0013] The molten steel treatment apparatus may include a remained molten steel hole defined to pass through a lower portion of the fixed dam in the length direction.

[0014] The molten steel treatment apparatus may include a control portion for controlling an operation of the driving part to move the control dam in the length direction of the main body to partition the inner space of the main body into a supply region and a discharge region and to isolate the supply region and the discharge region from each other.

[0015] The control dam may have a dimension in a width direction so as to be spaced apart from both the

length-direction side walls of the main body at a position where the stopper is installed.

[0016] The control dam may have a dimension in a width direction so as to contact both the bottom and both length-direction side walls of the main body at a position where the fixed dam is installed.

[0017] The control dam may have a width-direction dimension so that both width-direction side edges of the control dam respectively contact or overlap the stoppers at a position where the stopper is installed.

[0018] The molten steel treatment apparatus may include a protrusion protruding on a lower portion of one side face of the control dam, wherein the protrusion has a molten steel loading top face.

[0019] Each of the stoppers may extend in a height direction of the main body and may protrude in the width-direction.

[0020] The fixed dam may include a plurality of fixed dams, wherein the fixed dams are spaced apart from each other in the length direction and are disposed around a central portion of the main and face each other, wherein a discharge region is defined in a region spanning from each fixed dam toward the tap hole, while a supply region is defined in a region spanning from each fixed dam away from the tap hole.

[0021] A plurality of control dams are disposed to face each other in the supply region, wherein a plurality of stoppers are disposed to face each other in the supply region.

[0022] A molten steel treatment method in accordance with an embodiment of the present disclosure includes providing a main body having an inner space, an open top and a bottom having a tap hole defined therein, wherein the inner space is divided into a supply region and a discharge region via a plurality of dams received therein; isolating the supply region from the discharge region using the plurality of dams; supplying molten steel to the supply region; communicating the supply and discharge regions with each other using the plurality of dams; and isolating the discharge region from the supply region using the plurality of dams, and controlling a level of the molten steel in the discharge region using the plurality of dams.

[0023] Communicating the supply and discharge regions with each other may include casting a slab using the molten steel in the discharge region in communication with the supply region.

[0024] Controlling a level of the molten steel in the discharge region may include casting a slab using a remaining molten steel in the discharge region isolated from the supply region.

[0025] Controlling a level of the molten steel in the discharge region may include: casting a slab using a remaining molten steel in the discharge region isolated from the supply region; and supplying a subsequent molten steel into the supply region.

[0026] The molten steel treatment method may include, after supplying the subsequent molten steel into

the supply region: communicating the supply region and the discharge region with each other using the plurality of dams and supplying the subsequent molten steel to the discharge region; isolating the discharge region from the supply region using the plurality of dams and controlling the molten steel level in the discharge region; and casting a slab using a remaining molten steel in the discharge region isolated from the supply region.

10 ADVANTAGEOUS EFFECTS

[0027] The embodiments of the present disclosure can control the level of the molten steel inside the main body on a region basis. Further, the embodiments of the present disclosure can locally raise a molten steel level in the initial, middle, and late stages of the process. That is, the embodiments of the present disclosure can quickly increase the molten steel level on the shroud nozzle side in the initial stage of the process and thereby advance the injection time of the flux. The embodiments of the present disclosure is capable of moving the remaining molten steel to the tap hole side in the middle stage and late stage of the process to secure the amount of remained molten steel near the tap hole.

[0028] In this way, the embodiments of the present disclosure can reduce the index of inclusions in slabs produced in the initial, middle, and late stages of the process.

[0029] For example, when the present disclosure is applied to a steel casting continuous casting plant, the inner space of the main body is divided into the supply region and the discharge region, and the supply region is isolated from the discharge region using the fixed dam and the control dam, or the molten steel in the supply region is moved to the discharge region using the fixed dam and control dam. Thus, at the initial stage of the process, the molten steel level in the supply region where the shroud nozzle is located can be increased faster than in the prior art. The time of injection of the flux can be more advanced than in the prior art. In the middle stage and late stage of the process, the remaining molten steel can be moved into the discharge region where the tap hole is located, and, the amount of remained molten steel near the tap hole can be secured higher than the minimum amount of remained molten steel.

[0030] In this way, the inclusions index of the slabs produced in the initial stage, middle stage and late stage of the continuous casting process can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0031]

FIG. 1 shows a molten steel treatment apparatus according to an embodiment of the present disclosure.

FIG. 2 is an illustration of a main part of a molten steel treatment apparatus according to an embodiment of the present disclosure.

FIG. 3 is a diagram for explaining a main part of a molten steel treatment apparatus according to a variant of the present disclosure.

FIG. 4 is an illustration of a main part of a molten steel treatment apparatus according to an embodiment of the present disclosure.

FIG. 5 is an illustration of a main part of a molten steel treatment apparatus according to an embodiment of the present disclosure.

FIG. 6 is an illustration of an operation of a molten steel treatment apparatus according to an embodiment of the present disclosure.

FIG. 7 illustrates an operation of a molten steel treatment apparatus according to a comparison example of the present disclosure.

FIG. 8 is a graph illustrating the comparison between casting results of continuous casting processes using molten steel treatment methods according to an embodiment and comparison example of the present disclosure.

DETAILED DESCRIPTIONS

[0032] An embodiment of the present disclosure will now be described in detail with reference to the accompanying drawings. However, the present disclosure is not limited to an embodiment disclosed below but may be embodied in various different forms. An embodiment of the present disclosure, however, is provided in order to make the present disclosure complete and to give a complete knowledge of the invention to those of ordinary skill in the art. The drawings may be exaggerated or expanded to illustrate an embodiment of the present disclosure, wherein like reference numerals refer to like elements throughout.

[0033] Hereinafter, an embodiment of the present disclosure will be described in detail with reference to a continuous casting facility of a steel mill. However, the present disclosure may be applied to various equipment and processes which are supplied with various melts and keep the melts therein for a predetermined time, treat and supply the melts to subsequent facilities.

[0034] FIG. 1 is a schematic diagram of a molten steel treatment apparatus according to an embodiment of the present disclosure. FIG. 2(a) is a schematic enlarged view of a main body of the molten steel treatment apparatus according to an embodiment of the present disclosure. FIG. 2(b) is an enlarged top view of the main body of the molten steel treatment apparatus according to an embodiment of the present disclosure. FIG. 3 is an enlarged schematic view of the main body of the molten steel treatment apparatus according to a variant of the present disclosure.

[0035] Further, FIGs. 4(a) to 4(c) are side cross-sectional views showing an interior of the main body of the molten steel treatment apparatus according to an embodiment of the present disclosure. In this connection, FIG. 4(a) is a side cross-sectional view showing the main

body cut in the width direction at a position where a stopper is not disposed. FIG. 4(b) is a side cross-sectional view of the main body cut in the width direction at a position where the stopper is disposed. FIG. 4(c) is a side cross-sectional view showing the main body cut in the width direction at the position where the stopper is installed when a control dam has been moved to the position where the stopper is installed.

[0036] Further, FIGs. 5(a) to 5(c) are top views showing an interior of the main body of the molten steel treatment apparatus according to an embodiment of the present disclosure. In this connection, FIG. 5(a) is a top view showing the main body in a position where a stopper is not disposed. FIG. 4(b) is a top view showing the main body at the position where the stopper is installed. FIG. 4(c) is a top view showing the main body at the position where the stopper is installed when the control dam has been moved to the position where the stopper is installed.

[0037] Meanwhile, as shown in FIGs. 1 to 3, in accordance with an embodiment and a variant of the present disclosure, the control dam is pressed against the stopper from the tap hole with respect to the stopper. However, the contact-pressing position of the control dam with respect to the stopper is not limited to that described above. For example, the control dam may be brought close to the stopper from the opposite side of the tap hole with respect to the stopper. As a result, the control dam may control the flow of the molten steel more stably by partially dispersing the pressure of the molten steel inside the main body to the stopper side while the molten steel is continuously injected into the main body.

[0038] Referring to FIG. 1, FIG. 2, FIG. 4 and FIG. 5, the molten steel treatment apparatus according to an embodiment of the present disclosure is described in detail.

[0039] The molten steel treatment apparatus according to an embodiment of the present disclosure may include a conveying container 10, a first nozzle 20, a main body 30, a second nozzle 40, a mold 50, a dam unit 60, a driving part 70 and a control portion 80. Such a molten steel treatment apparatus may be applied to various processes, for example, including, a continuous casting process of the same or different grades in which a subsequent molten steel with the same or different components as or from the previous molten steel is fed into the main body 30 containing the previous molten steel while the conveying container 10 is being exchanged, and, then, the molten steel is continuously cast into slabs.

[0040] The conveying container 10 may include a ladle. The conveying container 10 is, for example, a cylindrical container whose interior is opened upward. The refractory material is built in the container 10 so that molten steel M is contained therein. The conveying container 10 is movably disposed over the main body 30. The container 10 serves to supply the molten steel M contained in the container to the main body 30. A collector nozzle (not shown) passing through a portion of a bottom of the conveying container 10 may be formed. A lower portion of the collector nozzle may be connected to the first nozzle

zle 20.

[0041] The first nozzle 20 may include a shroud nozzle. For example, the first nozzle 20 is movably supported by a manipulator (not shown) provided at one side of the outside of the main body 30. The first nozzle 20 is coupled to the collector nozzle formed on the lower side of the conveying container 10 so that the nozzle 20 may be connected to the conveying container 10.

[0042] The main body 30 may include a tundish. The main body 30 is disposed under the conveying container 10. The main body 30 is a container of a predetermined shape for receiving molten steel M from the conveying container 10 and temporarily storing molten steel therein. The main body 30 includes a steel plate 31 that defines an outer wall of the main body 30 and keeps a shape thereof, and a refractory portion 32 which is formed in the inside of a steel plate 31. The main body 30 may be symmetrical with respect to the center of the longitudinal direction (x-axis direction), and the length of the main body 30 may be larger than the width of the main body 30. Further, the main body 30 at the center in the longitudinal direction may protrude in the width direction (y-axis direction).

[0043] Further, the width may be reduced toward the both ends in the longitudinal direction from the longitudinal center of the main body 30. That is, the main body 30 is tapered from the center portion in the longitudinal direction to each of the end portions in the longitudinal direction.

[0044] The interior of the main body 30 may be opened upward, and a cover (not shown) may be mounted on the top thereof. An injection port may be formed in the center of the cover. The first nozzle 20 may be inserted into the injection port and connected to the inside of the main body 30. Tap holes 35 may be formed in the bottom 33 of the main body 30. The tap holes 35 may be formed at a plurality of positions spaced apart from both ends in the longitudinal direction and symmetrical with respect to the center in the longitudinal direction (x-axis direction) of the main body 30.

[0045] In order that the tap hole 35 allows the molten steel M to be discharged inside the main body 30 there-through, the tap hole 35 may be formed to penetrate the bottom 33 of the main body 30 in the vertical direction in the vicinity of both side walls 34a extending in the width direction among the side walls of the main body 30. The second nozzle 40 may be mounted in the tap hole 35 and below the main body 30 and may be connected to the main body 30.

[0046] The second nozzle 40 may include a submerged entry nozzle. The second nozzle 40 is a hollow tube through which molten steel M passes. The nozzle 40 extends in the height direction (z-axis direction). Upper and lower portions thereof are opened, and the inside thereof may be protected by the refractory material. The second nozzle 40 may be mounted through the tap hole 35 and below the main body 30 so as to supply the molten steel M contained in the main body 30 to the mold 50. A

gate (not shown) of a slide structure may be provided on one side of the second nozzle 40. The gate may adjust the opening of the second nozzle 40 to control the amount of molten steel M as emitted.

[0047] The mold 50 includes a pair of first plates facing each other and spaced from each other in the longitudinal direction (x-axis direction), and a pair of second plates spaced from each other in the width direction (y-axis direction) and facing each other and connecting the opposite sides of the first plates respectively. The upper and lower portions of the mold 50 are opened. The mold has an inner space in which the molten steel M is first solidified therein. The mold 50 may be a rectangular or square hollow block. The mold 50 is positioned to surround the bottom of the second nozzle 40. The mold 50 is supplied with the molten steel M from the main body 30, and solidifies the molten steel into slabs, and continuously draws the slabs out.

[0048] A cooling station (not shown) may be provided under the mold 50. The cooling station cools the slabs drawn from the mold 50 and performs a series of shaping operations. The cooling station includes a plurality of segments. The plurality of segments are continuously arranged in a predetermined direction to form the cooling station of a curved or vertical curved shape. Each of the segments is provided with a plurality of rolls which guide the withdrawal of the slab. A nozzle is provided between each roll. The nozzle cools the slab by injecting cooling water into the slab.

[0049] Hereinafter, the dam unit according to an embodiment of the present disclosure is described in detail. The dam unit 60 may be installed inside the main body 30 to control the flow of the steel contained in the main body 30, for example, molten steel M. The dam unit 60 may be provided on both left and right sides with respect to the center of the main body 30 in the longitudinal direction (x-axis direction), and may have a symmetrical shape and structure.

[0050] The dam unit 60 may include fixed dams 61 installed in a width direction (y-axis direction) of the main body 30 and being in contact with the bottom 33 and longitudinal side walls 34b of the main body 30 at a position spaced from the central portion in the longitudinal direction of the main body 30 toward the tap hole 35; remained molten steel holes 62 formed respectively through the lower portions of the fixed dams 61 in the longitudinal direction; control dams 63 extending in the width direction of the main body 30; and stoppers 64 respectively installed on the longitudinal side walls 34b of the main body 30 at the opposite side of each tap hole 35 around the fixed dam 63.

[0051] The fixed dam 61 is made of refractory material and extends in the width direction of the main body 30. The fixed dam may be formed in a shape of a plate having a predetermined thickness in the longitudinal direction and a predetermined area in the width direction and the height direction. The fixed dam may be spaced from the stopper 64 toward the tap hole 35 and installed at a lower

portion of the main body 30. The fixed dam 61 may raise the molten steel M which is guided to the lower side of the inside of the main body 30 by the control dam 63. The upper end of the fixed dam 61 may have a constant height from the bottom 33 of the main body 30 so that the upward flow of the molten steel M is facilitated and the flux of the molten steel M becomes the desired flux. Meanwhile, as the height of the fixed dam 61 increases, the upward flow of the molten steel M is relatively suppressed, while as the height of the fixed dam decreases, the flux of molten steel M increases relatively.

[0052] The fixed dam 61 may have a plurality of, for example, two fixed dams 61 as spaced apart in the longitudinal direction from the center of the main body 30 so as to face each other. The inside of the main body 30 may be divided into a supply region A and a discharge region B by the installation structure for partitioning the fixed dam 61, for example, into the supply region A and the discharge region B. For example, the supply region A may be formed in the inner side of the fixed dam 61, while the discharge region B may be formed in the outer side of the fixed dam 61.

[0053] In this connection, the inside of the fixed dam 61 in which the supply region A is formed may be the opposite side of the tap hole 35 with respect to the fixed dam 61. Further, the outer side of the fixed dam 61 in which the discharge region B is formed may be the region on the side of the tap hole 35 around the fixed dam 61.

[0054] In the supply region A, a plurality, for example, two of stoppers 64 may be provided facing each other. Correspondingly, in the supply region A, a plurality, for example, two of control dams 63 may be installed facing each other.

[0055] The remained molten steel hole 62 may be formed to penetrate the lower portion of the fixed dam 61 in the longitudinal direction and may contact the bottom 33 of the main body 30. Through the remained molten steel hole 62, the molten steel M on the inner lower side of the main body 30 may be moved from the supply region A to the discharge region B.

[0056] The control dam 63 is made of refractory material and extends in the width direction of the main body 30. The dam 63 may be formed in the shape of a plate having a thickness in the longitudinal direction and a width in the width direction and the height direction. The control dam 63 is disposed in the supply region A of the main body 30. The control dam 63 may be supported by the driving part 70 and may be moved the longitudinal direction, the width direction and the height direction, respectively, and may be rotated about an axis in the height direction.

[0057] The control dam 63 is arranged to have the width such that it is spaced apart from the longitudinally opposite side walls 34b of the main body 30 in the width direction so as to prevent structural interference with the main body 30 in a movement and rotation thereof at a position where the stopper 64 is installed or in the supply region A. The control dam 63 has a width in a width di-

rection such that the control dam 63 contacts both the bottom 33 of the main body 30 and both side walls 34b in the longitudinal direction at the position where the fixed dam 61 is installed.

[0058] Thus, the control dam 63 may be freely moved and rotated in the supply region A of the main body 30 without collision with the main body 30. The control dam 63 moves from the supply region A to the installation position of the fixed dam 61 and is brought into close contact with both the fixed dam 61 and the bottom 33 of the main body 30 and both the longitudinal side walls 34b, thereby to isolate the supply region A from the discharge region B.

[0059] Further, the control dam 63 has a width in the width direction so as to be spaced apart from both longitudinal side walls 34b of the main body 30. The control dam 63 may have a width in the width direction so that both side edges thereof in the width direction contact or overlap the stopper 64 at a position where the stopper 64 is installed.

[0060] Further, the control dam 63 has a height such that it moves from the upper side of the main body 30 to the position where the stopper 64 is installed and, thus, the both side edges thereof in the width direction close-contact the stopper 64 such that the upper end thereof is positioned higher than the surface level of the molten steel M and the lower end thereof is separated from the bottom 33 of the main body 30.

[0061] Thus, the control dam 63 is in close contact with the stopper 64, for example, acting as a weir. Accordingly, the control dam 63 guides a flow of the molten steel M falling down and received in the main body 30 and guided to the discharge B to the inner lower side of the main body 30 and reduces an initial flow intensity of the molten steel M to a desired intensity.

[0062] The stopper 64 is installed at each of both longitudinal side walls 34b of the main body 30 at a position spaced from the fixed dam 61 toward the longitudinal center of the main body 30 and extends in the height direction of the main body 30, and protrudes in a width direction. When the control dam 63 is moved to the position where the stopper 64 is installed and is in close contact with the stopper 64, the stopper 64 seals between the control dam 63 and the longitudinal side walls 34b of the main body 30. The stopper 64 may be made of refractory material.

[0063] The protrusion length of the stopper 64 in the width direction may be formed corresponding to the width of the control dam 63 in the width direction. The protrusion length of the stopper 64 in the width direction may be equal to or greater than the spacing between the control dam 63 and the longitudinal side walls 34b of the main body 30.

[0064] Meanwhile, the position of the stopper 64 in the longitudinal direction of the main body 30 is a position such that when the control dam 63 is in close contact with the stopper 64, the molten steel is supplied in a steady state and the ability to remove the inclusions from

the molten steel is maximized.

[0065] The driving part 70 may be a mechanical or hydraulic drive apparatus, for example, provided at a predetermined position outside the main body 30. The driving part 70 may be configured to support the control dam 63 movably and rotatably. More specifically, the driving part may be configured to movably support the control dam 63 along the longitudinal direction of the main body 30. Further, the driving part 70 may be configured to support the control dam 63 in a tilting or rotatable manner about an axis in the height direction.

[0066] In this connection, the above-mentioned tilting controls the angle of the control dam 63 about the axis in the height direction and changes the angle of the control dam 63 to such a small degree that the control dam 63 can pass into the gap between the stoppers 64 and controls the posture of the control dam 63. Further, the above-mentioned rotation controls the angle of the control dam 63 about the axis in the height direction, and changes the angle of the control dam 63 to a larger degree than such a small degree that the control dam 63 can pass into the gap between the stoppers 64 and controls the posture of the control dam 63.

[0067] The driving part 70 may include a first drive rod 71 extending in the height direction and mounted on the upper end of the control dam 63 so as to be aligned with the center of the control dam 63 in the width direction above the control dam 63, a second drive rod 72 extending in the width direction and supported at one end of the width direction by a drive rod 71 movably in the height direction, a third drive rod 73 formed to be movable in the longitudinal direction and mounted on the other end of the second drive rod 72, and a fourth drive rod 74 connected to the third drive rod 73 for supporting the movement in the longitudinal direction.

[0068] Meanwhile, the driving part 70 may be constructed in various configurations and manners capable of movably and rotatably supporting the control dam 63. The present disclosure is not particularly limited in the above-described configuration and manner.

[0069] The control portion 80 may be configured to control the operation of the driving part 70 according to a previously input process pattern. For example, the control portion 80 moves the control dam 63 in the longitudinal direction and the height direction of the main body 30 and rotates the same about the axis in the height direction. In this way, the control dam may be brought into close contact with the fixed dam 61, or the stop damper 64 in the supply region A of the main body 30 or may be moved from the stop damper 64 to a central position in the longitudinal direction of the main body 30. These operations may be controlled differently according to the detailed processes. By the control of the control portion 80, the inside of the main body 30 may be divided into a supply region A and a discharge region B, the bath surface slag of the molten steel M in the supply region A may be removed to the center side of the main body 30, and the remaining molten steel in the supply region A of

the main body 30 may be pushed to the discharge region B side and may be moved.

[0070] Although an embodiment of the present disclosure has been described above with reference to FIGS. 1, 2, 4, and 5, the present disclosure may be configured in various ways including the following a variant.

[0071] The molten steel treatment apparatus according to a variant of the present disclosure is described below with reference to FIGS. 1 and 3. The molten steel treatment apparatus according to a variant of the present disclosure is partially similar to the molten steel treatment apparatus according to an embodiment of the present disclosure described above. Therefore, the description of the components overlapping with the molten steel treatment apparatus according to an embodiment of the present disclosure described above is omitted. The following description will focus on components that differ from an embodiment of the present disclosure.

[0072] The dam unit 60' of the molten steel treatment apparatus according to a variant of the present disclosure may include fixed dams 61' installed in a width direction (y-axis direction) of the main body 30 and being in contact with the bottom 33 and longitudinal side walls 34b of the main body 30 at a position spaced from the central portion in the longitudinal direction of the main body 30 toward the tap hole 35; remained molten steel holes 62 formed respectively through the lower portions of the fixed dams 61 in the longitudinal direction; control dams 63 extending in the width direction of the main body 30; and stoppers 64 respectively installed on the longitudinal side walls 34b of the main body 30 at the opposite side of each tap hole 35 around the fixed dam 63. The dam unit 60' may further include a protrusion 65 protruding on a lower portion of one side of the control dam 63 facing the longitudinal center portion of the main body 30. In this connection, the protrusion 65 protrudes from one side lower portion of the control dam 63 and protrudes from a central portion in the width direction of one lower side of the control dam 63.

[0073] The protrusion 65 may be in the shape of a block. The block includes a top face extending in width-direction and length-direction and intersecting one side of the control dam 63, an inclined face extending obliquely downward from one side of the width-direction of the top face and contacting the lower end of the control dam 63, and a vertical face extending vertically downward from both sides of the length direction of the top face and tangent to the width-direction end of the top face and the inclined face. The protrusion 65 can remove and remove a predetermined amount of slag or flux formed on the molten steel M bath surface by using the top face. In this connection, the top face of the protrusion 65 may be formed as a plane to serve as a loading surface. In this case, slag or flux may be removed from the molten steel by depositing at least one of the slag and flux on the loading surface. Alternatively, the protrusion 65 may be configured such that the top face is opened upward and the loading space is formed therein. In this case, slag or

flux may be removed from the molten steel by accommodating the at least one of the slag and flux in the internal loading space of the protrusion 65 through the open top face.

[0074] FIGs. 6a to 6e are process drawings to illustrate the operation of a molten steel treatment apparatus according to an embodiment of the present disclosure. In this connection, FIG. 6a is a process diagram showing the process of supplying molten steel from the discharge region B of the main body 30 to the isolated supply region A. FIG. 6b is a process diagram showing the process in which molten steel is supplied to the isolated supply region A from the discharge region B of the main body 30 by a certain level and then flux F is injected and applied.

[0075] Further, FIG. 6c is a process diagram showing the process of casting using the molten steel of the discharge region b connected to the supply region A of the main body 30. FIG. 6d shows a process diagram of a process of moving and removing at least one of the slags (not shown) and flux F on the molten steel molten steel toward the center of the length-direction of the body 30 during the casting process using the molten steel of the discharge region B connected to the supply region A of the main body 30. Further, FIG. 6e is a process diagram showing the process of completing the casting using the remaining molten steel, for example, residual molten steel or remained molten steel of the isolated discharge region B from the supply region A of the main body 30.

[0076] The operation of the molten steel treatment apparatus according to an embodiment of the present disclosure is described with reference to FIG. 1 and FIGs. 6a to 6e. In this connection, the location and operation of the dam unit 60 will be described in detail with reference to the right-hand side of both left and right sides of the length-direction of the main body 30.

[0077] First, as shown in FIGs. 6a and 6b, for example, in the initial stage of the continuous casting process, the control dam 63 is brought into close contact with the fixed dam 61 to isolate the supply region A of the main body 30 from the discharge region B. Thereafter, molten steel M is injected into the main body 30. In this connection, the molten steel M may be injected only in the supply region A of the main body 30, thereby rapidly raising the molten steel level. Thereafter, the molten steel level of the main body 30 becomes higher than the level of the end of the first nozzle 20, whereby the end of the first nozzle 20 is immersed in the molten steel M. As a result, the flux F is quickly injected into the main body 30 and applied to the bath surface, so that molten steel M may be prevented from being rapidly re-oxidized.

[0078] Thereafter, when the supply of the molten steel M is continued and the molten steel level of the main body 30 reaches a predetermined level, the control dam 63 is moved to the stopper 64 and raised to come in close contact with the stopper 64. During this process, through the space formed between the control dam 63 and the bottom face 33 of the main body 30 and the space formed between the control dam 63 and the length-direction both

side walls 34b of the main body 30, the molten steel M and flux F may be moved and fed into the discharge region B.

[0079] In the above process, the control dam 63 may be close-contact to the stopper 64 from the second nozzle 40 side or from the first nozzle 20 to the stopper 64 based on the stopper 64.

[0080] Meanwhile, the control dam 63 may be tilted or rotated by a predetermined angle around the axis in the height direction before the control dam 63 is moved to the stopper 64 side and brought into close contact with the stopper. Thus, the size of the space formed between the control dam 63 and the length-direction both side walls 34b of the main body 30 may be adjusted, and the molten steel M and the flux F may be moved more smoothly.

[0081] Then, when the molten steel M supplied to the discharge region B reaches a predetermined level, casting is started. During the casting process using molten steel M in discharge region B connected to supply region A, as shown in FIG. 6c, the molten steel in the main body 30 may be maintained at the working level. In this connection, the control dam 63 serves as a weir in the upper region of the main body 30, and controls the flow strength of the molten steel M to the target strength while guiding the molten steel M to the inner lower side of the main body 30.

[0082] Thereafter, while the supply of the molten steel M into the main body 30 is completed and the molten steel level in the main body 30 is lowered, as shown in FIG. 6d, the control dam 63 is moved toward the first nozzle 20 side. In this connection, the control dam 63 may be moved by passing the control dam between the stoppers 64 in a state where the control dam 63 is tilted or rotated by a predetermined angle about the axis in the height direction. In this manner, the control dam 63 may be easily passed between the stoppers 64 without being structurally interfered by the stopper 64 within the main body 30. During this process, the slag or flux formed on the melt surface of the molten steel M may be moved toward the center of the main body 30. As a result of anti-reaction to this reaction, molten steel in a relatively clean state located at the bottom of the main body 30 may be moved to the discharge region B side. In this connection, the slag and flux moved toward the center side of the main body 30 are stacked on the top face of the protrusion 65 protruding on one side of the control dam 63, thereby being removed from the molten steel M bath surface.

[0083] Thereafter, in the middle stage or late stage of the continuous casting process, in which the molten steel level inside the main body 30 gradually decreases and then reaches a predetermined level, as shown in FIG. 6e, the control dam 63 is moved and lowered to the fixed dam 61 side. Thereby, the molten steel in the supply region A may be moved to the discharge region B. Thereafter, the control dam 63 is brought into close contact with the fixed dam 61, and the discharge region B having the molten steel level as raised may be isolated from the

supply region A. Thus, the molten steel level h_B in the discharge region B side may be higher than the molten steel level h_A in the supply region A side. Thereafter, casting proceeds using the remaining molten steel in the isolated discharge region B from the supply region A.

[0084] In this way, in the middle stage or late stage of the continuous casting process, by making the molten steel level in the discharge region B higher than the molten steel level in the supply region A, it is possible to secure the height of the remaining molten steel near the tap hole to be higher than the height to prevent the slag from flowing, thereby improving the quality of the slab manufactured in the middle or late stage of the process.

[0085] FIGs. 7a to 7d are process drawings showing the operation of the molten steel treatment apparatus according to the comparison example of the present disclosure. Referring to FIG. 6 and FIG. 7, the operation of the molten steel treatment apparatus according to the comparison example of the present disclosure is described in relation to the operation of the molten steel treatment apparatus according to an embodiment of the present disclosure.

[0086] Referring to FIGs. 7a to 7d, in the molten steel treatment apparatus according to the comparison example of the present disclosure, unlike an embodiment of the present disclosure, in the main body 30, a lower dam 91 and upper dam 92 are fixedly installed. For example, as in a conventional dam structure, the upper dam 92 is fixedly installed in an inner upper portion of the main body 30 at a position spaced from the first nozzle 20 toward the second nozzle 40, while the lower dam 91 is fixedly installed at an inner lower portion of the main body 30 at a position spaced from the upper dam 92 to the second nozzle 40 side.

[0087] In the comparison example of the present disclosure, from the initial stage of the continuous casting process (see FIG. 7a and FIG. 7b) in which the molten steel starts to be supplied into the main body 30 to the late stage (see FIG. 7c, FIG. 7d) of the continuous casting process to finish the casting process using the remaining molten steel, the molten steel level in the main body 30 is constant throughout the entire region in the main body 30. Particularly, in the late stage of the process, the molten steel level h'_A of the first nozzle 20 and the molten steel level h'_B of the second nozzle 40 are formed at the same height. In this way, in the comparison example of the present disclosure, the molten steel level at the first nozzle 20 side and the molten steel level at the second nozzle 40 side cannot be locally adjusted, respectively. In particular, the remaining molten steel height near the tap hole cannot be adjusted separately.

[0088] In this way, in the comparison example of the present disclosure, since the dams' positions are fixed in the main body, the molten steel flow and the molten steel level in the initial and late stages of the continuous casting process are not controlled in a desired manner. That is, since the molten steel is accommodated in the entire interior of the main body 30 when the first nozzle

20 is opened, the rise of the molten steel level is delayed as compared to an embodiment of the present disclosure, thereby delaying the flux injection. Thus, the comparative example cannot rapidly inhibit or prevent the re-oxidation of molten steel by contact with air. Further, in the late stage of the continuous casting process, the molten steel level is lowered throughout the interior of the main body 30, which makes it difficult to maintain the minimum amount of remained molten steel, thus, to lower the yield of the molten steel.

[0089] In contrast, in an embodiment of the present disclosure, the molten steel levels may be controlled differently between the supply region A and the discharge region B in the main body 30, as described above. Thus, this embodiment can advance the flux injection timing in the initial stage of the process. Further, the amount of remained molten steel near the tap hole in the middle stage or late stage of the process may be ensured to a minimum amount of remained molten steel, thereby securing the quality and actual yield of the slab.

[0090] FIG. 8 is a graph showing the inclusions index in a cast slab using a continuous casting process using the molten steel treatment method according to an embodiment and comparison example of the present disclosure.

[0091] In this connection, the inclusions index in FIG. 8 means the oxygen content contained in the slab. At the initial stage of the continuous casting process, for example, at a first charge (Ch), a slab cast using molten steel is prepared, a specimen for each length of the slab is obtained, and the oxygen content of each specimen is analyzed and is numerically quantified. The method of analyzing the oxygen content in the slab and deriving the inclusions index is a well-known technique, and therefore, a detailed description thereof will be omitted.

[0092] Referring to FIG. 8, the inclusions index of the slabs produced in the continuous casting process of the molten steel treatment apparatus according to an embodiment of the present disclosure is generally lower than the inclusions index of the slab prepared in the continuous casting process of the molten steel treatment apparatus according to the comparison example of the present disclosure. This is because, in an embodiment of the present disclosure, the molten steel level in the supply region is rapidly increased in the initial stage of the continuous casting process, and the molten steel re-oxidization is inhibited or prevented. On the other hand, this because, in the comparison example of the present disclosure, the initial stage rise rate of the molten steel level is slower than in an embodiment of the present disclosure, such that the flux injection timing is also slow, and thus, unlike in an embodiment of the present disclosure, the comparison example does not rapidly inhibit the re-oxidization of the molten steel.

[0093] Hereinafter, a molten steel treatment method using a molten steel treatment apparatus according to an embodiment of the present disclosure will be described with reference to FIGs. 1 to 6. In this connection,

in the following, a duplicate of the above description of the molten steel treatment apparatus according to an embodiment or a variant of the present disclosure is omitted or briefly described.

[0094] The molten steel treatment method according to an embodiment of the present disclosure may include providing a main body having a plurality of dams received therein, wherein the body has an inner space and an open top and a tap hole defined in a bottom thereof, wherein the dams divide the interior of the main body into a supply region and a discharge region; isolating the supply region from the discharge region using the plurality of dams; supplying molten steel to the supply region; communicating the supply and discharge regions using the plurality of dams; and isolating the discharge region from the supply region using the plurality of dams, and controlling the molten steel level in the discharge region using the plurality of dams.

[0095] First, the method includes providing a main body 30 having a plurality of dams received therein, wherein the body has an inner space and an open top and a tap hole 35 defined in a bottom 33 thereof, wherein the dams divide the interior of the main body 30 into a supply region A and a discharge region B. Thereafter, the control portion 80 controls the driving part 70 so that the control dam 63 is brought into close contact with the fixed dam 61 to isolate the supply region A from the discharge region B.

[0096] Then, the conveying container 10 is placed on the supply region A of the main body 30, and molten steel is supplied into the supply region A of the main body 30. Thus, the molten steel M may be supplied only into the supply region A, and the molten steel level can be rapidly increased.

[0097] That is, by using the control dam 63, it is possible to reduce the injection space of the molten steel in the initial stage. As a result, the molten steel level can reach the lower end of the first nozzle 20 at a lower amount and more rapidly than conventionally.

[0098] When the molten steel level rises above the end level of the first nozzle 20, the flux F is uniformly applied to the molten steel bath surface to quickly prevent the molten steel from being re-oxidized. In this connection, the molten steel bath surface can be protected more quickly because the initial stage application area of flux F may be smaller than conventionally.

[0099] As described above, as the application time of the flux F is advanced and thus the suppression of the re-oxidation reaction is achieved, the molten steel having a clean state resulting from the suppression of the re-oxidation reaction may be supplied to the discharge region B as compared with the prior art. Thus, incorporation of oxidized inclusions in the slab produced in the initial stage of the continuous casting process can be reduced, so that the quality of the initial stage slab can be secured.

[0100] Thereafter, when the molten steel level rises to reach a predetermined height, the control dam 63 moves up and away and separates from fixed dam 61. This al-

lows the supply region A and the discharge region B to communicate with each other. Thereafter, the control dam 63 is brought into close contact with the stopper 64 to induce the flow of the molten steel to the lower side of the main body 30. When molten steel supplied to discharge region B reaches a certain level, the method initiates casting of the slab using molten steel in the discharge region B in communication with the supply region A.

[0101] In the above process, the control dam 63 may be close-contact with the stopper 64 on the side of the second nozzle 40 or on the stopper 64 on the side of the first nozzle 20 based on the stopper 64.

[0102] Thereafter, while the molten steel in the main body 30 is maintained at a working level, the casting is continuously performed.

[0103] When the supply of the molten steel into the main body 30 is completed, and as the casting progresses, the molten steel level in the main body 30 is lowered. During this process, the control dam 63 is moved to the first nozzle 20 side so that the slag is moved to the center of the length-direction of the main body 30. Thus, the molten steel having a clean state in the lower region of the main body 30 is moved toward the discharge region B side. Thereafter, a slag gathered at the center of the main body 30 is loaded on the upper surface of the protrusion 65 formed at the lower portion of the control dam 63, whereby the slag may be removed from the molten steel bath surface and may be removed by a certain amount. As a result, it is possible to effectively suppress or prevent the slag from moving toward the tap hole side of the main body 30 and flowing into the tap hole.

[0104] When the supply of molten steel into the main body 30 is completed, the molten steel level in the main body 30 is further lowered as the casting progresses. Thus, the amount of remaining molten steel in the main body 30 reaches the lowest amount of remained molten steel. During this process, the control dam 63 is moved to the fixed dam 61 side with the control dam 63 being lowered to a predetermined height, whereby the molten steel in the supply region A is moved to the discharge region B side. Thereby, the molten steel level in the discharge region B is controlled. Thereafter, the control dam 63 is brought into close contact with the fixed dam 61 and, thus, the discharge region B is isolated from the supply region with the molten steel level being raised.

[0105] Then, the remaining molten steel in the isolated discharge region B from the supply region A is continuously fed into the mold and is cast into a slab. When the molten steel level in discharge region B reaches the molten steel level at the lowest amount of remained molten steel, the continuous casting process is completed.

[0106] In this way, before the remaining molten steel amount in the main body 30 reaches the minimum amount of remained molten steel, the molten steel level of the discharge region B may be easily raised. Thus, in an embodiment of the present disclosure, the introduction of the slag into the tap hole 35 may be suppressed

or prevented, and, thus, the quality of the slab may be ensured. Further, as the molten steel level rises, continuous casting may continue, thereby reducing the amount of remained molten steel in the main body 30 at the end of the continuous casting process.

[0107] Although the molten steel treatment method according to the embodiment of the present disclosure has been described in detail above, the present disclosure may be variously configured including the following variant. Hereinafter, the molten steel treatment method according to a variant of the present disclosure is described.

[0108] The molten steel treatment method according to a variant of the present disclosure may be applied to, for example, a continuous casting process of the same or different grades. The method may include providing a main body having a plurality of dams received therein, wherein the body has an inner space and an open top and a tap hole defined in a bottom thereof, wherein the dams divide the interior of the main body into a supply region and a discharge region; isolating the supply region from the discharge region using the plurality of dams; supplying molten steel to the supply region; communicating the supply and discharge regions using the plurality of dams; and isolating the discharge region from the supply region using the plurality of dams, and controlling the molten steel level in the discharge region using the plurality of dams.

[0109] In this connection, controlling the molten steel level of the discharge region may further include casting the slab using the remaining molten steel in the isolated discharge region from the supply region and supplying the subsequent molten steel to the supply region, communicating the supply region and the discharge region using the plurality of dams and supplying the subsequent molten steel to the discharge region, isolating the discharge region from the supply region using the plurality of dams and controlling the molten steel level of the discharge region, and casting the slab using the remaining molten steel in the isolated discharge region from the supply region.

[0110] First, the molten steel treatment method includes providing a main body 30 having a plurality of dams received therein, wherein the body has an inner space and an open top and a tap hole 35 defined in a bottom 33 thereof, wherein the dams divide the interior of the main body 30 into a supply region A and a discharge region B. Thereafter, the control portion 80 controls the driving part 70 so that the control dam 63 is brought into close contact with the fixed dam 61 to isolate the supply region A from the discharge region B.

[0111] Then, the conveying container 10 is placed on the supply region A of the main body 30, and molten steel is supplied into the supply region A of the main body 30. Thus, the molten steel M may be supplied only into the supply region A, and the molten steel level can be rapidly increased.

[0112] That is, by using the control dam 63, it is possible to reduce the injection space of the molten steel in

the initial stage. As a result, the molten steel level can reach the lower end of the first nozzle 20 at a lower amount and more rapidly than conventionally.

[0113] When the molten steel level rises above the end level of the first nozzle 20, the flux F is uniformly applied to the molten steel bath surface to quickly prevent the molten steel from being re-oxidized. In this connection, the molten steel bath surface can be protected more quickly because the initial stage application area of flux F may be smaller than conventionally.

[0114] Thereafter, when the molten steel level rises to reach a predetermined height, the control dam 63 moves up and away and separates from fixed dam 61. This allows the supply region A and the discharge region B to communicate with each other. Thereafter, the control dam 63 may be close-contact with the stopper 64 on the side of the second nozzle 40 or on the stopper 64 on the side of the first nozzle 20 based on the stopper 64, to induce the flow of the molten steel to the lower side of the main body 30. When molten steel supplied to discharge region B reaches a certain level, the method initiates casting of the slab using molten steel in the discharge region B in communication with the supply region A.

[0115] In this connection, as the application time of the flux F is advanced and thus the suppression of the re-oxidation reaction is achieved, the molten steel having a clean state resulting from the suppression of the re-oxidation reaction may be supplied to the discharge region B as compared with the prior art. Thus, incorporation of oxidized inclusions in the slab produced in the initial stage of the continuous casting process can be reduced, so that the quality of the initial stage slab can be secured.

[0116] Thereafter, while the molten steel in the main body 30 is maintained at a working level, the casting is continuously performed.

[0117] When the supply of the molten steel into the main body 30 is completed, and as the casting progresses, the molten steel level in the main body 30 is lowered. During this process, the control dam 63 is moved to the first nozzle 20 side so that the slag is moved to the center of the length-direction of the main body 30. Thus, the molten steel having a clean state in the lower region of the main body 30 is moved toward the discharge region B side. Thereafter, a slag gathered at the center of the main body 30 is loaded on the upper surface of the protrusion 65 formed at the lower portion of the control dam 63, whereby the slag may be removed from the molten steel bath surface and may be removed by a certain amount. As a result, it is possible to effectively suppress or prevent the slag from moving toward the tap hole side of the main body 30 and flowing into the tap hole.

[0118] When the supply of molten steel into the main body 30 is completed, the molten steel level in the main body 30 is further lowered as the casting progresses. Thus, the amount of remaining molten steel in the main body 30 reaches the lowest amount of remained molten steel. During this process, the control dam 63 is moved

to the fixed dam 61 side with the control dam 63 being lowered to a predetermined height, whereby the molten steel in the supply region A is moved to the discharge region B side. Thereby, the molten steel level in the discharge region B is controlled. Thereafter, the control dam 63 is brought into close contact with the fixed dam 61 and, thus, the discharge region B is isolated from the supply region with the molten steel level being raised.

[0119] Then, while the remaining molten steel in the isolated discharge region B from the supply region A is continuously fed into the mold and is casted, a subsequent molten steel may be fed to the supply region B. In this connection, the subsequent molten steel may have the same grade as or different grade from the remaining molten steel in the isolated discharge region B.

[0120] Thereafter, when the molten steel level of the subsequent molten steel in the supply region A rises to reach a predetermined height, the control dam 63 is moved up and away and thus separated from the fixed dam 61. As a result, the supply region A and the discharge region B communicate with each other. Thereby, the subsequent molten steel contained in the supply region A can be supplied to the discharge region B. Thereafter, the control dam 63 is brought into close contact with the stopper 64 to induce the flow of the molten steel to the lower side of the main body 30. Thereby, the molten steel in the discharge region B communicated with the supply region A is used to continuously carry out the casting of the slab without interruption.

[0121] When the supply of the subsequent molten steel to the main body 30 is completed, the molten steel level in the main body 30 is lowered as the casting proceeds. During this process, the control dam 63 is moved to the first nozzle 20 side so that the slag is moved to the center of the length-direction of the main body 30. Thus, the molten steel having a clean state in the lower region of the main body 30 is moved toward the discharge region B side. Thereafter, a slag gathered at the center of the main body 30 is loaded on the upper surface of the protrusion 65 formed at the lower portion of the control dam 63, whereby the slag may be removed from the molten steel bath surface and may be removed by a certain amount. As a result, it is possible to effectively suppress or prevent the slag from moving toward the tap hole side of the main body 30 and flowing into the tap hole.

[0122] When the supply of the subsequent molten steel into the main body 30 is completed, the molten steel level in the main body 30 is further lowered as the casting progresses. Thus, the amount of remaining molten steel in the main body 30 reaches the lowest amount of remained molten steel. During this process, the control dam 63 is moved to the fixed dam 61 side with the control dam 63 being lowered to a predetermined height, and the molten steel in the supply region A is moved to the discharge region B side. Thereby, the molten steel level of the subsequent molten steel in the discharge region B is raised. Thereafter, the control dam 63 is brought into close contact with the fixed dam 61 such that the molten steel level

raised. In this state, the discharge region B is isolated from the supply region.

[0123] Then, the remaining molten steel in the isolated discharge region B from the supply region A is continuously fed into the mold and is cast into a slab. When the molten steel level in discharge region B reaches the molten steel level at the lowest amount of remained molten steel, the continuous casting process is completed.

[0124] In this way, according to an embodiment of the present disclosure, it is possible to prevent flux injection delay in the initial casting process, thereby minimizing the exposure of the molten steel in the main body to an atmospheric air to prevent molten steel re-oxidation. Thus, the quality of the initial stage slab can be effectively improved. Further, in the late stage of the process, the molten steel level can be locally raised to prevent the slag from entering the tap hole by the vortex formed near the tap hole. At the end of the continuous casting process, the minimum amount of molten steel remaining in the main body can be reduced. In the continuous casting process of different grades, it is possible to reduce the mixture.

[0125] In this way, according to an embodiment of the present disclosure, the quality of the slab in the initial stage and the late stage of the continuous casting process can be ensured and the yield thereof may be secured while the continuous casting process is smoothly carried out. Further, during the continuous casting process of different grades, the mixture in the slab can be minimized.

[0126] It should be noted that the above embodiment of the present disclosure is for the explanation of the present disclosure and not for the limitation of the present disclosure. The present disclosure will be implemented in a variety of different forms within the scope of claims and equivalent technical ideas. Those skilled in the art will appreciate that the present disclosure is susceptible to various embodiments within the scope of the technical idea of the present disclosure.

Claims

1. A molten steel treatment apparatus comprising:

a main body having an inner space, an open top and a bottom having a tap hole defined therein;
a fixed dam extending in a width-direction of the main body and installed in contact with both the bottom and length-direction both side walls of the main body;
a control dam extending in the width-direction of the main body; and
a driving part for supporting the control dam in a movable and rotatable manner.

2. The molten steel treatment apparatus of claim 1, comprising stoppers installed respectively on the length-direction both side walls of the main body,

wherein the fixed dam is disposed between the stoppers and the tap hole.

3. The molten steel treatment apparatus of claim 1, comprising a remained molten steel hole defined to pass through a lower portion of the fixed dam in the length direction. 5
4. The molten steel treatment apparatus of claim 1, comprising a control portion for controlling an operation of the driving part to move the control dam in the length direction of the main body to partition the inner space of the main body into a supply region and a discharge region and to isolate the supply region and the discharge region from each other. 10
5. The molten steel treatment apparatus of claim 2, wherein the control dam has a dimension in a width direction so as to be spaced apart from both the length-direction side walls of the main body at a position where the stopper is installed. 15
6. The molten steel treatment apparatus of one of claims 1, 2 and 5, wherein the control dam has a dimension in a width direction so as to contact both the bottom and both length-direction side walls of the main body at a position where the fixed dam is installed. 20
7. The molten steel treatment apparatus of one of claims 2 and 5, wherein the control dam has a width-direction dimension so that both width-direction side edges of the control dam respectively contact or overlap the stoppers at a position where the stopper is installed. 25
8. The molten steel treatment apparatus of claim 1, comprising a protrusion protruding on a lower portion of one side face of the control dam, wherein the protrusion has a molten steel loading top face. 30
9. The molten steel treatment apparatus of claim 2, wherein each of the stoppers extends in a height direction of the main body and protrudes in the width-direction. 35
10. The molten steel treatment apparatus of claim 2, wherein the fixed dam includes a plurality of fixed dams, wherein the fixed dams are spaced apart from each other in the length direction and are disposed around a central portion of the main and face each other, wherein a discharge region is defined in a region spanning from each fixed dam toward the tap hole, while a supply region is defined in a region spanning from each fixed dam away from the tap hole. 40
11. The molten steel treatment apparatus of claim 10, 45

wherein a plurality of control dams are disposed to face each other in the supply region, wherein a plurality of stoppers are disposed to face each other in the supply region.

12. A molten steel treatment method comprising:

providing a main body having an inner space, an open top and a bottom having a tap hole defined therein, wherein the inner space is divided into a supply region and a discharge region via a plurality of dams received therein;
isolating the supply region from the discharge region using the plurality of dams;
supplying molten steel to the supply region;
communicating the supply and discharge regions with each other using the plurality of dams; and
isolating the discharge region from the supply region using the plurality of dams, and controlling a level of the molten steel in the discharge region using the plurality of dams.

13. The molten steel treatment method of claim 12, wherein communicating the supply and discharge regions with each other includes casting a slab using the molten steel in the discharge region in communication with the supply region.

14. The molten steel treatment method of claim 13, wherein controlling a level of the molten steel in the discharge region includes casting a slab using a remaining molten steel in the discharge region isolated from the supply region.

15. The molten steel treatment method of claim 12 or 13, wherein controlling a level of the molten steel in the discharge region includes:

casting a slab using a remaining molten steel in the discharge region isolated from the supply region; and
supplying a subsequent molten steel into the supply region.

16. The molten steel treatment method of claim 15, comprising, after supplying the subsequent molten steel into the supply region:

communicating the supply region and the discharge region with each other using the plurality of dams and supplying the subsequent molten steel to the discharge region;
isolating the discharge region from the supply region using the plurality of dams and controlling the molten steel level in the discharge region; and
casting a slab using a remaining molten steel in

the discharge region isolated from the supply region.

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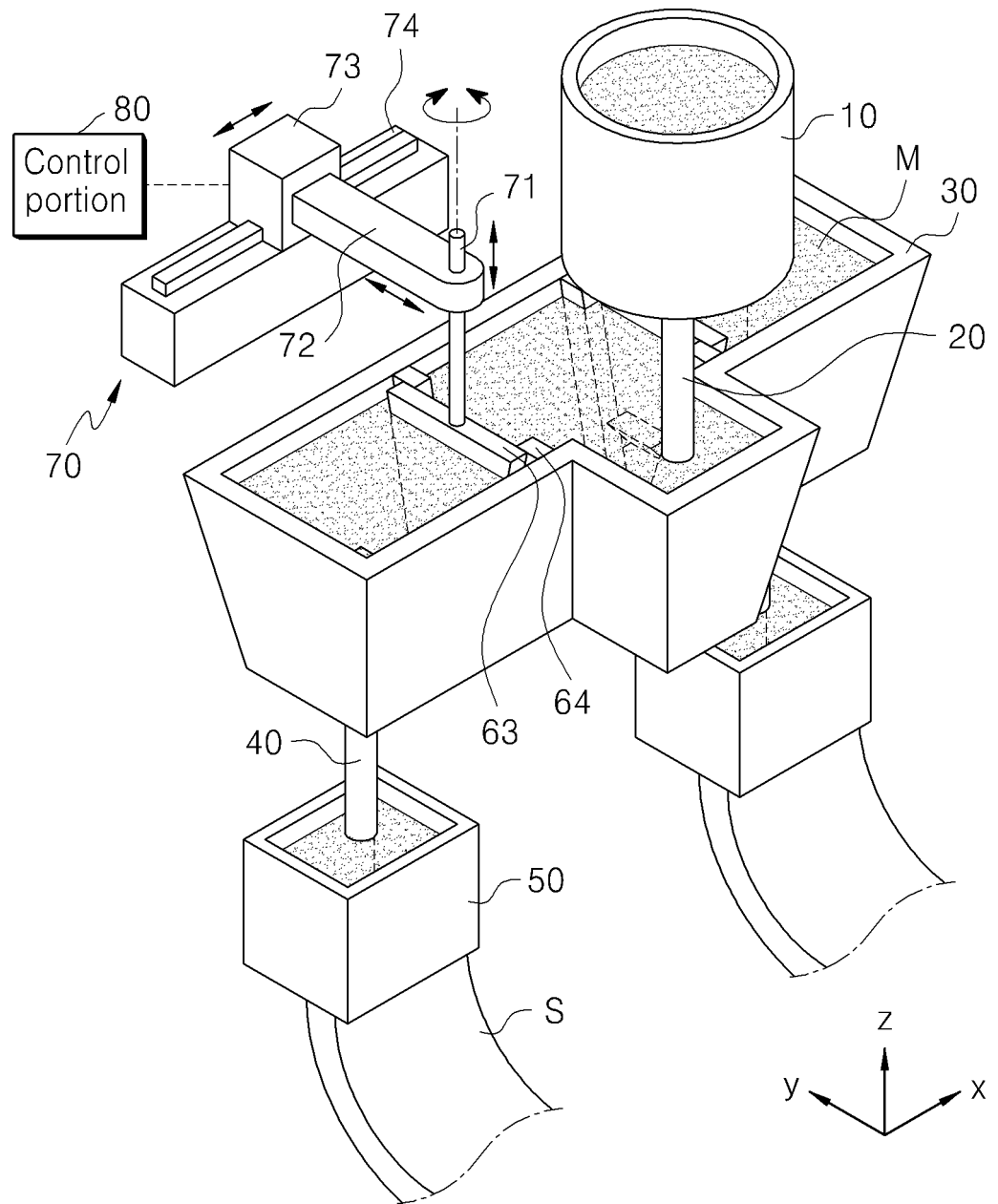
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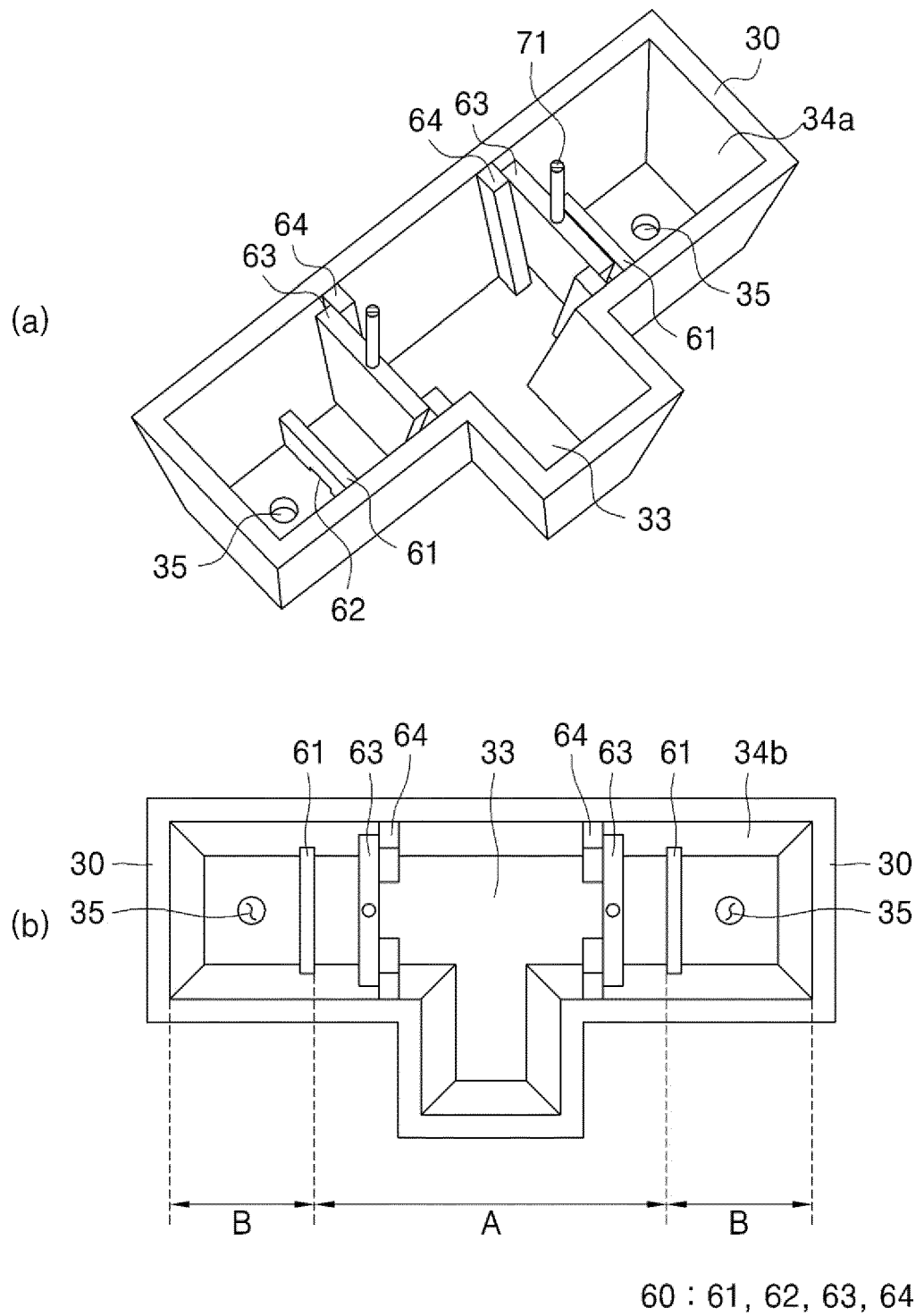
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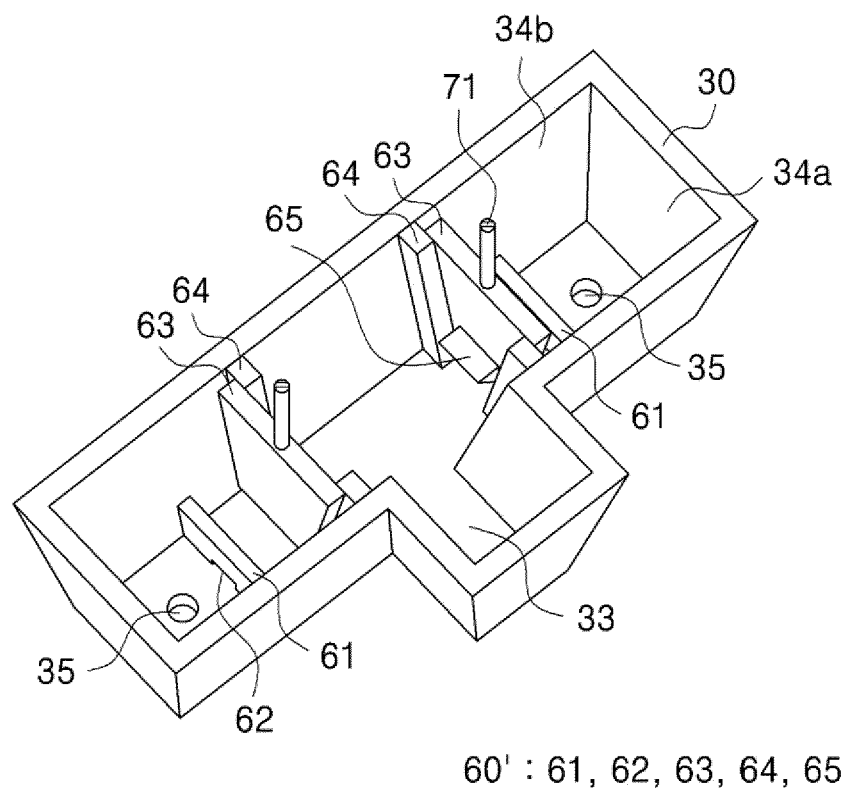
【FIG. 1】



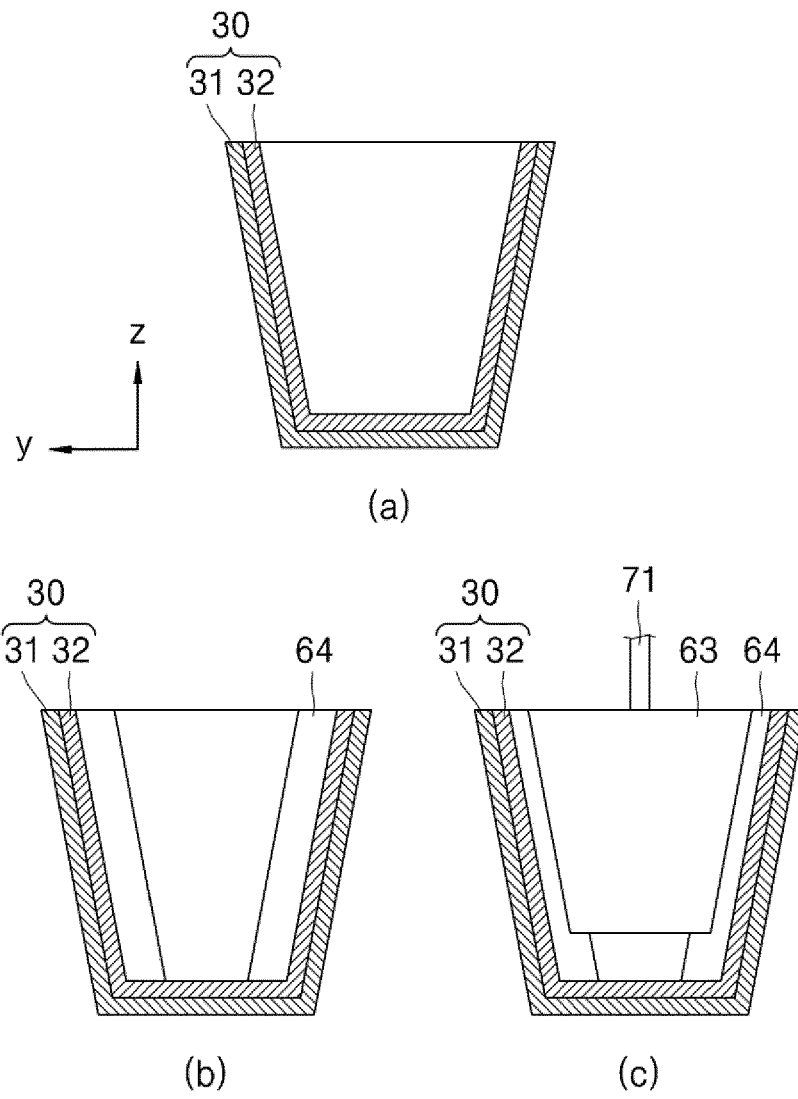
【FIG. 2】



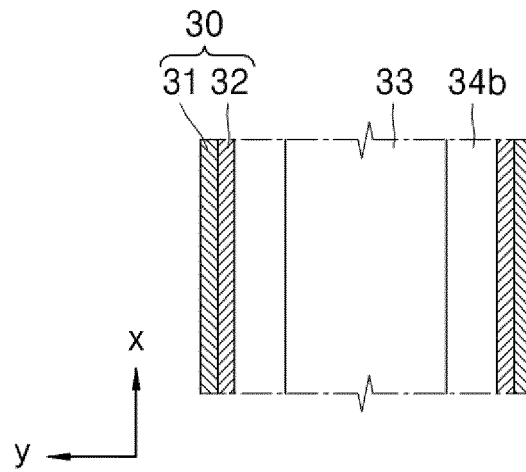
【FIG. 3】



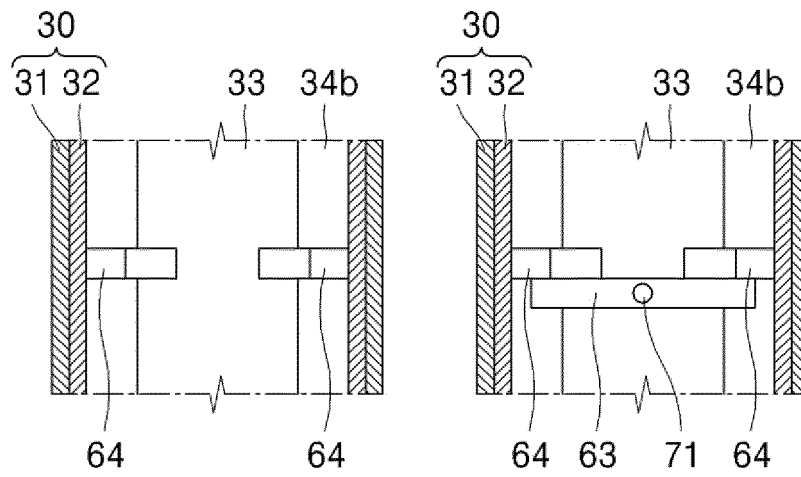
【FIG. 4】



【FIG. 5】



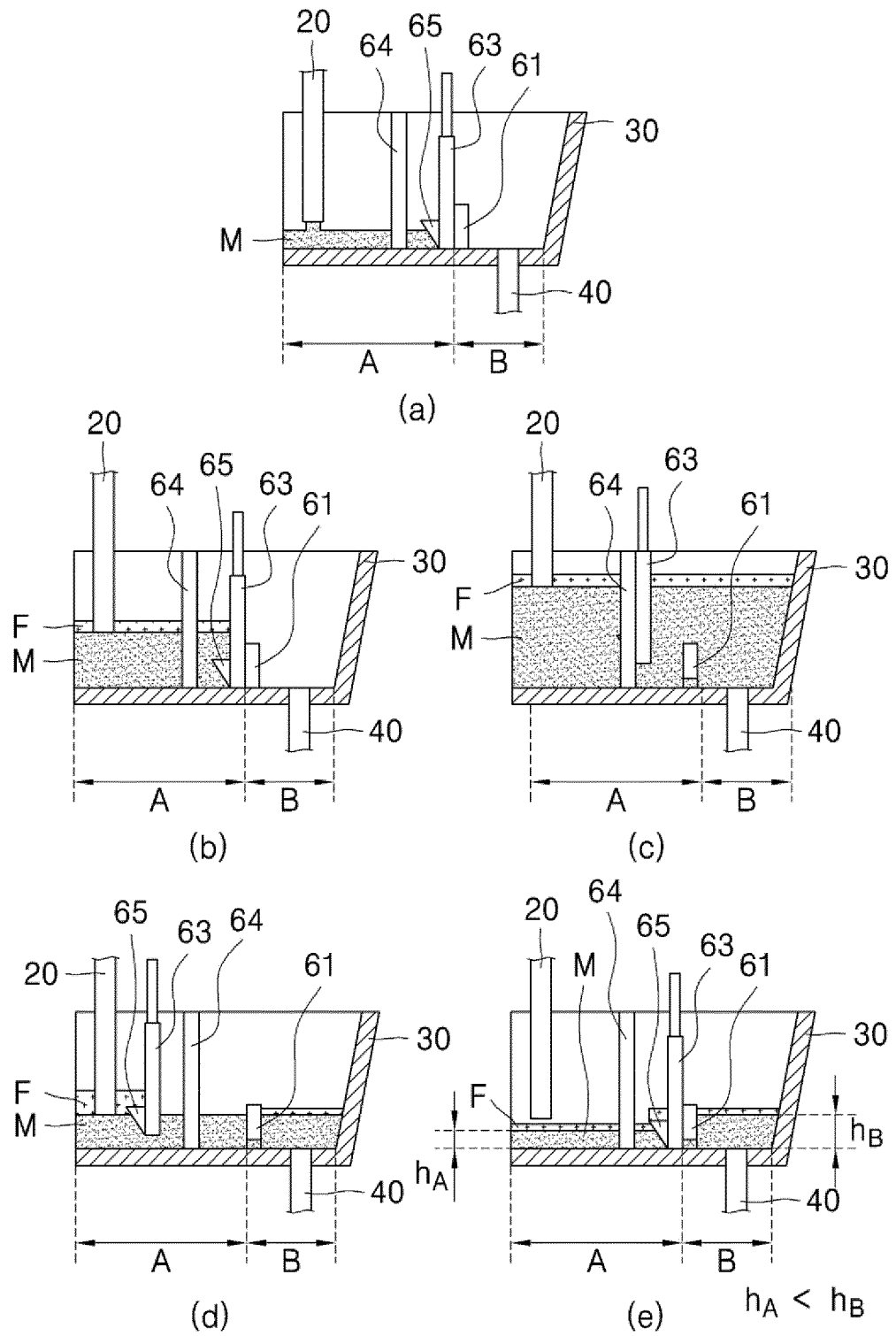
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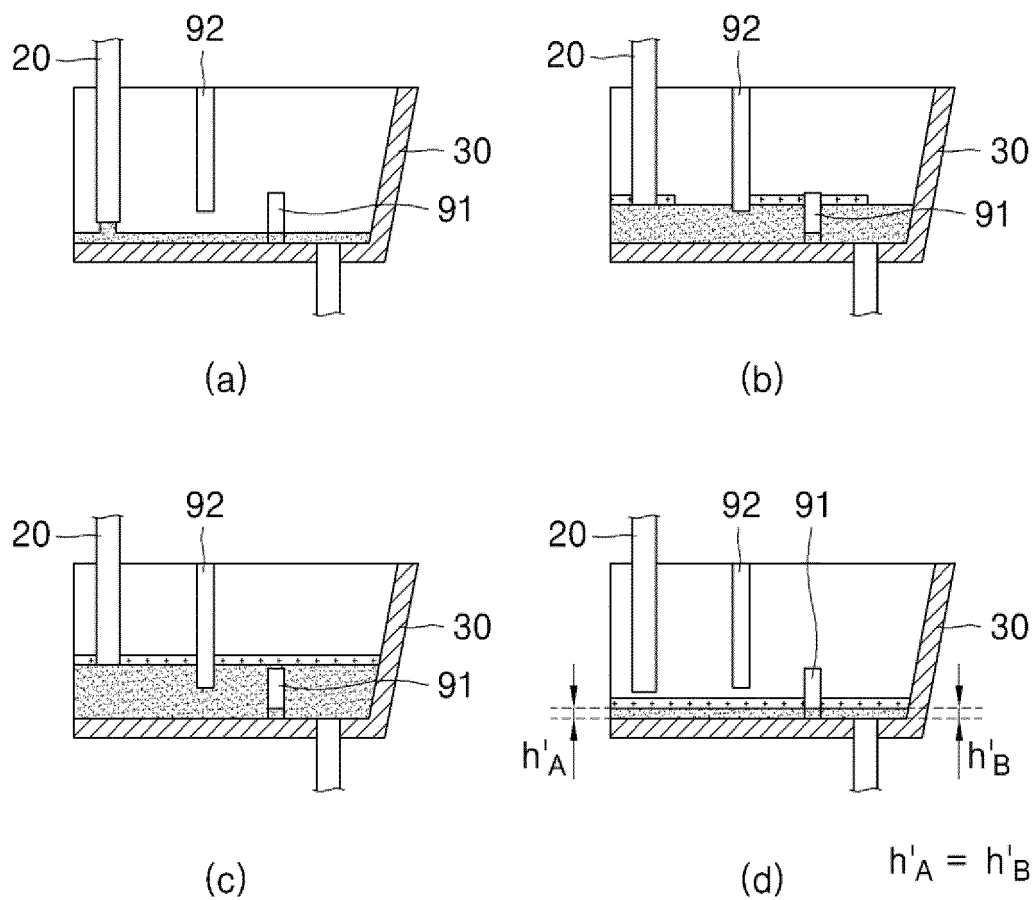
(b)

(c)

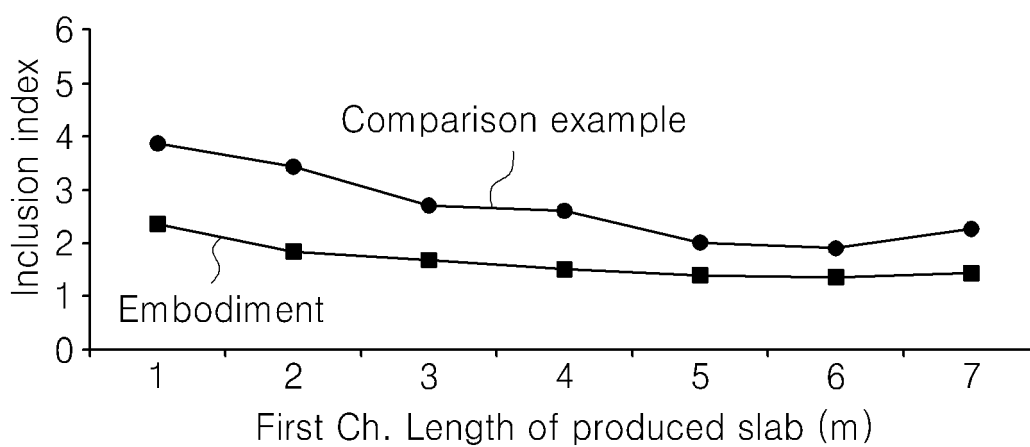
【FIG. 6】



【FIG. 7】



【FIG. 8】



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2016/012307

A. CLASSIFICATION OF SUBJECT MATTER

B22D 41/00(2006.01)i, B22D 11/10(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 41/00; B22D 11/10; B22D 11/18

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: molten steel treating device, fixing dam, control dam, stopper, drive part

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 10-2015-0073448 A (POSCO) 01 July 2015 See paragraphs [0030]-[0057]; and figures 1-3.	1-2,4-16
Y		3
Y	KR 10-2003-0044589 A (POSCO) 09 June 2003 See page 2, line 4-page 3, line 15; and figure 3.	3
A	KR 10-2014-0145382 A (POSCO) 23 December 2014 See paragraphs [0007]-[0042]; and figure 1.	1-16
A	JP 2014-087835 A (KOBELITE LTD.) 15 May 2014 See paragraphs [0011]-[0045]; and figure 1.	1-16
A	JP 2013-086147 A (JFE STEEL CORP.) 13 May 2013 See paragraphs [0017]-[0054]; and figure 1.	1-16

☐ 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

"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

26 JANUARY 2017 (26.01.2017)

Date of mailing of the international search report

02 FEBRUARY 2017 (02.02.2017)

Name and mailing address of the ISA/KR


 Korean Intellectual Property Office
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 Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/KR2016/012307

Patent document cited in search report	Publication date	Patent family member	Publication date
KR 10-2015-0073448 A	01/07/2015	NONE	
KR 10-2003-0044589 A	09/06/2003	NONE	
KR 10-2014-0145382 A	23/12/2014	NONE	
JP 2014-087835 A	15/05/2014	JP 5794969 B2	14/10/2015
JP 2013-086147 A	13/05/2013	JP 5831124 B2	09/12/2015

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- KR 1020140085127 A [0005]
- KR 1020130076187 A [0005]
- KR 1020130127247 A [0005]
- KR 1020130047136 A [0005]