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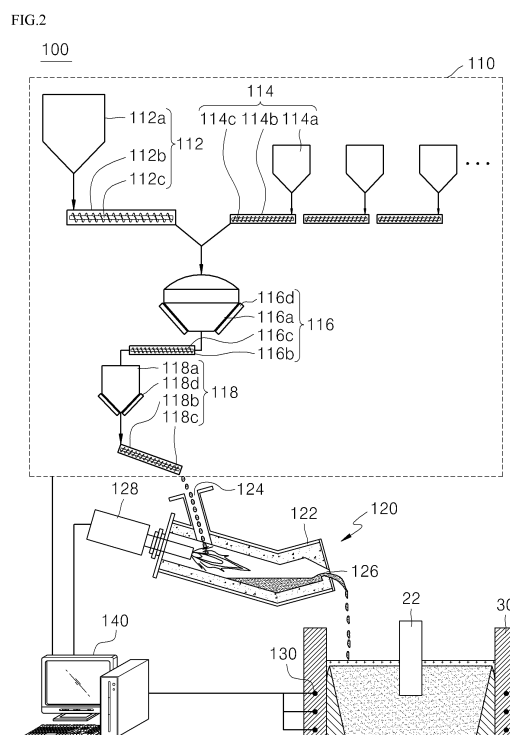
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(54) **DEVICE FOR INJECTING MOLTEN MATERIAL, CASTING EQUIPMENT USING SAME, AND CASTING METHOD**

(57) The present disclosure relates to a device for injecting molten material, a casting equipment using the same, and a casting method. A casting method comprises: preparing main mold flux; injecting molten steel into a mold; melting the main mold flux to produce molten mold flux and injecting the molten mold flux onto a top face of the molten steel; casting a slab; and determining whether to input an additive based on a casted state of the slab during casting thereof. A quality and productivity of the slab may be improved.



Description

BACKGROUND

1. Technical Field

[0001] The present disclosure relates to a device for injecting molten material, a casting equipment using the same, and a casting method. More specifically, the present disclosure relates to a device for injecting molten material able to improve a quality and productivity of a slab, a casting equipment using the same, and a casting method.

2. Description of the Related Art

[0002] A device for injecting molten material, for example a device for injecting molten mold flux used in a slab casting process, is an equipment that melts the mold flux in powder and supplies it to a mold. Typical molten mold flux injecting equipment includes a hopper configured for storing the mold flux therein, a smelting furnace configured for receiving the mold flux from the hopper and melting it, and a torch disposed at one side of the smelting furnace and configured for melting the mold flux by spraying a flame into the smelting furnace. In this connection, at the smelting furnace, a discharge port configured for discharging the molten mold flux may be defined.

[0003] Thus, when the mold flux is melted and supplied to the mold, a temperature drop of molten steel in the mold may be suppressed, and at the same time a lubricating ability may be improved to reduce a defect of the slab.

[0004] However, when a slab is casted by melting a mold flux produced to have a certain component for each steel grade, the component of the mold flux changes due to a reaction between impurities contained in the steel and the mold flux. For example, when a slab is casted using molten steel containing a large amount of Al, as Al₂O₃ is picked up in the mold flux, a viscosity of the mold flux is increased.

[0005] Thus, the mold flux does not inflow smoothly between the mold and the slab (solidified shell), therefore a heat transfer between the molten steel and the mold becomes uneven and the lubricating ability decreases. Thus, an operation accident such as a solidified shell break-out or a crack on a surface of the slab occurs.

[0006] Such change in the components of the mold flux may lead to difficulty in carrying out multiple continuous-castings of a single steel grade at least one charge.

[0007] On the other hand, in case of multiple continuous-castings of two grades of steel, change in the grade of the steel may requires a mold flux suitable for the changed grade. Therefore, when the steel grade is changed, the mold flux produced so as to have a suitable component for the changed grade should be injected into the mold. However, when supplying the mold flux suitable for the steel grade, it is preferable mold fluxes having

different components not to be mixed with each other, but due to an operation property, a transient phenomenon in which the mold fluxes having different components are mixed with each other is inevitable. In such the transient phenomenon, the mold flux does not inflow smoothly between the mold and the solidified shell, so that the solidified shell sometimes breaks out.

SUMMARY

[0008] The present disclosure provides a device for injecting molten material which is able to improve a casting efficiency, a casting equipment using the same, and a casting method.

[0009] The present disclosure provides a device for injecting molten material which is able to improve a quality of a slab, a casting equipment using the same, and a casting method.

[0010] A device for injecting molten material according to an embodiment of the present disclosure, the device may comprise: raw material supply units configured for supplying different first and second raw materials respectively; a mixing unit configured for mixing the different first and second raw materials supplied from the raw material supply units to produce a mixture; a melting unit connected to the mixing unit to melt the mixture supplied from the mixing unit to produce molten material, and the melting unit has a discharge port through which the molten material is discharged; and a control unit configured for controlling a component of the mixture by controlling operations of the raw material supply units, mixing unit and melting unit.

[0011] The raw material supply unit may include: a first raw material supply unit configured for supplying a first raw material; and second raw material supply units configured for respectively supplying a plurality of second raw materials containing different components.

[0012] The first raw material supply unit may include: a first storage unit configured for storing the first raw material therein; a first transfer pipe for communicating the first storage unit and the mixing unit; and a first feeder coupled to at least one of the first storage unit and the first transfer pipe to regulate a discharge amount of the first raw material.

[0013] Each of the second raw material supply unit may include: a second storage unit configured for storing each of the plurality of second raw materials therein; a second transfer pipe configured for communicating each of the plurality of second storage units and the mixing unit; and a second feeder coupled to at least one of the second storage unit and the second transfer pipe to regulate a discharge amount of each of the second raw material.

[0014] The mixing unit may include: a mixing vessel in communication with the first supply pipe and the second supply pipe; an agitator disposed in the mixing vessel for mixing the first raw material and the second raw material; and a third transfer pipe for transferring the mixture of the first raw material and the second material to the melt-

ing unit.

[0015] The mixing unit may include a mixing vessel in communication with the first supply pipe and the second supply pipe, and the mixing vessel is rotatable.

[0016] The melting unit may include: a smelting furnace having a smelting space defined therein for receiving the first raw material and the second raw material therein; a heat source supply unit disposed at one side of the smelting furnace to supply a heat source to the smelting space.

[0017] The heat source supply unit uses plasma as the heat source.

[0018] The control unit may be configured to determine whether or not to inject the second raw material based on an input signal.

[0019] A casting equipment may comprise: a mold for receiving and initially solidifying molten steel; a device for injecting molten mold flux into the mold; a measuring unit configured for measuring temperatures of at least one of a temperature of the mold and a component of the molten mold flux injected into the mold; and a control unit configured for controlling an operation of the device based on a measurement from the measuring unit to change the component of the molten mold flux to be injected into the mold.

[0020] The device may include: a first raw material supply unit configured for supplying main mold flux; second raw material supply units configured for supplying additives; a mixing unit configured for mixing the main mold flux and the additives respectively supplied from the first raw material supply unit and the second raw material supply units, thereby to produce a mixture; and a melting unit configured for melting the mixture supplied from the mixing unit to produce molten mold flux, and for injecting the molten mold flux into the mold.

[0021] The second raw material supply units may store therein the plurality of additives individually, and the second supply units feed selectively the plurality of additives to the mixing unit.

[0022] The measuring unit may include a thermometer configured for measuring a temperature of the mold.

[0023] The measuring unit may include: a probe configured for collecting molten mold flux injected into the mold; an analyzing unit configured for analyzing a component of the molten mold flux collected by the probe.

[0024] The control unit may be configured to determine whether to input the additives using a measurement from the measuring unit, and to control types and input amounts of the additives by controlling the second raw material supply units based on the measurement.

[0025] A casting method may comprise: preparing main mold flux; injecting molten steel into a mold; melting the main mold flux to produce molten mold flux and injecting the molten mold flux onto a top face of the molten steel; casting a slab; and determining whether to input an additive based on a casted state of the slab during casting thereof.

[0026] In preparing of the main mold flux, the additive

may be prepared.

[0027] During melting the main mold flux to produce the molten mold flux, the main mold flux and the additive may be melted together.

5 **[0028]** In casting the slab, a temperature of the mold may be measured to indicate the casted state of the slab, and the method may include determining whether to input the additive based on the measured temperature of the mold.

10 **[0029]** In casting the slab, a component of the molten mold flux injected into the mold may be analyzed to indicate the casted state of the slab, the method may include determining whether to input the additive based on the analyzed component of the molten mold flux.

15 **[0030]** The method may include, upon determination that the additive is added, mixing the main mold flux and the additive to form a mixture, and melting the mixture, and injecting molten mold flux containing a changed component into the mold.

20 **[0031]** The method may include, when, in casting the slab, a grade of molten steel to be injected into the mold has been changed, mixing the main mold flux and the additive, melting the mixture, and injecting molten mold flux containing a changed component into the mold.

25 **[0032]** When the main mold flux and the additive are mixed, components of the additives as injected may vary depending on the grades of the molten steel.

30 **[0033]** When the main mold flux and the additive are mixed, injection amounts of the additives containing the same component may vary depending on the grades of the molten steel.

35 **[0034]** According to embodiments of the present disclosure, casting efficiency and slab quality may be improved by rapidly responding to the component changes in the mold slag during the casting.

[0035] In other words, by adding an additive to control the component of the mold slag during the casting, it may cope with the component change of the mold slag in real time.

40 **[0036]** Therefore, it is possible to prevent slab surface cracking or solidified shell breaking-out resulted from the component change of the mold slag, which may improve the quality of the slab.

[0037] In addition, continuous-continuous castings of a single steel grade is possible and productivity may be improved.

[0038] In addition, the casting efficiency may be improved by rapidly producing and supplying the molten mold flux suitable for the steel grade in continuous-continuous casting of various steel grades.

[0039] Therefore, it is possible to suppress or prevent occurrence of the slab breaking-out phenomenon by reducing a mixing time of molten mold fluxes having different physical properties.

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BRIEF DESCRIPTION OF DRAWINGS

[0040]

Figure 1 is a schematic view of a casting equipment according to an embodiment of the present disclosure.

Figure 2 shows a main configuration of the casting equipment shown in Figure 1.

Figure 3 is a block diagram showing the configuration of the casting equipment shown in Figure 2.

Figure 4 is a sequence diagram showing a casting method according to a first embodiment of the present disclosure.

Figure 5 is a block diagram conceptually showing a method of injecting molten mold flux into a mold when a slab is casted according to a second embodiment of the present disclosure.

Figure 6 is a graph showing experimental results based on whether an additive inputted when a slab is casted according to a casting method of the embodiment of the present disclosure.

DETAILED DESCRIPTION

[0041] Hereinafter, an embodiment of the present disclosure will now be described in detail with reference to the accompanying drawings. The present disclosure may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein, rather, these embodiments are provided by way of illustration only and so that this disclosure will be thorough, complete and will fully convey the full scope of the invention to those skilled in the art.

[0042] Figure 1 is a schematic view of a casting equipment according to an embodiment of the present disclosure, Figure 2 shows a main configuration of the casting equipment shown in Figure 1, and Figure 3 is a block diagram showing the configuration of the casting equipment shown in Figure 2.

[0043] Referring to Figure 1, a casting equipment according to an embodiment of the present disclosure may include a ladle 10 configured for receiving molten steel refined in a steelmaking process therein; a tundish 20 configured for receiving the molten steel through an injecting nozzle (unshown) connected to the ladle 10, storing the molten steel therein temporarily and supplying it to a mold 30; the mold 30 configured for receiving the molten steel through a submerged nozzle 22 connected to the tundish 20 and initially solidifying it in a uniform shape; a cooling line 40 disposed below the mold 30 and having a plurality of segments continuously arranged for performing a series of molding operations while cooling an unsolidified slab 1 drawn from the mold 30.

[0044] Further, referring to Figure 2 and 3, the casting equipment may include a device 100 for injecting molten material, wherein the device 100 is configured for melting and supplying a mold flux onto a top face of the molten steel to be supplied to the mold 30; a measuring unit 130 configured for measuring various component changes resulted from a change in a component of the mold flux in the mold 30; a control unit 140 configured for controlling

an operation of the device 100 for injecting the molten material based on a measured result from the measuring unit 130.

[0045] The device 100 for injecting the molten material may melt a solid mold flux and supply a liquid mold flux i.e. molten mold flux, to the mold 30. Conventionally, the device for injecting the molten material melted a mold flux provided to have a certain component suitable for a steel grade as it is by a heating means such as a plasma torch and supplied to the mold 30 simultaneously. However, although the molten mold flux supplied into the mold 30 during casting reacts with impurities in the molten steel to change its component, the device for injecting the molten material continuously supplies the mold flux of the same component, therefore it was impossible to cope with the component change in real time.

[0046] In addition, when in case of continuous-continuous-castings of different steel grades, mold fluxes having different components suitable for the steel grades provided. Thus, it is time consuming to change the mold flux to a mold flux having a component suitable for the steel grade, and mold fluxes of different components are inevitably mixed to each other in a smelting furnace 112. Result from the mixing of the mold fluxes, the mold flux does not inflow smoothly between the mold 30 and a solidified shell, so that a problem such as a solidified shell break-out occurred.

[0047] Therefore, in order to solve the above-mentioned problem of the device for injecting the molten material, the device 100 for injecting the molten material is configured to change the molten mold flux component supplied to the mold 30 in real time in the present disclosure. Hereinafter, the term "mold flux" refers to a solid mold flux when before being supplied to the smelting furnace 112, and then when after the solid mold flux being melted in the smelting furnace 112, it is referred as the "molten mold flux". In addition, when after the molten mold flux is injected into the mold 30, it is referred as "mold slag".

[0048] The device 100 for injecting the molten material according to an embodiment of the present disclosure may include: a raw material supply unit 110 configured for supplying the solid mold flux; a melting unit 120 configured for receiving and melting the solid mold flux to generate the molten mold flux, and injecting the molten mold flux into the mold 30; and the control unit 140 configured for controlling an operation of the raw material supply unit 110 and the melting unit 120.

[0049] The raw material supply unit 110 may include: a first raw material supply unit 112 configured for supplying a first raw material; a second raw material supply unit 112 configured for supplying a second raw material; and a mixing unit 116 connected to the first raw material supply unit 112 and the second raw material supply unit 114, and configured for mixing a first raw material and a second raw material respectively supplied from the first raw material supply unit 112 and the second raw material supply unit 114.

[0050] In addition, the raw material supply unit 110 may supply the mixture of the first raw material and the second material to the melting unit 120 through the mixing unit 116, but a raw material feeding unit 118 may be disposed between the mixing unit 116 and the melting unit 120 to supply the first raw material or the mixture of the first raw material and the second raw material uniformly to the melting unit 120.

[0051] The first raw material supply unit 112 may include: a first storage unit 112a configured for storing the first raw material, such as a main mold flux therein; and a first transfer pipe 112b for communicating the first storage unit 112a and the mixing unit 116.

[0052] The first storage unit 112a stores the solid first raw material e.g. the main mold flux therein. A first feeder 112c may be disposed at a portion where the main mold flux is discharged from the first storage unit 112a or at the first transfer pipe 112b to discharge the main mold flux by a predetermined amount or uniformly. In this connection, the first feeder 112c may be a screw feeder provided at the first storage unit 112a or the first transfer pipe 112b and operated by an operation of a driving device, or may be a valve that opens or closes a connection of the first storage unit 112a and the first transfer pipe 112b or a flow path inside the first transfer pipe 112b.

[0053] The second raw material supply unit 114 may include a second storage unit 114a for storing the second raw material, such as an additive therein, and a second transfer pipe 114b for communicating the second storage unit 114a and the mixing unit 116. In this connection, the plurality of second storage units 114a may be provided so that various types of the additive may be independently stored therein. A second feeder 114c may be provided at a portion of the second storage unit 114a from which the additive is discharged or at the second transfer pipe 114b to discharge the additive to the mixing unit 116 by a predetermined amount or uniformly. The second feeder 114c may be a screw feeder connected to the second storage unit 114a or the second transfer pipe 114b and operated by the operation of the driving device or may be a valve that opens or closes a connection of the second storage unit 114a and the second transfer pipe 114b or a flow path inside the second transfer pipe 114b.

[0054] Due to this configuration, the second raw material supply unit 114 may selectively supply at least one of the plurality of additives.

[0055] The mixing unit 116 may supply a mold flux uniformly mixed of the main mold flux and the additive respectively from the first raw material supply unit 112 and the second raw material supply unit 114 to the melting unit 120. The mixing unit 116 may also supply only the first raw material from the first raw material supply unit 112 to the melting unit 120.

[0056] The mixing unit 116 may include: a mixing vessel 116a configured for receiving the main mold flux and the additive respectively supplied from the first raw material supply unit 112 and the second raw material supply

unit 114 therein; an agitator (not shown) configured for uniformly mixing the main mold flux and the additive received in the mixing vessel 116a; and a third transfer pipe 116b configured for transferring the mixture of the main mold flux and the additive, that is, the mold flux, to the melting unit 120.

[0057] The mixing vessel 116a may receive solid main mold flux and additive discharged from the first raw material supply unit 112 and the second raw material supply unit 114 therein. A third feeder 116c may be disposed at a portion from which the mixture of the main mold flux and the additive is discharged or at the third transfer pipe 116b to discharge the mixture of the first raw material and the second raw material by a predetermined amount or uniformly. In this connection, the third feeder 116c may be a screw feeder provided at the mixing vessel 116a or the third transfer pipe 116b and operated by the operation of the driving device or may be a valve that opens or closes a connection of the mixing vessel 116a and the third transfer pipe 116b or a flow path inside the third transfer pipe 116b.

[0058] The agitator may be formed of a screw or an impeller configured to be rotatable in the mixing vessel 116a. In addition, the agitator may be formed of a nozzle capable of blowing inert gas and the like into the mixing vessel 116a.

[0059] In this specification, the mixing unit 116 includes the mixing vessel 116a and the agitator. However, the mixing vessel 116a may be configured to be rotatable to uniformly mix the main mold flux and the additive without the agitator. The mixing unit 116 may not limited thereto and formed in various shapes to uniformly mix the main mold flux and the additive.

[0060] The mixing unit 116 may also include a heater 116d configured for preheating the main mold flux or the mixture of the main mold flux and the additive. The heater 116d may be provided at the agitator or the mixing vessel. The main mold flux or the mixture of the main mold flux or the additive may be heated at a predetermined temperature and supplied to the raw material feeding unit 118.

[0061] The raw material feeding unit 118 may include: a third storage unit 118a for communicating with the third transfer pipe 116b of the mixing unit 116; a fourth transfer pipe 118b configured for connecting the third storage unit 118a to the melting unit 120 and supplying the first raw material or the mixture of the first raw material and the second raw material through an internal flow path thereof; and a fourth feeder 118c may be provided to connect the third storage unit 118a and the fourth transfer pipe 118b to supply the first raw material or the mixture of the first raw material and the second raw material to the melting unit 120 by a predetermined amount or uniformly. The fourth feeder 118c may be a screw feeder or a valve that is connected to the third storage unit 118a and the fourth transfer pipe 118b like as above-mentioned first to third feeders 112c, 114c, and 116c.

[0062] The raw material feeding unit 118 may also in-

clude a heater 118d for preheating the main mold flux or the mixture of the main mold flux and the additive supplied from the mixing unit 116. The heater 118d may be disposed at the third storage unit 118a or the fourth transfer pipe 118b. The heater 118d may heat the main mold flux or the mixture of the main mold flux and the additive at a predetermined temperature and supply to the melting unit 120. Therefore, by accelerating the melting of the main mold flux or the mixture of the main mold flux and the additive, it may be possible to respond more rapidly to the change of the component of the mold slag.

[0063] The melting unit 120 may generate and temporarily store molten mold flux by heating and melting the mold flux, that is the mixture of the main mold flux and the additive supplied from the mixing unit 116, and discharge the molten mold flux and inject it into the mold 30. The melting unit 120 may include: the smelting furnace 112 configured for receiving the mixture supplied from the mixing unit 116 therein; a heat source supply unit 128 configured for supplying a heat source inside the smelting furnace 112.

[0064] A smelting space where the main mold flux and the additive are injected and melted may be defined inside of the smelting furnace 112, and a discharge port 126 for injecting the molten mold flux to the mold 30 may be defined at one side of the smelting furnace 112. The smelting furnace 112 may be formed in an approximately "V" shaped with downwardly bent center portion and may be provided in a tilted manner. The smelting furnace 112 may include an injection port 124 for injecting the mold flux discharged from the mixing unit 116 into the smelting space at an upper side thereof and the discharge port 126 for injecting the molten mold flux generated in the smelting space into the mold 30. Further, the heat source supply unit 128 may be connected to one side of the smelting furnace 112 so as to supply the heat source to the smelting space. By the heat source from the one side of the smelting furnace 112 may be supplied, the mold flux in the smelting space may be melted so that the molten mold flux may be generated and temporarily stored therein and through the discharge port 126 at the other side thereof, the molten mold flux may be discharged and injected into the mold 30. This is possible because the smelting furnace 112 is provided in the tilted manner. A discharging amount of the molten mold flux may be regulated based on a degree of tilting of the smelting furnace 112.

[0065] The heat source supply unit 128 may include a plasma torch and a gas supply pipe that supplies plasma gas such as nitrogen (N_2), argon (Ar), helium (He), etc. with the plasma torch. The plasma torch is a device for generating plasma of a high temperature of 20,000 °C or above using electricity, and generates the plasma to the smelting space of the smelting furnace 112. The plasma torch may include: a plasma confinement tube for receiving a plasma gas supplied from the gas supply pipe; an induction coil disposed to surround the plasma confinement tube; and a power supply unit for supplying power

to the induction coil. Thus, when the power from the power supply unit is applied to the induction coil, the plasma is generated inside the plasma confinement tube. Plasma thus generated and heat induced by the plasma may be used as a heat source to melt the mixture, i.e. the solid mold flux and the additive supplied to the smelting space through the injection port 124. The molten mold flux in the smelting space may be temporarily stored therein, and when the smelting furnace 112 is tilted, it may be discharged from the discharge port 126 and injected into the mold 30.

[0066] The smelting furnace 112 constituting the melting unit 120 may be formed in various shapes, and the molten mold flux may also be discharged by various ways. Such a melting unit 120 is a well-known technology, therefore a detailed description thereof will be omitted.

[0067] With this configuration, the device 100 for injecting the molten material may control and melt the component of the mold flux in real time and inject into the mold 30.

[0068] In addition, the measuring unit 130 may be disposed at the mold 30. The measuring unit 130 may include a thermometer for measuring a heat transferring behavior of the mold 30, or a probe for measuring the component of the mold flux injected into the mold 30.

[0069] When the thermometer is used as the measuring unit 130, the thermometer may be installed at the mold 30 to measure a temperature change of the mold 30. For example, when in case of multiple continuous-castings of the single steel grade, the viscosity of the mold slag is increased due to an introduction of Al_2O_3 into the mold slag after a certain period of time. Thus, the mold slag is ununiformly introduced between the mold 30 and the solidified shell, and a lubrication is not properly performed.

[0070] As a result, a heat transfer from the solidified shell to the mold 30 is not uniform, resulting in a variation in a temperature value measured by the thermometer. Therefore, a casting performance may be improved by changing the component of the molten mold flux to be injected into the mold 30 based on the temperature value measured by the thermometer.

[0071] When the probe is used as the measuring unit 130, a portion of the mold slag in the mold 30 is sampled. Then, by analyzing the components of the mold slag collected from the probe, the components of the molten mold flux injected into the mold 30 and the mold slag may be compared and analyzed. In response to the change of the component of the mold slag during casting, the casting performance may be improved by changing the component of the molten mold flux to be injected into the mold 30 in the future.

[0072] The addition of the additive to the mold flux based on the measurement of the measuring unit 130 will be described again in the description of the casting method.

[0073] The control unit 140 may receive the measure-

ment of the measuring unit 130. Based on the measurement of the measurement, the control unit 140 may control the operation of the raw material supply unit and control the component of the molten mold flux to be injected into the mold 30. As a result, supply amounts of the main mold flux and the additive may be controlled. In addition, the control unit 140 controls the operation of the melting unit 120 and the measuring unit 130, thereby controlling supply amount of the molten mold flux to be injected into the mold 30 based on the measurement.

[0074] Hereinafter, the casting method according to an embodiment of the present disclosure will be described.

[0075] The casting method according to the present disclosure may include a first embodiment for casting a slab using a single steel grade and a second embodiment for casting a slab using two grades of the steel.

[0076] Figure 4 is a sequence diagram showing the casting method according to the first embodiment of the present disclosure.

[0077] First, the first embodiment for casting the slab using the single steel grade will be described.

[0078] The casting method according to the first embodiment of the present disclosure may include: a step S110 of preparing the main mold flux and the additive; a step S120 of injecting the molten steel passed through the ladle 10 and the tundish 20 into a mold 30; a step S130 for injecting the molten mold flux to a top face of the molten steel injected into the mold 30; a step S140 for measuring the casting state; and a step S150 for analyzing the casting state and determining whether or not to input the additive; and a step S160 for inputting the additive. Injecting the molten steel and the molten mold flux into the mold 30 may be performed continuously during casting. Further, by a step S170 of determining whether the casting is completed, measuring the casting state and inputting the additive may be repeatedly performed during casting.

[0079] Hereinafter, the molten mold flux injected into the mold 30 at beginning of the casting is called a first molten mold flux, and the molten mold flux mixed with the additive during the casting and injected into the mold 30 is called a second molten mold flux.

[0080] In preparing the main mold flux and the additive, the solid main mold flux is provided into the first storage unit 112a, and the additive to be mixed with the main mold flux during the casting is provided into the second storage unit 114a. In this connection, the molten mold flux may include CaO, SiO₂, MnO, P₂O₅, Al₂O₃, MgO, TiO₂, K₂O, Na₂O, F, Fe₂O₃ and the like. The main mold flux may be prepared to have a composition suitable for the molten steel to be used in the casting. In addition, the additive may be one or a mixture of at least two components selected from a group consisting of NaF(s), Na₃AlF₆, CaF₂(s), AlF₃(s), SiO₂(s), Li₂O(s), LiF(s), CaO, MnO, P₂O₅, MgO, Al₂O₃(s), TiO₂, Fe₂O₃, K₂O(s), Na₂O(s).

[0081] In injecting the molten steel into the mold 30, a refining process is completed and the molten steel re-

ceived in the ladle 10 is supplied to the tundish 20 through the injecting nozzle, and the molten steel supplied to the tundish 20 is injected into the mold 30 through the submerged nozzle 22 provided at the tundish 20.

[0082] Once the molten steel has been injected into the mold 30, the first molten mold flux is injected to the top face of the molten steel in the mold 30. The main mold flux is transferred from the first storage unit 112 where it is firstly stored to the melting unit 120 through the mixing vessel 116a of the mixing unit 116. The first molten mold flux may be produced by melting said main mold flux in the melting unit 120. The first molten mold flux injected at the beginning of the casting may be produced by melting only the main mold flux in the melting unit 120.

[0083] In this way, the slab may be casted by injecting the molten steel and the first molten mold flux into the mold 30. The first molten mold flux injected into the mold 30, i.e. the mold slag, inflows between the mold 30 and the solidified shell (or the molten steel), controlling the heat transfer between the mold 30 and the solidified shell, and lubricating to smooth the casting of the slab.

[0084] At the beginning of the casting, the mold slag maintains its components when injected, but as the casting progresses, the impurities in the molten steel flow into the mold slag and the components of the mold slag change. For example, when Al₂O₃ in the molten steel is introduced into the mold slag, the viscosity of the mold slag increases. In this case, the mold slag does not inflow smoothly between the mold 30 and the solidified shell, and the mold slag is unevenly introduced in the width direction and the longitudinal direction of the mold 30.

[0085] As a result, the heat is unevenly transferred between the mold 30 and the solidified shell, and the solidified shell is not formed properly. Therefore, after the casting, a crack on a surface of the slab or a slab break-out may occur.

[0086] By injecting the second molten mold flux prepared by mixing the main mold flux and the additive during the casting into the mold 30, a quality of the slab may be improved by allowing the mold slag to inflow uniformly between the mold and the solidified shell in response to the component change of the mold slag.

[0087] Whether or not to inject the additive may be determined based on the casting state, for example, the temperature change of the mold 30 or the change of the component of the mold slag.

[0088] By measuring the temperature change of the mold 30 during the casting, mixing the additive to the mold flux based on the measured temperature change, and melting and injecting the mixture into the mold 30, thereby rapidly responding to the component change of the mold slag. Therefore, by allowing the mold slag to inflow uniformly between the mold 30 and the solidified shell, the same heat transfer characteristics and lubricating ability as in the initial stage of casting may be maintained until the casting is completed.

[0089] The temperature of mold 30 may be measured

by installing a plurality of thermometers in the longitudinal direction and the width direction of the mold 30 and measuring the temperature value in the longitudinal direction and/or the width direction of the mold 30. Then, the deviation of the measured temperature value from the thermometer may be measured. When the measured temperature value falls within a deviation range of about 0% to 5% from the initial measured temperature value, the casting may proceed as it is. Or when the measured temperature value deviates from above-stated deviation range, the additive may be determined to be injected.

[0090] As a result of comparison, when the measured temperature value is within the deviation range, it is determined that the mold slag is being uniformly injected between the mold 30 and the solidified shell, and the component change of the mold slag is insignificant, thus the molten mold flux of the same component as the initial casting, i.e. the first molten mold flux is injected into the mold 30.

[0091] However, when the measured temperature value deviates from the deviation range, it is determined that the component of the mold slag has changed greatly. Therefore, the molten mold flux into which the additive is injected, i.e. the second molten mold flux may be injected into the mold 30.

[0092] The additive to be injected into the mold 30 may be selected as follows.

[0093] At the beginning of the casting, the temperature value measured from the thermometer changes within a certain range because there is little change in the component of the mold slag. However, as the casting progresses, the impurities in the molten steel flow into the mold slag, causing a change in the component of the mold slag. For example, Al_2O_3 in the molten steel may inflow, or fluorine (F) component in the mold slag may volatilize, resulting in a higher viscosity of the mold slag. In this case, since the mold slag is not uniformly introduced between the mold 30 and the solidified shell, the heat transfer ability is lowered, and the measured temperature value measured from the thermometer installed at the mold 30 is changed. In this case, by mixing the mold flux and the additive and melting and injecting the mixture into the mold 30, thereby suppressing or preventing a deterioration of casting efficiency resulted from the component change of the mold slag. When a large amount of Al_2O_3 is introduced into the mold slag, at least one of NaF, CaF_2 , and Li_2CO_3 may be used as the additive, and when fluorine in the mold slag is volatilized, Na_3AlF_6 or NaF and the like may be used as the additive. Because of this, the viscosity of the mold slag in the mold 30 may be reduced to some extent, so that the mold slag may be uniformly injected between the mold 30 and the solidified shell. For example, when the molten mold slag is injected at 1 kg/min, Na_3AlF_6 as the additive may be inputted at 50 g/min. That is, the additive may be inputted in a range of 1 to 5% by weight of the molten mold slag. In this case, the fluorine content of the component in the mold slag injected into the mold 30 is increased up to

about 2.7 wt%, and the viscosity of the mold slag is increased, thereby smooth inflow of the mold slag between the mold and the solidified shell. In this connection, Al_2O_3 and Na_2O components also somewhat increased within a range of more than 0 to 2 wt%. The change of the Al_2O_3 and Na_2O contents is not so much compared to the change of the fluorine content, thus it does not affect the casting much.

[0094] In addition, at least one of various kinds of additives described above may be used as the additive.

[0095] Mixing of the main mold flux and the additive is performed via the control unit 140. The control unit 140 receives the measurement from the measuring unit 130, for example, the thermometer, and controls the operations of the first feeder 112c of the first raw material supply unit 112 and the second feeder 114c of the second raw material supply unit 114. Then, the main mold flux and the additive respectively stored in the first storage unit 112a and the second storage unit 114a are supplied into the mixing vessel 116a of the mixing unit 116.

[0096] Thereafter, the control unit 140 operates the agitator of the mixing unit 116 to uniformly mix the main mold flux and the additive supplied to the mixing vessel 116a. When the main mold flux and the additive are uniformly mixed, the control unit 140 operates the third feeder 116c of the mixing unit 116 to inject the mixture of the main mold flux and the additive into the smelting furnace 112 of the melting unit 120.

[0097] The mixture injected into the smelting furnace 112 is melted by the heat supplied from the heat source supply unit 128 of the melting unit 120, that is, the plasma, to be produced as the second molten mold flux. The second molten mold flux thus produced is injected into the mold 30 through the discharge port 126 formed at the smelting furnace 112 by the inclination of the smelting furnace 112 and mixed with the mold slag. Thus, the viscosity of the mold slag in the mold 30 is lowered, allowing the uniform inflow between the mold 30 and the solidified shell.

[0098] Thus, by continuously monitoring the temperature of the mold 30 during the casting of the slab, the quality of the slab may be improved by rapidly responding to the temperature change of the mold 30 resulting from the component change of the mold slag. Control of the component of the mold slag during the casting may be repeated many times, depending on the measurement from the measuring unit 130. Therefore, since the component of the mold slag may be rapidly controlled in response to the component change of the mold slag during the casting, unless deterioration of the device such as the submerged nozzle 22 and the like occurs, the number of the charge may be increased to prolong the casting time, and the continuous continuous-casting becomes possible, which may improve a throughput of the molten steel, that is a production amount of the slab.

[0099] In the present specification, it is described that the component change of the mold slag is measured based on the temperature change of the mold 30. How-

ever, the component of the mold slag may be analyzed by collecting the mold slag during the casting. Alternatively, when Al_2O_3 is injected into the mold slag, because color of the mold slag is changed, the component change of the mold slag may be measured visually.

[0100] Hereinafter, the second embodiment of the present disclosure will be described below.

[0101] Figure 5 is a block diagram conceptually showing a method of injecting the molten mold flux into the mold when the slab is casted according to a second embodiment of the present disclosure.

[0102] The second embodiment of the present disclosure describes a method of casting different steel grades, such as the two grades of the steel.

[0103] For example, when the slabs are casted using high Al or high Mn steel, mold fluxes with different components are used. In this case, the mold flux to be used includes CaO , SiO_2 , MnO , P_2O_5 , Al_2O_3 , MgO , TiO_2 , K_2O , Na_2O , F , Fe_2O_3 and the like, but there is a difference in contents thereof, and other components may be further included. Therefore, when continuously casting these two grades of the steel, different mold fluxes are injected as the steel grade changes. In this case, suitable mold flux based on the steel grade should be provided separately. In this connection, when production amount of the steel grade to be casted is small, the molten mold flux remaining in the melting furnace is discarded, and new mold flux is melted and provided as molten mold flux, or a transient phenomenon in which mold fluxes having different components are mixed with each other during the casting occurs.

[0104] Therefore, in the second embodiment of the present disclosure, the component of the molten mold flux may be controlled based on the steel grade used in the casting and injected into the mold 30.

[0105] Hereinafter, a mold flux applicable to all steel grades is called a main mold flux, an additive used at the beginning of the casting is called a first additive, and an additive used when the steel grade is changed during the casting is called a second additive. In addition, an additive used based on the results measured by the measuring unit 130 during the casting is called a third additive.

[0106] The casting method according to the second embodiment of the present disclosure may include: preparing the main mold flux and the first additive, the second additive and the third additive; injecting a first molten steel passed through the ladle 10 and the tundish 20 into the mold 30; injecting a first molten mold flux prepared by mixing the main mold flux and the first additive to the top face of the first molten steel injected into the mold 30; injecting a second molten steel into the mold 30 when after the casting using the first molten steel is completed; and injecting a second molten mold flux, prepared using the main mold flux and the second additive, to the top face of the second molten steel injected into the mold 30. In addition, in casting the slab using the first molten steel and the second molten steel, measuring the casting state

and injecting the third additive based on the casting state may be included.

[0107] In this connection, the casting using the first molten steel and the casting using the second molten steel may be performed sequentially, measuring the casting state and injecting the third additive may be repeatedly performed during the casting by determining the completion of the casting using the second molten steel.

[0108] First, in preparing the main mold flux, first additive, second additive and third additive, the main mold flux applicable to all steel grades, the first additive for controlling the component of the mold flux based on the steel grade, the second additive for controlling the component of the mold slag during the casting are prepared.

The main mold flux may include CaO , SiO_2 , MnO , P_2O_5 , Al_2O_3 , MgO , TiO_2 , K_2O , Na_2O , F , Fe_2O_3 and the like. Further, the third additive may be at least one selected from a group consisting of NaF(s) , Na_3AlF_6 , $\text{CaF}_2(\text{s})$, $\text{AlF}_3(\text{s})$, $\text{SiO}_2(\text{s})$, $\text{Li}_2\text{O(s)}$, LiF(s) , CaO , MnO , P_2O_5 , MgO , $\text{Al}_2\text{O}_3(\text{s})$, TiO_2 , Fe_2O_3 , $\text{K}_2\text{O(s)}$, $\text{Na}_2\text{O(s)}$, C . The first additive and the second additive are prepared for control the component of the mold flux based on the steel grade, may include at least one of the components of the main mold flux and may include at least one of the components of the second additive. That is, the first additive and the second additive may be at least one of CaO , SiO_2 , MnO , P_2O_5 , Al_2O_3 , MgO , TiO_2 , K_2O , Na_2O , F , Fe_2O_3 , NaF S , Na_3AlF_6 , $\text{CaF}_2(\text{s})$, $\text{AlF}_3(\text{s})$, $\text{SiO}_2(\text{s})$, $\text{Li}_2\text{O(s)}$, LiF(s) , CaO , MnO , P_2O_5 , MgO , $\text{Al}_2\text{O}_3(\text{s})$, TiO_2 , Fe_2O_3 , $\text{K}_2\text{O(s)}$, $\text{Na}_2\text{O(s)}$, C . In addition, the first additive and the second additive may be the same component.

[0109] The main mold flux thus prepared may be stored in the first storage unit 112a of the first raw material storage unit, and the first additive, the second additive and the third additive may be stored in the second storage unit 114a of the second raw material storage unit. In this connection, the second storage unit 114a may be provided in a plurality, and may store each of the components of the first additive, the second additive, and the third additive.

[0110] Thereafter, when the casting starts, the first molten steel is injected into the mold 30, and the first molten mold flux, which is produced by mixing the main mold flux and the first additive is injected to the top face of the first molten steel.

[0111] After the casting using the first molten steel is completed, the second molten steel is injected into the mold 30, and the second molten mold flux, which is produced by mixing the main mold flux and the second additive is injected to the top face of the second molten steel.

[0112] For example, when the first molten steel is high manganese steel and the second molten steel is high manganese-high aluminum steel, the first molten mold flux and the second molten mold flux have different Al_2O_3 contents. That is, the first molten mold flux contains less Al_2O_3 than the second molten mold flux.

[0113] Therefore, when the first molten steel is injected into the mold 30 at the beginning of the casting, a small

amount, for example less than 1 % of the Al_2O_3 is injected into the main mold flux and the first additive. When the casting using the first molten steel is completed and then the second molten steel is injected into mold 30, 1 to 3 % of the Al_2O_3 may be inputted to the main mold flux and second additive. The second additive may be injected in a gradual manner so that the second molten mold flux has a suitable physical property for the second molten steel. This is because when the physical property of the second molten mold flux, such as the viscosity or a basicity is changed suddenly, the second molten mold flux may not inflow smoothly between the mold and the solidified shell, thus slab break-out may occur.

[0114] In the above example, an example of the first additive and the second additive being composed of the same component, and increasing the amount of the input thereof was described. However, depending on the grade of the molten steel to be injected into the mold 30, the input amount of the first additive and the second additive may be gradually reduced, and the components of the first additive and the second additive may be different. In addition, although the method of casting using two grades of the molten steel has been described, it is also possible to cast using two or more grades of the molten steel.

[0115] Further, during the casting using two grades of the steel, i.e. the first molten steel and the second molten steel, the casting state may be measured as in the above-described embodiment, and the second additive may be used to control the component of the mold slag based on the measurement.

[0116] Hereinafter, an experimental example of casting the slab by the casting method according to the present disclosure will be described. In this experimental example, temperature changed of the mold during the casting of the slab using the single steel grade will be inspected.

[0117] Figure 6 is a graph showing experimental results based on whether the additive inputted when the slab is casted according to the casting method of the embodiment of the present disclosure. Figure 6 shows the temperature change of the mold depending on whether the additive is inputted during the casting.

[0118] The plurality of thermometers were installed at the mold 30, and the temperature of the mold 30 during the casting was measured. The thermometer was installed at a plurality of points along the width direction of the mold 30, for example, from a widthwise center of the slab to the longitudinal direction of the mold 30, for example, a casting direction of the slab, specifically at 300, 400, 500 and 600 mm from the top of the mold 30.

[0119] Then, the molten steel was injected into the mold 30, and the first molten mold flux which melted the main mold flux was injected to the top face of the molten steel injected into the mold 30.

[0120] Figure 6 shows that the temperature of the mold 30 changes within a certain range at a beginning of the casting (section A). However, in a middle of the casting

(section B), the temperature of the mold 30 changes sharply and fluctuates irregularly. The temperature of the mold 30 was observed for a certain period of time, but it did not return to the same pattern as the beginning of the casting (period A).

[0121] The second molten mold flux, which was produced by mixing and melting the main mold flux and the additive, was injected into mold 30. In this connection, the fluorine F was injected as the additive.

[0122] When the second molten mold flux was injected into the mold 30, the temperature of the mold 30 became gradually and stably changed, and changed within a certain range.

[0123] This phenomenon may be caused by the change of the component of the mold slag through the reaction with the impurities in the molten steel during the casting. Therefore, it is possible to smoothly perform casting by controlling the component of the mold slag by injecting the additive during the casting, thereby suppressing or preventing the slab quality deterioration.

[0124] Although the method and the equipment for casting the slab have been described above, the present disclosure is not limited thereto and may be applied to various operations such as a refining process using an aqueous dephosphorization agent.

[0125] As such, although the detailed description of the present disclosure has been provided for specific embodiments, it should be understood that various modifications may be made without departing from the scope of the present disclosure.

[0126] Therefore, the scope of the present disclosure should not be construed as limited to the described embodiments, but should be determined by the claims appended hereto, as well as the appended claims.

[0127] The device for injecting the molten material, the casting equipment using the same, and the casting method according to the present disclosure may be applied to the continuous slab casting process to improve the quality and productivity of the slab.

Claims

1. A device for injecting molten material, the device comprising:

raw material supply units configured for supplying different first and second raw materials respectively;

a mixing unit configured for mixing the different first and second raw materials supplied from the raw material supply units to produce a mixture; a melting unit connected to the mixing unit to melt the mixture supplied from the mixing unit to produce molten material wherein the melting unit has a discharge port through which the molten material is discharged; and

a control unit configured for controlling a com-

- ponent of the mixture by controlling operations of the raw material supply units, mixing unit and melting unit.
2. The device for injecting molten material according to claim 1, wherein the raw material supply unit including:
 - a first raw material supply unit configured for supplying a first raw material; and
 - second raw material supply units configured for respectively supplying a plurality of second raw materials containing different components.
 3. The device for injecting molten material according to claim 2, wherein the first raw material supply unit including:
 - a first storage unit configured for storing the first raw material therein;
 - a first transfer pipe for communicating the first storage unit and the mixing unit; and
 - a first feeder coupled to at least one of the first storage unit and the first transfer pipe to regulate a discharge amount of the first raw material.
 4. The device for injecting molten material according to claim 3, wherein each of the second raw material supply units includes:
 - a second storage unit configured for storing each of the plurality of second raw materials therein;
 - a second transfer pipe configured for communicating each of the plurality of second storage units and the mixing unit; and
 - a second feeder coupled to at least one of the second storage unit and the second transfer pipe to regulate a discharge amount of each of the second raw materials.
 5. The device for injecting molten material according to claim 4, wherein the mixing unit includes:
 - a mixing vessel in communication with the first supply pipe and the second supply pipe;
 - an agitator disposed in the mixing vessel for mixing the first raw material and the second raw material; and
 - a third transfer pipe for transferring the mixture of the first raw material and the second material to the melting unit.
 6. The device for injecting molten material according to claim 4, wherein the mixing unit include a mixing vessel in communication with the first supply pipe and the second supply pipe, wherein the mixing vessel is rotatable.
 7. The device for injecting molten material according to claim 6, wherein the melting unit including:
 - a smelting furnace having a smelting space defined therein for receiving the first raw material and the second raw material therein;
 - a heat source supply unit disposed at one side of the smelting furnace to supply a heat source to the smelting space.
 8. The device for injecting molten material according to claim 7, wherein the heat source supply unit uses plasma as the heat source.
 9. The device for injecting molten material according to claim 8, wherein the control unit is configured to determine whether or not to inject the second raw material based on an input signal.
 10. A casting equipment comprising:
 - a mold for receiving and initially solidifying molten steel;
 - a device configured for injecting molten mold flux into the mold;
 - a measuring unit configured for measuring at least one of a temperature of the mold and a component of the molten mold flux injected into the mold; and
 - a control unit configured for controlling an operation of the device based on a measurement from the measuring unit to change the component of the molten mold flux to be injected into the mold.
 11. The casting equipment according to claim 10, wherein the device includes:
 - a first raw material supply unit configured for supplying main mold flux;
 - second raw material supply units configured for supplying additives;
 - a mixing unit configured for mixing the main mold flux and the additives respectively supplied from the first raw material supply unit and the second raw material supply units, thereby to produce a mixture; and
 - a melting unit configured for melting the mixture supplied from the mixing unit to produce molten mold flux, and for injecting the molten mold flux into the mold.
 12. The casting equipment according to claim 11, wherein the second raw material supply units store therein the plurality of additives individually, wherein the second supply units feed selectively the plurality of additives to the mixing unit.

13. The casting equipment according to claim 12, wherein the measuring unit includes a thermometer configured for measuring a temperature of the mold.
14. The casting equipment according to claim 12, wherein the measuring unit includes:
- a probe configured for collecting molten mold flux injected into the mold;
 - an analyzing unit configured for analyzing a component of the molten mold flux collected by the probe.
15. The casting equipment according to claim 13 or claim 14, wherein the control unit is configured to determine whether to input the additives using a measurement from the measuring unit, and to control types and input amounts of the additives by controlling the second raw material supply units based on the measurement.
16. A casting method comprising:
- preparing main mold flux;
 - injecting molten steel into a mold;
 - melting the main mold flux to produce molten mold flux and injecting the molten mold flux onto a top face of the molten steel;
 - casting a slab; and
 - determining whether to input an additive based on a casted state of the slab during casting thereof.
17. The casting method according to claim 16, wherein in preparing of the main mold flux, the additive is prepared.
18. The casting method according to claim 17, wherein, during melting the main mold flux to produce the molten mold flux, the main mold flux and the additive are melted together.
19. The casting method according to claim 18, wherein in casting the slab, a temperature of the mold is measured to indicate the casted state of the slab, wherein the method includes determining whether to input the additive based on the measured temperature of the mold.
20. The casting method according to claim 18, wherein in casting the slab, a component of the molten mold flux injected into the mold is analyzed to indicate the casted state of the slab, wherein the method includes determining whether to input the additive based on the analyzed component of the molten mold flux.
21. The casting method according to claim 19 or claim 20, wherein, the method includes, upon determination that the additive is added, mixing the main mold flux and the additive to form a mixture, and melting the mixture, and injecting molten mold flux containing a changed component into the mold.
22. The casting method according to claim 21, wherein, the method includes, when, in casting the slab, a grade of molten steel to be injected into the mold has been changed, mixing the main mold flux and the additive, melting the mixture, and injecting molten mold flux containing a changed component into the mold.
23. The casting method according to claim 22, when the main mold flux and the additive are mixed, components of the additives as injected vary depending on the grades of the molten steel.
24. The casting method according to claim 22, when the main mold flux and the additive are mixed, injection amounts of the additives containing the same component vary depending on the grades of the molten steel.

FIG. 1

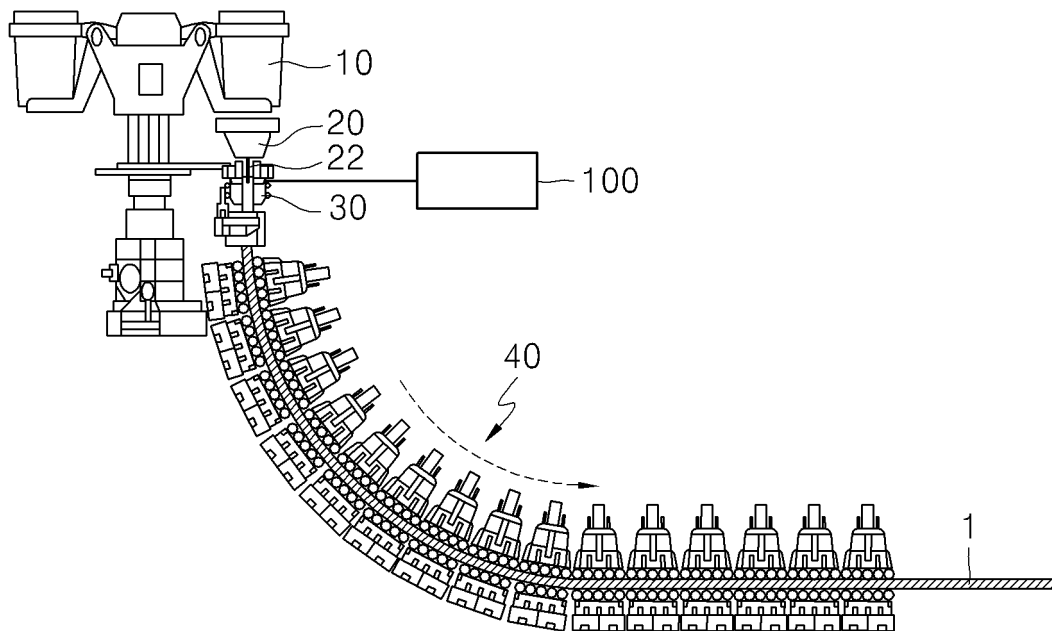


FIG.2

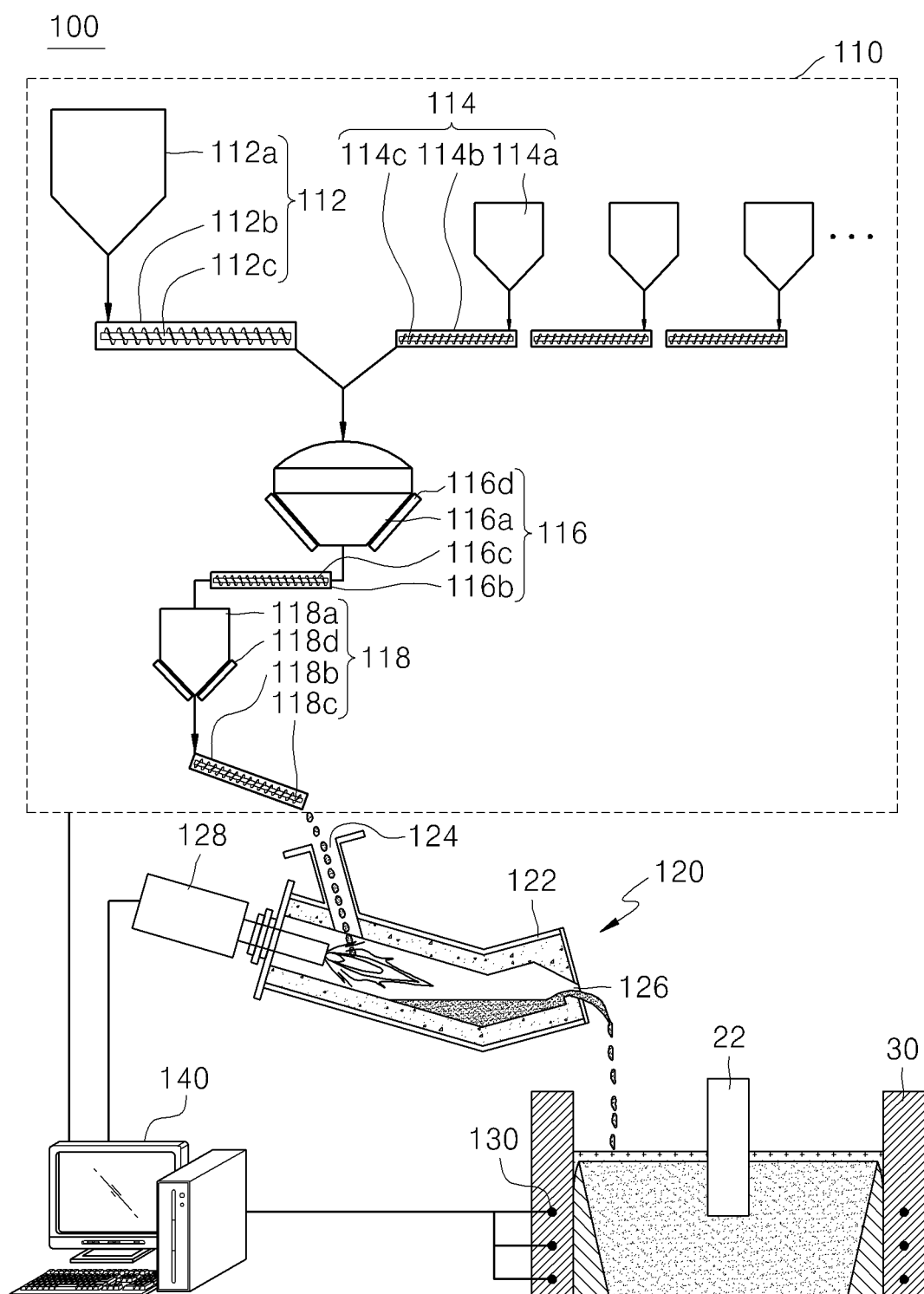


FIG.3

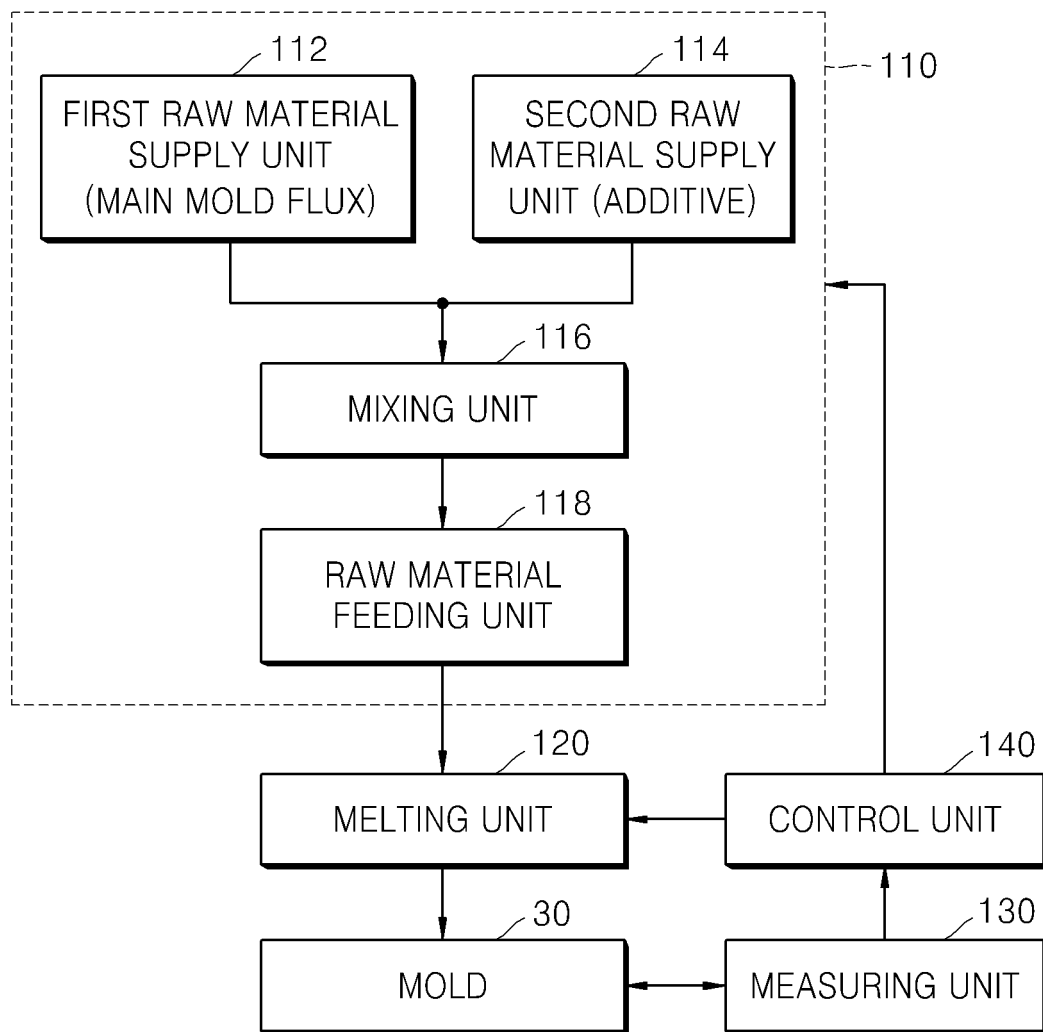


FIG.4

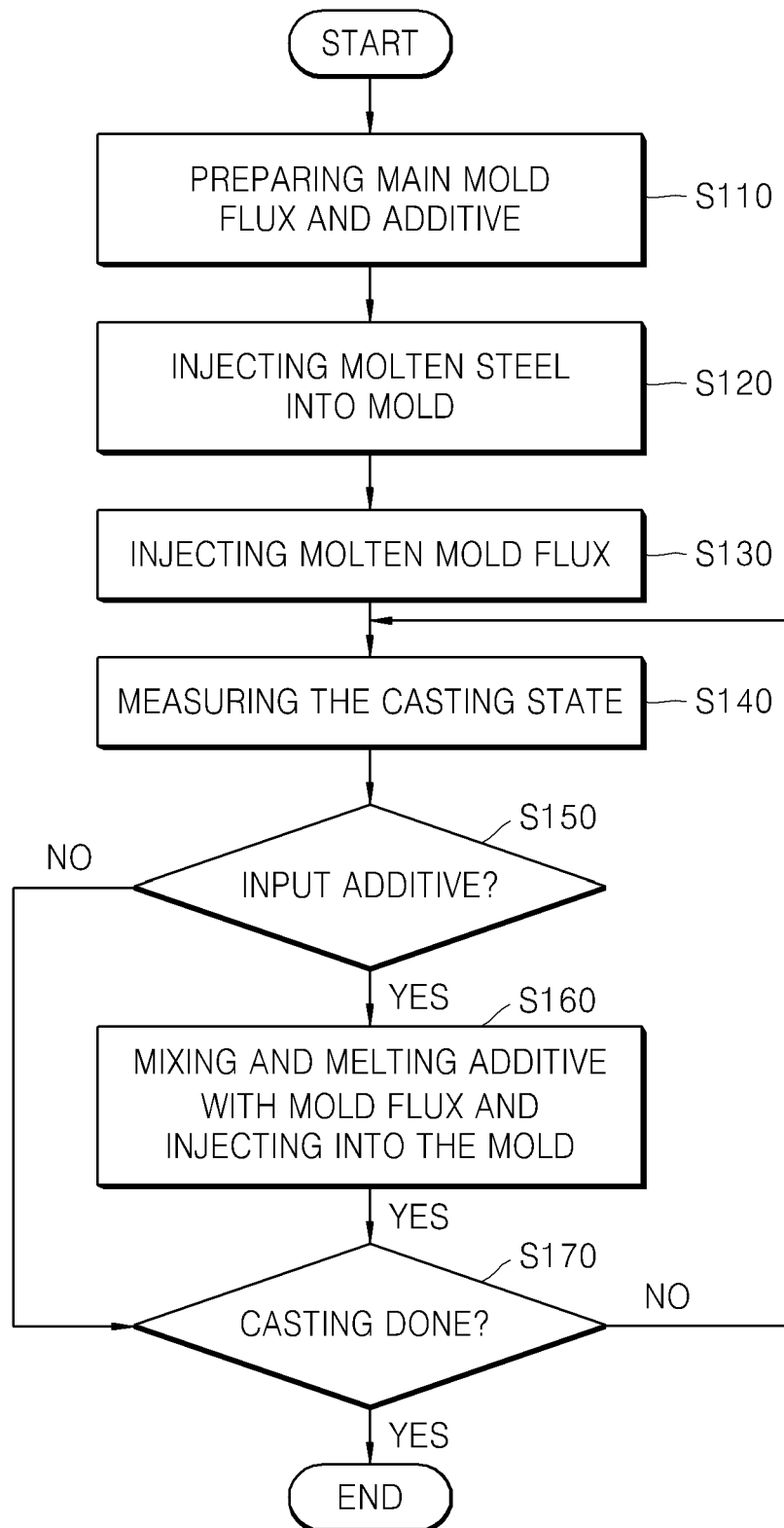


FIG.5

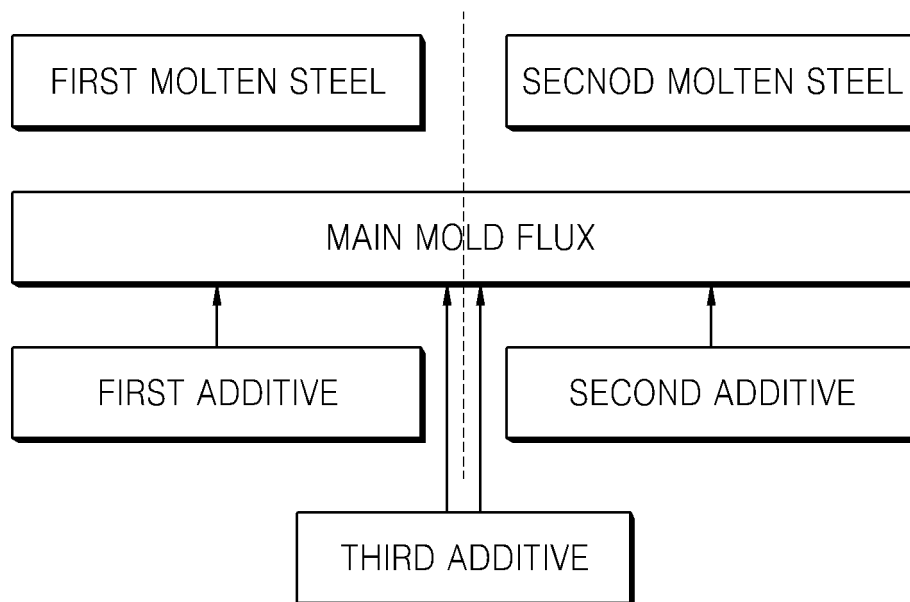
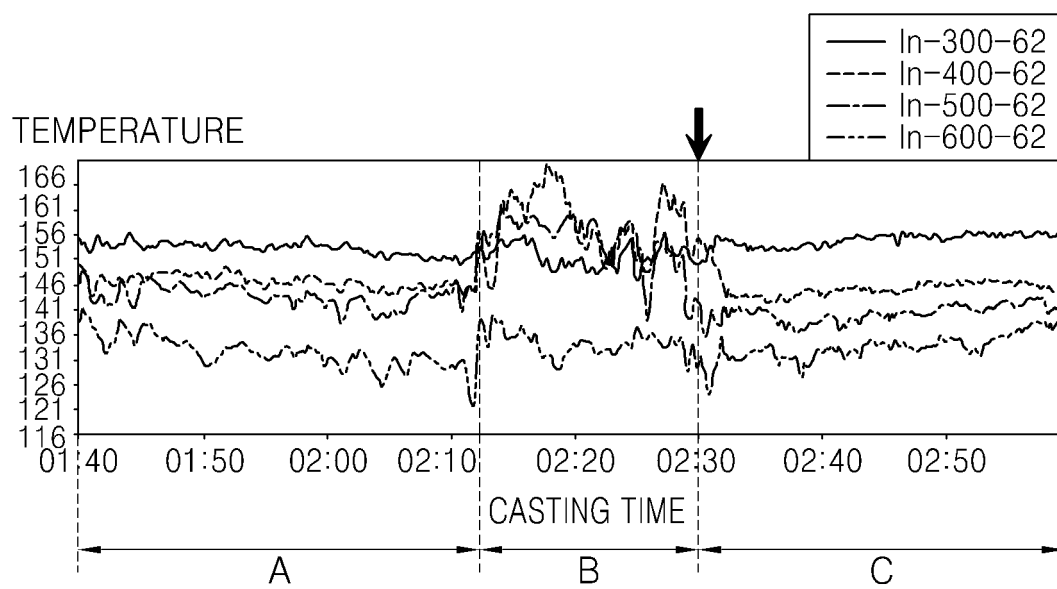


FIG.6



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2016/013161

5	A. CLASSIFICATION OF SUBJECT MATTER		
	<i>B22D 11/10(2006.01)i, B22D 11/103(2006.01)i, B22D 11/108(2006.01)i, B22D 11/16(2006.01)i</i>		
	According to International Patent Classification (IPC) or to both national classification and IPC		
	B. FIELDS SEARCHED		
10	Minimum documentation searched (classification system followed by classification symbols) B22D 11/10; G01K 13/12; B22D 11/00; B22D 11/106; B22D 11/108; G01N 1/10; F27B 14/00; B22D 11/103; B22D 11/16		
	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		
15	Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) eKOMPASS (KIPO internal) & Keywords: continuous casting, molten material, injection, mold, flux, heterogeneity and mixing		
	C. DOCUMENTS CONSIDERED TO BE RELEVANT		
20	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	X	KR 10-2014-0070037 A (POSCO) 10 June 2014 See paragraphs [0030]-[0060] and figures 1-3, 6.	10
	Y		1-9, 11-24
25	Y	KR 10-2014-0003856 A (POSCO) 10 January 2014 See paragraphs [0022]-[0023] and figures 1-3.	1-9, 11-24
	Y	KR 10-1114422 B1 (GLOBAL TECHNOLOGY VIDEO CO., LTD. et al.) 22 February 2012 See paragraphs [0040]-[0041] and figure 2.	3-9
30	Y	KR 10-1455534 B1 (HYUNDAI STEEL COMPANY) 28 October 2014 See paragraphs [0017]-[0021] and figure 1.	14, 20
35	A	JP 2015-085387 A (NISSHIN STEEL CO., LTD.) 07 May 2015 See paragraphs [0013]-[0065] and figures 1-5.	1-24
40	☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
45	* 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		
50	Date of the actual completion of the international search 15 FEBRUARY 2017 (15.02.2017)		Date of mailing of the international search report 15 FEBRUARY 2017 (15.02.2017)
55	Name and mailing address of the ISA/KR  Korean Intellectual Property Office Government Complex-Daejeon, 189 Seonsa-ro, Daejeon 302-701, Republic of Korea Facsimile No. +82-42-481-8578		Authorized officer Telephone No.

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Information on patent family members

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PCT/KR2016/013161

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