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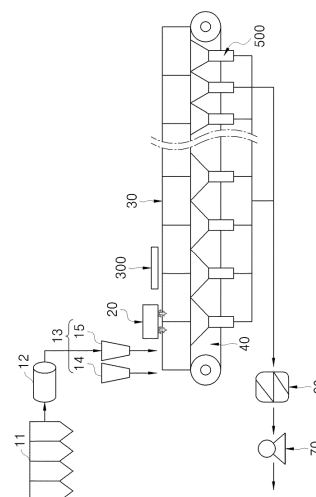
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(54) **SINTERING APPARATUS AND METHOD FOR MANUFACTURING SINTERED ORE USING SAME**

(57) Provided is a sintering apparatus including: a carriage in which a sintering raw material may be charged and which is movable in a sintering process progress direction; an ignition furnace installed on a path along which the carriage moves in the sintering process progress direction so as to spray flame to a raw material layer charged into the carriage; and a plurality of wind boxes installed side by side such that the closer to a sintering completion position from the ignition furnace, the smaller an area of a suction path. Thus, in accordance with exemplary embodiments, the flow velocity of air is adjusted through a plurality of wind boxes, and an additional heat source is further supplied to an upper layer part by using a reflective member, so that generation of unreacted sintered ore in an upper layer part and generation of over-sintered sintered ore in a lower layer part can be suppressed or reduced. Due to this, sintered ore having uniform quality in the entirety of the raw material layer can be obtained regardless of an upper layer part,

a middle layer part, and a lower layer part.

FIG. 1



Description

TECHNICAL FIELD

[0001] The present disclosure relates to a sintering apparatus and a method for manufacturing sintered ore using the same, and more particularly, to a sintering apparatus and a method for manufacturing sintered ore using the same, wherein the production rate of sintered ore is improved and sintered ore having uniform quality can be manufactured.

BACKGROUND ART

[0002] Sintered ore, used as a raw material in a blast furnace iron-making process, is produced in such a way that iron ore and coal (or coke), as a heat source, are mixed, and then coal is burnt to sinter the iron ore by the heat of burning.

[0003] A method for manufacturing sintered ore will be described simply. First, hearth layer ore stored in a hearth layer ore hopper and the material mixture stored in a surge hopper are charged into a carriage and conveyed, and the moving carriage passes under an ignition furnace. At this point, flames (that is, flare) ejected from the ignition furnace ignites the upper portion, that is the surface layer, of the sintering raw material charged in the carriage. The carriage having passed the ignition furnace is conveyed by a conveyor in the process progress direction, and at this point, the carriage passes through over the plurality of wind boxes arranged side by side in the process progress direction. A downward suction force is generated in the carriage passing over the wind boxes, and the ignited flame is moved downward by air suctioned from the outside of the carriage. At this point, the ignited flame and the air introduced from the outside react and a combustion reaction occurs, and the temperature of the raw material layer around the flame is raised to approximately 1,300-1400°C. In addition, low melting-point compounds are formed by reactions between iron ore and supplementary materials together with the rise in temperature, and a melt is locally generated, and in a re-cooling process of the melt, sintered ore is manufactured while the melt is solidified. Further, when the carriage reaches a wind box located at the process progress completion position, the flame reaches the bottom of the carriage. At this point, sintering is completed, and the above operation is continuously carried out for a plurality of carriages.

[0004] Meanwhile, as described above, since the carriage, in which flame is ignited, passes over the wind boxes, the flame and heat moves downward, and thus, there is a problem in that the sintered layer of the raw material layer is rapidly cooled by the room-temperature air introduced from the outside after the ignition of the flame and the temperature of the sintered layer is lowered. Accordingly, the upper layer portion, which is the upper region of the raw material layer, lacks in heat

amount and reaction time for a sintering reaction, so that unreacted sintering ore (that is, sintered ore lacking in reaction of iron ore) is generated in the upper layer portion, and thus, there is a problem in that the production rate of sintered ore is reduced or the recovering rate of sintered ore increases.

[0005] In addition, heat due to the flame in the upper layer portion is gradually moved downward according to the movement of the carriage, and thus, a heat accumulation phenomenon occurs in which temperatures rise toward the bottom side. Accordingly, in a lower layer portion of the raw material layer, the amount of generated over-sintered sintered ore is increased. In addition, due to the generation of temperature gradient in the raw material layer as described above, there is a problem in that unsintered ore is generated in an upper layer portion and over-sintered sintered ore is generated in a lower layer portion, so that quality deviation of sintered ore is caused in one carriage.

[0006] In order to solve the problem of generation of unsintered sintered ore in the upper layer portion, there is a method in which the movement speed of the carriage is reduced or the operation of a blower is adjusted to thereby induce an increase in the reaction time of the upper layer portion. However, there is a problem in that sintering productivity ($T/D/m^2$) is reduced due to an increase in the reaction time.

[0007] In order to solve the problem caused by cooling of the upper layer portion of a raw material layer, a method was proposed, in which an additional heat source is added to the uppermost surface of the raw material layer to raise the reaction temperature, or a supplementary material such as CaO is added so as to improve the strength of the sintered ore according to an increase in the amount of generated melt on the surface of the uppermost layer. However, in case of such a method, since heat sources or supplementary materials, which are fine powder, on the uppermost surface of the raw material layer, the heat sources or the supplementary materials are scattered and thereby generate dust, and thus, a problem occurs in an environmental aspect.

[0008] Accordingly, in order to reduce generation of dust, moisture was added to fine-powder heat sources and the heat sources were supplied to the uppermost surface of the raw material layer, but there was a problem in that the quality of sintered ore is degraded due to moisture.

DISCLOSURE OF THE INVENTION

TECHNICAL PROBLEM

[0009] The present disclosure provides a sintering apparatus and a method for manufacturing sintered ore using the same, wherein the production rate of sintered ore is improved and sintered ore having uniform quality can be manufactured.

[0010] The present disclosure also provides a sintering

apparatus and a method for manufacturing sintered ore using the same, wherein generation of unsintered sintered ore in an upper layer part and over-sintered sintered ore in a lower layer part can be suppressed.

[0011] The present disclosure also provides a sintering apparatus and a method for manufacturing sintered ore using the same, wherein a reaction temperature can be raised and a reaction time can be increased at the outer surface layer part of a material mixture inside a carriage.

TECHNICAL SOLUTION

[0012] In accordance with an exemplary embodiment, a sintering apparatus includes: a carriage which is configured to be able to charge a sintering raw material and which is movable in a sintering process progress direction; an ignition furnace installed on a path along which the carriage moves in the sintering process progress direction so as to spray flame to a raw material layer charged into the carriage; and a plurality of wind boxes installed side by side such that the closer to a sintering completion position from the ignition furnace, the smaller an area of a suction path.

[0013] Each of the plurality of wind boxes may have a cylindrical shape having an inner space, and include: a one-side opening open in a direction toward the carriage; and the other-side opening open in a direction toward a blower connected to the plurality of wind boxes, and the plurality of wind boxes may be installed side by side such that the closer to the sintering completion position from the ignition furnace, the smaller the area of the suction path, wherein the wind boxes may be installed such that the closer to the sintering completion position, the smaller inner diameters of the one-side openings thereof.

[0014] The other-side openings of the plurality of wind boxes may be formed to have the same inner diameters such that the closer to the sintering completion position, the greater the inclination connected from each of the one-side opening to each of the other-side opening with respect to a center in a width direction of each of the wind boxes.

[0015] Each of the plurality of wind boxes may have a cylindrical shape having an inner space, and include a one-side opening open in a direction toward the carriage and the other-side opening open in a direction toward a blower connected to the plurality of wind boxes; shutters configured to control communication between the one-side opening and the other-side opening may be respectively provided inside the plurality of wind boxes; and the plurality of wind boxes may be installed side by side such that the closer to the sintering completion position from the ignition furnace, the smaller the area of the suction path, wherein the closer to the sintering completion position, the smaller an open area of each of the shutters.

[0016] When a portion from the ignition furnace to the sintering completion position is a sintering section, the plurality of wind boxes may be installed side by side such that the closer to the sintering completion position in the

entirety of the sintering section, the smaller the area of the suction path of each of the wind boxes.

[0017] When a portion from the ignition furnace to the sintering completion position is the sintering section, and when the sintering section, in which a sintering reaction of an upper layer part including an upper surface of the raw material layer is mainly performed inside the carriage in moving, is an early part, the sintering section in which a sintering reaction of a middle layer part, which is a layer under the upper layer part, is mainly performed inside the carriage in moving is a middle part, and the sintering section in which a sintering reaction of a lower layer part, which is a layer under the middle layer part, is mainly performed inside the carriage in moving is a late part, the area of the suction path of the wind box disposed corresponding to the middle part may be smaller than the area of the suction path of the wind box disposed corresponding to the early part, and the area of the suction path of the wind box disposed corresponding to the late part may be smaller than the area of the suction path of the wind box disposed corresponding to the middle part.

[0018] The plurality of wind boxes disposed corresponding to the early part may have the suction paths which are the same as each other, the plurality of wind boxes disposed corresponding to the middle part may have the suction paths which are the same as each other, and the plurality of wind boxes disposed corresponding to the late part may have the suction paths which are the same as each other.

[0019] When a portion from the ignition furnace to the sintering completion position is the sintering section, and when the sintering section in which a sintering reaction of an upper layer part, including an upper surface of the raw material layer, is mainly performed inside the carriage in moving is an early part, the sintering section in which a sintering reaction of a middle layer part, which is a layer under the upper layer part, is mainly performed inside the carriage in moving is a middle part, and the sintering section in which a sintering reaction of a lower layer part, which is a layer under the middle layer part, is mainly performed inside the carriage in moving is a late part, the plurality of wind boxes may be installed side by side in a portion of the sintering section such that the closer to the sintering completion position, the smaller the area of the suction path, and the areas of the suction paths of the wind boxes disposed corresponding to the early part may be larger than the areas of the suction paths of the wind boxes disposed corresponding to the middle part and the late part.

[0020] The sintering apparatus may include a reflective member installed, on a movement path of the carriage, on a downstream side of the ignition furnace or inside the ignition furnace, having an opening, and configured to reflect radiant energy generated from the raw material layer and to transfer the energy toward the raw material layer again.

[0021] When the reflective member is installed on the downstream side of the ignition furnace, one end of the

reflective member may be located downstream from the ignition furnace, the reflective member may extend from the one end in the sintering process progress direction, and the other end of the reflective member extending from the one end in the sintering process progress direction may be located at a position, which is a sintering position when a sintering reaction position inside the carriage, in which a sintering reaction gradually moves downward while the carriage moves in the sintering section in which the plurality of wind boxes are installed side by side, is one of positions of approximately 80-120 mm downward from a surface of the raw material layer.

[0022] In accordance with another exemplary embodiment, a sintering apparatus includes: a plurality of carriages which are each configured to be able to charge sintering raw materials and which are movable in a sintering process progress direction; a hopper installed so as to charge the sintering raw materials into the carriages; an ignition furnace installed on a downstream side of the hopper with respect to the process progress direction of the carriage and configured to spray flame to a raw material layer of the sintering raw materials charged into the carriage; and a lance installed so as to supply a heat source into an upper layer part of the raw material layer on an upstream side of the ignition furnace when the raw material layer of the sintering raw materials charged into the carriage is divided, from an uppermost surface thereof, into the upper layer part, a middle layer part, and a lower layer part.

[0023] The lance may extend in a direction corresponding to a movement direction of the carriages, and a tip thereof from which the heat source is discharged may be installed on a upstream side of the ignition furnace so as to be located at a position at which the sintering raw materials are completely charged or on a downstream side of the position at which the sintering raw materials are completely charged.

[0024] The tip of the lance may be located between the hopper and the ignition furnace.

[0025] The sintering apparatus may include a pressurizing part located between the hopper and the ignition furnace and configured to pressurize the raw material layer to which the heat source is further added, wherein the tip of the lance may be located between the hopper and the pressurizing part.

[0026] The sintering apparatus may include an air vent bar extending in a direction corresponding to the movement direction of the carriage, installed at a position corresponding to the middle layer part and the lower layer part of the raw material layer, and configured to be inserted into and detached from the carriage.

[0027] The lance may be located over the air vent bar, and the tip of the lance may be located between a tip of the air vent bar and the ignition furnace.

[0028] In accordance with another exemplary embodiment, a method for manufacturing sintered ore includes: charging sintering raw materials into a carriage moving in a sintering process progress direction; allowing the

carriage, in which the sintering raw materials are chargeable, to pass under an ignition furnace and igniting flame on a raw material layer in which the sintering raw materials are stacked; and moving the flame-ignited carriage over a plurality of wind boxes which are installed side by side from a lower side of the ignition furnace to a sintering completion position, and performing a sintering reaction while gradually increasing a velocity of external air introduced into the carriage such that the closer to the sintering completion position, the higher the velocity.

[0029] In the increasing the velocity of external air introduced into the carriage such that the closer to the sintering completion position, the higher the velocity, arrangement of the plurality of wind boxes may be adjusted such that an area of a suction path decreases from the lower side of the ignition furnace to the sintering completion position.

[0030] Each of the plurality of wind boxes may have a cylindrical shape having an inner space, and include a one-side opening open in a direction toward the carriage and the other-side opening open in a direction toward a blower connected to the plurality of wind boxes, and in adjusting arrangement of the plurality of wind boxes such that the closer to the sintering completion position from the ignition furnace, the smaller the area of the suction path, the wind boxes are installed such that the closer to the sintering completion position, the smaller inner diameters of the one-side openings thereof.

[0031] Each of the plurality of wind boxes may have a cylindrical shape having an inner space, and include a one-side opening open in a direction toward the carriage and the other-side opening open in a direction toward a blower connected to the plurality of wind boxes,

[0032] in adjusting arrangement of the plurality of wind boxes such that the area of the suction path decreases from a lower side of the ignition furnace to the sintering completion position, a shutter configured to control communication between the one-side opening and the other-side opening may be provided, and the closer to the sintering completion position, the smaller an open area of the shutter.

[0033] When a portion from the ignition furnace to the sintering completion position is a sintering section, in the adjusting the arrangement of the plurality of wind boxes such that the area of the suction path decreases from the lower side of the ignition furnace to the sintering completion position, the arrangement of the plurality of wind boxes may be adjusted such that the closer to the sintering completion position in the entirety of the sintering section, the smaller the area of the suction path.

[0034] When the portion from the ignition furnace to the sintering completion position is the sintering section, and when inside the carriage in moving: the sintering section in which a sintering reaction of an upper layer part, including an upper surface of the raw material layer, is mainly performed is an early part; the sintering section in which a sintering reaction of a middle layer part, which is a layer under the upper layer part, is mainly performed

is a middle part; and the sintering section in which a sintering reaction of a lower layer part, which is a layer under the middle layer part, is mainly performed is a late part, a flow velocity of external air introduced into the carriage disposed corresponding to an upper side of the wind boxes disposed corresponding to the middle part may be lower than a flow velocity of external air introduced into the carriage disposed corresponding to an upper side of the wind boxes disposed corresponding to the early part, and a flow velocity of external air introduced into the carriage disposed corresponding to an upper side of the wind boxes disposed corresponding to the middle part may be lower than a flow velocity of external air introduced into the carriage disposed corresponding to an upper side of the wind boxes disposed corresponding to the late part.

[0035] When the portion from the ignition furnace to the sintering completion position is the sintering section, and when inside the carriage in moving: the sintering section in which a sintering reaction of an upper layer part, including an upper surface of the raw material layer, is mainly performed is an early part; the sintering section in which a sintering reaction of a middle layer part, which is a layer under the upper layer part, is mainly performed is a middle part; and the sintering section in which a sintering reaction of a lower layer part, which is a layer under the middle layer part, is mainly performed is a late part, the carriage may be configured, in a portion of section in the sintering section, such that the closer to the sintering completion position, the higher a flow velocity of introduced external air, and a flow velocity of external air introduced into the carriage moving to an upper side of the wind boxes disposed corresponding to the early part may be lower than flow velocities of external air introduced into the carriages moving to upper sides of the wind boxes disposed corresponding to the middle part and the late part.

[0036] The method for manufacturing sintered ore may include reflecting radiant heat source energy generated from the raw material layer inside the carriage in which flame is ignited by the ignition furnace and transferring the heat source energy to the raw material layer again.

[0037] In accordance with another exemplary embodiment, a method for manufacturing sintered ore includes: charging sintering raw materials into a carriage moving in a sintering process progress direction; adding a heat source into an upper layer part of a raw material layer in which the sintering raw materials are stacked when the raw material layer in which the sintering raw materials are stacked is divided, from an uppermost surface thereof, into the upper layer part, a middle layer part, and a lower layer part, and when the sintering raw materials are completely charged up to a target height; and igniting flame to an outer surface layer of the raw material layer inside the carriage in which the heat source is added into the upper layer part, and moving the carriage in the sintering process progress direction to manufacture sintered ore.

[0038] In the charging of the sintering raw materials into the carriage, the sintering raw materials may be charged, according to a movement direction of the carriage, in a direction from one side inside the carriage to the other side such that the sintering raw materials are completely charged up to a desired height in the direction from the one side to the other side, and in the adding the heat source into the upper layer of the raw material layer, the heat source may be sequentially added into the upper layer part in the direction from the one side to the other side of the carriage in which the sintering raw materials are completely charged.

[0039] In the adding the heat source, a lance extending in a direction corresponding to the movement direction of the carriage may be used to spray the heat source on an upstream side of the ignition furnace.

[0040] In adding the heat source, the heat source may be sprayed between a hopper configured to charge the sintering raw materials into the carriage and the ignition furnace.

[0041] While the carriage, in which the heat source is added into the upper layer part, passes under a pressurizing part located between the hopper and the ignition furnace, the raw material layer may be pressurized by the pressurizing part and then pass under the ignition furnace.

[0042] Before the charging of the sintering raw materials into the carriage, an air vent bar extending in a direction corresponding to the movement direction of the carriage may be arranged inside the carriage, and the air vent bar may be located at a position of at least one of the middle layer part or the lower layer part of the raw material layer.

[0043] In adding the heat source to the upper layer part, supplementary materials may be added together.

[0044] The heat source may include powder comprising a plurality of particles.

[0045] In adding the heat source, a gas may be added together so as to assist a movement of the heat source, and the gas may include at least any one of air or inert gas.

ADVANTAGEOUS EFFECTS

[0046] In accordance with exemplary embodiments, the flow velocity of air is adjusted through a plurality of wind boxes, and the additional heat source is supplied to an upper layer part by using a reflective member, so that generation of unreacted sintered ore in the upper layer part and generation of over-sintered sintered ore in a lower layer part may be suppressed or reduced. In addition, due to this, sintered ore having uniform quality in the entirety of the raw material layer may be obtained regardless of the upper layer part, the middle layer part, and the lower layer part.

[0047] In addition, in accordance with exemplary embodiments, the heat source is further added into the upper layer part of the raw material layer part, so that the temperature of the upper layer part is raised as much as the

added heat source, and thus, the degree and rate of temperature drop due to air introduced from the outside may be lowered. Thus, the temperature of the upper layer part is higher than those in typical arts, and the reaction time is longer than those in typical arts, so that a sintering reaction is performed in the upper layer part with sufficient heat and reaction time. Thus, the production rate of sintered ore may be improved in the upper layer part.

[0048] In addition, in adding the heat source to the upper layer part, fine-powder heat source is supplied by using a lance from a side under the uppermost surface of the raw material layer. Thus, fine-powder heat source or supplementary materials are supplied so as not to be exposed to the outside, so that generation of dust caused by the fine-powder heat source or the supplementary materials may be minimized or prevented. Thus, there is an effect in that an environmental contamination problem due to dust may be minimized or prevented.

BRIEF DESCRIPTION OF THE DRAWINGS

[0049]

FIG. 1 is a view illustrating main parts of a sintering apparatus in accordance with a first exemplary embodiment.

FIG. 2 is a view for describing a plurality of wind boxes in accordance with the first exemplary embodiment.

FIG. 3 is a view for describing a plurality of wind boxes in accordance with a modified example of the first exemplary embodiment.

FIG. 4 is a view for describing a raw material layer inside a carriage.

FIG. 5 is a graph illustrating a tendency of sintering reaction temperatures according to a flow velocity.

FIG. 6 is a view illustrating temperatures according to a reaction time in sintering apparatuses in accordance with a typical art and the first exemplary embodiment.

FIG. 7 is a view for describing an installation position of a reflective member in accordance with the first exemplary embodiment.

FIG. 8 is a view illustrating main parts of a sintering apparatus in accordance with a second exemplary embodiment.

FIG. 9 is a view for describing charging of sintering raw materials and heat sources in accordance with the second exemplary embodiment.

FIG. 10 is a view for describing installation of an air vent bar and a lance with respect to a carriage.

FIG. 11 is a view for describing the position of the tip of a lance from which a heat source is spayed.

FIG. 12 is a view illustrating a structure of a lance in accordance with the second exemplary embodiment.

FIG. 13 is a view for describing a sintering raw material charged in a carriage and a heat source addi-

tionally charged.

FIG. 14 is a graph illustrating strength of sintered ore.

FIG. 15 is a graph illustrating productivity according to heat source addition depths.

MODE FOR CARRYING OUT THE INVENTION

[0050] Hereinafter exemplary embodiments will be described in detail with reference to the accompanying drawings. The present invention may, however, be embodied in different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the present invention to those skilled in the art. In the drawings, like reference numerals refer to like elements throughout.

[0051] FIG. 1 is a view illustrating main parts of a sintering apparatus in accordance with a first exemplary embodiment. FIG. 2 is a view for illustrating a plurality of wind boxes in accordance with the first exemplary embodiment. FIG. 3 is a view for describing a plurality of wind boxes in accordance with a modified example of the first exemplary embodiment. FIG. 4 is a view for describing a raw material layer inside a carriage. FIG. 5 is a graph illustrating a tendency of sintering reaction temperatures according to a flow velocity. FIG. 6 is a view illustrating temperatures according to a reaction time in sintering apparatuses in accordance with a typical art and the first exemplary embodiment. FIG. 7 is a view for describing an installation position of a reflective member in accordance with the first exemplary embodiment.

[0052] Referring to FIG. 1, a sintering apparatus in accordance with a first exemplary embodiment includes: a hopper 13 in which sintering raw materials are stored; a plurality of carriages 30 in which the sintering raw materials are charged and which sequentially moves in the sintering process progress direction; a conveyor 40 installed in the process progress direction and configured to move the plurality of carriages 30; an ignition furnace installed on an upper side of the conveyor 40 at one side of the hopper 13 and configured to spray flame to the sintering raw materials charged in the carriage 30; a plurality of wind boxes 500 installed side by side on a path through which the plurality of carriages 30 are conveyed and configured to absorb or suction insides of the carriages 30; and a reflective member 300 located downstream from the ignition furnace 20 with respect to the movement direction of the carriages 30 or installed inside the ignition furnace 20; an ore discharge part configured to distribute sintered ore from the carriages 30; and a blower 70 connected to the plurality of wind boxes 500 and configured to allowing external air to be suctioned into the carriage 30.

[0053] In addition, the sintering apparatus includes a storage bins 11 in which various materials (that is, sintering raw materials) for manufacturing sintered ore are respectively stored; and a dust collector 60 configured

to collect dust in exhaust gas discharged through the wind boxes 50.

[0054] The sintering raw materials charged in the carriages 30 include: a hearth layer ore which is firstly charged in the carriages 30; and a material mixture charged on the hearth layer ore. The material mixture includes Fe-containing iron ore, a bonding material containing carbon (C) such as powder coke or anthracite, and a supplementary material containing lime stone or quicklime. In addition, the material mixture may further include a byproduct containing carbon or both an iron source and carbon, and a supplementary material for adjusting basicity.

[0055] The storage bins 11 store each of materials constituting the material mixture, that is, iron ore, bonding materials, byproducts, supplementary materials, basicity adjusting materials, etc., and the materials are moved to an assembly machine 12 and are mixed and assembled. Of course, a mixer for forming the material mixture and an assembly machine for mixing these may separately be provided.

[0056] The hopper 13 includes: a first hopper 14 for storing hearth layer ore; and a second hopper 15 for storing assembled objects in which the material mixture is assembled. Such first and second hoppers 14 and 15 are installed so as to be located upstream from the ignition furnace 20 with respect to the movement path of the carriage 30 over the carriage 30.

[0057] The second hopper 15 is located downstream from the first hopper 14 with respect to the movement path of the carriages 30, and charges the assembled material mixture, that is, the assembled objects, in the carriages 30. The second hopper 15 uniformly charges the sintering raw materials without particle-size segregation in the width direction of the carriages 30, and segregates the particle size and charges the sintering raw materials in the depth direction (that is, the vertical direction) of the carriage 30 while segregating the particle size such that the higher from the bottom toward the top of the carriage, the smaller the particle size.

[0058] The ignition furnace 20 is located downstream from the second hopper 15 and supplies flame on the outer surface layer of the raw material layer, formed by charging the sintering raw material in the carriages 30, and ignites the outer surface layer.

[0059] The carriages 30 are for providing a space in which the sintering raw material, that is, the hearth layer ore and the material mixture are charged to form a raw material layer, each have an inner space and a shape having an open upper side where the hopper 13 and the ignition furnace 20 are located. At least a portion of the air vent bar (not shown) may be detachably disposed into the raw material layer in such carriages 30.

[0060] Referring to FIG. 4, when the charging of the sintering raw materials in each carriage 30 is completed, the raw material layer may be divided into: a lower layer part L3 extending a certain height upward from a lower surface coming into contact with the bottom part inside

a carriage 30; a middle layer part L2 extending a certain height upward from the lower layer part L3; and an upper layer part L1 extending from the middle layer part L2 up to the uppermost surface. In a more specific example, the upper layer part L1 means a place to a place approximately 80-120 mm lower than the uppermost surface of the raw material layer, and favorably means a portion up to the depth of 100 mm, and the region under the upper layer part L1 is the middle layer part L2, and the region under the middle layer part L2 is the lower layer part L3.

[0061] Hereinafter referring to FIGS. 2 and 3, wind boxes in accordance with the first exemplary embodiment and a modified exemplary embodiment will be described.

[0062] Here, for convenience of description, a section in which a plurality of wind boxes are installed side by side is named as a "sintering section". In addition, since the carriages move from the ignition furnace 20 in the direction toward the ore discharge part, sintering reactions progress downward, and describing this in other words, sintering progresses in the order of the upper layer part L1, the middle layer part L2, and the lower layer part L3. Thus, hereinafter an initial section of the sintering section in which a sintering reaction of the upper layer part L1 of the raw material layer is mainly performed is named as an early part, the sintering section in which the sintering reaction of the middle layer part L2 is mainly performed is named as a middle part, and the sintering section in which the sintering reaction of the lower layer part L3 is mainly performed is named as a late part. That is, the sintering section is divided into the early part, the middle part, and the late part from the ignition furnace 20 in the direction toward the ore discharge part.

[0063] The plurality of wind boxes 500 suction external air into the carriages 30 and move an ignited flame or the heat due to the flame to a lower side. Such a plurality of wind boxes 500 are arranged side by side between the ignition furnace 20 and the ore discharge part.

[0064] The wind boxes 500 each have a cylindrical shape in which an upper side corresponding to a lower portion of the carriage 30 and for example, a lower side, where the blower 60 is located, are open and which has an inner space. A plurality of wind boxes 500 are provided and disposed so as to be continuously arranged side by side in the movement path of the carriages 30 from at least a portion corresponding to the ignition furnace 20 to the ore discharge part. In addition, pipes are respectively connected to the plurality of wind boxes 500, and the pipes are connected to the dust collector 60 and the blower 70.

[0065] As described above, the wind boxes 500 each have a cylindrical shape in which a direction facing the carriages 30 and a direction connected to the pipes are open. Hereinafter in each of the wind boxes 500, the opening in the direction facing the carriages 30 is named as a one-side opening, and the opening in the direction connected to the pipes is named as the other opening. In a more specific exemplary embodiment, the one-side opening of each wind box 500 may be an upper opening,

and the other-side opening may be a lower opening. Here, the one-side opening (that is, the upper opening) of each wind box 500 serves as a suction path.

[0066] In the first exemplary embodiment, in installing, side by side, the plurality of wind boxes 500 from the position of the ignition furnace, the wind boxes are configured such that the closer to the ore discharge part, or the farther from the ignition furnace 20 in the sintering process progress direction, the smaller the area of the suction path of the wind boxes 500. That is, the plurality of wind boxes are installed side by side such that the closer to a sintering completion position, the smaller the inner diameter of the one-side opening. Here, the other-side openings (lower openings) of the wind boxes from which gas and dust are discharged are configured to have the same inner diameter.

[0067] In the first exemplary embodiment, as illustrated in FIGS. 1 and 2, the area of the suction path, that is, the one-side openings of the plurality of wind boxes disposed in the sintering section are all made different from each other such that the closer to the sintering completion position, the smaller the areas of the one-side openings. Accordingly, as illustrated in FIG. 2, the closer to the sintering completion position, the smaller the intervals between the plurality of carriages. In addition, the closer to the sintering completion position, the larger the inclination of the outer peripheral surface of each wind box 500 in the direction from the one-side opening toward the other-side opening.

[0068] As such, in the first exemplary embodiment, in installing the plurality of wind boxes 500 side by side from the position of the ignition furnace 20 to the ore discharge part, the wind boxes are configured such that the closer to the ore discharge part from the ignition furnace 20, the smaller the inner diameters of the one-side openings. That is, the wind boxes 500 are configured such that the closer to the ore discharge part, or the further adjacent to the discharge part, the smaller the inner diameters or the one-side openings of the wind boxes. Describing this in other words, in installing the plurality of wind boxes 500 side by side, the wind boxes are configured such that the closer to the ignition furnace 20 from the ore discharge part, the larger the inner diameters W1 of the one-side openings. That is, the wind boxes 500 are installed such that the closer to the ignition furnace 20 from the ore discharge part, or the more adjacent to the ignition furnace 20, the larger the inner diameters W1 of the one-side openings of the wind boxes. At this point, all the inner diameters W2 of the other openings of the respective wind boxes 500 are the same.

[0069] When the plurality of wind boxes 500 are configured and disposed as such, it is possible to adjust the flow velocity of external air introduced into the carriages. That is, when external air is introduced into each of the plurality of carriages, the closer to the ore discharge part, the greater the inflow velocity of external air. In other words, the flow velocity of external air introduced into the carriages decreases in the direction from the ore dis-

charge part toward the ignition furnace 20.

[0070] In the first exemplary embodiment described above, the inner diameter W1 of the upper opening of each wind box 500 is adjusted, but the area of the suction path may be adjusted inside the wind boxes 500.

[0071] That is, in all the plurality of wind boxes 500 in accordance with a modified exemplary embodiment, the inner diameters of the upper openings and the lower openings are the same. However, inside each of the plurality of wind boxes 500, the area W3 of an opening, through which the upper opening and the lower opening communicates with each other, is adjusted such that the closer to the ore discharge part, the narrower the area W3. At this point, the suction path in wind box in accordance with the second exemplary embodiment serves as the open area of a shutter.

[0072] To this end, a shutter 800 for controlling the communication between the upper opening and the lower opening is installed inside each of the plurality of wind boxes 500, and the opening degree of the shutter 800 inside each wind box 500 is adjusted, so that the shutter may be adjusted such that the closer to the ore discharge part, the narrower the open area W3.

[0073] In case of such a modified exemplary embodiment, intervals between the plurality of wind boxes are the same, and the inclinations of the outer peripheral surfaces facing from the one-side openings toward the lower openings are also the same. In addition, in the modified exemplary embodiment, the number of wind boxes may be smaller than that in the first exemplary embodiment.

[0074] In the above-mentioned exemplary embodiments, the area of the suction path of each wind box 500 was configured such that the closer to the ore discharge part from the ignition furnace 20, or the farther from the ignition furnace in the sintering progress direction, the smaller the area of the suction path. However, the embodiment of the inventive concept is not limited thereto. The wind boxes may be configured such that the closer to the sintering completion position, the smaller the area of the suction path, and may also be configured such that a portion of the wind boxes have the same suction path.

[0075] That is, the area W1 of the suction path of each of the wind boxes 500 disposed corresponding to the middle part is made smaller than the area W1 of the suction path of each of the wind boxes 500 disposed corresponding to the early part, and the area W1 of the suction path of each of the wind boxes 500 disposed corresponding to the late part is made smaller than the area W1 of the suction path of each of the wind boxes 500 disposed corresponding to the middle part.

[0076] In addition, the embodiment of inventive concept is not limited thereto, but the area W1 of the suction path may also be made small in only a portion of the sintering section. For example, only in the section of the early part, the plurality of wind boxes 500 may be configured such that the closer to the sintering completion position from the ignition furnace 20, the smaller the area W1 of the suction path, and the plurality of wind boxes

500 positioned corresponding to the middle part and the late part may be configured such that the areas W1 of the suction paths are the same and are smaller than those of the suction paths of the early part.

[0077] In exemplary embodiments described above, the flow velocity of external air introduced into the carriages gradually increases from the early part toward the middle part and the late part by adjusting the area of the openings of the plurality of wind boxes 500. That is, in the early part in which the reaction of the upper layer part L1 is mainly performed, the flow velocity of introduced external air is lower than that in the middle part, and in the middle part in which the reaction of the middle part L2 is mainly performed, the flow velocity of external air is lower than that in the late part.

[0078] Thus, compared to typical arts in which the inner diameters W1 of the one-side opening of each of the plurality of wind boxes 500 are made the same, in case of the exemplary embodiment, a time period for which heat stays in the upper layer part L1 is increased, and thus, the reaction retaining time at a high temperature for a sintering reaction increases. Accordingly, since the sintering reaction is performed in the upper layer part L1 with sufficient heat and reaction time, the production rate of sintered ore is improved in the upper layer part L1, and the production rate of the entirety of the raw material layer is improved.

[0079] In addition, the flow velocity of introduced air is increased in the late part of the sintering section, so that the time period, for which heat generated by the combustion of flames and coupling agents may reduce stay time in the late part, may be reduced compared to that in a typical art, and thus, the problem of over-sintering in the lower layer part L3 may be suppressed or prevented.

[0080] Referring to FIG. 5, it may be understood that as the flow velocity of air increases, the average reaction speed decreases. It is recognized that when increasing the flow velocity, since the heat generated by the combustion of flames and bonding materials quickly move downward, temperature is not raised to a certain temperature or higher, and a cooling effect is rather generated by the increased flow velocity and thus, the reaction temperature decreases.

[0081] Meanwhile, as described above, in a typical art, there was a problem in that the lower layer part L3 was over-sintered due to an excessive temperature rise caused by the heat due to the combustion of flames and bonding materials.

[0082] However, as in the exemplary embodiment, the flow velocity of air in the late part is increased compared to those in the early part and the middle part, so that an excessive temperature rise in the lower layer part L3 may be suppressed, and thus, an appropriate reaction temperature at which over-sintering does not occur may be maintained. Accordingly, the generation of over-sintered sintered ore may be suppressed or prevented in the lower layer part L3.

[0083] As such, in the exemplary embodiment, when

the plurality of wind boxes 500 are installed side by side from the ignition furnace 20 to the ore discharge part, the closer to the ore discharge part, the smaller the inner diameter W1 of the one-side opening, or the closer to the ignition furnace, the larger the inner diameter W1 of the one-side opening.

[0084] Accordingly, compared to the typical art, the sintering reaction time in the upper layer part L1 increases and the sintering reaction temperature and the sintering reaction time decrease in the lower layer part L3. Thus, the generation of unreacted sintered ore in the upper layer part L1 and the generation of over-sintered sintered ore in the lower layer part L3 may be suppressed or prevented. In addition, due to this, sintered ore having uniform quality in the entirety of the raw material layer may be obtained regardless of the upper layer part L1, the middle layer part L2, and the lower layer part L3.

[0085] The reflective member 300 is installed downstream from the ignition furnace 20 or inside the ignition furnace, and transfers the radiant energy generated from the upper layer part L1 again to the upper layer part. That is, the reflective member 300 uses the radiant energy generated from the upper layer part L1 and additionally supplies the upper layer part L1 with a heat source. To this end, the reflective member 300 may be formed of a material which may reflect the radiant energy to supply the upper layer part L1 with the radiant energy.

[0086] In addition, when the reflective member 300 is installed downstream from the ignition furnace 20, the reflective member 300 is configured to have a shape having an opening so that external air may be introduced into the carriage located under the reflective member 300. The opening may have a mesh shape in which one or multiple openings are formed to be spaced apart from each other.

[0087] The reflective member 300 is formed to extend corresponding to the movement direction of the carriages, and when the reflective member 300 is installed downstream from the ignition furnace 20, one end of the reflective member 300 is located downstream from the ignition furnace 20 and the reflective member extends from the one end in the movement direction of the carriages 30, and the extension end is the other end.

[0088] As the carriages 30 move in the sintering process progress direction, the position (hereinafter, a sintering position) at which a sintering reaction occurs move gradually downward. This is because while the carriage 30, in which flame is ignited, moves in the sintering process progress direction, the flame or heat is moved downward by suction force due to wind boxes 500.

[0089] The other end of the reflective member 300 extends such that the sintering position is located at any one position separated approximately 80-120 mm downward from the upper surface of the raw material layer.

[0090] For example, the position separated 80 mm downward from the upper surface of the raw material layer is defined as h1, and the position separated 120 mm is defined as h2. In addition, when the sintering po-

sition is h1, the position within the sintering section is X1, and when the sintering position is h2, the position within the sintering section is X2. At this point, the reflective member 300 extends so that the other end thereof is positioned at position X1 in a minimum case, and is positioned at position X2 in a maximum case (see FIG. 7). In other words, the reflective member 300 extends up to any one position among X1 to X2 within the sintering section in the downstream side from the ignition furnace 20. This is to supply the upper part layer L1 of the carriage in moving with an additional heat source by using the reflective member 300.

[0091] The temperature of the upper layer part L1 is raised by the supply of the heat source using the reflective member. Accordingly, a sintering reaction occurs in the upper layer part L1 with sufficient heat and reaction time, and thus, the production rate of sintered ore may be improved in the upper layer part L1.

[0092] Hereinafter the operation of the sintering apparatus in accordance with the first exemplary embodiment will be described with reference to FIGS. 1 to 4. Here, an example will be described in which the plurality of carriages 30 move in the process progress direction or from left to right, and the reflective member 300 is installed downstream from the ignition furnace 20.

[0093] First, sintering raw materials for manufacturing sintered ore, that is, hearth layer ore and a material mixture are prepared. Here, the hearth layer ore is small sintered ore having particle sizes of approximately 2-3 mm among the manufactured sintered ore, is not used for a blast furnace operation, and is used as hearth layer ore during the material processing for a next charge. The hearth layer ore functions to make the gas flow inside the carriages 30 smooth in a material processing process, and to protect the carriages formed of an iron material when iron ore is melted. The material mixture includes Fe-containing iron ore, bonding materials containing carbon (C) such as powder coke and anthracite, and a supplementary material containing lime stone or quicklime. The prepared hearth layer ore is transferred to and stored in the first hopper 14, and the material mixture is stored in the corresponding storage bin 11, is assembled in a shape of assembled object in the assembly machine 12, and is then charged and stored in the second hopper 15.

[0094] As described above, when the hearth layer ore and the assembled objects are prepared, the hearth layer ore and the assembled objects are sequentially charged into the carriages 30 while each of the carriages 30 passes under the first hopper 14 and the second hopper 15.

[0095] Describing the charging into one carriage 30 among the plurality of carriages 30, the one carriage 30 passes under the first hopper 14, so that the hearth layer ore is charged therein, and the carriage 30 charged with the hearth layer ore passes under the second hopper 15, so that the assembled objects are charged therein. At this point, since the carriage 30 moves from left to right, the sintering raw materials are completely charged

up to a target height from left to right inside the carriage 30.

[0096] In addition, the completely charged carriage 30 moves so as to pass under the ignition furnace 20, and at this point, flame is ignited from the ignition furnace 20, so that the upper surface (or outer surface layer part) of the raw material layer is ignited. The flame-ignited carriage 30 moves in the direction in which the plurality of wind boxes 50 are arranged or in the direction toward the ore discharge part, and external air is suctioned and supplied into the carriage 30 by means of the suction force of the wind boxed 50. Accordingly, the flame gradually moves downward by the movement of the carriage 30, and thus, the sintering reaction progresses downward from the upper side of the raw material layer and sintered ore is thereby manufactured.

[0097] Subsequently, when the carriage 30 reaches the most downstream-side wind box 50, that is, the ore discharge part and the flame reaches the bottom of the carriage or the lowermost layer of the raw material layer, the flame is extinguished and the sintering is completed, the carriage 30 reaching the end of the wind boxes 50 discharges the manufactured sintered ore, and the discharged sintered ore is cooled in a cooler.

[0098] As such, while each of the plurality of carriages 30 moves from the upper side of the wind box 500 under the ignition furnace 20 in the direction toward the ore discharge part, the position of a combustion band inside each carriage 30 moves from the upper layer part L1 to the lower layer part L3. Here, according to the sintering apparatus of exemplary embodiments, the plurality of wind boxes 500 are installed or configured such that the closer to the ore discharge part, the smaller the open area, or the closer to the ignition furnace 20, the larger the open area. That is, as in the first exemplary embodiment illustrated in FIG. 2, the wind boxes 500 are arranged which are configured such that the closer to the ore discharge part, the smaller the area W1 of the upper opening, or as in the modified exemplary embodiment illustrated in FIG. 3, the open degree of a shutter 800 installed inside each of the plurality of wind boxes 500 is adjusted such that the closer to the ore discharge part, the smaller the open area W3 of the shutter 800.

[0099] Using such arrangement structure of the plurality of wind boxes 500, the flow velocity of external air introduced into the carriages 30 increases such that the farther from the early part toward the middle and the late part in the sintering section, the higher the flow velocity.

[0100] Thus, compared to a typical art, the time period for which heat stays in the upper layer part L1 is increased, and the reaction-maintaining time at a high temperature for the sintering reaction is increased. Accordingly, since the sintering reaction is performed in the upper layer part L1 with sufficient heat and reaction time, the production rate of sintered ore is improved in the upper layer part L1, and the production rate of the entirety of the raw material layer is improved.

[0101] In addition, the flow velocity of introduced air is

increased in the late part of the sintering section, so that the time period, for which heat generated by the combustion of flames and bonding materials stays in the later part, may be reduced compared to that in a typical art. Thus, the problem of over-sintering in the lower layer part L3 may be suppressed or prevented.

[0102] In addition, the carriage 30, in which flame is ignited by the ignition furnace 20, passes under the reflective member 300 installed downstream from the ignition furnace 20. At this point, the radiant energy generated by the flame ignited to the upper layer part is reflected while the carriage passes under the reflective member, and is transferred to the upper layer part again, so that an additional heat source is supplied to the upper layer part.

[0103] Accordingly, the temperature of the upper layer part L1 is raised, the sintering reaction is performed in the upper layer part L1 with sufficient heat and reaction time, so that the production rate of sintered ore maybe improved in the upper layer part L1.

[0104] As such, in the exemplary embodiment, the flow velocity of air is adjusted through the plurality of wind boxes 500, and the additional heat source is supplied to the upper layer part by using the reflective member 300, so that generation of unreacted sintered ore in the upper layer part and generation of over-sintered sintered ore in the lower layer part may be suppressed or reduced. In addition, due to this, sintered ore having uniform quality in the entirety of the raw material layer may be obtained regardless of the upper layer part L1, the middle layer part L2, and the lower layer part L3.

[0105] Hereinafter, a sintering apparatus in accordance with a second exemplary embodiment will be described with reference to FIGS. 8 to 13. Here, descriptions duplicated with those of the first exemplary embodiment will be omitted or simply described.

[0106] FIG. 8 is a view illustrating main parts of a sintering apparatus in accordance with the second exemplary embodiment. FIG. 9 is a view for describing charging of sintering raw materials and heat sources in accordance with the second exemplary embodiment. FIG. 10 is a view for describing installation of an air vent bar and a lance with respect to a carriage. FIG. 11 is a view for describing the position of the tip of the lance from which a heat source is sprayed. FIG. 12 is a view illustrating the structure of the lance in accordance with the second exemplary embodiment. FIG. 13 is a view for describing a sintering raw material charged in a carriage and a heat source additionally charged.

[0107] Referring to FIG. 8, a sintering apparatus in accordance with the second exemplary embodiment includes: a hopper 13 in which sintering raw materials are stored; a plurality of carriages 30 in which the sintering raw materials are charged and which sequentially moves in the sintering process progress direction; a conveyor 40 installed to extend in the process progress direction and configured to convey the plurality of carriages 30; an ignition furnace 20 installed over the conveyor at one

side of the hopper 13 and configured to spray flame to the sintering raw materials charged in the carriage; a plurality of wind boxes 50 installed side by side under the conveyor 40 on a path, along which the plurality of carriages are conveyed, and configured to suction or absorb the inside of the carriages; a heat source supply part 120 located downstream from the ignition furnace with respect to the movement direction of the plurality of carriages 30 and including a lance 110 configured to supply a heat source to the inside of an upper layer part in a sintering raw material layer (hereinafter, referred to as raw material layer) charged in the carriages; an air vent bar 200 located upstream from the ignition furnace 20 with respect to the movement direction of the carriages 30 so as to be inserted into or detached out of the carriage 30 and configured to form an air vent gap for venting air in a lower region of an upper layer part L1 of the raw material layer charged in the carriage 30; and a pressurizing part 300 located between the hopper 13 and the ignition furnace 20 and configured to pressurize and firm an upper portion of the raw material layer inside the carriage 30.

[0108] In addition, the sintering apparatus includes: storage bins 11 in which various materials (that is, the sintering raw materials) for manufacturing sintered ore are respectively stored; an assembly machine 12 configured to mix the plurality of sintering raw materials, add moisture, and assemble the materials into a pseudo particles; an ore discharge part configured to discharge sintered ore from the carriages 100; a blower 70 connected to the plurality of wind boxes 50 and configured to allow external air to be suctioned into the carriages; and a dust collector 60 configured to collect dust in exhaust gas discharged through the wind boxes 50.

[0109] Referring to FIG. 13, when the sintering raw materials are completely charged in the carriages 30, the raw material layer may be divided into: a lower layer part L3 extending a certain height upward from a lower surface coming into contact with the bottom part inside a carriage 30; a middle layer part L2 extending a certain height upward from the lower layer part L3; and an upper layer part L1 extending from the middle layer part L2 up to the uppermost surface. In a more specific example, the upper layer part L1 means a portion from the uppermost surface of the raw material layer up to a depth of approximately 100 mm, and the region under the upper layer part L1 is the middle layer part L2, and the region under the middle layer L2 is the lower layer part L3.

[0110] The air vent bar 200 is installed under the second hopper 15 for charging the material mixture so as to be inserted into or detached from the carriage 30 which passes under the second hopper 15, and ensures the permeability of the raw material layer inside the carriage 30. The air vent bar 200 has a bar shape extending in the movement direction of the carriages 30, is provided in plurality as illustrated in FIG. 10, and is installed so as to be arranged side by side in the width direction and the height direction of the carriages 30 which cross the move-

ment direction of the carriages 30. That is, the plurality of air vent bars 200 are arranged side by side in the width direction of the carriages 30 to be spaced apart from each other, and the plurality of air vent bars 200 arranged side by side in the width direction may be installed in multiple stages or in a plurality of layers.

[0111] As described above, the upper layer part L1 means the uppermost surface of the raw material layer, and a lower portion from the uppermost surface of the raw material layer up to a predetermined distance of approximately 100 mm. Here, the "inside of the upper layer part L1", to which a heat source is added or supplied, means a region excluding the uppermost surface of the raw material layer in the upper layer part L1, that is, excluding the upper most surface of the upper layer part L1.

[0112] The heat source supplied into the upper layer part L1 of the raw material layer is a carbon (C)-containing material, for example, a solid phase material of at least any one of anthracite or powder coke, and may favorably be fine powder having small particle sizes.

[0113] The heat source supply part 120 in accordance with the second exemplary embodiment supplies, to the upper layer part L1 of the raw material layer, not only the heat source, but also supplementary materials, such as materials containing quicklime and materials containing quicklime, in addition to supplementary materials contained in the material mixture.

[0114] In addition, in order to smoothly supply the heat source or the supplementary materials, a carrier gas is supplied together by means of the lance 110. Accordingly, material storage parts 120, 130 and 140 in accordance with the second exemplary embodiment includes a heat source storage part 130, a gas storage part 120, and a supplementary material storage part 140, which are respectively connected to the lance 110 through separate pipes.

[0115] The lance 110 supplies the upper layer part L1 of the raw material layer with at least any one of the heat source or the supplementary materials. The lance 110 is formed to extend in the movement direction of the carriage 30, and the heat source or the supplementary materials move inside the lance and are sprayed or discharged to the outside through an open tip.

[0116] The lance 110 in accordance with the second exemplary embodiment simultaneously supplies the gas in order to facilitate the supply of the heat source or the supplementary materials. To this end, as illustrated in FIG. 12, the lance 110 includes an inner pipe 111 which is the movement path for the heat source or the supplementary materials; and an outer pipe 112 in which the inner pipe 111 is insertedly installed and which is the movement path for a gas, for example, air or an inert gas, which assists the movement of the heat source or the supplementary materials. That is, the lance 110 has a dual-pipe shape in which the inner pipe 111 is inserted into the outer pipe 112, the heat source or supplementary materials are sprayed from the tip of the inner pipe 111, and the gas is sprayed from the tip of the outer pipe 112.

[0117] In the above, it has been described that the lance 110 has the dual pipe structure including the inner pipe 111 which is the movement path for the heat source or the supplementary material and the outer pipe 112 which is the movement path for the gas. However, the embodiment of inventive concept is not limited thereto, and the lance 110 may not have a dual-pipe shape but a single-pipe shape. That is, the lance may be composed of one pipe, and may be configured to spray the heat source or supplementary materials and gas together through the pipe.

[0118] In addition, a plurality of lances 110 are provided and are arranged side by side so as to be spaced apart from each other, as illustrated in FIG. 10, in a direction crossing or perpendicular to the movement direction of the carriages. Here, the plurality of lances 110 may be disposed to be spaced apart from each other at regular intervals or at irregular intervals.

[0119] The lances 110 are installed so as to correspond to the upper layer part L1 at a position in the height direction of the raw material layer. That is, when the sintering raw materials are charged 100% up to a target charge height (completely charged) and when a lower portion from the uppermost surface of the raw material layer (a layer in which the sintering raw materials are stacked) up to the depth of approximately 100 mm is the upper layer part L1, the lances 110 are installed at positions within a range from the lower side of the uppermost surface of the raw material layer to the position separated approximately 100 mm downward from the uppermost surface.

[0120] In addition, the heat source should be sprayed so as to be located inside the upper layer part L1 in a state in which the sintering raw materials are charged approximately 100% up to the height to charge. In addition, the carriages 30 move in the sintering process progress direction, for example, in FIG. 8, from left to right, and the materials are stacked from right to left when viewed from the left-to-right direction of the carriages 30. That is the materials are stacked from right to left in the carriage 30 so as to be gradually close to 100%. In other words, charging is sequentially completed from right to left in the carriages 30. Accordingly, as illustrated in FIG. 11, the tip of each of the lances 110, from which the heat source is sprayed, is installed in the carriage moving under the second hopper 15 so as to be located at a position at which the raw material layer is stacked 100% or at which the charging is completed, or at a position downstream a predetermined distance from the charge completion position and upstream from the ignition furnace 20. More favorably, the lances 110 are installed so as to be located between the tips of the air vent bars 200 and the ignition furnace 20 or between the tips of air vent bars 200 and the pressurizing part 300.

[0121] Thus, as illustrated in FIG. 11, the heat source is supplied to the upper layer part L1 at the position at which charging is completed, and is not supplied at positions in which charging is not completed.

[0122] As such, in the exemplary embodiment, the heat source is additionally added inside the upper layer part L1 of the raw material layer, so that the material mixture of the upper layer part L1 reacts at a sufficient reaction temperature. Thus, the reactivity of the upper layer part L1 is improved and generation of unreacted sintered ore in the upper layer part L1 may be minimized or prevented.

[0123] In addition, the tip of each of the lances 110 is located between the tips of the air vent bars 200 and the ignition furnace 20, or between the tips of the air vent bars 200 and the pressurizing part 300, so that the charged density of the upper layer part L1 in which the heat source or the supplementary materials are added is improved. Thus, the time period for which a high-temperature heat stays in the upper layer part L1 is increased and there is an effect of further improving the reactivity of the upper layer part L1.

[0124] Fine powder heat source or supplementary materials are blown or added into the upper layer part by means of the lances 110. Fine powder heat source or supplementary materials are not supplied on to the uppermost surface of the raw material layer, but are added to a portion downward from the uppermost surface in the upper layer part L1. That is, fine powder heat source or supplementary materials are added so as not to be exposed to the outside. Thus, generation of dust due to the further added fine powder heat source or supplementary materials may be minimized or prevented, and the environmental contamination problem due to dust may be minimized or prevented.

[0125] In addition, it is unnecessary to add moisture to the further added fine powder heat source or supplementary materials so as to prevent generation of dust, so that processes are simplified and the moisture-caused degradation in quality of sintered ore may be prevented.

[0126] Meanwhile, in typical arts, in order to further add a heat source or supplementary materials, a method of adding to the uppermost surface of the raw material layer was adopted, but in case of such a method, there was a problem in that dust is generated from fine powder heat source or supplementary materials. In order to solve this, moisture was added to the fine powder heat source or supplementary materials, but the moisture serves as a factor which causes degradation of quality of sintered ore.

[0127] Hereinafter referring to FIGS. 14 and 15, changes in the productivity and strength according to depths of heat source addition will be described.

[0128] FIG. 14 is a graph illustrating strength of sintered ore and FIG. 15 is a graph illustrating productivity according to depths of heat source addition.

[0129] For experiments, sintered ore is prepared under the same condition. At this point, a material mixture contains approximately 3.8 wt% of bonding material with respect to the entirety of the material mixture..

[0130] In addition, in manufacturing sintered ore by charging, into a carriage, assembled objects manufactured by using hearth layer ore and the material mixture,

a heat source was not added (heat source addition depth = 0 mm) to the upper layer part of a raw material layer in a first experimental example (first comparative example), and a heat source was added from the uppermost surface of a raw material layer up to a position separated downward approximately 150 mm in a fourth experimental example (second comparative example). In addition, in second and third experimental examples (first and second examples), a heat source was added from the uppermost surface of a raw material layer up to a position separated downward approximately 50 mm, and added from the uppermost surface of a raw material layer up to a position separated downward approximately 100 mm, respectively.

[0131] Referring to FIG. 14, it may be found that the greater the heat source addition depth, the lower the strength (tumbler index) of sintered ore.

[0132] Referring to FIG. 15, it may be found that compared to the first experimental example (first comparative example) in which a heat source was not added, the productivity was improved in the second and third experimental examples (first and second examples) in which a heat source was added. However, it may be found that in the fourth experimental example (second comparative example) in which a heat source was added from the uppermost surface of a raw material layer up to a position separated downward approximately 150 mm exceeding 100 mm, the productivity rather decreased compared to the first comparative example in which no heat source was added. This is because when a heat source was added up to a position exceeding the 100 mm position, the heat source was added up to the middle layer part exceeding the upper layer part, too great thickness, that is, too much amount of heat source was added, so that the amount of bonding materials reacting with the heat source in the middle layer part is increased and the remaining bonding materials to react later in the lower layer part was thereby decreased, and thus, a sufficient reaction temperature for performing sintering reaction is not maintained in the lower layer part.

[0133] Thus, through experimental results of FIGS. 14 and 15, it may be understood found that a heat source is added to a lower side of the uppermost surface of the raw material layer, and may favorably be added to a position maximally up to approximately 100 mm downward from directly below the outer surface layer of the raw material layer. In other words, the maximum position at which a heat source is added is favorably configured not to be a position exceeding approximately 100 mm downward from the outer surface layer of the raw material layer.

[0134] Hereinafter the operation of the sintering apparatus in accordance with the second exemplary embodiment will be described with reference to FIGS. 8 to 13. Here, an example will be described in which a plurality of carriages move in the process progress direction or from left to right.

[0135] First, sintering raw materials for manufacturing

sintered ore, that is, hearth layer ore and a material mixture are prepared. Here, the hearth layer ore is small sintered ore having particle sizes of approximately 2-3 mm among the already manufactured sintered ore, is not used for a blast furnace operation, and is used as hearth layer ore during the material processing for a next charge. The hearth layer ore functions to make the gas flow inside the carriages 30 smooth in a material processing process, and to protect the carriages formed of an iron material when iron ore is melted. The material mixture includes Fe-containing iron ore, bonding materials containing carbon (C) such as powder coke or anthracite, and supplementary materials containing lime stone or quicklime. The prepared hearth layer ore is transferred to and stored in the first hopper 14, and the material mixture is stored in the corresponding storage bin 11, is assembled in an assembly shape in the assembly machine 12, and is then charged and stored in the second hopper 15.

[0136] As described above, when the hearth layer ore and the assembled objects are prepared, each of the carriages 30 is sequentially moved from a portion under the first hopper 14 to a portion under the ignition furnace 20, and the hearth layer ore, the assembled objects, and the heat source are sequentially charged into each carriage 30.

[0137] Describing the charge into one carriage 30 among the plurality of carriages 30, the one carriage 30 passes under the first hopper 14, so that the hearth layer ore is charged therein, and the carriage 30 charged with the hearth layer ore passes under the second hopper 15, so that the assembled objects are charged therein. At this point, since the carriage 30 moves from left to right, the sintering raw materials are completely charged up to a target height from right to left inside the carriage 30.

[0138] At this point, in the carriage 30 passing under the second hopper 15, the lance 110 is located at the height corresponding to the upper layer part in a region under the uppermost surface of the raw material layer, and the tip of the lance 110 is located a predetermined distance downstream from the position at which charging is completed or at the charging completion position. Therefore, a heat source is further supplied or added into the upper layer part L1 of the charge-completed raw material layer.

[0139] Of course, not only the heat source but also supplementary materials, for example, a CaO-containing material may further be added, if necessary.

[0140] The carriage 30 to which the heat source is further added to the upper layer part L1 is pressurized by the operation of the pressurizing part 300 while passing under the pressurizing part 300, and thus, the charged density of the upper layer part L1 to which the heat source is added is improved. Subsequently, while the carriage, having passed through the pressurizing part 300, passes under the ignition furnace 20, the flame ignited by the ignition furnace 20 ignites the outer surface layer (uppermost surface) of the raw material layer. In addition, the

flame-ignited carriage 30 moves in the direction in which the plurality of wind boxes 50 are arranged side by side or in the direction toward the ore discharge part, and external air is suctioned and supplied into the carriage 30 by means of the suction force of the wind boxed 50. Accordingly, the flame gradually moves downward by the movement of the carriage 30, and thus, the sintering reaction progresses downward from the upper side of the raw material layer and sintered ore is thereby manufactured. Subsequently, when the carriage 30 reaches the position of the most downstream stage wind box 50, that is, the ore discharge part, and the flame reaches the bottom of the carriage or the lowermost layer of the raw material layer, the flame is extinguished and the sintering is completed, the carriage 30 reaching the end of the wind boxes 50 discharges the manufactured sintered ore, and the discharged sintered ore is cooled in a cooler.

[0141] The sintered ore manufactured as such is used as a material for steel making process in a blast furnace.

[0142] As described above, the flame-ignited carriage 30 moves in the extension direction of the wind boxes 50, so that the sintering reaction progresses downward from the upper side of the raw material layer, that is, in the direction from the upper layer part L1 to the lower layer part L3.

[0143] However, in typical arts, the flame-ignited carriage passes through the wind boxes 50, flame and heat moves downward, and thus, there is a problem in that a sintered layer of the raw material layer is rapidly cooled by the room-temperature air introduced from the outside after the ignition of the flame and the temperature of the sintered layer is lowered. Accordingly, the upper layer part L1 lacks in heat amount and reaction time for a sintering reaction, so that unreacted sintering ore (that is, sintered ore lacking in reaction of iron ore) is generated in the upper layer part L1. Therefore, the production rate of the sintered ore is reduced (or the recovery rate of the sintered ore increases).

[0144] However, in the exemplary embodiments a heat source is further added into the upper layer part L1 of the raw material layer, so that the temperature of the upper layer part L1 is raised as much as the added heat source, and the degree of temperature drop and the temperature drop rate caused by air introduced from the outside may be lowered. Thus, the temperature of the upper layer part L1 is higher and the reaction time is longer than those in typical arts, and sintering reaction is performed in the upper layer part L1 with sufficient heat and reaction time. Therefore, the production rate of sintered ore in the upper layer part L1 may be improved.

[0145] In addition, in adding the heat source to the upper layer part L1, fine powder heat source is supplied from a lower side of the uppermost surface of the raw material layer to the upper layer part L1 by using a lance 110 in accordance with the second exemplary embodiment. Since fine-powder heat source or supplementary materials are supplied so as not to be exposed to the outside, there is an effect in that generation of dust

caused by the fine-powder heat source or the supplementary materials may be minimized or prevented, and environmental contamination problem caused thereby may be minimized or prevented.

INDUSTRIAL APPLICABILITY

[0146] In accordance with a sintering apparatus and a method for manufacturing sintered ore using the same, generation of unreacted sintered ore in an upper layer part and generation of over-sintered sintered ore in a lower layer part may be suppressed or reduced. Due to this, sintered ore having uniform quality in the entirety of the raw material layer may be obtained regardless of an upper layer part, a middle layer part, and a lower layer part. In addition, the temperature at the upper layer part is higher than those in typical arts, and the reaction time is longer than those in typical arts, so that a sintering reaction is performed in the upper layer part with sufficient heat and reaction time. Thus, the production rate of sintered ore may be improved in the upper layer part.

Claims

1. A sintering apparatus comprising:

a carriage which is configured to be able to charge a sintering raw material and which is movable in a sintering process progress direction;
an ignition furnace installed on a path along which the carriage moves in the sintering process progress direction so as to spray flame to a raw material layer charged in the carriage; and
a plurality of wind boxes installed side by side such that the closer to a sintering completion position from the ignition furnace, the smaller an area of a suction path of each of the wind boxes.

2. The sintering apparatus of claim 1, wherein each of the plurality of wind boxes has a cylindrical shape having an inner space, and comprises:

a one-side opening open in a direction toward the carriage; and
the other-side opening open in a direction toward a blower connected to the plurality of wind boxes, and

the plurality of wind boxes are installed side by side such that the closer to the sintering completion position from the ignition furnace, the smaller the area of the suction path, wherein the wind boxes are installed such that the closer to the sintering completion position, the smaller inner diameters of the one-side openings thereof.

3. The sintering apparatus of claim 2, wherein the other-side openings of the plurality of wind boxes are formed to have the same inner diameters such that the closer to the sintering completion position, the greater the inclination connected from each of the one-side opening to each of the other-side opening with respect to a center in a width direction of each of the wind boxes.

4. The sintering apparatus of claim 1, wherein:

each of the plurality of wind boxes has a cylindrical shape having an inner space, and comprises a one-side opening open in a direction toward the carriage and the other-side opening open in a direction toward a blower connected to the plurality of wind boxes;
shutters configured to control communication between the one-side opening and the other-side opening are respectively provided inside the plurality of wind boxes; and
the plurality of wind boxes are installed side by side such that the closer to the sintering completion position from the ignition furnace, the smaller the area of the suction path, wherein the closer to the sintering completion position, the smaller an open area of each of the shutters.

5. The sintering apparatus of any one of claims 1 to 4, wherein when a portion from the ignition furnace to the sintering completion position is a sintering section, the plurality of wind boxes are installed side by side such that the closer to the sintering completion position in the entirety of the sintering section, the smaller the area of the suction path of each of the wind boxes.

6. The sintering apparatus of claim 5, wherein when a portion from the ignition furnace to the sintering completion position is the sintering section, and when the sintering section in which a sintering reaction of an upper layer part, including an upper surface of the raw material layer, is mainly performed inside the carriage in moving is an early part; the sintering section in which a sintering reaction of a middle layer part, which is a layer under the upper layer part, is mainly performed inside the carriage in moving is a middle part; and the sintering section in which a sintering reaction of a lower layer part, which is a layer under the middle layer part, is mainly performed inside the carriage in moving is a late part,

the area of the suction path of the wind box disposed corresponding to the middle part is smaller than the area of the suction path of the wind

- box disposed corresponding to the early part,
and
the area of the suction path of the wind box disposed corresponding to the late part is smaller than the area of the suction path of the wind box disposed corresponding to the middle part. 5
7. The sintering apparatus of claim 6, wherein the plurality of wind boxes disposed corresponding to the early part have the suction paths which are the same as each other, 10
the plurality of wind boxes disposed corresponding to the middle part have the suction paths which are the same as each other, and
the plurality of wind boxes disposed corresponding to the late part have the suction paths which are the same as each other. 15
8. The sintering apparatus of any one of claims 1 to 4, wherein 20
when a portion from the ignition furnace to the sintering completion position is the sintering section, and
when the sintering section in which a sintering reaction of an upper layer part, including an upper surface of the raw material layer, is mainly performed inside the carriage in moving is an early part, 25
the sintering section in which a sintering reaction of a middle layer part, which is a layer under the upper layer part, is mainly performed inside the carriage in moving is a middle part, and 30
the sintering section in which a sintering reaction of a lower layer part, which is a layer under the middle layer part, is mainly performed inside the carriage in moving is a late part, 35
the plurality of wind boxes are installed side by side in a portion of the sintering section such that the closer to the sintering completion position, the smaller the area of the suction path, and 40
the areas of the suction paths of the wind boxes disposed corresponding to the early part is larger than the areas of the suction paths of the wind boxes disposed corresponding to the middle part and the late part. 45
9. The sintering apparatus of any one of claims 1 to 4, comprising a reflective member installed, on the movement path of the carriage, downstream from the ignition furnace or inside the ignition furnace, having an opening, and 50
configured to reflect radiant energy generated from the raw material layer and to transfer the energy toward the raw material layer again.
10. The sintering apparatus of claim 9, wherein when the reflective member is installed on the downstream side of the ignition furnace, 55
one end of the reflective member is located downstream from the ignition furnace, the reflective member extends from the one end in the sintering process progress direction, and
the other end of the reflective member extending from the one end in the sintering process progress direction is located at a position, which is a sintering position when a sintering reaction position inside the carriage, in which a sintering reaction gradually moves downward while the carriage moves in the sintering section in which the plurality of wind boxes are installed side by side, is one of positions of approximately 80-120 mm downward from a surface of the raw material layer.
11. A sintering apparatus comprising: 15
a plurality of carriages which are each configured to be able to charge sintering raw materials and which are movable in a sintering process progress direction;
a hopper installed so as to charge the sintering raw materials into the carriages;
an ignition furnace installed on a downstream side of the hopper with respect to the process progress direction of the carriage and configured to spray flame to a raw material layer of the sintering raw materials charged into the carriage; and
a lance installed so as to supply a heat source into an upper layer part of the raw material layer on an upstream side of the ignition furnace when the raw material layer of the sintering raw materials charged into the carriage is divided, from an uppermost surface thereof, into the upper layer part, a middle layer part, and a lower layer part.
12. The sintering apparatus of claim 11, wherein the lance extends in a direction corresponding to a movement direction of the carriages and a tip thereof from which the heat source is discharged is installed on an upstream side of the ignition furnace so as to be located at a position at which the sintering raw materials are completely charged or on a downstream side of the position at which the sintering raw materials are completely charged.
13. The sintering apparatus of claim 12, wherein a tip of the lance is located between the hopper and the ignition furnace.
14. The sintering apparatus of claim 13, comprising a pressurizing part located between the hopper and the ignition furnace and configured to pressurize the raw material layer to which the heat source is further added, wherein the tip of the lance is located between the hopper and the pressurizing part.

15. The sintering apparatus of any one of claims 11 to 14, comprising an air vent bar extending in a direction corresponding to the movement direction of the carriage, installed at a position corresponding to the middle layer part and the lower layer part of the raw material layer, and configured to be inserted into and detached from the carriage.
16. The sintering apparatus of claim 15, wherein the lance is located over the air vent bar, and the tip of the lance is located between a tip of the air vent bar and the ignition furnace.
17. A method for manufacturing sintered ore, the method comprising:
- charging sintering raw materials into a carriage moving in a sintering process progress direction; allowing the carriage, in which the sintering raw materials are charged, to pass under an ignition furnace and igniting flame on a raw material layer in which the sintering raw materials are stacked; and moving the flame-ignited carriage over a plurality of wind boxes which are installed side by side from a lower side of the ignition furnace to a sintering completion position, and performing a sintering reaction while gradually increasing a velocity of external air introduced into the carriage such that the closer to the sintering completion position, the higher the velocity.
18. The method of claim 17, wherein in the increasing the velocity of external air introduced into the carriage such that the closer to the sintering completion position, the higher the velocity, arrangement of the plurality of wind boxes are adjusted such that an area of a suction path decreases from the lower side of the ignition furnace to the sintering completion position.
19. The method of claim 18, wherein each of the plurality of wind boxes has a cylindrical shape having an inner space, and includes a one-side opening open in a direction toward the carriage and the other-side opening open in a direction toward a blower connected to the plurality of wind boxes, and in adjusting the arrangement of the plurality of wind boxes such that the closer to the sintering completion position from the ignition furnace, the smaller the area of the suction path, the wind boxes are installed such that the closer to the sintering completion position, the smaller inner diameters of the one-side openings thereof.
20. The method of claim 18, wherein each of the plurality of wind boxes has a cylindrical shape having an inner space, and includes a one-side opening open in a direction toward the carriage and the other-side opening open in a direction toward a blower connected to the plurality of wind boxes, and in adjusting arrangement of the plurality of wind boxes such that the area of the suction path decreases from a lower side of the ignition furnace to the sintering completion position, a shutter configured to control communication between the one-side opening and the other-side opening is provided, and the closer to the sintering completion position, the smaller an open area of the shutter.
21. The method of any one of claims 18 to 20, wherein when a portion from the ignition furnace to the sintering completion position is a sintering section, in the adjusting the arrangement of the plurality of wind boxes such that the area of the suction path decreases from the lower side of the ignition furnace to the sintering completion position, the arrangement of the plurality of wind boxes is adjusted such that the closer to the sintering completion position in the entirety of the sintering section, the smaller the area of the suction path.
22. The method of claim 21, wherein when the portion from the ignition furnace to the sintering completion position is the sintering section, and when inside the carriage in moving:
- the sintering section in which a sintering reaction of an upper layer part, including an upper surface of the raw material layer, is mainly performed is an early part;
- the sintering section in which a sintering reaction of a middle layer part, which is a layer under the upper layer part, is mainly performed is a middle part; and
- the sintering section in which a sintering reaction of a lower layer part, which is a layer under the middle layer part, is mainly performed is a late part,
- a flow velocity of external air introduced into the carriage disposed corresponding to an upper side of the wind boxes disposed corresponding to the middle part is lower than a flow velocity of external air introduced into the carriage disposed corresponding to an upper side of the wind boxes disposed corresponding to the early part, and
- a flow velocity of external air introduced into the carriage disposed corresponding to an upper side of the wind boxes disposed corresponding to the middle part is lower than a flow velocity of external air introduced into the carriage disposed corresponding to an upper side of the wind boxes disposed corresponding to the late part.

- 23.** The method of claim 21, wherein
when the portion from the ignition furnace to the sintering completion position is the sintering section,
and
when inside the carriage in moving:

the sintering section in which a sintering reaction of an upper layer part, including an upper surface of the raw material layer, is mainly performed is an early part;

the sintering section in which a sintering reaction of a middle layer part, which is a layer under the upper layer part, is mainly performed is a middle part; and

the sintering section in which a sintering reaction of a lower layer part, which is a layer under the middle layer part, is mainly performed is a late part,

the carriage is configured, in a portion of section in the sintering section, such that the closer to the sintering completion position, the higher a flow velocity of introduced external air, and

a flow velocity of external air introduced into the carriage moving to an upper side of the wind boxes disposed corresponding to the early part is lower than flow velocities of external air introduced into the carriages moving to upper sides of the wind boxes disposed corresponding to the middle part and the late part.

- 24.** The method of any one of claims 18 to 20, comprising reflecting radiant heat source energy generated from the raw material layer inside the carriage in which flame is ignited by the ignition furnace and transferring the heat source energy to the raw material layer again.

- 25.** A method for manufacturing sintered ore, the method comprising:

charging sintering raw materials into a carriage moving in a sintering process progress direction; adding a heat source into an upper layer part of a raw material layer in which the sintering raw materials are stacked when the raw material layer, in which the sintering raw materials are stacked, is divided, from an uppermost surface thereof, into the upper layer part, a middle layer part, and a lower layer part, and when the sintering raw materials are completely charged up to a target height; and igniting flame to an outer surface layer of the raw material layer inside the carriage in which the heat source is added into the upper layer part, and moving the carriage in the sintering process progress direction to manufacture sintered ore.

- 26.** The method of claim 25, wherein in the charging of the sintering raw materials into the carriage, the sintering raw materials are charged, according to a movement direction of the carriage, in a direction from one side inside the carriage to the other side such that the sintering raw materials are completely charged up to a desired height in the direction from the one side to the other side, and in the adding the heat source into the upper layer of the raw material layer, the heat source is sequentially added into the upper layer part in the direction from the one side to the other side of the carriage in which the sintering raw materials are completely charged.

- 27.** The method of claim 26, wherein in the adding the heat source, a lance extending in a direction corresponding to the movement direction of the carriage is used to spray the heat source on an upstream side of the ignition furnace.

- 28.** The method of claim 26, wherein in adding the heat source, the heat source is sprayed between a hopper configured to charge the sintering raw materials into the carriage and the ignition furnace.

- 29.** The method of claim 28, wherein while the carriage in which the heat source is added into the upper layer part passes under a pressurizing part located between the hopper and the ignition furnace, the raw material layer is pressurized by the pressurizing part and then passes under the ignition furnace.

- 30.** The method of claim 26, wherein before the charging of the sintering raw materials into the carriage, an air vent bar extending in a direction corresponding to the movement direction of the carriage is arranged inside the carriage, and the air vent bar is located at a position of at least one of the middle layer part or the lower layer part of the raw material layer.

- 31.** The method of claim 25, wherein in adding the heat source to the upper layer part, supplementary materials are added together.

- 32.** The method of any one of claims 25 to 31, wherein the heat source comprises powder comprising a plurality of particles.

- 33.** The method of any one of claims 25 to 31, wherein in adding the heat source, a gas is added together so as to assist a movement of the heat source, and the gas comprises at least any one of air or inert gas.

FIG. 1

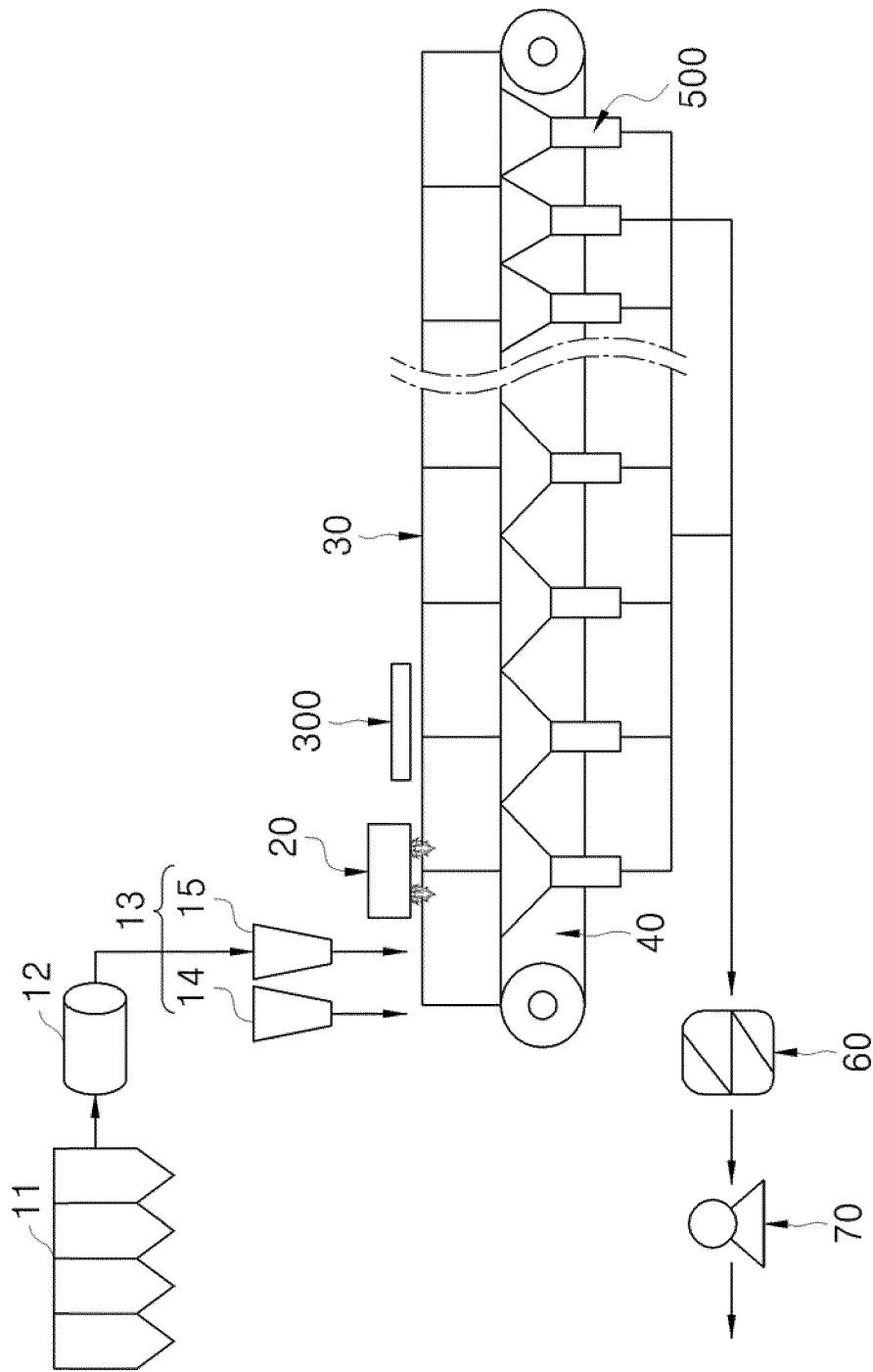


FIG. 2

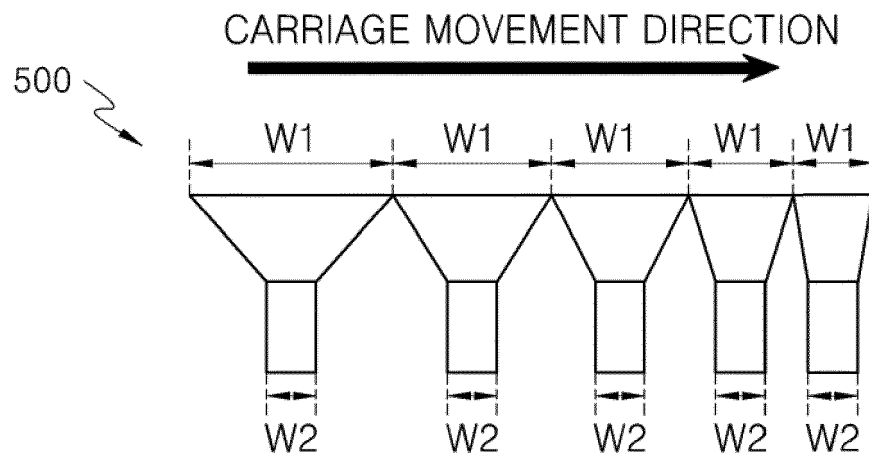


FIG. 3

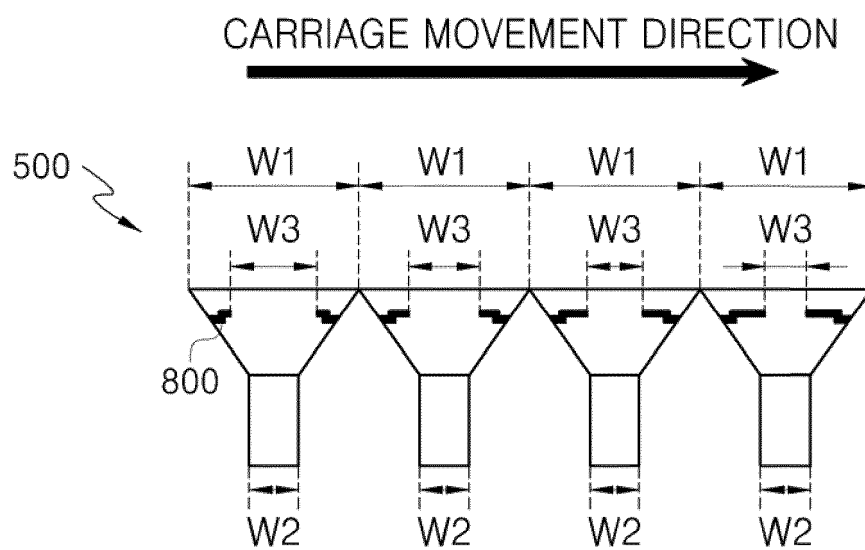


FIG. 4

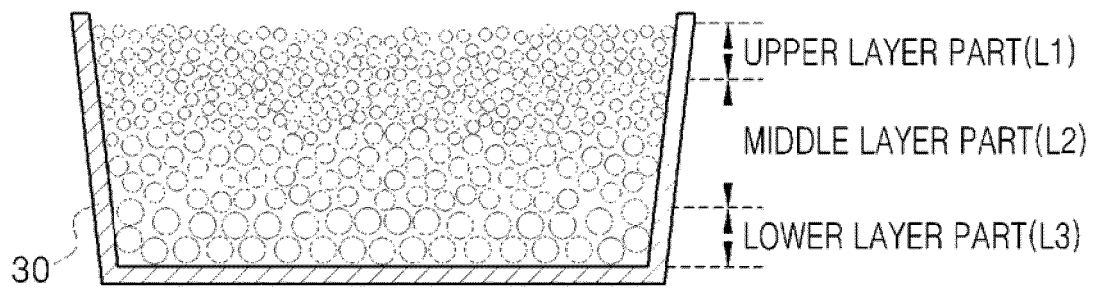


FIG. 5

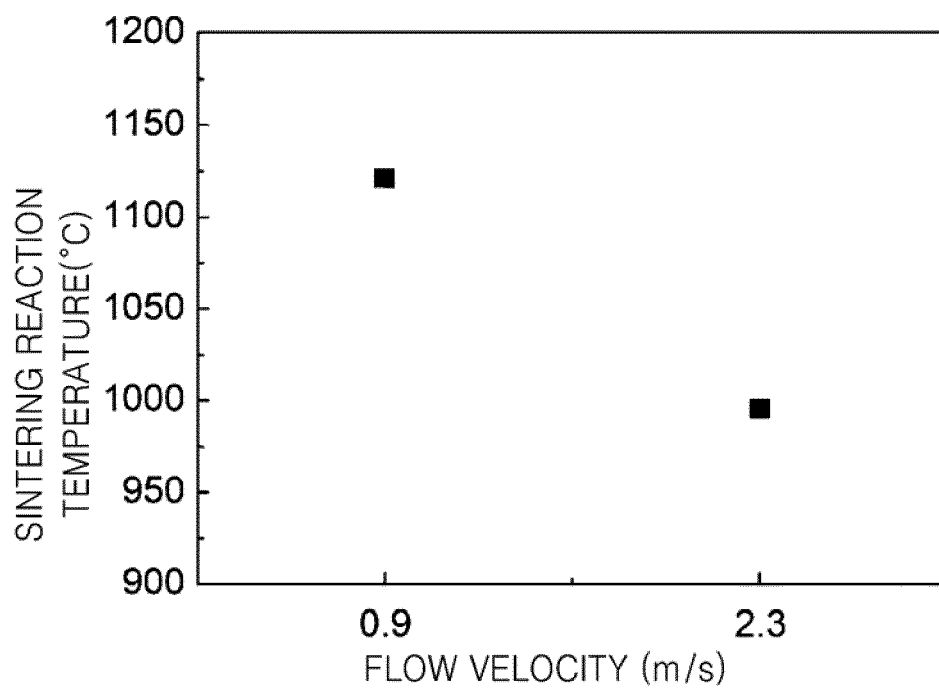


FIG. 6

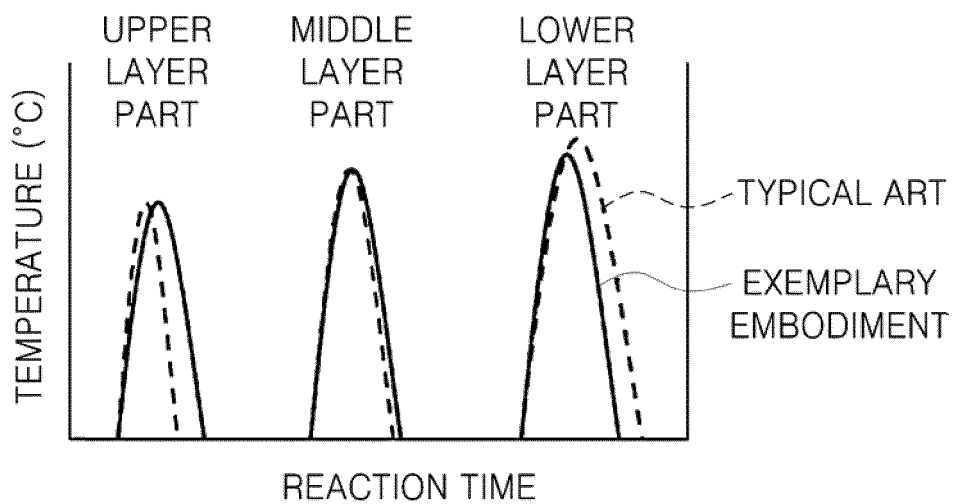


FIG. 7

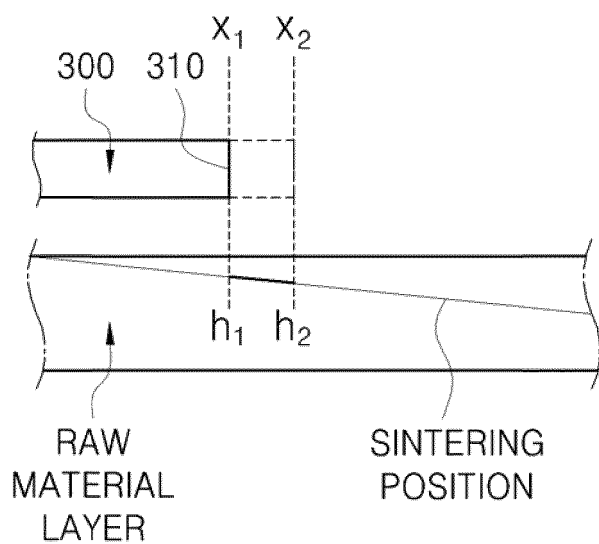


FIG. 8

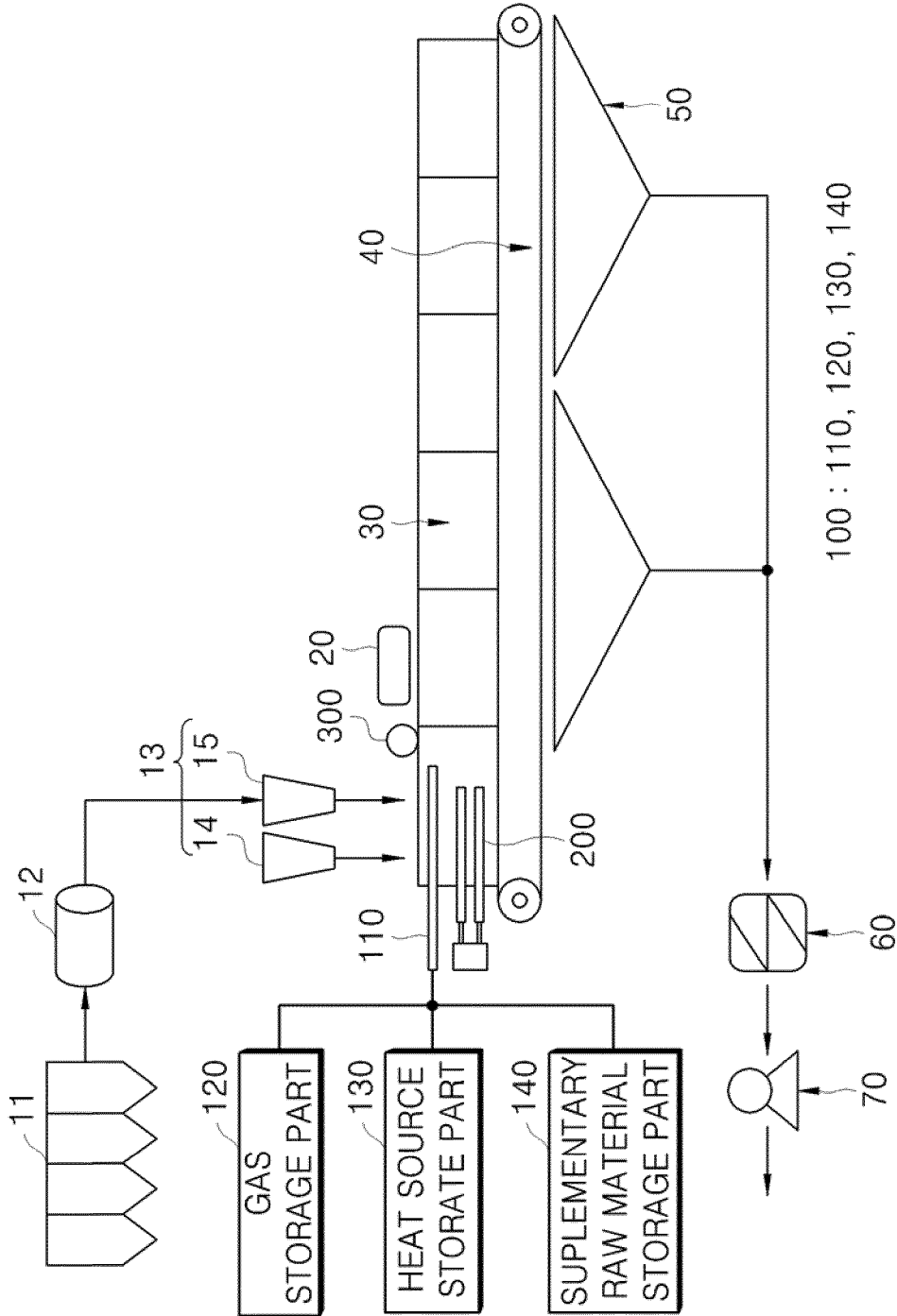


FIG. 9

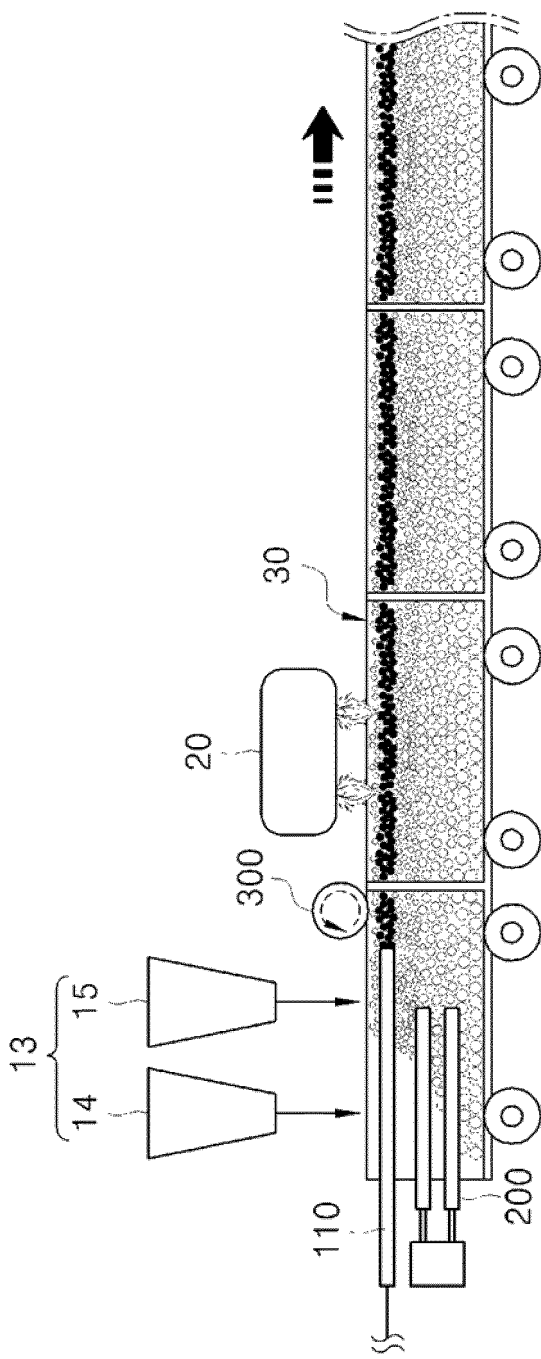


FIG. 10

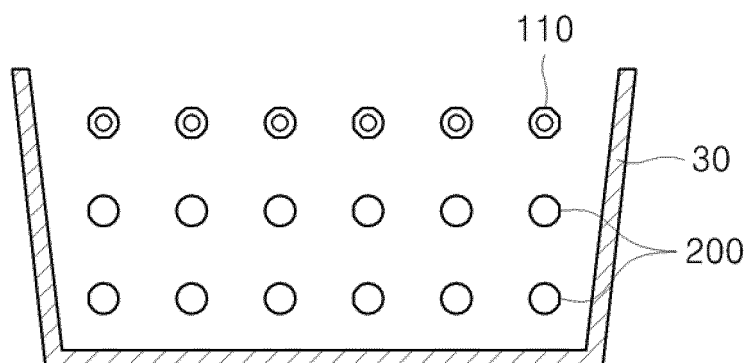


FIG. 11

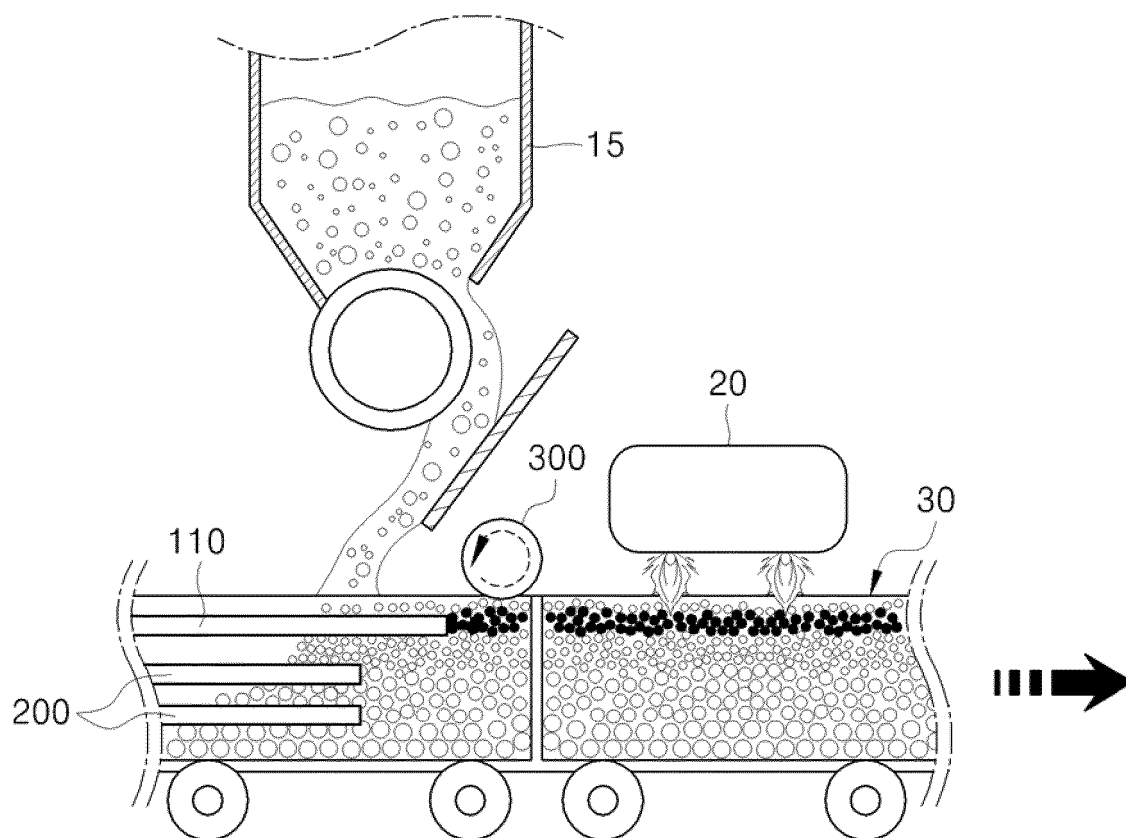


FIG. 12

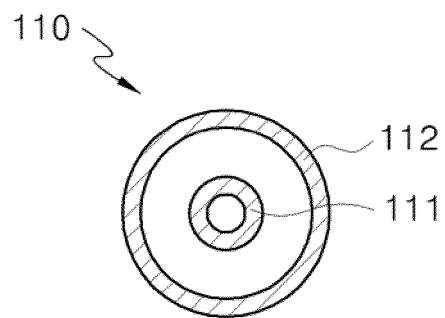


FIG. 13

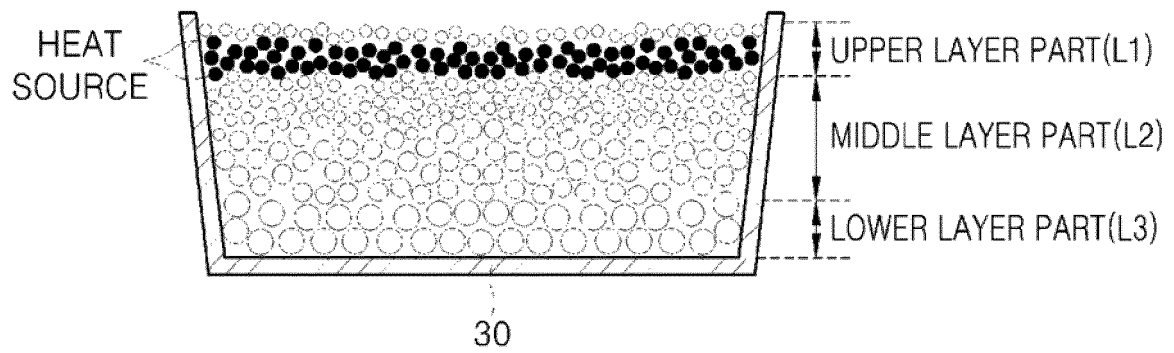


FIG. 14

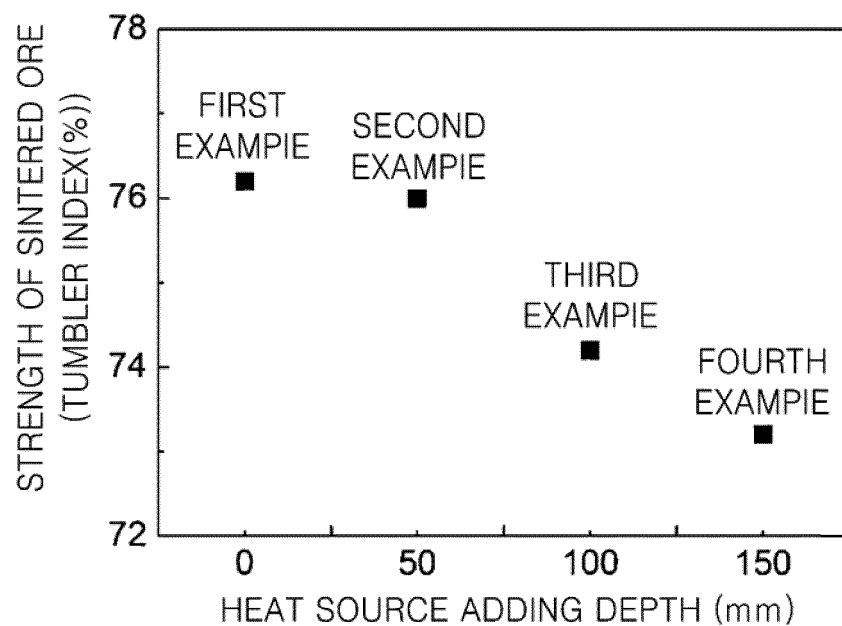
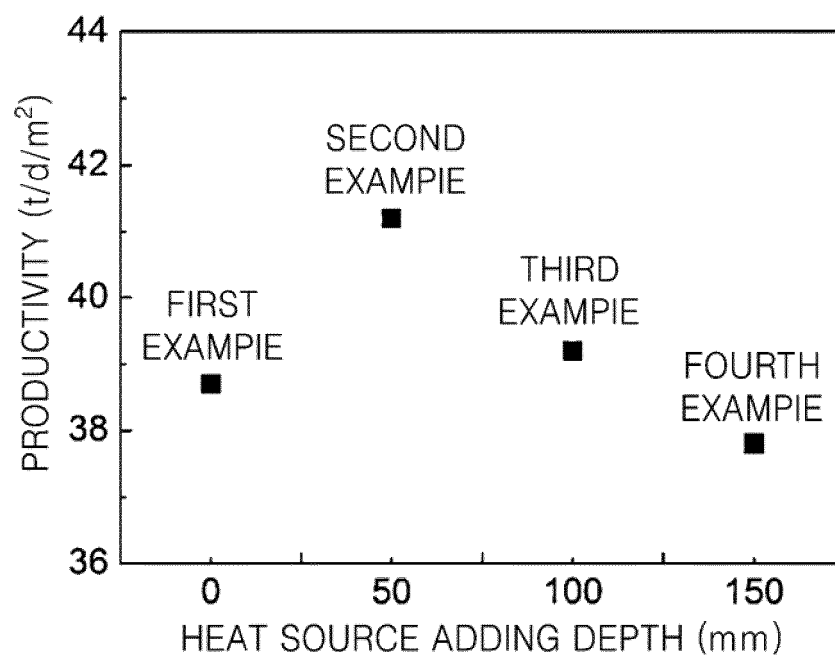


FIG. 15



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2016/014732

A. CLASSIFICATION OF SUBJECT MATTER

F27B 21/06(2006.01)i, C22B 1/20(2006.01)i, F27D 3/10(2006.01)i, F27B 21/02(2006.01)i, F27D 3/16(2006.01)i, F27D 19/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F27B 21/06; C22B 1/20; F27B 21/00; C10B 35/00; C22B 1/16; F27D 3/10; F27B 21/02; F27D 3/16; F27D 19/00

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) & Key words: sintering, bogie, ignition, wind box, inner diameter, width, hopper, air drain bar, lance, flux

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 10-2004-0017540 A (POSCO) 27 February 2004 See page 2, line 17-page 3, line 37 and figures 1, 3, 4.	11,25,26,28,31-33
Y		12-16,27,29,30
A		1-10,17-24
Y	JP 09-031553 A (SUMITOMO METAL IND. LTD.) 04 February 1997 See paragraphs [0007]-[0014] and figures 1, 2.	12-16,27,30
Y	JP 2002-121620 A (KOBE STEEL LTD.) 26 April 2002 See paragraphs [0052]-[0054] and figure 2.	14,29
A	KR 10-2016-0062288 A (POSCO) 02 June 2016 See paragraph [0064] claims 1, 10, 14 and figure 1.	1-33
A	KR 10-2016-0034666 A (POSCO) 30 March 2016 See claims 1, 7 and figures 1, 2.	1-33

☐ 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

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