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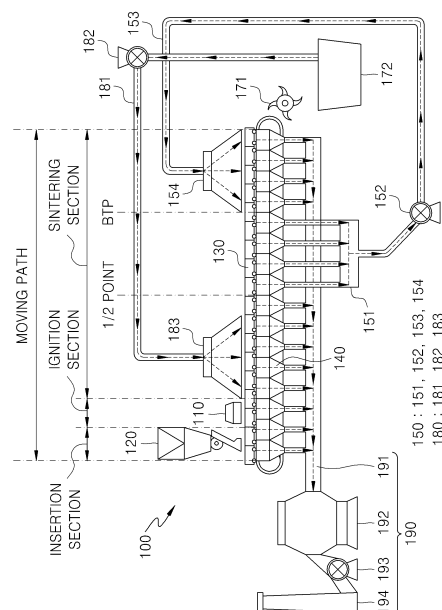
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(54) **SINTERING APPARATUS AND SINTERING METHOD**

(57) Provided is a sintering apparatus. The sintering apparatus includes a plurality of sintering trailers movably disposed along a moving path and in which a raw material is inserted therein, an ignition furnace disposed above the sintering trailers to spray flames to a top surface of the raw material, a wind box provided in plurality under the sintering trailers along the moving path to suction air downward from the sintering trailers to sinter the raw material, a cooler disposed on one side of the moving path to supply a cooling gas to a sintered ore discharged from each of the sintering trailers, and a first circulation part connected to the cooler to supply at least one portion of the cooling gas supplied to the raw material to an upper portion of the sintering trailer to control a combustion process of the raw material or improve combustion efficiency, thereby improving quality and productivity of the raw material.

FIG. 1



Description**BACKGROUND**

5 [0001] The present disclosure relates to a sintering apparatus and a sintering method, and more particularly, to a sintering apparatus capable of improving quality and productivity of a raw material by controlling a combustion process of the raw material or improving combustion efficiency and a sintering method.

10 [0002] In general, in sintering processes, iron ore fines, supplementary materials, and fuel (cokes breeze, anthracite) are put into a drum mixer, mixed with each other, and humidified and then be inserted into a sintering trailer at a predetermined height. Then, a surface of the mixed raw material ignites by using an ignition furnace, and the sintered mixed raw materials are sintered while forcibly suctioning air from a lower side. Then, the sintered ore generated by the sintering is distributed to pass through a crusher and then is cooled in a cooler. Thereafter, the sintered ore, which has a particle size that is easy to react and be inserted into a blast furnace, of the sintered ore may be transferred to the blast furnace, and fine ore that is the sintered ore having a relatively small size may be classified as return fine and thus be reused as the sintered material.

15 [0003] Such a sintering process is performed by generating a negative pressure of a wind box disposed under the sintering trailer to apply a suction force to the sintering trailer. When a main blower is driven, the negative pressure is generated in the wind box. While the air is suctioned downward from the ignited surface of the mixed raw material by the negative pressure of the wind box, the mixed raw material loaded on the sintering trailer may be sintered. The completely sintered raw material may pass through the crusher and be cooled by a cooling gas sprayed from the cooler.

20 [0004] However, when the mixed material in the sintering trailer is sintered, since heat generated due to combustion by the air suctioned from an upper portion to a lower portion of the sintering trailer is accumulated in the lower portion of the sintering trailer, an upper layer of the mixed material has a temperature higher than that of a lower layer of the mixed material. Thus, since sintering reaction is insufficiently performed in the upper layer of the material, the generated material may be deteriorated in quality and productivity.

25 [0005] Typically, a sintering exhaust gas that is the air suctioned through the wind box or the cooling gas that cools the sintered ore is discharged to the outside as it is. The gases may contain components capable of contaminating environments and may have a lot of heat energy while passing through the sintered ore having a high temperature. Thus, if these gases are discharged to the outside as it is, it may cause environmental pollution, and a lot of energy may be lost.

SUMMARY

35 [0006] The present disclosure provides a sintering apparatus capable of controlling a combustion process of a raw material and a sintering method.

[0007] The present disclosure also provides a sintering apparatus capable of circulating gases generated during a sintering process and a sintering method.

[0008] The present disclosure also provides a sintering apparatus capable of improving quality and productivity of a raw material and a sintering method.

40 [0009] In accordance with an exemplary embodiment, a sintering apparatus includes: a plurality of sintering trailers movably disposed along a moving path and in which a raw material is inserted therein; an ignition furnace disposed above the sintering trailers to spray flames to a top surface of the raw material; a wind box provided in plurality under the sintering trailers along the moving path to suction air downward from the sintering trailers to sinter the raw material; a cooler disposed on one side of the moving path to supply a cooling gas to a sintered ore discharged from each of the sintering trailers; and a first circulation part connected to the cooler to supply at least one portion of the cooling gas supplied to the raw material to an upper portion of the sintering trailer.

[0010] The sintering apparatus may further include a gas fuel supply part connected to the first circulation part to supply a gas fuel to the first circulation part.

50 [0011] The first circulation part may include: a first hood disposed above the sintering trailers to extend along the moving path; a first connection line having one end that is connected to the cooler and the other end that is connected to the first hood; and a first blower disposed in the first connection line.

[0012] The sintering apparatus may further include a second circulation part connected to one portion of the wind boxes to supply the air suctioned into the portion of the wind boxes to the upper portion of the sintering trailers, wherein the moving path may include: an insertion section in which the raw material is inserted into the sintering trailer; an ignition section in which the raw material is ignited by the ignition furnace; and a sintering section in which the raw material is sintered, wherein the first and second circulation parts may supply the suctioned air or cooling gas to the sintering section.

55 [0013] The second circulation part may include: a suction tube connected to one portion of the wind boxes, the suction tube defining a space in which the air is accommodated therein; a second hood disposed above the sintering trailers to

extend along the moving path; a second connection line having one end that is connected to the suction tube and the other end that is connected to the second hood; and a second blower disposed in the second connection line.

[0014] The first hood disposed in the first circulation part may be disposed between the ignition furnace and the second hood, and the first hood may be disposed above the wind boxes that are disposed before 1/2 point of the moving path.

[0015] The second hood may have one end that is disposed between upper sides of the wind boxes disposed after a point at which the raw material is completely burnt to the rearmost position on the moving path.

[0016] A length of an extending portion of the second hood may be greater than a value in which the number of the wind boxes connected to the suction tube $\times$ a length of one wind box.

[0017] The suction tube may be connected to the wind boxes disposed between the 1/2 point of the moving path and a point at which the suctioned air has the maximum temperature.

[0018] The moving path may include: an insertion section in which the raw material is inserted into the sintering trailer; an ignition section in which the raw material is ignited; and a sintering section in which the raw material is sintered, wherein the first circulation part and the gas fuel supply part may supply the cooling gas and the gas fuel to the sintering section.

[0019] The gas fuel supply part may include a connection supply line defining a path through which the gas fuel moves therein, and the connection supply line may be connected to a first connection line disposed in the first circulation part.

[0020] The gas fuel supply part may include: a fuel supply line defining a path through which the gas flue moves therein, the fuel supply line having one end that is connected to a first hood of the first circulation part; and a spray unit disposed on one end of the fuel supply line to spray the gas fuel to the upper portion of the sintering trailer.

[0021] The gas fuel may be diluted at concentration less than the lowest concentration limit of combustion.

[0022] In accordance with another exemplary embodiment, a sintering method of manufacturing a sintered ore includes: inserting a raw material into a sintering trailer moving along a moving path; igniting the raw material; suctioning air downward from the raw material; discharging the sintered ore to supply a cooling gas to the sintered ore; and supplying at least one of the cooling gas supplied to the sintered ore to the raw material in the sintering trailer, wherein, in the supplying of the cooling gas to the raw material, the cooling gas is supplied to an upper side of a wind box disposed before 1/2 point of the moving path.

[0023] The supplying of the cooling gas to the raw material in the sintering trailer may include: measuring a temperature of the cooling gas; and supplying the cooling gas to the raw material when the temperature of the cooling gas is higher than a preset temperature.

[0024] The sintering method may further include mixing a gas fuel with the cooling gas to supply the mixed gas to the raw material after the cooling gas is supplied to the raw material in the sintering trailer.

[0025] The sintering method may further include supplying one portion of the suctioned air to the raw material in the sintering trailer after the air is suctioned downward from the raw material.

[0026] In the supplying of the one portion of the suctioned air to the raw material in the sintering trailer, the air may be suctioned in an area between the 1/2 point of the moving path and a point at which the suctioned air has the maximum temperature.

[0027] In the mixing of the gas fuel, the gas fuel may be supplied before the cooling gas is supplied, at the same time when the cooling gas is supplied, or after the cooling gas is supplied.

[0028] In the mixing of the gas fuel with the cooling gas to supply the mixed gas, the cooling gas and the gas fuel may be supplied to the upper portion of the sintering trailer moving between after a point at which the raw material is ignited and the 1/2 point of the moving path.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] Exemplary embodiments can be understood in more detail from the following description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a view of a sintering apparatus in accordance with an embodiment;

FIG. 2 is a view illustrating a section shape of a sintering layer and characteristics of a flue gas during a sintering process of a raw material in accordance with an embodiment;

FIG. 3 is a view of a sintering apparatus in accordance with another embodiment;

FIG. 4 is a view of a sintering apparatus in accordance with further another embodiment;

FIG. 5 is a flowchart showing a sintering method in accordance with an embodiment;

FIG. 6 is a view of a pot experimental device in accordance with an embodiment; and

FIG. 7 is a graph showing a temperature variation in the sintering layer in accordance with an embodiment.

DETAILED DESCRIPTION OF EMBODIMENTS

[0030] Hereinafter, specific 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

[0031] FIG. 1 is a view of a sintering apparatus in accordance with an embodiment, and FIG. 2 is a view illustrating a section shape of a sintering layer and characteristics of a flue gas during a sintering process of a raw material in

[0032] Referring to FIG. 1, a sintering apparatus 100 in accordance with an embodiment includes a plurality of sintering trailers 130 movably disposed along a moving path and to which a raw material is inserted thereto, an ignition furnace 110 disposed above the sintering trailer 130 to spray flames to a top surface of the raw material, a plurality of wind boxes 140 disposed under the sintering trailers 130 along the moving path, each of which suctions air downward from an upper side of each of the sintering trailers 130 to sinter the raw material, a cooler 172 for supplying a cooling gas to a sintered ore discharged from the sintering trailer 130, and a first circulation part 180 connected to the cooler 172 to supply at least one portion of the cooling gas supplied to the raw material to an upper portion of the sintering trailer 130. Also, the sintering apparatus may further include an insertion part 120, a crushing part 171, a discharge part 190, and a second circulation part 150. Here, the cooling gas supplied to the sintered ore to cool the sintered ore may be a cooling flue gas.

[0033] Here, the sintering trailers 130 are disposed to rotate in a caterpillar manner. The sintering trailers 130 form a closed loop to define a moving path on an upper side of the closed loop and a turning path on a lower side of the closed loop. In the moving path, the raw material is inserted into the sintering trailer 140 and sintered. In the turning path, empty sintering trailers 130 from which the sintered ore that is completely sintered are distributed move to be turned to the moving path on the upper side of the closed loop for a sintering process.

[0034] The moving path extends in a longitudinal direction. The sintering trailer 130 may move from a front side of the moving path toward a rear side of the moving path. Also, the moving path may include an insertion section disposed at the foremost side of the moving path and in which the insertion part is disposed, an ignition section disposed at a rear side of the insertion section and in which the ignition furnace 110 is disposed, and a sintering section disposed at a rear side of the ignition section and in which the raw material is sintered. That is, the insertion section is a section in which the raw material is inserted or supplied into the sintering trailer 130, and the ignition section is a section in which the raw material is ignited. Also, the sintering section is a section in which the flames igniting on the top surface of the raw material moves downward to sinter the raw material.

[0035] Each of the sintering trailers 130 may define a space in which the raw material is accommodated therein. The plurality of sintering trailers 130 may be disposed on the caterpillar to move along the moving path and the turning path. Thus, the sintering trailers 130 may allow the raw material to be inserted therein to sinter the raw material, thereby discharging or distributing the sintered ore while moving along the moving path and the turning path.

[0036] The insertion part 120 is disposed in the insertion section of the moving path. That is, the insertion section may include an area having the same length as that of the insertion part 120 in the longitudinal direction. The insertion part 120 may be disposed above the sintering trailers 130 and include a hopper defining a space in which the raw material is stored and an insertion chute defining a moving path of the raw material and having an inclined surface. Thus, when the raw material is discharged downward from the hopper, the raw material may be guided into the sintering trailer 130 through the insertion chute disposed under the hopper.

[0037] The ignition furnace 110 is disposed in the ignition section of the moving path. That is, the ignition section may include an area having the same length as that of the ignition furnace 110 in the longitudinal direction. The ignition furnace 110 is disposed above the sintering trailer 130 and at a rear side of the insertion part 120 to supply flames to the top surface of the raw material of the sintering trailer 130 to ignite the raw material.

[0038] The plurality of wind boxes 140 are disposed under the sintering trailers 130 along the moving path. More particularly, each of the wind boxes 140 may be disposed between the ignition furnace 110 and the section in which the raw material is discharged from the sintering trailer 130. The wind box 140 suctions the air downward from the upper side of the sintering trailer 130. Thus, the air at the upper side of the sintering trailer 130 passes through the raw material in the sintering trailer 130 and is suctioned to the wind box 140 at a lower side of the sintering trailer 130. Thus, the flames ignited on the top surface of the raw material in the sintering trailer 130 may move to a bottom surface of the raw material by the air suctioned by the wind box 140 to sinter the raw material. However, the section in which the wind box 140 is disposed may not be limited and variously provided.

[0039] The discharge part 190 is connected to the plurality of wind boxes 140 to provide a suction force to the wind boxes 140 and discharge the suctioned air to the outside. The discharge part 190 is connected to a lower portion of each of the plurality of wind boxes 140. The discharge part 190 includes a suction chamber 191 defining a space in which the air is accommodated to move therein, a dust collector 192 disposed on the suction chamber 191, a main

blower 193 disposed at a rear side of the dust collector 192 with respect to a path through which the air moves, and a chimney 194 disposed at a rear side of the main blower 193.

[0040] Thus, when the main blower 193 generates a suction force, the air is suctioned downward from the upper side of the wind boxes 140 through the wind boxes 140. The suctioned air passes through the dust collector 192 while moving toward the main blower 193 along the suction chamber 191 and then is filtered to pass through the main blower 193 and discharged to the chimney 194. That is, the main blower 193 generates a negative pressure in the wind boxes 140 to suction the air in the upper portion of the sintering trailers 130. Here, the air may move from a front side to a rear side within the suction chamber 191.

[0041] The crushing part 171 may be disposed at one side of the moving path, that is, a portion spaced apart from the rearmost side of the moving path. Thus, when a distributed lump of sintered ore after being completely sintered is supplied to the crushing part 171, the lump of sintered ore is crushed.

[0042] The cooler 172 is disposed to be spaced apart from the crushing part 171. The cooler 172 has a space in which the raw material, that is, the sintered ore is accommodated therein. Thus, when the sintered ore crushed in the crushing part 171 is supplied to the cooler 172, the cooling gas may be supplied to the inner space of the cooler 172 through a cooling gas spray unit such as a nozzle. Thus, the cooling gas may absorb thermal energy of the sintered ore while passing through the inner space of the cooler 172 in a state where the cooling gas contacts the sintered ore. Through these processes, the sintered ore may be selected in an appropriate size and inserted into the blast furnace (not shown), and the sintered ore having a relatively small size may be classified as return fine and recycled as a sintering material.

[0043] However, the sintered flue gas that is the air suctioned through the wind box 140 may have thermal energy while passing through a sintered layer. Also, the cooling gas passing through the sintered ore may include dusts and thus include components capable of contaminating environments. The cooling gas may have a lot of thermal energy while passing through the raw material having a high temperature. Thus, when these gases are discharged to the outside, it may cause environmental pollution, and a lot of energy may be lost. Thus, the first and second circulation parts 150 and 180 in accordance with an embodiment may be provided to supply and circulate the air or cooling gas to the sintering section.

[0044] The first circulation part 180 is connected to the cooler 172 to suction at least one portion of the cooling gas generated from the cooler 172, thereby supplying the cooling gas to the upper portion of the sintering trailer 130. The first circulation part 180 includes a first hood 183 disposed above the sintering trailer 130 to extend along the moving path, a first connection tube 181 having one end that is connected to the cooler 172 and the other end that is connected to the first hood 183, and a first blower 182 disposed in the first connection tube 181. Also, the first circulation part 180 may include a temperature measuring unit (not shown) and a control unit (not shown).

[0045] The first hood 183 is disposed above the sintering trailer 130. The first hood 183 may be disposed at a point before 1/2 point with respect to the moving path. That is, the first hood 183 may be disposed between the ignition furnace 110 and a second hood 154 that will be described later. Also, the first hood 183 may extend in a longitudinal direction and have a width that gradually increases from an upper portion to a lower portion thereof. Thus, the cooling gas and gas fuel may be supplied to the upper portion of the sintering trailer 130 moving from a start point of the sintering section to the 1/2 point of the moving path.

[0046] Since the cooling gas supplied from the cooler 172 to the raw material absorbs the thermal energy of the raw material having a high temperature, the cooling gas increases in temperature and includes dusts generated from the raw material. Referring to FIG. 2, a combustion zone is disposed on the sintering layer of the raw material in the section between the ignition furnace 110 and the 1/2 point. Thus, when the high temperature cooling gas absorbing thermal energy by cooling the raw material is supplied to the top portion of the raw material in the section between the ignition furnace 110 and the 1/2 point through the first hood 183, the cooling gas supplies the thermal energy to the raw material while passing through the raw material to allow the raw material to be easily burnt and to prevent or restrict a temperature of the raw material from being reduced while the high temperature cooling gas is supplied.

[0047] Also, the cooling gas absorbing the thermal energy may be reused to reduce the use of energy. It is necessary to perform a work for removing dusts in the cooling gas to discharge the cooling gas to the outside. However, since the cooling gas containing the dusts is supplied to the raw material in the sintering trailer 130, the dusts may be reused as a raw material, and it is unnecessary to perform a separate work for removing the dusts in the cooling gas, and thus the facilities may be simplified, and workability may be improved.

[0048] The first connection tube 181 has one end that is connected to the cooler 172 and the other end that is connected to the first hood 183. Also, the first connection tube 181 defines a path through which the cooling gas moves therein. Thus, at least one portion of the cooling gas supplied from the cooler 172 to the raw material may be suctioned from the one end of the first connection tube 181, and the first connection tube 181 may supply the cooling gas to the first hood 183 to discharge the cooling gas toward the raw material thereunder.

[0049] The first blower 182 is disposed in the first connection tube 181, that is, on the moving path of the cooling gas. The first blower 182 may provide a suction force to the one end of the first connection tube 181. Thus, when the cooler 172 provides the cooling gas, and the first blower 182 provides the suction force to the first connection tube 181, it may

prevent a phenomenon in which the cooling gas is suctioned into the one end of the first connection tube 181 and discharged to the outside of the cooler 172 after the cooling gas supplied from the cooler 172 absorbs thermal energy while passing through the raw material.

[0050] The temperature measuring unit is disposed in the first connection tube 181 to measure a temperature of the cooling gas moving through the first connection tube 181. Various sensors capable of measuring temperatures may be used as the temperature measuring unit.

[0051] The control unit is connected to the temperature measuring unit and the first blower 182 to control an operation of the first blower 182. The reason why the cooling gas suctioned from the cooler 172 is supplied to the raw material between the ignition furnace 110 and the 1/2 point is to help combustion in the raw material. In order to help the combustion in the raw material, the cooling gas has to have a high temperature. When the cooling gas has a too low temperature, the cooling gas may take away the thermal energy of the raw material to disturb the combustion.

[0052] Thus, the temperature measuring unit may measure the temperature of the cooling gas passing through the first connection tube 181 to control the operation of the first blower 182. For example, when the temperature of the cooling gas measured in the temperature measuring unit is below about 100 °C, the control unit may stop the operation of the first blower 182 to prevent the cooling gas from being supplied to the first hood 183. When the temperature of the cooling gas measured in the temperature measuring unit is above about 100 °C, the control unit may operate the first blower 182 to allow the cooling gas to be supplied to the first hood 183. Thus, only the cooling gas having a high temperature may be supplied to the raw material of which the combustion zone is disposed on the sintering layer to help the combustion in the raw material.

[0053] The sintering apparatus in accordance with an embodiment may further include the second circulation part 150. The second circulation part 150 is connected to a portion of the plurality of wind boxes 140 to supply the suctioned air to the upper portion of the sintering trailer 130. The second circulation part 150 includes a suction tube 151 connected to the wind boxes 140 and defining a space in which the air is accommodated, a second hood 154 disposed above the sintering trailer 130 to extend along the moving path, a second connection line 153 having one end that is connected to the suction tube 151 and the other end that is connected to the second hood 154, and a second blower 152 disposed in the second connection line 153. Here, the suctioned air may be the air (hereinafter, referred to as "suctioned air") passing through the sintering layer in the sintering trailer 130.

[0054] The suction tube 151 defines the space in which the air is accommodated. The suction tube 151 is connected to a portion of the plurality of wind boxes 140. For example, the suction tube 151 may be connected to the wind boxes 140 disposed between the 1/2 point of the moving path and a point (hereinafter, referred to as a "BTP") at which the suctioned air has the maximum temperature. That is, the suction tube 151 may circulate the air suctioned in the area. Since a sensor for measuring a temperature of the suctioned air is disposed in each of the wind boxes 140, the temperatures of the air suctioned into the plurality of wind boxes 140 may be monitored to recognize a position of the BTP. Although the BTP varies in position according to sintering conditions, a worker may adjust the sintering conditions to match the position of the BTP with a predetermined wind box 140.

[0055] Referring to Fig. 2, an amount of air may be affected by a ventilation resistance of the sintering layer, and the ventilation resistance may vary according to thicknesses of the sintered layer, combustion zone, and unsintered layer. As the combustion zone having a relatively high ventilation resistance increases in thickness, the amount of air gradually decreases to the minimum between the 1/2 point of the moving path and the BTP and then increases again.

[0056] Since the air passing through the raw material may be reduced in amount at a portion having a high ventilation resistance by the wind box 140, sintering may not be smoothly performed. Thus, when the wind boxes 140 disposed between the 1/2 point of the moving path (hereinafter, referred to as a "1/2 point") and the BTP are connected to the suction tube 151, the second blower 152 that will be described later provides a portion of the entire wind boxes 140, and thus, a relatively large suction force may be supplied when compared to a case in which one main blower 193 provides a suction force to the entire wind boxes 140. That is, the number of wind boxes 140 connected to the second blower 152 is relatively small, and thus the suction force is less divided. Thus, each of the wind boxes connected to the second blower 152 may increase in suction force.

[0057] Therefore, even though the ventilation resistance is high in the combustion zone between the 1/2 point and the BTP, the suction force provided from the second blower 152 is relatively high, and thus, a phenomenon in which the amount of air in the sintering trailer 130 decreases between the 1/2 point and the BTP may be minimized. That is, although movement of the air may be disturbed due to the ventilation resistance of the raw material in the sintering trailer 130, the suction force that suctioned the air from the lower side of the sintering trailer 130 may increase to increase the amount of air that is reduced due to the ventilation resistance. Thus, the raw material may be smoothly sintered to improve productivity and quality of the sintered raw material, i.e., the sintered ore.

[0058] When the wind boxes disposed between the 1/2 point and the BTP are connected to the suction tube 151, the rest wind boxes except for the wind boxes between the 1/2 point and the BTP are connected to the suction chamber 191. However, a range of the wind boxes 140 connected to the suction tube 151 may not be limited and variously provided.

[0059] The second hood 154 is disposed above the sintering trailer 130 to supply the air suctioned from the suction

tube 151 to the raw material. The second hood 154 may be disposed at the rear side of the moving path when compared to the wind boxes connected to the suction tube 151. That is, one end of the second hood 154 may be disposed above the wind boxes disposed after a burn rising point (BRP) (a point at which the raw material is completely burnt) to the rearmost position. The second hood 154 may extend in a longitudinal direction and gradually increase in width from an upper portion to a lower portion thereof.

[0060] For example, a length of the extending portion of the second hood 154 may be greater than a value in which the number of the wind boxes 140 connected to the suction tube 151 $\times$ a length of a longitudinal direction of one wind box 140. Since the air suctioned through the suction tube 151 has a high temperature by absorbing the thermal energy of the thermal layer, the air may have a volume greater than that of the air having a general outside temperature. Here, since the volume of the air suctioned through the wind box 140 is limited, when an area to which the second hood 154 supplies the air or the number of wind boxes 140 covered by the second hood 154 is reduced, all of the air discharged from the second hood 154 may not be suctioned to the wind boxes thereunder, and a portion of the air may leak to the outside to cause the environmental pollution.

[0061] Since the number of wind boxes 140 disposed under the second hood 154 increases when the length of the extending portion of the second hood 154 increases, the wind boxes 140 disposed under the second hood 154 may sufficiently suction the air discharged from the second hood 154 to prevent the air discharged from the second hood 154 from leaking to the outside. Thus, the extending portion of the second hood 154 may have a length capable of covering above the wind boxes 140 more than the number of the wind boxes 140 connected to the suction tube 151. That is, the second hood 154 disposed above the wind boxes 140 may have a length for covering the number of wind boxes 140 in which the air discharged from the second hood 154 is sufficiently suctioned. However, the position and the length of the extending portion of the second hood 154 may not be limited thereto and variously provided. For example, an area on which the other end of the second hood 154 is disposed may overlap a portion of an area on which the wind boxes connected to the suction tube 151 are disposed. That is, the wind boxes connected to the suction tube 151 may overlap a portion of the wind boxes disposed under the second hood 154.

[0062] The second hood 154 may supply the air to the wind boxes disposed after the BRP to the rearmost position with respect to the moving path. That is, referring to FIG. 2, since the air suctioned from the wind boxes 140 disposed between the 1/2 point and the BTP contains moisture and has oxygen density lower than that of the outside air, when the air is supplied to the raw material in the section in which the combustion is performed, the combustion may be disturbed. Thus, the air suctioned between the 1/2 point and the BTP may be supplied to the raw materials at the rear side of the moving path where the combustion is almost or completely finished, for example, to the raw materials above the wind boxes 140 disposed after the BRP to the rearmost position. However, the position of the second hood 154 or the area and shape for supplying the air may not be limited thereto and variously provided.

[0063] The second connection line has one end that is connected to the suction tube 151 and the other end that is connected to the second hood 154. Also, the second connection line 153 defines a path through which the air introduced into the suction tube 151 flows therein. Thus, the air introduced into the suction tube 151 may be supplied to the second hood 154 through the second connection line 153 and then be discharged to the raw material thereunder.

[0064] The second blower 154 is disposed in the second connection line 153 to provide suction forces for suctioning the air to the wind boxes 140 connected to the suction tube 151. The number of wind boxes 140 receiving the suction forces from the second blower 152 is relatively low when compared to the main blower 193. Thus, even though the second blower 152 and the main blower 193 provide the same suction force, the wind boxes receiving the suction forces from the second blower 152 may have suction forces greater than those of the wind boxes received from the main blower 193, which are further divided. Thus, even though air permeability in the sintering trailers 130 above the wind boxes 140 connected to the second blower 152 is low, the wind boxes connected to the second blower 152 may provide a relatively large suction force when compared to the wind boxes connected to the main blower 183 to increase the amounts of air in the sintering trailers 130 connected to the second blower 152.

[0065] That is, since the air is suctioned with a relatively large suction force from a portion having relatively low air permeability, the amount of air may increase to improve quality of the produced sintered ore. However, the method of improving the suction force of the second blower 152 may not be limited thereto and various provided.

[0066] Like this, since the air generated during the sintering process, that is, the sintering flue gas, or the cooling gas generated while cooling the sintered ore, that is, the cooling flue gas circulates the upper portion of the sintering trailer 130 and is involved in the sintering, the flue gases may not be discharged to the outside as it is to prevent the environmental pollution from occurring. Also, these flue gases may have a lot of thermal energy while passing through the raw material, when the flue gases are supplied to the raw material while the raw material is sintered, combustion efficiency may be improved. Thus, an amount of sintered ore that is usably produced may increase versus the amount of used raw material to improve productivity.

[0067] FIG. 3 is a view of a sintering apparatus in accordance with another embodiment. Hereinafter, the sintering apparatus in accordance with another embodiment will be described.

[0068] When the raw material in the sintering trailer 130 is sintered, since the upper layer of the raw material contacts

the outside and loses thermal energy thereof by the outside air, a temperature rise in the upper layer may be difficult when compared to the lower layer of the raw material, and also, even though the temperature of the upper layer increases, time maintained in a high temperature state may be short. Thus, since the sintering reaction is not sufficiently performed in the upper portion of the raw material, the produced raw material may be deteriorated in quality and productivity.

Therefore, the sintering apparatus in accordance with another embodiment may further include a gas fuel supply part 160 in addition to the first circulation part 180 to supply a cooling gas having a high temperature and a gas fuel to the upper portion of the sintering trailer 130 moving in the sintering section. Here, the sintering apparatus in accordance with another embodiment may further include the second circulation part 150 in accordance with the foregoing embodiment.

[0069] Referring to FIG. 3, the gas fuel supply part 160 is connected to the first circulation part 180 to supply the fuel gas to allow the fuel gas to be mixed with the cooling gas and then supply the mixed gas to the upper portion of the sintering trailer 130. The gas flue supply part 160 may define a path through which the gas fuel moves therein. The gas fuel supply part 160 may include a fuel supply line 161 connected to the first connection tube 181 and a control valve 162.

[0070] The fuel supply line 161 defines a path through which the gas fuel moves and has one end that communicates with the first connection tube 181. Thus, the gas fuel moving through the fuel supply line 161 is introduced into the first connection tube 181 and mixed with the cooling gas moving through the first connection tube 181. Also, the gas fuel and the cooling gas mixed with each other may move through the first connection tube 181 and then be supplied to the upper portion of the sintering trailer 130 through the first hood 183.

[0071] The control valve 162 may be disposed in the fuel supply line 161 to control movement of the gas fuel. Thus, when an operation of the control valve 162 is controlled, an amount of gas fuel supplied to the upper portion of the sintering trailer 130 or time in which the gas fuel is supplied may be adjusted.

[0072] Here, as the gas fuel, at least one of LNG, LPG, coke oven gas (COG), blast furnace gas (BFG), carbon monoxide (CO), and hydrogen (H₂) may be used. These gas fuels may be supplied to the raw material in the sintering trailer 130 to control the combustion process of the raw material. That is, time in which the raw material is burnt may increase by the gas fuel supplied to the upper portion of the raw material. Thus, the raw material may easily increase in temperature due to the increase of the combustion time. Also, time in which the raw material is maintained in a high temperature may increase. However, the gas fuel is not limited thereto, and various gas type fuels having combustibility may be used.

[0073] Also, the gas fuel may be diluted at concentration less than the lowest limit of combustion concentration and then be supplied. That is, the gas fuel has to be supplied to the upper portion of the sintering trailer 130 and burnt to allow the raw material to be easily sintered. However, if the gas fuel is supplied to the upper portion of the sintering trailer 130 after being mixed with the cooling gas having a high temperature in the first connection tube 181 and burnt, the gas fuel may not help the sintering of the raw material. Thus, in order to prevent the gas fuel from being mixed with the cooling gas and burnt before being supplied to the upper portion of the sintering trailer 130, the gas fuel may be diluted at concentration less than the lowest limit of combustion concentration. Thus, even though the gas fuel is mixed with the cooling gas having a high temperature in the first connection tube 181, the gas fuel may be supplied to the upper portion of the sintering trailer 130 without being burnt and then be burnt by flames in the raw material to allow the raw material to be easily sintered.

[0074] The lowest limit of combustion concentration of the gas fuel may vary according to temperatures. That is, as the gas fuel increases in temperature, the lowest limit of combustion concentration may gradually decrease. Also, as the gas fuel decreases in temperature, the lowest limit of combustion concentration may gradually increase. For example, when LNG is used as the gas fuel, the lowest concentration limit of combustion of the LNG is about 4.2% at a temperature of about 200°C. Also, the lowest concentration limit of combustion of the LNG is about 3.6% at a temperature of about 400°C. Also, the lowest concentration limit of combustion of the LNG is about 2.9% at a temperature of about 600°C.

[0075] Like this, since the lowest limit of combustion concentration of the gas fuel varies according to temperature conditions, the lowest limit of combustion concentration of the gas fuel has to be diluted according to temperature conditions. Thus, a temperature of the cooling gas that most affects the temperature of the gas fuel by being mixed with the gas fuel has to be measured, and the lowest limit of combustion concentration of the gas fuel has to be adjusted according to the temperature of the cooling gas. That is, when the cooling gas has a high temperature, even though a relatively small amount of gas fuel is supplied, the combustion may be easily performed. Also, when the cooling gas has a low temperature, the combustion may be performed only when a relatively large amount of gas fuel is supplied. Thus, the lowest limit of combustion concentration of the gas fuel corresponding to the temperature of the cooling gas has to be checked, and then the lowest limit of concentration of the gas fuel has to be diluted, and the diluted gas fuel has to be supplied to the raw material. Here, the cooling gas may have a temperature of about 100°C to about 300°C. However, the temperature of the cooling gas may not be limited and variously provided.

[0076] Like this, since the gas fuel and the cooling gas having a high temperature are supplied to the raw material, while the raw material is sintered, the combustion may be easily performed from the upper portion to the lower portion of the raw material, and the raw material may be maintained in a high temperature for a long time. Thus, the raw material

may be improved in quality, and the amount of raw material useably produced may increase versus the used raw material to improve productivity.

[0077] FIG. 4 is a view of a sintering apparatus in accordance with further another embodiment. Hereinafter, a gas fuel supply part of a sintering apparatus in accordance with further another embodiment will be described.

[0078] Referring to FIG. 4, a gas fuel supply part 160 in accordance with further another embodiment may include a fuel supply line 161 defining a path through which a gas fuel moves therein and having one end that is connected to the first hood 183, a spray unit 163 disposed on one end of the fuel supply line 161 to spray the gas fuel to the upper portion of the sintering trailer, and a control valve 162.

[0079] The fuel supply line 161 may be directly connected to the first hood 183. For example, the fuel supply line 161 may have one end passing through the first hood 183 and thus be connected to the first hood 183. Thus, the gas fuel supplied to the fuel supply line 161 may be mixed with the cooling gas supplied through the first connection tube 181 in the first hood 183 and then be supplied to the sintering trailer 130. Also, the control valve 162 is disposed in the fuel supply line 161 to control the movement of the gas fuel. Thus, when the operation of the control valve 162 is controlled, the amount of gas fuel supplied to the sintering trailer 130 or time in which the gas fuel is supplied may be adjusted.

[0080] The spray unit 163 may be disposed in the first hood 183 and connected to the one end of the fuel supply line 161 passing through the first hood 183 and thus be supported. For example, the spray unit 163 may include a plurality of nozzles disposed along the moving path. Or, the spray unit 163 may include a body part having a space to which the gas is introduced. Here, a plurality of spray holes are defined in a lower portion of the body part to spray the gas fuel. That is, the spray unit 163 may be a showerhead type spray unit to spray the gas fuel. Thus, the gas fuel moving to the spray unit 163 through the fuel supply line 161 may be discharged to the upper portion of the sintering trailer 130 through the nozzle. However, the structure of the spray unit 163 and the method of supplying the gas fuel to the upper portion of the sintering trailer 130 may not be limited thereto and variously provided.

[0081] The gas fuel may extend the combustion time of the raw material, and the cooling gas having a high temperature may provide thermal energy to the raw material. Thus, since the gas fuel and the cooling gas having a high temperature are supplied to the raw material, the combustion may be easily performed from the upper portion to the lower portion of the raw material while the raw material is sintered, and the raw material may be maintained in a high temperature for a long time. Thus, the raw material may be improved in quality, and the amount of raw material useably produced may increase versus the used raw material to improve productivity.

[0082] FIG. 5 is a flowchart showing a sintering method in accordance with an embodiment. Hereinafter, a sintering method in accordance with an embodiment will be described.

[0083] Referring to FIG. 5, the sintering method in accordance with an embodiment is a method of manufacturing the sintered ore. The sintering method includes a process (S100) for inserting the raw material in the sintering trailer moving along the moving path, a process (S200) for igniting the raw material, a process (S300) for suctioning the air downward from the raw material, a process (S400) for discharging the sintered ore and supplying the cooling gas to the sintered ore, and a process for supplying at least one of the cooling gas supplied to the sintered ore to the raw material in the sintering trailer. Here, in the process for supplying the cooling gas to the raw material, the cooling gas may be supplied to the upper portion of the wind boxes disposed before the 1/2 point of the moving path. Also, the moving path may be the same as that described in the sintering apparatus 100.

[0084] First, the plurality of sintering trailers 130 may successively pass through a lower side of the insertion part 120. The raw material is inserted into each of the plurality of sintering trailers 130 through the insertion part 120 to form a raw material layer. When the plurality of sintering trailers 130 successively pass through a lower side of the ignition furnace 110, the flames are ignited on the upper portion of the raw material layer by the ignition furnace 110, and each of the sintering trailers 130 sinters the raw material through the sintering section. That is, while the sintering trailer 130 moves the sintering section, the flames on the upper portion of the raw material layer may move downward by the suction force of the wind box 140 in the sintering section to burn the raw material, thereby manufacturing the sintered ore. The completely sintered raw material, that is, the sintered ore may be discharged from the sintering trailer 130 and transferred to the cooler 172 and then be cooled by the cooling gas supplied from the cooler 172.

[0085] Here, a portion of the suctioned air may be supplied to the raw material in the sintering trailer 130. Particularly, the air may be suctioned in an area between the 1/2 point of the moving path of the sintering trailer 130 and the BTP where the air suctioned into the wind box 140 has the maximum temperature.

[0086] Since the ventilation resistance in the raw material is relatively high on the area between the 1/2 point of the moving path and the BTP, the amount of air decreases to the minimum and then increases again. The amount of air passing through the raw material may decrease by the wind box 140 on the area having a relatively high ventilation resistance, and thus the sintering process may not be smoothly performed. Thus, when the wind boxes disposed between the 1/2 point of the moving path and the BTP are connected to the suction tube 151 of the second circulation part 150, and the air above the wind boxes connected to the suction tube 151 is suctioned through the second blower 152, a relatively large suction force may be provided when compared to a case in which the main blower 193 provides a suction force to the entire wind boxes.

[0087] Thus, even though the combustion zone between the 1/2 point and the BTP has a high ventilation resistance, the suction force provided from the second blower 152 is relatively high, and thus a phenomenon in which the amount of air in the sintering trailer 130 decreases between the 1/2 point and the BTP may be minimized. Thus, the raw material may be smoothly sintered to improve quality of the sintered ore.

[0088] The air introduced into the suction tube 151 through the wind box 140 is discharged to the raw material under the second hood 154 through the second hood 154 disposed above the sintering trailer 130. The second hood 154 may supply the air to the wind boxes disposed after the BRP to the rearmost position with respect to the moving path. Since the air suctioned from the wind box 140 between the 1/2 point and the BTP contains moisture and has oxygen density lower than that of the outside air, when the air is supplied to the raw material in the section in which the combustion is performed, the combustion may be disturbed. Thus, the air may be supplied to the rear side of the moving path after the BRP where the combustion is almost or completely finished. That is, since the combustion is finished after the BRP, even though the air containing moisture and having relatively low oxygen density is supplied to the sintering trailer 130 after the BRP, it may not affect the sintering process.

[0089] Here, the number of wind boxes 140 more than that of the wind boxes which sufficiently suction the air discharged from the second hood 154 has to be disposed under the second hood 154. For example, when the air discharged from the second hood 154 is not sufficiently suctioned into the wind boxes under the second hood 154, the air that is not suctioned may leak to the outside to contaminate the environment. Thus, the length of the second hood 154 in the longitudinal direction or the number of the wind boxes 140 covered by the second hood 154 has to be adjusted in consideration of the amount of air suctioned by being connected to the suction tube 151.

[0090] The cooling gas generated after cooling the completely sintered raw material may circulate through the first circulation part 180 and thus be reused. Also, the gas fuel supply part 160 may be connected to the cooling gas circulation part 180 to allow the cooling gas to be mixed with the gas fuel to supply the mixed gas to the raw material in the sintering trailer 130. In particular, the cooling gas and the gas fuel may be supplied to the upper portion of the sintering trailer 130 moving after the point at which the raw material is ignited of the moving path to the 1/2 point of the moving path.

[0091] In this section, the combustion zone is disposed on the sintering layer of the raw material. Thus, when the cooling gas having a high temperature that absorbs the thermal energy by cooling the raw material is supplied to the upper portion of the raw material in the section between the ignition furnace 110 and the 1/2 point through the first hood 183 of the first circulation part 180, the cooling gas may supply the thermal energy to the raw material while passing through the raw material to allow the raw material to be easily burnt. Thus, the combustion efficiency may increase to improve the productivity, and the amount of raw material useably produced may increase versus the used raw material. Also, the cooling gas absorbing the thermal energy may be reused to reduce the energy consumption.

[0092] Here, the temperature of the cooling gas is measured, and when the temperature of the cooling gas is above a preset temperature, the first circulation part 180 may supply the cooling gas to the raw material. For example, the preset temperature may be about 100 °C. That is, when the temperature of the cooling gas is too low, the cooling gas may take heat from the raw material while passing through the raw material to disturb the combustion of the raw material. Thus, in order to easily perform the combustion of the raw material, the cooling gas having sufficient thermal energy, for example, only a cooling gas having a temperature of about 100°C capable of evaporating moisture in the raw material may be supplied to the raw material.

[0093] Thus, when the temperature of the cooling gas suctioned into the first circulation part 180 is measured, and the temperature of the cooling flue gas is compared with the preset temperature, if the temperature of the cooling flue gas is higher than the preset temperature, the operation of the first blower 182 is controlled to supply the cooling gas to the raw material through the first hood 183. If the temperature of the cooling flue gas is less than the preset temperature, the operation of the first blower 182 may be controlled to stop supply of the cooling gas to the first hood 183 to prevent the cooling gas from being supplied to the raw material. However, the preset temperature may not be limited thereto and various provided.

[0094] Also, the gas fuel supply part 160 may be connected to the first circulation part 180 to supply the cooling gas and the gas fuel to the sintering trailer 130. The gas fuel supply part 160 is connected to the first hood 183 or the first connection tube 181 of the first circulation part 180. Thus, when the gas fuel supply part 160 supplies the gas fuel, the gas fuel is supplied to the first hood 183 or the first connection tube 181 and mixed with the cooling gas moving through the first hood 183 or the first connection tube 181. Also, the mixed cooling gas and the gas fuel may be supplied to the raw material in the sintering trailer 130 to allow the raw material to be easily burnt.

[0095] While the gas fuel is mixed with the cooling gas, the gas fuel may be supplied before the cooling gas is supplied, at the same time when the cooling gas is supplied, or after the cooling gas is supplied. That is, the cooling gas may be supplied while firstly supplying the gas fuel to the sintering trailer 130 through the first connection tube 181 or the first hood 183, or the gas fuel and the cooling gas may be simultaneously supplied. Or, the gas fuel may be supplied while firstly supplying the cooling gas. However, an order in which the gas fuel and the cooling gas are supplied may not be limited thereto and variously provided.

[0096] The gas fuel may extend the combustion time of the raw material, and the cooling gas having a high temperature

may provide the thermal energy to the raw material. That is, when the gas fuel is supplied to the top surface of the raw material in the sintering trailer 130, the gas fuel may meet the flames generated due to the ignition part 110 in the raw material and be burnt. Since the combustion of the gas fuel increases the temperature of the raw material, a temperature of the upper portion of the raw material contacting the outside may easily increase. Also, the gas fuel supplied downward

from the upper portion of the raw material may be supplied to a central portion or the lower portion of the raw material and then be burnt when the flames in the raw material moves downward, to increase combustion efficiency in the raw material. Also, during this process, since the cooling gas having a high temperature is supplied to supply the thermal energy to the raw material, it may help the combustion of the raw material and prevent the temperature from being reduced.

[0097] Thus, since the gas fuel and the cooling gas having a high temperature are supplied to the raw material, while the raw material is sintered, the combustion may be easily performed from the upper portion to the lower portion of the raw material, and the raw material may be maintained in high temperature for a long time. Thus, the raw material may be improved in quality, and the amount of raw material useably produced may increase versus the used raw material to improve productivity.

[0098] FIG. 6 is a view of a pot experimental device in accordance with an embodiment, and FIG. 7 is a graph showing a temperature variation in the sintering layer in accordance with an embodiment.

[0099] Hereinafter, the present disclosure will be described in detail with reference to an experimental example.

[0100] To check an effect in a case in which the cooling gas used to cool the sintered ore is supplied to the upper portion of the sintering layer, a case in which the cooling gas is supplied to the upper layer of the sintering layer (the embodiment) is compared with a case in which the cooling gas is not supplied (a comparative example) by using a pot 500 of FIG. 6.

[0101] That is, in the comparative example, the raw material 1 is put into the pot 500 and ignited to measure a temperature variation of the sintering layer. In the embodiment, the raw material 1 is put into the pot 500 and ignited, and the air having a high temperature of about 250 °C (the temperature of cooling gas) is blown in the pot 500 to measure the temperature variation of the sintering layer.

[0102] In accordance with an experimental condition of the comparative example, the raw material 1 is inserted into the pot 500 in height of about 900 mm. The raw material 1 has insertion density of about 1888 kg/m³ and a negative pressure of about 1700 mmAq. Ignition time is about 90 seconds, and an ignition temperature is about 1050 °C. Also, the temperature of the raw material 1 is measured at A, B, C, and D points, which are disposed at a distance of about 255 mm therebetween, from the upper layer to the lower layer of the raw material 1 in order.

[0103] In accordance with an experimental condition of the embodiment, the raw material 1 is inserted into the pot 500 in a height of about 900 mm. The raw material 1 has insertion density of about 1888 kg/m³ and a negative pressure of about 1700 mmAq. Ignition time is about 90 seconds, and an ignition temperature is about 1050°C. Also, the air (or the gas having a high temperature) having a high temperature is supplied to the upper layer of the raw material 1 for 4 minutes to 11 minutes. Here, the temperature of supplied air is about 250 °C (the temperature of the cooling gas), and an amount of blown air is about 322 L/min (2,382 Nm³/min). Also, the temperature of the raw material 1 is measured at A, B, C, and D points, which are disposed at a distance of about 255 mm therebetween, from the upper layer to the lower layer of the raw material 1 in order.

[0104] Referring to FIG. 7, when the air having a high temperature is supplied to the upper layer of the raw material, a high temperature area range at the A point in the embodiment increases when compared to a high temperature area range in the comparative example, and the maximum temperature in the embodiment increases as well.

[0105] Also, in the embodiment, although a sintering speed (or sintering time) of the raw material at the A point is longer than that of the raw material in the comparative example, the sintering speed of the raw material increases after the B point. This is because that since the air having a high temperature is blown in, a removing speed of a humid zone increases, and thus the ventilation resistance of the sintering layer decreases. Or, the sintering speed may decrease because the air permeability is improved due to improvement of the sintering quality of the upper layer of the raw material to increase a flow rate of the suctioned air. Also, in the embodiment, the high temperature area range increases at the entire points of A to D when compared to the comparative example. Thus, time to finally reach the BTP in the embodiment is reduced when compared to the comparative example, and thus, the raw material is further efficiently burnt. Thus, the sintered ore may be improved in quality from the upper layer to the lower layer thereof.

[0106] Also, the temperature of the flue gas in the embodiment is higher than that of the flue gas in the comparative example. When the temperature of the flue gas decreases less than a temperature of about 130 °C, moisture may be condensed to allow the tube suctioning the flue gas to be corroded. Thus, the flue gas has to be maintained in a temperature above about 130°C. Here, since the flue gas in the embodiment has a relatively high temperature, the flue gas may be easily maintained in a temperature above about 130°C. Thus, the corrosion of the tube suctioning the flue gas may be prevented.

[0107] BTP reach time, a BTP temperature, and a sintering speed of the comparative example and the embodiment are shown in the following Table 1.

[Table 1]

	Comparative example	Embodiment
BTP Reach time	35 min. 27 sec.	34 min. 31 sec.
BTP Temperature	457.5 °C	480.1 °C
Sintering speed	25.4 mm/min	26.1 mm/min

[0108] Thus, referring to FIG. 7 and Table 1, when the cooling gas having a high temperature which cools the sintered ore is supplied to the upper portion of the sintering layer, it may be seen that the sintering is performed at a higher temperature and faster speed. Thus, when the cooling gas having a high temperature is supplied to the upper portion of the raw material, the sintered ore may be improved in quality, and an energy reduction effect may be secured. Also, since the dusts in the cooling gas is removed themselves during the combustion process, the environmental pollution due to the dusts may be prevented.

[0109] In accordance with the embodiments, the cooling gas having a high temperature and the gas fuel may be supplied to the upper portion of the raw material to control the combustion process of the raw material. The gas fuel may increase the time in which the raw material is burnt. Thus, the temperature of the raw material may easily increase, and the time in which the raw material is maintained in a high temperature may increase. Thus, the raw material may be improved in quality, and the amount of raw material useably produced may increase versus the used raw material to improve productivity.

[0110] Also, the cooling flue gas generated during the sintering process or the cooling gas generated while the sintered ore is cooled may circulate to the upper portion of the sintering trailer and be involved to the sintering. When these flue gases are supplied to the raw material during the process for sintering the raw material, combustion efficiency may be improved, and a phenomenon in which the upper portion of the sintering layer is cooled due to the outside air may be restrained or prevented. Thus, the amount of sintered ore useably produced may increase versus the used raw material to improve productivity.

[0111] Also, although the amount of air in the sintering trailer decreases while the sintering is performed, an amount of air of the portion where the amount of air decreases may increase to improve quality of the sintered ore.

[0112] Although the sintering apparatus and the sintering method have been described with reference to the specific embodiments, they are not limited thereto. Therefore, it will be readily understood by those skilled in the art that various modifications and changes can be made thereto without departing from the spirit and scope of the present invention defined by the appended claims.

Claims

1. A sintering apparatus comprising:

a plurality of sintering trailers movably disposed along a moving path and in which a raw material is inserted therein;
 an ignition furnace disposed above the sintering trailers to spray flames to a top surface of the raw material;
 a wind box provided in plurality under the sintering trailers along the moving path to suction air downward from the sintering trailers to sinter the raw material;
 a cooler disposed on one side of the moving path to supply a cooling gas to a sintered ore discharged from each of the sintering trailers; and
 a first circulation part connected to the cooler to supply at least one portion of the cooling gas supplied to the raw material to an upper portion of the sintering trailer.

2. The sintering apparatus of claim 1, further comprising a gas fuel supply part connected to the first circulation part to supply a gas fuel to the first circulation part.

3. The sintering apparatus of claim 1, wherein the first circulation part comprises:

a first hood disposed above the sintering trailers to extend along the moving path;
 a first connection line having one end that is connected to the cooler and the other end that is connected to the first hood; and

a first blower disposed in the first connection line.

4. The sintering apparatus of claim 1 or 2, further comprising a second circulation part connected to one portion of the wind boxes to supply the air suctioned into the portion of the wind boxes to the upper portion of the sintering trailers, wherein the moving path comprises:

an insertion section in which the raw material is inserted into the sintering trailer;
an ignition section in which the raw material is ignited by the ignition furnace; and
a sintering section in which the raw material is sintered,
wherein the first and second circulation parts supply the suctioned air or cooling gas to the sintering section.

5. The sintering apparatus of claim 4, wherein the second circulation part comprises:

a suction tube connected to one portion of the wind boxes, the suction tube defining a space in which the air is accommodated therein;
a second hood disposed above the sintering trailers to extend along the moving path;
a second connection line having one end that is connected to the suction tube and the other end that is connected to the second hood; and
a second blower disposed in the second connection line.

6. The sintering apparatus of claim 5, wherein the first hood disposed in the first circulation part is disposed between the ignition furnace and the second hood, and
the first hood is disposed above the wind boxes that are disposed before 1/2 point of the moving path.

7. The sintering apparatus of claim 5, wherein the second hood has one end that is disposed between upper sides of the wind boxes disposed after a point at which the raw material is completely burnt to the rearmost position on the moving path.

8. The sintering apparatus of claim 5, wherein a length of an extending portion of the second hood is greater than a value in which the number of the wind boxes connected to the suction tube $\times$ a length of one wind box.

9. The sintering apparatus of claim 5, wherein the suction tube is connected to the wind boxes disposed between the 1/2 point of the moving path and a point at which the suctioned air has the maximum temperature.

10. The sintering apparatus of claim 2, wherein the moving path comprises:

an insertion section in which the raw material is inserted into the sintering trailer;
an ignition section in which the raw material is ignited; and
a sintering section in which the raw material is sintered,
wherein the first circulation part and the gas fuel supply part supply the cooling gas and the gas fuel to the sintering section.

11. The sintering apparatus of claim 10, wherein the gas fuel supply part comprises a connection supply line defining a path through which the gas fuel moves therein, and
the connection supply line is connected to a first connection line disposed in the first circulation part.

12. The sintering apparatus of claim 10, wherein the gas fuel supply part comprises:

a fuel supply line defining a path through which the gas flue moves therein, the fuel supply line having one end that is connected to a first hood of the first circulation part; and
a spray unit disposed on one end of the fuel supply line to spray the gas fuel to the upper portion of the sintering trailer.

13. The sintering apparatus of claim 10, wherein the gas fuel is diluted at concentration less than the lowest concentration limit of combustion.

14. A sintering method of manufacturing a sintered ore, the sintering method comprising:

inserting a raw material into a sintering trailer moving along a moving path;
igniting the raw material;
suctioning air downward from the raw material;
discharging the sintered ore to supply a cooling gas to the sintered ore; and
supplying at least one of the cooling gas supplied to the sintered ore to the raw material in the sintering trailer,
wherein, in the supplying of the cooling gas to the raw material, the cooling gas is supplied to an upper side of
a wind box disposed before 1/2 point of the moving path.

15. The sintering method of claim 14, wherein the supplying of the cooling gas to the raw material in the sintering trailer comprises:

measuring a temperature of the cooling gas; and
supplying the cooling gas to the raw material when the temperature of the cooling gas is higher than a preset temperature.

16. The sintering method of claim 14, further comprising mixing a gas fuel with the cooling gas to supply the mixed gas to the raw material after the cooling gas is supplied to the raw material in the sintering trailer.

17. The sintering method of claim 14 or 16, further comprising supplying one portion of the suctioned air to the raw material in the sintering trailer after the air is suctioned downward from the raw material.

18. The sintering method of claim 17, wherein, in the supplying of the one portion of the suctioned air to the raw material in the sintering trailer, the air is suctioned in an area between the 1/2 point of the moving path and a point at which the suctioned air has the maximum temperature.

19. The sintering method of claim 16, wherein, in the mixing of the gas fuel, the gas fuel is supplied before the cooling gas is supplied, at the same time when the cooling gas is supplied, or after the cooling gas is supplied.

20. The sintering method of claim 16, wherein, in the mixing of the gas fuel with the cooling gas to supply the mixed gas, the cooling gas and the gas fuel are supplied to the upper portion of the sintering trailer moving between after a point at which the raw material is ignited and the 1/2 point of the moving path.

FIG. 1

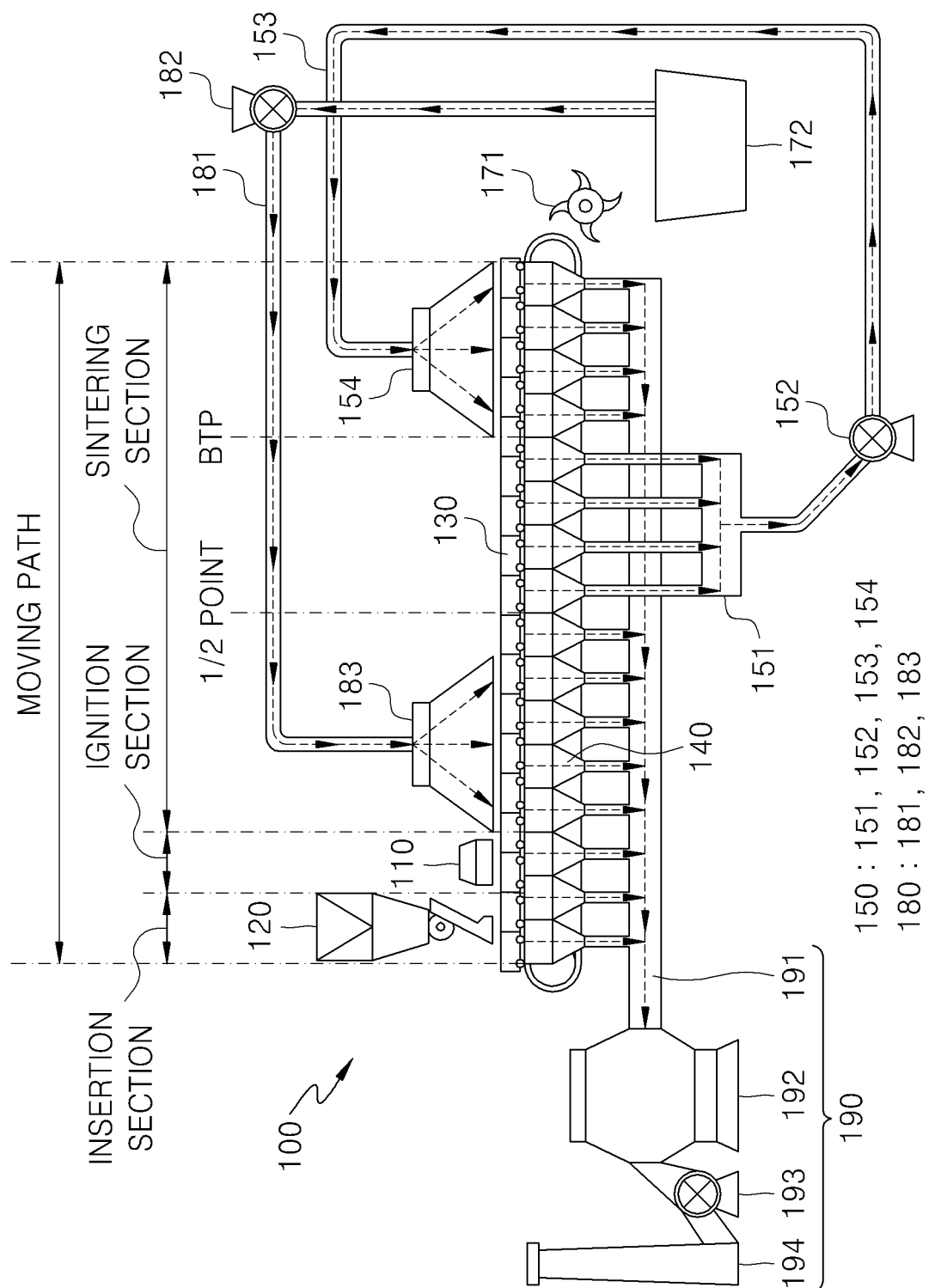


FIG. 2

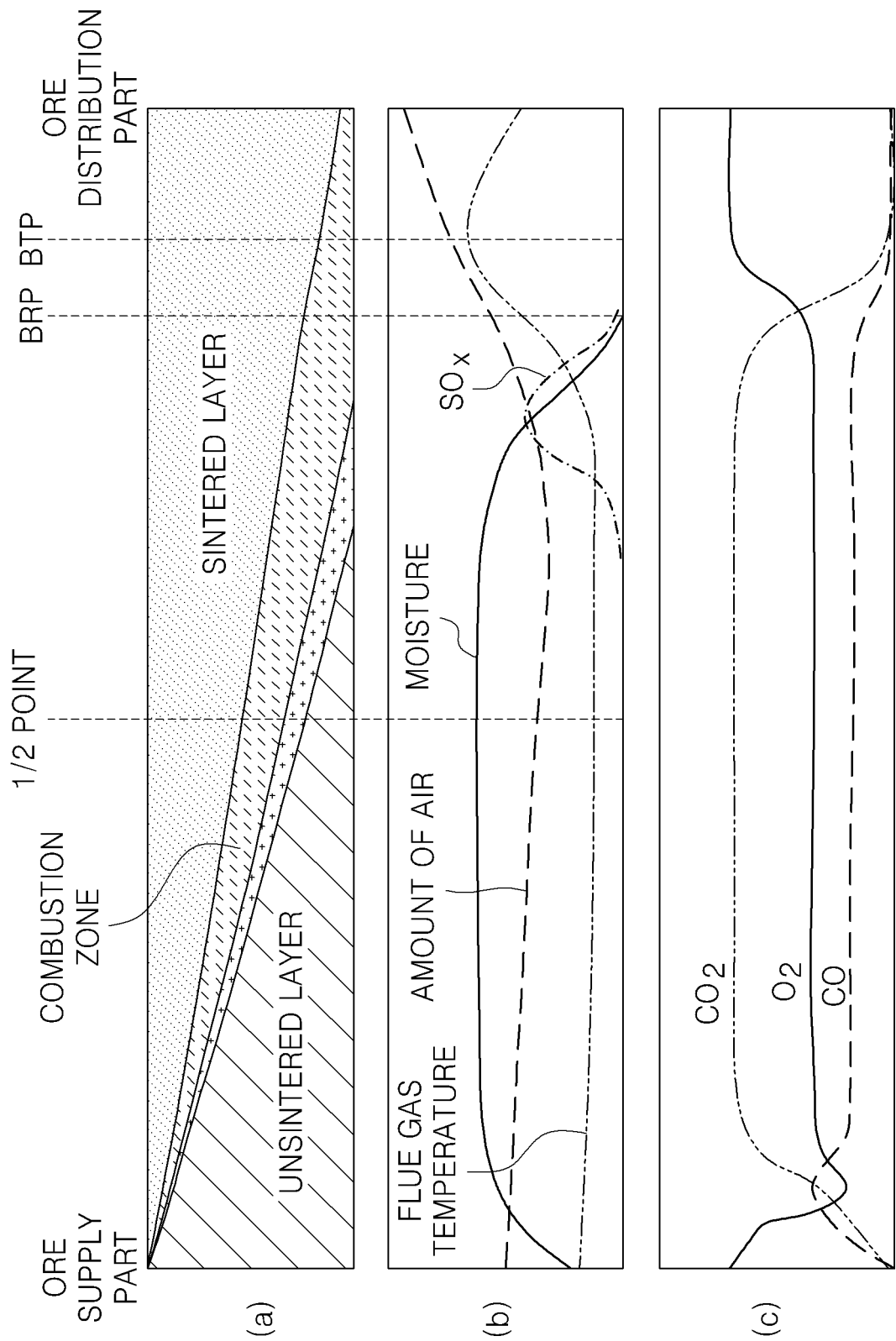


FIG. 3

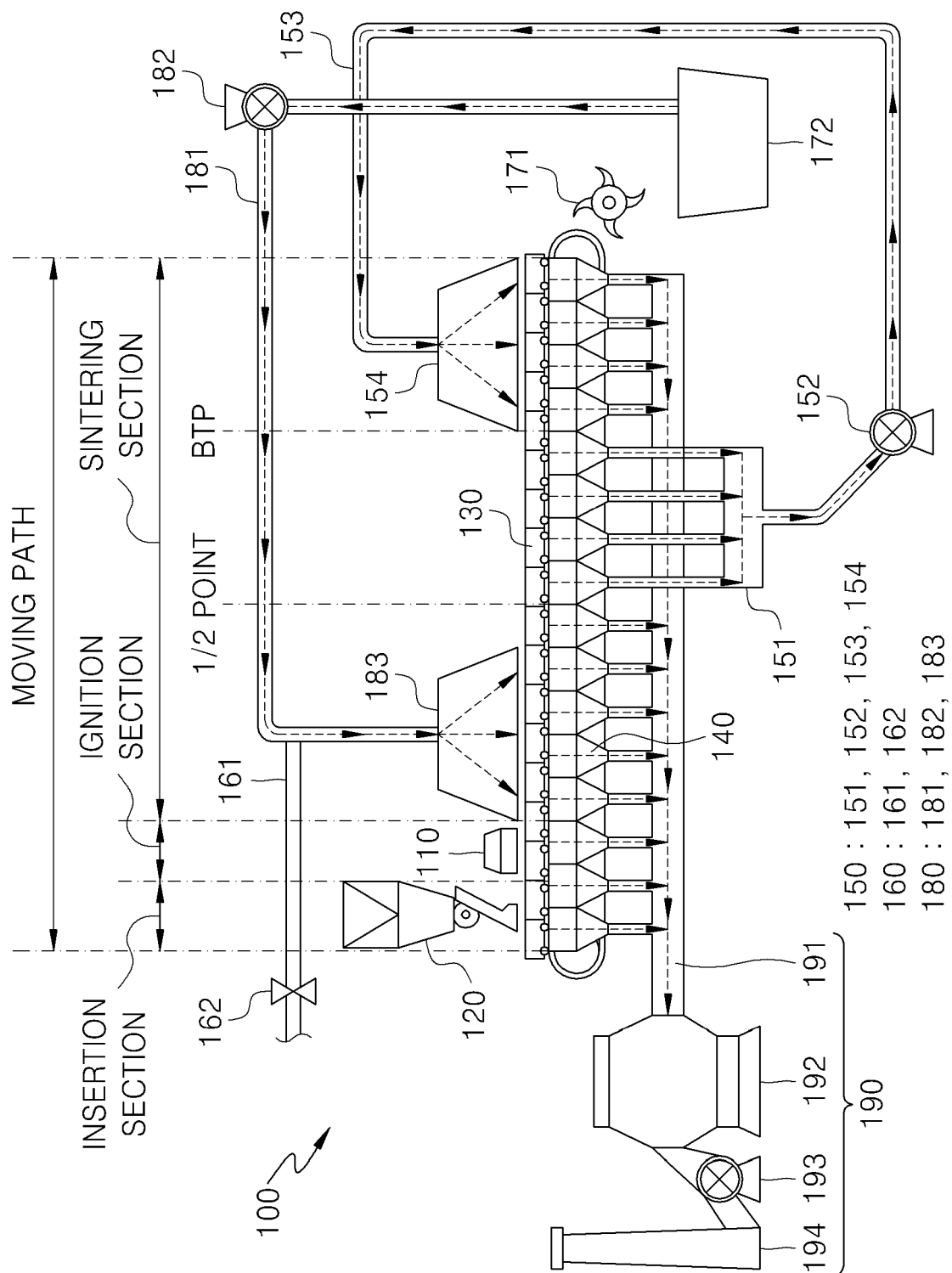


FIG. 4

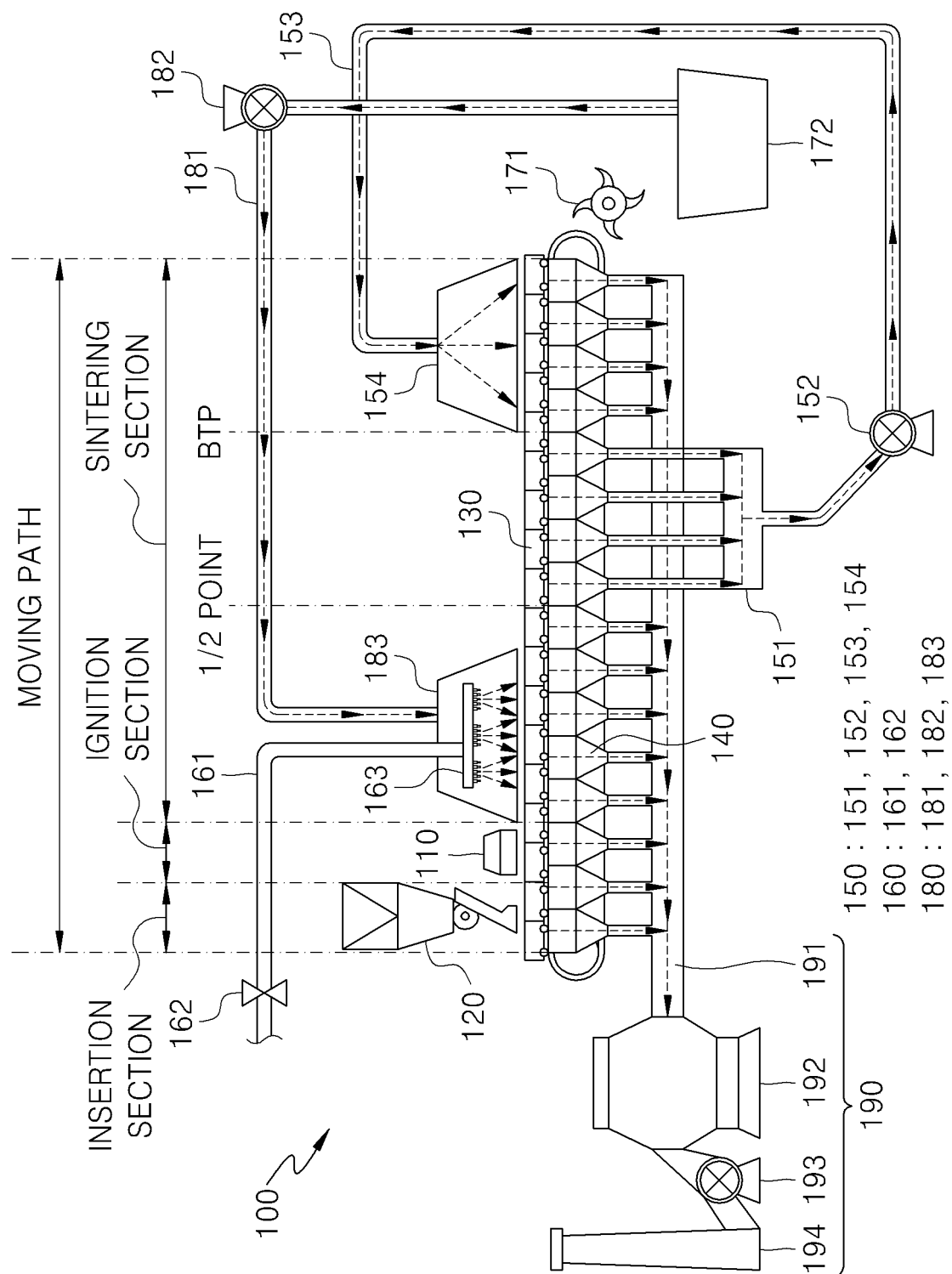


FIG. 5

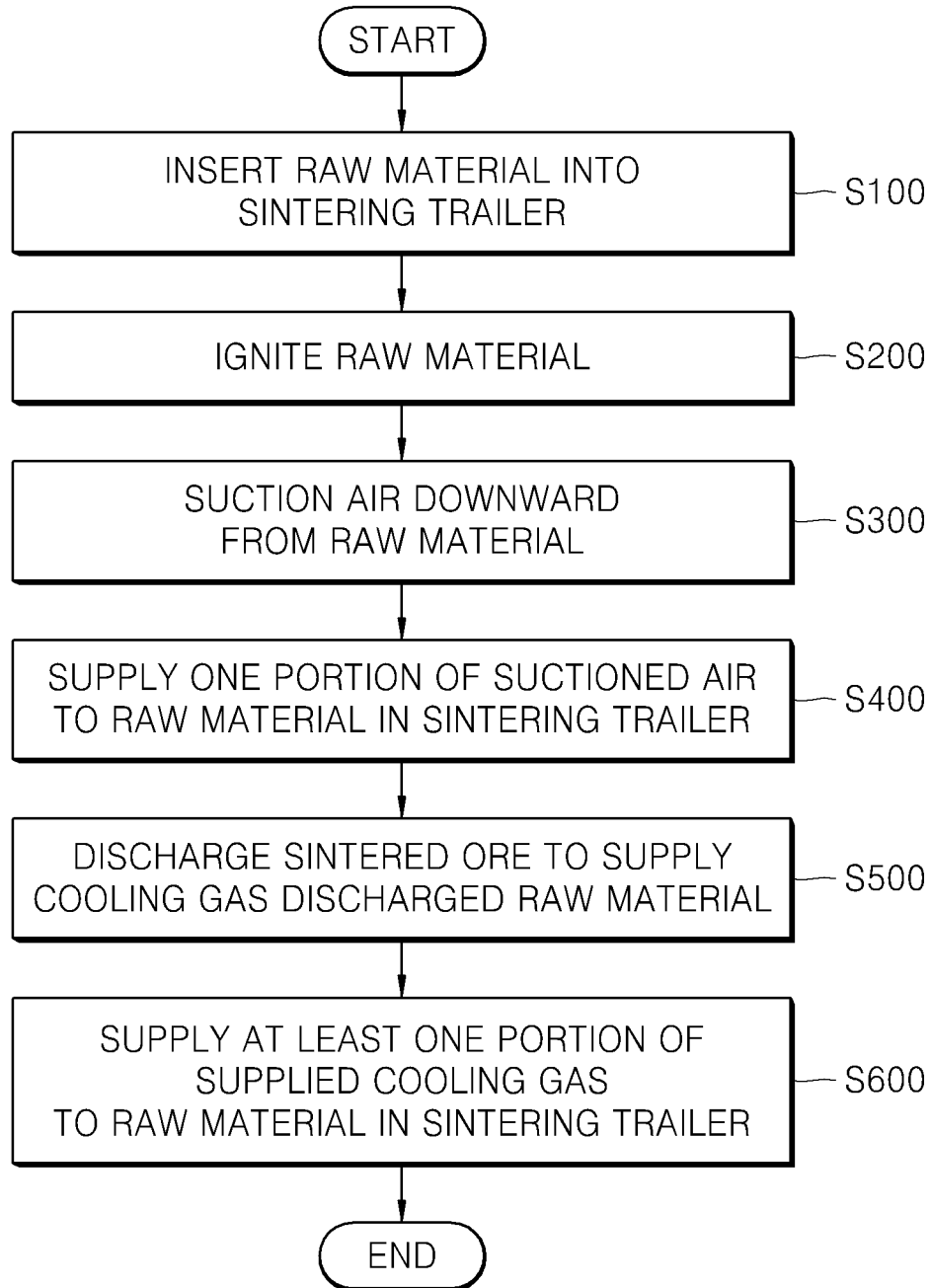


FIG. 6

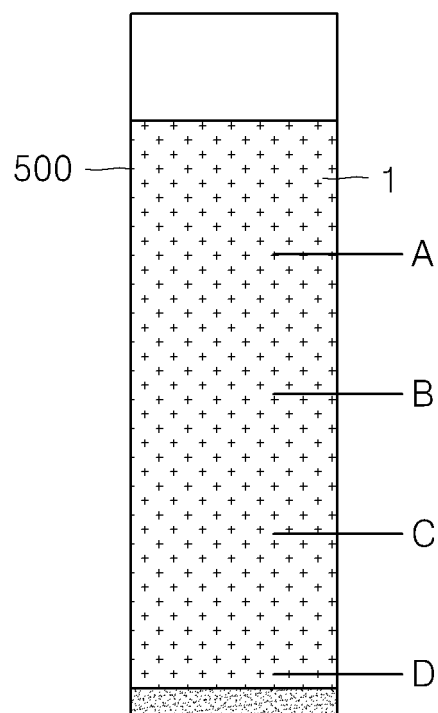
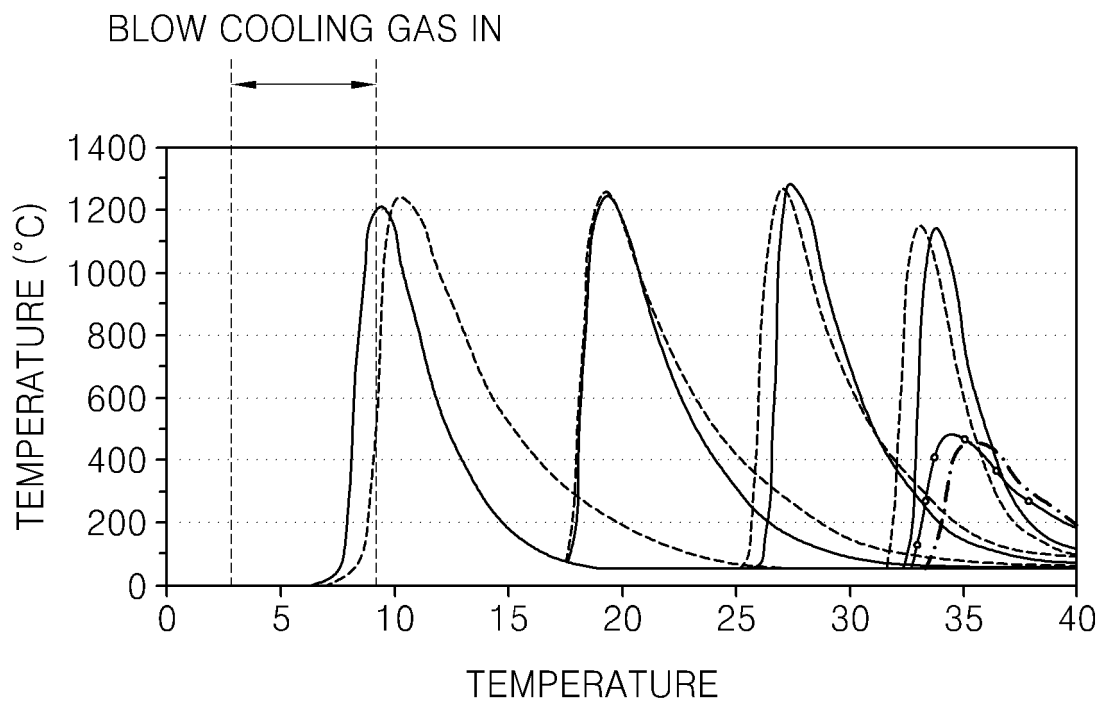


FIG. 7



- COMPARATIVE EXAMPLE
- - - EMBODIMENT
- · - · - COMPARATIVE EXAMPLE (FLUE GAS TEMPERATURE)
- · - · - ○ EMBODIMENT (FLUE GAS TEMPERATURE)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2015/009979

A. CLASSIFICATION OF SUBJECT MATTER

F27B 21/08(2006.01)i, F27B 21/10(2006.01)i, C22B 1/22(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 21/08; F27B 21/14; C22B 1/20; F27B 21/00; C22B 1/16; C22B 1/26; F27B 21/10; C22B 1/22

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

Korean Utility models and applications for Utility models: IPC as above

Japanese Utility models and applications for Utility models: IPC as above

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

eKOMPASS (KIPO internal) & Keywords: sintering, cooler, cooling, wind box, wind and frost, collection, circulation

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2010-132946 A (JFE STEEL CORP.) 17 June 2010 See paragraphs [0056]-[0061], claims 1, 2, 16 and figures 11, 12.	1-3, 10-16, 19, 20
Y		4-9, 17, 18
Y	KR 10-2013-0072877 A (POSCO) 02 July 2013 See paragraphs [0021]-[0031], [0035]-[0040], claims 1, 5 and figures 1, 2.	4-9, 17, 18
A	JP 2012-251698 A (JP STEEL PLANTECH CO.) 20 December 2012 See paragraph [0028], claims 1, 6 and figure 1.	1-20
A	JP 08-110170 A (SUMITOMO METAL IND. LTD.) 30 April 1996 See paragraphs [0009]-[0010], claim 1 and figure 1.	1-20
A	JP 06-330194 A (SUMITOMO METAL IND. LTD.) 29 November 1994 See paragraph [0014] and figure 1.	1-20

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

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Date of the actual completion of the international search

18 DECEMBER 2015 (18.12.2015)

Date of mailing of the international search report

22 DECEMBER 2015 (22.12.2015)

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/KR2015/009979

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JP 08-110170 A	30/04/1996	NONE	
JP 06-330194 A	29/11/1994	NONE	

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