



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

(43) Date of publication:
21.08.2019 Bulletin 2019/34

(51) Int Cl.:
C21B 13/14 (2006.01) **C21B 13/00** (2006.01)
C21B 5/00 (2006.01)

(21) Application number: **17862794.9**

(86) International application number:
PCT/KR2017/006682

(22) Date of filing: **26.06.2017**

(87) International publication number:
WO 2018/074700 (26.04.2018 Gazette 2018/17)

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

(72) Inventors:
• **KWON, Gi Woong**
Pohang-si
Gyeongsangbuk-do 37859 (KR)
• **YI, Sang-Ho**
Pohang-si
Gyeongsangbuk-do 37859 (KR)
• **KANG, Tae-In**
Pohang-si
Gyeongsangbuk-do 37859 (KR)

(30) Priority: **17.10.2016 KR 20160134326**

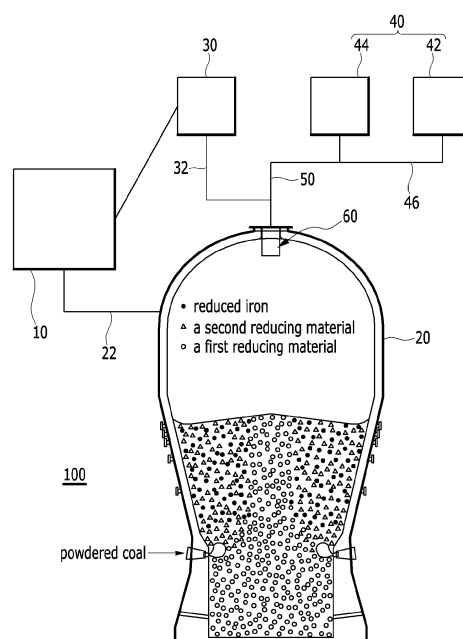
(71) Applicant: **Posco**
Pohang-si, Gyeongsangbuk-do 37859 (KR)

(74) Representative: **Zech, Stefan Markus**
Meissner Bolte Patentanwälte
Rechtsanwälte Partnerschaft mbB
Postfach 86 06 24
81633 München (DE)

(54) **METHOD FOR MANUFACTURING MOLTEN IRON AND APPARATUS FOR MANUFACTURING MOLTEN IRON USING SAME**

(57) Provided is a method of manufacturing molten iron by charging a raw material and a reducing material into a melting and gasifying furnace, blowing oxygen to manufacture molten iron, and supplying a reducing gas to a reducing furnace to reduce iron ore, comprises: a raw material preparation step of preparing a raw material; a reducing material preparation step of preparing a first reducing material which is pre-dried and a second reducing material which is not pre-dried without being mixed with each other as a reducing material; and a charging step of charging the raw material and the reducing material into the melting and gasifying furnace, wherein the charging step comprises a separation charging step of charging the first reducing material and the second reducing material into the melting and gasifying furnace without being mixed with each other, for improving the coal charging structure in the melting and gasifying furnace to stabilize the flow of the molten material and the reducing gas.

[Figure 1]



Description

[Technical Field]

[0001] The present invention discloses a molten iron manufacturing method which improves a fuel charging method and a molten iron manufacturing apparatus using the same.

[Background of the Invention]

[0002] Generally, about 60% of the world's iron production is produced through the blast furnace process developed from the 14th century. In the blast furnace process, iron ore and cokes are charged onto layers from the upper side of the blast furnace, and hot air and powdered coal are blown through the tuyere to produce molten iron. Cokes and powdered coal are used as a fuel or a reducing material, and cokes which is coal-dried is charged through the upper side of the blast furnace in the form of a lump, and the powdered coal which is not dried is supplied through the tuyere.

[0003] The so-called FINEX or COREX process is a direct iron ore smelting and reduction process for solving the problems of the blast furnace process. It directly uses ordinary coal as a fuel and reducing material, and directly uses iron ore as an iron source to the melting and gasifying furnace to produce molten iron. The coal used as a fuel is directly charged into the upper side of the melting and gasifying furnace in the form of lump, or coal in the form of powder is made into brequet and charged into the upper side of the melting and gasifying furnace. Powdered coal is blown through the tuyere of a blast furnace.

[0004] When the coal is heated above 500°C, volatile components are released through the carbonization process and become a char composed of fixed carbon and ash. The furnace temperature in the blast furnace is not as high as 200°C, but the temperature of the dome part is maintained at over 1000°C in the melting and gasifying furnace. Therefore, when undried coal is charged into the melting and gasifying furnace, during the process of releasing volatile components from bed and making a char, coal is divided into small particles.

[0005] If a small sized char is produced, the gas flow and melt flow in the melting and gasifying furnace deteriorate. Thus, the productivity and efficiency of the melting and gasifying furnace are lowered.

[0006] Conventionally, in order to increase the productivity and efficiency of the melting and gasifying furnace, coal is pre-dried and charged with coal and raw materials that have not been dry. In case of dry coal, the productivity in the melting and gasifying furnace can be increased because the division is relatively less than that of an undried coal.

[0007] In order to stabilize the operation of the melting furnace, the flow in which the high-temperature reducing gas generated from the combustion zone passes through the bed, heat-exchanges, reduces the raw material, and

then flows out to the dome portion, and the flow in which the melted material flows to the bottom of the melting and gasifying furnace and discharges to the iron notch should be stable.

[0008] However, for the conventional structure above, since the dried coal is mixed with the un-dried coal and the pores between the dried coal particles having a large size, which are not divided, are filled with un-dried coal particles having a small size, which are divided, there was a problem in that the size of the pores through which the gas and the melt can flow is reduced and the ratio of the pores is reduced to increase the resistance of the melting furnace bed and thus the flow of the reducing gas and the molten material is not smooth.

[0009] Therefore, the molten material cannot flow down to the bottom of the melting and gasifying furnace, so that the molten material fills the pores and the flow of the reducing gas is biased toward the reduced pores. As a result, the gas flow is not stabilized, so that the productivity is deteriorated and the operation cost is increased.

[Description]

[Problems to be solved]

[0010] A molten iron manufacturing method and a molten iron manufacturing apparatus using the same, which can stabilize the flow of the molten material and the reducing gas by improving the coal charging structure into the melting and gasifying furnace are provided.

[Means to Solve Problems]

[0011] In the embodiment, a method of manufacturing molten iron by charging a reduced material and a reducing material supplied from a reducing furnace into a melting and gasifying furnace, blowing oxygen to manufacture molten iron, and supplying a reducing gas to a reducing furnace to reduce iron ore, may include a reduced material preparation step of preparing a reduced material, a reducing material preparation step of preparing a first reducing material which is pre-dried and a second reducing material which is not pre-dried without being mixed with each other as a reducing material, and a charging step of charging the reduced material and the reducing material into the melting and gasifying furnace, wherein the charging step includes a separation charging step of charging the first reducing material and the second reducing material into the melting and gasifying furnace without being mixed with each other.

[0012] In the embodiment, a method of manufacturing molten iron by charging a reduced material and a reducing material supplied from a reducing furnace into a melting and gasifying furnace, blowing oxygen to manufacture molten iron, and supplying a reducing gas to a reducing furnace to reduce iron ore, may include: a reduced material preparation step of preparing a reduced material, a reducing material preparation step of preparing a

first reducing material having a relatively large size and a second reducing material having a relatively small size as a reducing material, and a charging step of charging the reduced material and the reducing material into the melting and gasifying furnace, wherein the charging step includes a separation charging step of charging the first reducing material and the second reducing material into the melting and gasifying furnace without being mixed with each other.

[0013] In the separation charging step, the first reducing material may be charged into the center of the melting and gasifying furnace and the second reducing material may be charged into the periphery of the melting and gasifying furnace.

[0014] The charging step may include a step of mixing the reduced material with the second reducing material to mix the reduced material with the second reducing material and charge to the periphery of the melting and gasifying furnace.

[0015] The reducing material preparation step may include a step of alternately discharging the first reducing material and the second reducing material from each of the first reducing material storage bin containing the first reducing material and the second reducing material storage bin containing the second reducing material and transferring, along the reducing material transferring line.

[0016] The charging step may sequentially charge the first reducing material and the second reducing material, which are alternately transferred to the melting and gasifying furnace, through a distributor installed in the melting and gasifying furnace.

[0017] The charging step may include a step of separating the first reducing material and the second reducing material and transferring to the melting and gasifying furnace, and a step of simultaneously charging the first reducing material and the second reducing material through a additional distributor installed in the melting and gasifying furnace.

[0018] In the embodiment, an apparatus for manufacturing a molten iron may include: a reducing furnace for reducing iron-containing material to convert to a reduced material; a melting and gasifying furnace manufacturing molten iron by charging a reduced material and a reducing material; a reduced material storage bin containing the reduced material converted in the reducing furnace; a reduced material transfer line for supplying the reduced material discharged from the reduced material storage bin to the melting and gasifying furnace; a reducing material storage bin containing a reducing material; a reducing material transfer line for supplying the reducing material discharged from the reducing material storage bin to the melting and gasifying furnace; and a distributor installed in the melting and gasifying furnace for charging the transferred reduced material and the lump carbon material into the melting and gasifying furnace,

[0019] The reducing material storage bin may include the first reducing material storage bin containing a first reducing material which is pre-dried and the second re-

ducing material storage bin containing a second reducing material which is not pre-dried and the first reducing material and the second reducing material are separately supplied, and wherein the distributor charges the first reducing material and the second reducing material into the melting and gasifying furnace without being mixed with each other.

[0020] In the embodiment, an apparatus for manufacturing a molten iron may include: a reducing furnace for reducing iron-containing material to convert to a reduced material; a melting and gasifying furnace manufacturing molten iron by charging a reduced material and a reducing material; a reduced material storage bin containing the reduced material converted in the reducing furnace; a reduced material transfer line for supplying the reduced material discharged from the reduced material storage bin to the melting and gasifying furnace; a reducing material storage bin containing a reducing material; a reducing material transfer line for supplying the reducing material discharged from the reducing material storage bin to the melting and gasifying furnace; and a distributor installed in the melting and gasifying furnace for charging the transferred reduced material and the lump carbon material into the melting and gasifying furnace,

[0021] The reducing material storage bin may include a first reducing material storage bin containing a first reducing material having a relatively large size, and a second reducing material storage bin containing a second reducing material having a relatively small size, and the first reducing material and the second reducing material are separately supplied and wherein the distributor charges the first reducing material and the second reducing material into the melting and gasifying furnace without being mixed with each other.

[0022] The distributor may be configured to charge the first reducing material to the center of the melting and gasifying furnace and the second reducing material to the periphery of the melting and gasifying furnace.

[0023] The reducing material storage bin may alternately discharge the first reducing material and the second reducing material by alternately opening and closing the first reducing material storage bin and the second reducing material storage bin, along the reducing material transfer line.

[0024] The apparatus may further include a charging material transfer pipe connected to the reduced material transfer line and the reducing material transfer line and installed in the melting and gasifying furnace to supply the reduced material and the lump carbon material to the distributor,

wherein the reduced material transfer line may be configured to be opened when the second reducing material is transferred to the charging material transfer pipe to supply the reduced material to the charging material transfer pipe and charge into the melting and gasifying furnace with the second reducing material.

[0025] The distributor may be configured to sequentially charge the first reducing material and the second

reducing material, which are alternately transferred through the charging material transfer pipe, to the melting and gasifying furnace.

[0026] The reducing material transfer line may further comprise an additional first transfer line transferring the first reducing material to separately transferring the first reducing material and the second reducing material through the first transfer line and the reducing material transfer line, and the apparatus may further comprise an additional first distributor installed in the melting and gasifying furnace and connected to the first transfer line to separate the first reducing material and the second reducing material by the first distributor and the distributor to simultaneously charge into the melting and gasifying furnace

[0027] The apparatus may further include a reducing gas supply line for supplying the reducing gas discharged from the melting and gasifying furnace to the reducing furnace.

[0028] The reducing furnace may be a fluidized bed type reducing furnace or a packed bed type reducing furnace.

[Effects of the Invention]

[0029] As described in the above, according to the present invention, the coal, that is pre-dried, may be charged to the center of the melting and gasifying furnace and the coal, that is not pre-dried, may be charged to the periphery of the melting and gasifying furnace to reduce the resistance against the flow of the molten material and the flow of the reducing gas and thus the flow may be smoothly maintained.

[0030] Accordingly, it is possible to increase the productivity by increasing the heat exchange efficiency while reducing the amount of fuel used in the melting and gasifying furnace.

[Brief Descriptions of the Drawings]

[0031]

FIG. 1 is a schematic view of showing an apparatus for manufacturing molten iron according to an embodiment of the present invention.

FIG. 2 is a schematic view of showing a structure for charging a charging material into a melting and gasifying furnace of a molten iron manufacturing apparatus according to an embodiment of the present invention.

FIG. 3 is a schematic cross-sectional view of showing a charge state of a charging material charged into the melting and gasifying furnace according to FIG. 2.

FIG. 4 is a schematic view of showing a structure for charging a charging material into a melting and gasifying furnace of a molten iron manufacturing apparatus according to another embodiment of the

present invention.

FIG. 5 is a schematic cross-sectional view of showing a charge state of a charging material charged into the melting and gasifying furnace according to FIG. 4.

[Detailed Descriptions of the Invention]

[0032] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to limit the invention. The singular forms as used herein include plural forms unless the phrases specifically state the opposite meaning thereof. The "comprises" means that a particular characteristic, region, integer, step, motion, element and/or component is specified and that does not exclude the presence or addition of other characteristics, regions, integers, steps, motions, elements, and/or components.

[0033] Hereinafter, embodiments of the present invention will be described with reference to the accompanying drawings so that those skilled in the art can easily carry out the present invention. It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the spirit or scope of the invention. Accordingly, the present invention may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein.

[0034] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to limit the invention. The singular forms as used herein include plural forms as long as the phrases do not specifically state the opposite meaning thereof. The "comprises" means that a particular characteristic, region, integer, step, motion, element and/or component is specified and that does not exclude the presence or addition of other characteristics, regions, integers, steps, motions, elements, and/or components.

[0035] In the following description, the iron-containing material may be iron itself or all materials including iron. For example, the iron-containing material may further include an additive. The iron-containing material may include iron ore. Iron may also be pure iron, iron oxide or reduced iron. The particle size of the iron-containing material may not be limited. Thus, the iron-containing material may include pellets, fine iron ore, iron ore assemblies, lump irons, and the like.

[0036] The reducing furnace means a manufacturing device by reducing the iron-containing material. The reducing furnace may include a fluidized-bed reducing furnace or packed-bed reducing furnace.

[0037] FIG. 1 schematically shows an apparatus for manufacturing molten iron according to the present embodiment. The molten iron manufacturing apparatus shown in Fig. 1 is merely for illustrating the present invention, and the present invention is not limited thereto. Therefore, the apparatus for manufacturing molten iron can be modified into another form.

[0038] The molten iron manufacturing apparatus 100 illustrated in Figure 1 includes a reducing furnace 10; a melting and gasifying furnace 20; a reduced material storage bin 30 for containing a reduced material discharged from the reducing furnace 10 and supplying the reduced material to the melting and gasifying furnace; a reduced material transfer line 32 for transferring the reduced material; a reducing material storage bin 40 for containing the lump carbon material as a reducing material; and a reducing material transfer line 46 for transferring the lump carbon material. Other devices may also be included if desired.

[0039] An iron-containing material is charged into the reducing furnace 10 to reduce the iron-containing material. The iron-containing material to be charged into the reducing furnace 10 is pre-dried and prepared. If necessary, a powdered raw material can be mixed. The iron-containing material is converted into a reduced material in the reducing furnace 10. The reducing furnace 10 may be a fluidized-bed reducing furnace or a packed-bed reducing furnace. The reducing furnace 10 is supplied with the reducing gas from the melting and gasifying furnace 20 through the reducing gas supply line 22 and reduces and fires the iron-containing material. The iron-containing material is converted into the reduced material through the reducing furnace 10. The reduced material may be manufactured as HCI (Hot Compacted Iron) by compression molding of a HCI manufacturing apparatus.

[0040] The melting and gasifying furnace 20 may manufacture a molten iron from the reduced material. For this, a reduced material is charged into the melting and gasifying furnace 20 together with the reducing material. As a reducing material, lump carbon materials may be used. In order to form a coal packed bed in the melting and gasifying furnace 20, a lump carbon material is prepared and charged into the melting and gasifying furnace 20. Examples of lump carbon materials may include lumpy coal or coal briquette. Coal briquette is manufactured by compression molding of powdered coal. In addition, cokes can be charged if necessary. The melting and gasifying furnace 20 has a structure in which a large number of tuyeres are installed on the outer wall. And oxygen is blown into the melting and gasifying furnace 20 through the tuyere.

[0041] At upper end of the dome portion of the melting and gasifying furnace 20, a charging material transfer pipe 50 connected to the reduced material transfer line 32 and the reducing material transfer line 46 to supply a reduced material and a lump carbon material to the melting and gasifying furnace 20 is installed. In addition, a distributor 60 connected to the charging material transfer pipe 50 for charging the reduced material and the lump carbon material into the melting and gasifying furnace 20 is installed inside the upper end of the melting and gasifying furnace 20.

[0042] As illustrated in Figure 2, the charging material transfer pipe 50 is vertically extended to the upper end of the dome portion of the melting and gasifying furnace

20 and the reduced material transfer line 32 and the reducing material transfer line 46 are connected along the charging material transfer pipe 50. The reduced material transfer line 32 and the reducing material transfer line 46 are respectively provided, on the exit side, with a reduced material discharging screw 39 and a reducing material discharging screw 49. They are connected to the charging material transfer pipe 50, for supplying the reduced material and reducing material in a fixed quantity or shutting off the supply.

[0043] If necessary, the reduced material discharge screw 39 is rotated, and the reduced material transferred along the reduced material transfer line 32 is supplied to the charging material transfer pipe 50 in a fixed amount. And when the reducing material discharging screw 49 is rotated, the reducing material transferred along the reducing material transfer line 46 is supplied to the charging material transfer pipe 50 in a fixed amount. The charging material transfer pipe 50 may mix the reduced material supplied through the reduced material transfer line 32 and the reducing material supplied through the reducing material transfer line 46 to supply the mixture to the distributor 60 connected to the lower end.

[0044] The distributor 60 may be, for example, a device (Gimbal Distributor) for controlling the distribution while charging raw materials and coal briquette in a molten iron manufacturing facility called FINEX. The distributor 60 may include a rotation chute for switching the direction of introduction of the raw material at the lower end and a driving unit for rotating the rotation chute and varying the tilting angle so as to vary the tilting angle of the rotation chute along the circumferential direction. Thus, the charging material is introduced into a desired region in the melting and gasifying furnace 20 by controlling the dropping position of the charging material.

[0045] The reduced material and the lump carbon material of the reducing material are supplied to the charging material transfer pipe 50 through the reduced material transfer line 32 and the reducing material transfer line 46 and are distributed and charged through the distributor 60 connected to the charging material transfer pipe 50, into the melting and gasifying furnace 20 to form a packed bed.

[0046] In the present embodiment, the lump carbon material of a reducing material may be divided into a lump carbon material that has been pre-dried and a lump carbon material that has not been pre-dried according to whether it has been pre-dried, and charged into the melting and gasifying furnace 20 without being mixed with each other.

[0047] To this end, in the molten iron manufacturing apparatus 100 of the present embodiment, the reducing material storage bin 40 may include a first reducing material storage bin 42 for containing the first reducing material which is pre-dried and a second reducing material storage bin 44 for containing the second reducing material which is not pre-dried. Thus, the first reducing material and the second reducing material are separately sup-

plied. The distributor 60 is configured to charge the first reducing material and the second reducing material to the melting and gasifying furnace 20 without being mixed with each other.

[0048] The first reducing material and the second reducing material are separated from each other in the melting and gasifying furnace 20 without being mixed with each other and charged in the respective regions. The problem that the pores of the dried first reducing material having a large size, which are not divided, are filled with the un-dried second reducing material having a small size, which are divided, is minimized, so that the flow of the gas and the molten material can be smoothly maintained.

[0049] In the conventional case, the pre-dried reducing material and the un-dried reducing material, in the melting and gasifying furnace, were mixed and charged into the melting and gasifying furnace 20. Thus, the pores between the particles having a large size, which are not divided, were filled with the particles having a small size, which are divided, so that the size of the pores where reducing gas and the melt can flow was reduced and the porosity was reduced. Therefore, the flow of the gas or the molten material was not smooth.

[0050] As described in the present embodiment, the first reducing material and the second reducing material can be determined by whether coal is dried or not. As already known, the division of pre-dried coal is less than that of un-dried coal in the melting and gasifying furnace.

[0051] In addition, the lump coal material can be sorted by size and differentiated as the first reducing material and the second reducing material. For example, a relatively large-sized lump carbon material may mean the upper 20% level of the particle size, when the prepared lump carbon material is sorted by particle size. For large-sized lump carbon materials, the division can be made less than the relatively small-sized lump carbon material in the melting and gasifying furnace.

[0052] Therefore, the first reducing material can be understood as a lump carbon material having a relatively larger size than the second reducing material or a pre-dried carbon material having less division in the melting and gasifying furnace. Further, the second reducing material can be understood as a lump carbon material having a relatively small size than the first reducing material or an un-pre-dried carbon material having more division in the melting and gasifying furnace.

[0053] By charging the lump carbon materials separately in the melting and gasifying furnace 20 as described above, it becomes possible to effectively stabilize the flow of the gas and the molten material in the melting and gasifying furnace 20 while ensuring the space between the lump carbon materials.

[0054] In the present embodiment, for separately charging the first reducing material and the second reducing material into the melting and gasifying furnace 20 without being mixed, the first reducing material is charged to the center of the melting and gasifying furnace 20 and

the second reducing material is charged to the periphery of the melting and gasifying furnace 20.

[0055] The central portion of the melting and gasifying furnace 20 refers to an inner central region, and the peripheral portion refers to an inner wall region of the melting and gasifying furnace 20.

[0056] FIG. 2 shows a structure for charging a charging material into the melting and gasifying furnace 20 according to the present embodiment.

[0057] As illustrated in FIG. 2, in the present embodiment, the first reducing material storage bin 42 and the second reducing material storage bin 44 may be configured to be alternately opened and closed in sequence along the reducing material transfer line 46 to alternately discharge the first reducing material and the second reducing material. That is, upon discharging the first reducing material, the second reducing material storage bin 44 may be closed to prevent discharging the second reducing material. Upon discharging the second reducing material, the first reducing material storage bin 42 may be closed to prevent discharging the first reducing material.

[0058] Accordingly, the respective storage bins are alternately opened in sequence so that the first reducing material and the second reducing material can be alternately transferred to the charging material transfer pipe 50 connected to the reducing material transfer line 46 in a separated state without being mixed with each other.

[0059] In addition, when the first reducing material and the second reducing material, which are alternately supplied through the charging material transfer pipe 50, are charged into the melting and gasifying furnace 20, the distributor 60 is configured to sequentially charge the first reducing material and the second reducing material. The first reducing material may be charged to the center portion of the melting and gasifying furnace 20 and the second reducing material may be charged to the peripheral portion of the melting and gasifying furnace 20.

[0060] As described in the above, by varying the tilting angle of the rotation chute, the distributor 60 may finally control the falling position of the charging material discharged through the rotation chute.

[0061] Accordingly, the distributor 60 may vary the tilting angle of the rotation chute in accordance with the supply timing of the first reducing material and the second reducing material alternately supplied along the charging material transfer pipe 50. Thus, the first reducing material and the second reducing material can be separately charged at desired positions.

[0062] That is, when the first reducing material reaches the charging material transfer pipe 50 or the reducing material discharging screw 49, the distributor 60 directs the rotation chute toward the center of the melting and gasifying furnace 20. When the second reducing material reaches the charging material transfer pipe 50 or the reducing material discharging screw 49 after the completion of charging the first reducing material, the rotation chute is directed to the periphery of the melting and gas-

ifying furnace 20. Thus, the respective reducing materials are separately charged.

[0063] The control operation of the distributor 60, for example, may calculate, in accordance with the opening and closing timings of the first reducing material storage bin 42 and the second reducing material storage bin 44 and the moving speed of the reducing material transfer line 46, the timing at which the first reducing material and the second reducing material are supplied to the reducing material transfer pipe 50. Further, the rotation chute of the distributor 60 may be controlled in accordance with the supply timing of the respective reducing materials. Thereby, the first reducing material and the second reducing material may be charged into a desired region in the melting and gasifying furnace 20.

[0064] In the present embodiment, the reduced material charged into the melting and gasifying furnace 20 may be configured to be charged into the periphery of the melting and gasifying furnace 20 along with the second reducing material.

[0065] To this end, the reduced material transfer line 32 may be opened when the second reducing material is transferred to the charging material transfer pipe 50 to supply the reduced material to the charging material transfer pipe 50. The reduced material discharge screw 39 installed in the reduced material transfer line 32 may be operated to supply the reduced material to the charging material transfer pipe 50 and, together with the second reducing material supplied to the charging material transfer pipe 50, may be charged into the periphery of the gasifying furnace 20.

[0066] In a state in which the first reducing material is transferred along the reducing material transfer line 46 and supplied to the charging material transfer pipe 50, the reducing material discharging screw 39 installed in the reduced material transfer line 32 stops the operation to prevent the reduced material from being supplied to the first reducing material. Thus, the reduced material may be supplied only when the second reducing material is supplied and mixed with the second reducing material, and the mixture is charged into the periphery of the melting and gasifying furnace 20.

[0067] As illustrated by FIG. 2, a plurality of storage bins 45, middle bins 47, and charging bins 48 may be further provided along the reducing material transfer line 46 for smooth and quantitative supply of the reducing material and may be sequentially connected. In the present embodiment, the first reducing material and the second reducing material which are alternately supplied along the reducing material transfer line 46 are loaded and transferred, in the same order, while passing through the storage bins, the middle bins, and the charging bins. Thus, the first reducing material and the second reducing material may be separately supplied to the reducing material transfer pipe 50. Finally, the first reducing material and the second reducing material may be differentiated and separated through the distributor 60.

[0068] A plurality of storage bins 35, intermediate bins

37, and charging bins 38 may be further provided along the reduced material transfer line 32 for more smoothly and quantitatively supplying the reduced material, and may be sequentially connected.

[0069] Hereinafter, a process of manufacturing molten iron according to the present embodiment will be described.

[0070] The reduced material went through the reducing furnace 10 is contained in the reduced material storage bin 30 and is prepared and supplied to the charging material transfer pipe 50 through the reduced material transfer line 32. The reducing material is differentiated by a first reducing material and a second reducing material, which are separately stored in a first reducing material storage bin 42 and a second reducing material storage bin 44, respectively.

[0071] The first reducing material storage bin 42 and the second reducing material storage bin 44 are alternately opened in order to sequentially supply the first reducing material and the second reducing material along the reducing material transfer line 46. The first reducing material and the second reducing material supplied along the reducing material transfer line 46 are alternately supplied to the charging material transfer pipe 50 connected to the exit side of the reducing material transfer line 46.

[0072] The distributor 60 installed in the melting and gasifying furnace 20 separates the first reducing material and the second reducing material supplied through the charging material transfer pipe 50 and alternately charges them in the melting and gasifying furnace 20. In the present embodiment, the distributor 60 is controlled and driven in accordance with the supply timing of the first reducing material and the second reducing material. It sequentially charges the first reducing material to the center of the melting and gasifying furnace 20 and the second reducing material to the periphery of the melting and gasifying furnace 20.

[0073] In this process, the reduced material is supplied to the charging material transfer pipe 50 through the reduced material transfer line 32 in accordance with the timing when the second reducing material is charged into the melting and gasifying furnace 20 in order. Thus, the reduced material is mixed with the second reducing material and charged into the melting and gasifying furnace 20.

[0074] Thus, the first reducing material and the second reducing material are separated from each other, and the first reducing material is distributed in the center of the melting and gasifying furnace 20 and the second reducing material is distributed in the peripheral portion.

[0075] FIG. 3 schematically shows the charging state of the charging material charged in the melting and gasifying furnace according to the present embodiment.

[0076] As shown in FIG. 3, without mixing the first reducing material and the second reducing material, the first reducing material is charged into the center of the melting and gasifying furnace 20, and the second reduc-

ing material mixed with the reduced material is charged into the periphery of the melting and gasifying furnace 20. The distributor sequentially charges the first reducing material and the second reducing material. Thus, although a certain level of mixing occurs at the boundary portion between the central portion and the peripheral portion of the melting and gasifying furnace, the distribution regions of the first reducing material and the second reducing material are divided, and charged without being mixed.

[0077] In the center of the melting and gasifying furnace, only the pre-dried first reducing material is charged, which causes less division compared to the peripheral portion, and thus the size of the pores is large and the porosity is also large.

[0078] The first reducing material charged in the center of the melting and gasifying furnace replace the lower bed as time passes by and fills the hearth area under the tuyere of the melting and gasifying furnace. Thus, the molten material can be more easily flowed down to the bottom of the melting and gasifying furnace.

[0079] As is known, since oxygen may be blown through a tuyere on the outer wall side, it is difficult for the gas to flow toward the center of the melting and gasifying furnace. However, according to the present embodiment, as only the first reducing material is charged in the central portion, the gas can flow more easily to the central portion of the melting and gasifying furnace. Further, the charging material at the center of the melting and gasifying furnace is heated to increase the temperature. Then, due to the lower viscosity, the molten material may flow down more easily.

[0080] The second reducing material is charged in the peripheral portion of the melting and gasifying furnace. Thus, the size of the pores is not increased but the porosity is larger than that of the conventional mixed packing structure. That is, in the melting and gasifying furnace, the resistance of the entire bed with respect to the flowing down of molten material and the resistance of the entire bed with respect to the flowing up of the reducing gas are reduced. Due to the reduced resistance, the gas flow is stabilized, and the discharge of the molten material is smooth. Thus, the operation of the melting and gasifying furnace can be stabilized and the productivity can be increased.

[0081] The reduced material as a raw material is charged to the peripheral portion of the melting and gasifying furnace together with the second reducing material. In the melting and gasifying furnace, oxygen may be blown through the tuyere on the outer wall. Thus, the gas flows up mainly to the peripheral portion of the melting and gasifying furnace, so that the reducing gas may easily reduce and heat the raw material.

[0082] As described in the above, according to this embodiment, the first reducing material and the second reducing material are separated from each other and charged in the melting and gasifying furnace. Thus, the gas flow may be stabilized and the flow of the molten

material is smooth so that the productivity can be increased and the fuel consumption can be reduced. In addition, the production cost can be lowered by minimizing the amount of pre-dried coal that is expensive to produce.

[0083] FIG. 4 and FIG. 5 illustrate the charging structure of charging material according to another embodiment.

[0084] In the following description, the same symbols are used for the parts already mentioned in the above among the parts of the apparatus, and a detailed description thereof will be omitted.

[0085] As illustrated in FIG. 4, in the present embodiment, the reducing material transfer line 46 is further provided with an additional first transfer line 70 transferring the first reducing material to separately transferring the first reducing material and the second reducing material through the first transfer line 70 and the reducing material transfer line 46. Further, in the melting and gasifying furnace 20, an additional first distributor 80 connected to the first transfer line 70 may be further provided in addition to the distributor 60 connected to the reducing material transfer line 46 to separate the first reducing material and the second reducing material by the first distributor 80 and the distributor 60 and simultaneously charge into the melting and gasifying furnace 20.

[0086] Since the first distributor 80 supplies only the first reducing material to the center of the melting and gasifying furnace 20 unlike the distributor 60, the first reducing material discharge angle may be fixed to the center of the melting and gasifying furnace. Or the first distributor 80 may have the same structure as that of the distributor 60 and may be configured in which the angle of the rotation chute is set to center. It is sufficient that the first distributor 80 can charge the first reducing material to the center of the melting and gasifying furnace, and its structure and installation position can be variously modified.

[0087] The first transfer line 70 may be connected to the melting and gasifying furnace 20 by branching from one side of the reducing material transfer line 46. In this case, the first reducing material and the second reducing material may be sequentially supplied to the reducing material transfer line 46 upon opening the first reducing material storage bin 42 and the second reducing material storage bin 44. During the transfer process, the first reducing material is transferred through the first transfer line 70, and only the second reducing material can be transferred through the reducing material transfer line 46.

[0088] The first reducing material storage bin 42 containing the first reducing material and the second reducing material storage bin 44 containing the second reducing material may be connected to the first transfer line 70 and the reducing material transfer line 46, respectively. Thus, the reducing material can be separately supplied.

[0089] Like the reducing material transfer line 46, the first transfer line 70 also may be further provided with a

plurality of storage bins 72, intermediate bins 74, and charging bins 76, along the first transfer line 70, for a smoother and a fixed amount supply of the first reducing material, which may be sequentially connected. A discharge screw 78 for discharging the first reducing material in a fixed amount may further be provided on the exit side of the first transfer line.

[0090] The reducing material transfer line 46 is connected to the charging material transfer pipe 50 and the charging material transfer pipe 50 is connected to the distributor 60. A reduced material transfer line 32 for supplying a reduced material is connected to the charging material transfer pipe 50.

[0091] A first distributor 80 may be installed on the upper portion of the melting and gasifying furnace 20 in addition to the distributor 60. The first transfer line 70 may be connected to the first distributor 80 to supply the first reducing material to the first distributor 80.

[0092] The distributor 60 may charge only the second reducing material and the reduced material to the melting and gasifying furnace 20, and the first distributor 80 may charge only the first reducing material transferred along the first transfer line 70 to the melting and gasifying furnace 20.

[0093] Therefore, for the distributor 60, the tilting angle of the rotation chute can be set to the periphery of the melting and gasifying furnace 20 so that the second reducing material can be charged into the periphery of the melting and gasifying furnace 20. Since the first distributor 80 also charges only the first reducing material, the tilting angle of the rotation chute can be set to the center of the melting and gasifying furnace 20 so that the first reducing material can be charged to the center of the melting and gasifying furnace 20.

[0094] Accordingly, in this embodiment, as the first reducing material and the second reducing material are charged through the first distributor 80 and the distributor 60, respectively, the charging of the first reducing material and the second reducing material is performed at the same time and continuously.

[0095] Thus, the first reducing material and the second reducing material are continuously charged into the melting and gasifying furnace 20, and the first reducing material is distributed to the central portion of the melting and gasifying furnace 20, and the second reducing material is distributed to the peripheral portion.

[0096] Fig. 5 schematically shows the charging state of the charging material charged into the melting and gasifying furnace according to the present embodiment.

[0097] As shown in FIG. 5, without mixing the first reducing material and the second reducing material, the first reducing material is charged into the center of the melting and gasifying furnace 20, and the second reducing material mixed with the reduced material is charged into the periphery of the melting and gasifying furnace 20. Further, as the first reducing material and the second reducing material are continuously charged without interruption, the mixing of the first reducing material and

the second reducing material can be minimized at the boundary between the center and the periphery of the melting and gasifying furnace. Thus, the fluctuation of the temperature and the gas composition in the dome portion of the melting and gasifying furnace can be minimized, and the amount of the first reducing material charged into the center portion can be further reduced.

[0098] As explained in the above, while the illustrative embodiments of the present invention have been shown and described, various modifications and alternative embodiments may be made by those skilled in the art. Such variations and other embodiments will be considered and included in the appended claims, without departing from the true spirit and scope of the invention.

[Description of Symbols]

[0099]

10 : The reducing furnace 20 : The melting and gasifying furnace
 30 : The reduced material storage bin 32 : The reduced material transfer line
 40 : The reducing material storage bin 42 : The first reducing material storage bin
 44 : The second reducing material storage bin 46 : The reducing material transfer line
 50 : Charging material transfer pipe 60 : Distributor
 70 : The first transfer line 80 : The first distributor

Claims

1. A method of manufacturing molten iron by charging a reducing material and a reduced material supplied from a reducing furnace into a melting and gasifying furnace, blowing oxygen to manufacture molten iron, and supplying a reducing gas to a reducing furnace to reduce iron ore, comprises:

a reduced material preparation step of preparing a reduced material,
 a reducing material preparation step of preparing a first reducing material which is pre-dried and a second reducing material which is not pre-dried without being mixed with each other as a reducing material, and
 a charging step of charging the reduced material and the reducing material into the melting and gasifying furnace,
 wherein the charging step comprises a separation charging step of charging the first reducing material and the second reducing material into the melting and gasifying furnace without being mixed with each other.

2. A method of manufacturing molten iron by charging a reducing material and a reduced material supplied

from a reducing furnace into a melting and gasifying furnace, blowing oxygen to manufacture molten iron, and supplying a reducing gas to a reducing furnace to reduce iron ore, comprises:

- a reduced material preparation step of preparing a reduced material,
 - a reducing material preparation step of preparing a first reducing material having a relatively large size and a second reducing material having a relatively small size as a reducing material, and
 - a charging step of charging the reduced material and the reducing material into the melting and gasifying furnace,
 - wherein the charging step comprises a separation charging step of charging the first reducing material and the second reducing material into the melting and gasifying furnace without being mixed with each other.
3. The method according to Claims 1 or 2, wherein the first reducing material is charged into the center of the melting and gasifying furnace and the second reducing material is charged into the periphery of the melting and gasifying furnace in the separation charging step.
 4. The method according to Claim 3, wherein the charging step comprises a step of mixing the reduced material with the second reducing material to mix the reduced material with the second reducing material and charge a mixture to the periphery of the melting and gasifying furnace.
 5. The method according to Claim 3, wherein the reducing material preparation step comprises a step of alternately discharging the first reducing material and the second reducing material from each of the first reducing material storage bin containing the first reducing material and the second reducing material storage bin containing the second reducing material and transferring, along the reducing material transfer line.
 6. The method according to Claim 5, wherein the charging step sequentially charges the first reducing material and the second reducing material, which are alternately transferred to the melting and gasifying furnace, through a distributor installed in the melting and gasifying furnace.
 7. The method according to Claim 3, wherein the charging step comprises a step of separating the first reducing material and the second reducing material and transferring to the melting and gasifying furnace, and a step of simultaneously charging the first reducing material and the second

reducing material through an additional distributor installed in the melting and gasifying furnace.

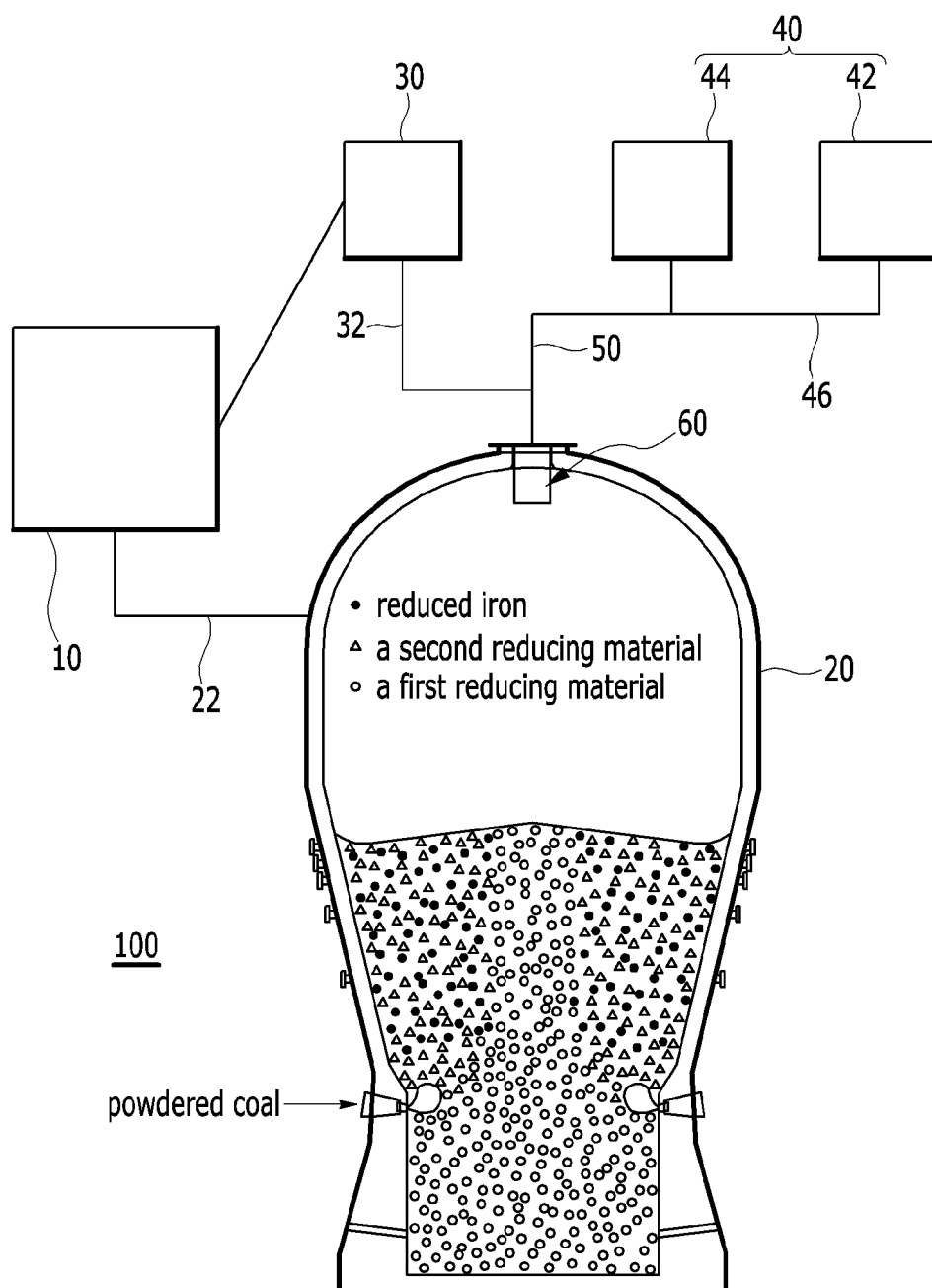
8. An apparatus for manufacturing a molten iron comprises: a reducing furnace for reducing iron-containing material to convert to a reduced material; a melting and gasifying furnace manufacturing molten iron by charging a reduced material and a reducing material; a reduced material storage bin containing the reduced material converted in the reducing furnace; a reduced material transfer line for supplying the reduced material discharged from the reduced material storage bin to the melting and gasifying furnace; a reducing material storage bin containing a reducing material; a reducing material transfer line for supplying the reducing material discharged from the reducing material storage bin to the melting and gasifying furnace; and a distributor installed in the melting and gasifying furnace for charging the transferred reduced material and the lump carbon material into the melting and gasifying furnace, wherein the reducing material storage bin comprises the first reducing material storage bin containing a first reducing material which is pre-dried and the second reducing material storage bin containing a second reducing material which is not pre-dried and the first reducing material and the second reducing material are separately supplied, and wherein the distributor charges the first reducing material and the second reducing material into the melting and gasifying furnace without being mixed with each other.
9. An apparatus for manufacturing a molten iron comprises:
 - a reducing furnace for reducing iron-containing material to convert to a reduced material; a melting and gasifying furnace manufacturing molten iron by charging a reduced material and a reducing material; a reduced material storage bin containing the reduced material converted in the reducing furnace; a reduced material transfer line for supplying the reduced material discharged from the reduced material storage bin to the melting and gasifying furnace; a reducing material storage bin containing a reducing material; a reducing material transfer line for supplying the reducing material discharged from the reducing material storage bin to the melting and gasifying furnace; and a distributor installed in the melting and gasifying furnace for charging the transferred reduced material and the lump carbon material into the melting and gasifying furnace,
 - wherein the reducing material storage bin comprises a first reducing material storage bin containing a first reducing material having a relatively large size, and a second reducing material

storage bin containing a second reducing material having a relatively small size, and the first reducing material and the second reducing material are separately supplied and wherein the distributor charges the first reducing material and the second reducing material into the melting and gasifying furnace without being mixed with each other.

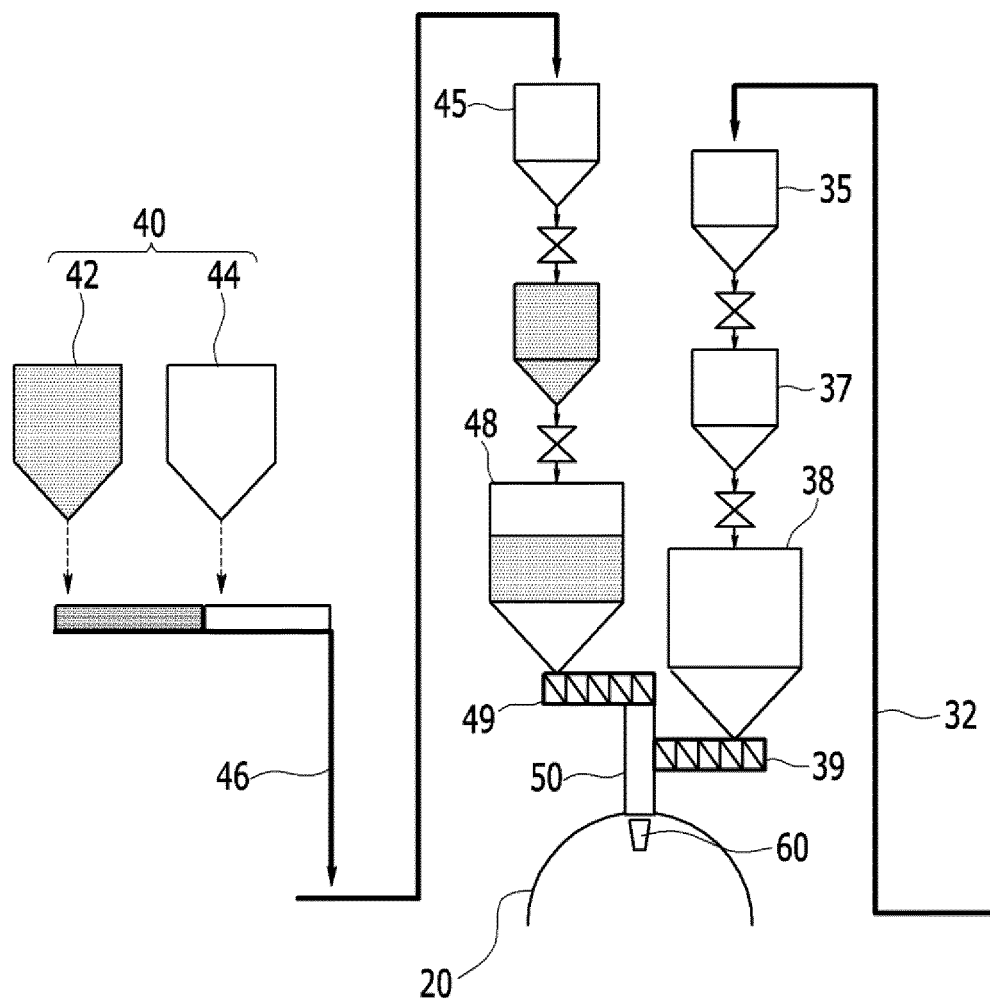
multaneously charge into the melting and gasifying furnace.

- 5
10. The apparatus according to Claims 8 or 9, wherein the distributor is configured to charge the first reducing material to the center of the melting and gasifying furnace and the second reducing material to the periphery of the melting and gasifying furnace. 10
15
11. The apparatus according to Claim 10, further comprising a charging material transfer pipe connected to the reduced material transfer line and the reducing material transfer line and installed in the melting and gasifying furnace to supply the reduced material and the lump carbon material to the distributor, 20
wherein the reduced material transfer line is configured to be opened when the second reducing material is transferred to the charging material transfer pipe to supply the reduced material to the charging material transfer pipe and charge into the melting and gasifying furnace with the second reducing material. 25
30
12. The apparatus according to Claim 10, wherein the reducing material storage bin alternately discharges the first reducing material and the second reducing material by alternately opening and closing the first reducing material storage bin and the second reducing material storage bin, along the reducing material transfer line. 35
13. The apparatus according to Claim 12, wherein the distributor is configured to sequentially charge the first reducing material and the second reducing material, which are alternately transferred through the charging material transfer pipe, to the melting and gasifying furnace. 40
45
14. The apparatus according to Claim 10, wherein the reducing material transfer line further comprises an additional first transfer line transferring the first reducing material to separately transferring the first reducing material and the second reducing material through the first transfer line and the reducing material transfer line, and wherein the apparatus further comprises an additional first distributor installed in the melting and gasifying furnace and connected to the first transfer line to separate the first reducing material and the second reducing material by the first distributor and the distributor and to si- 50
55

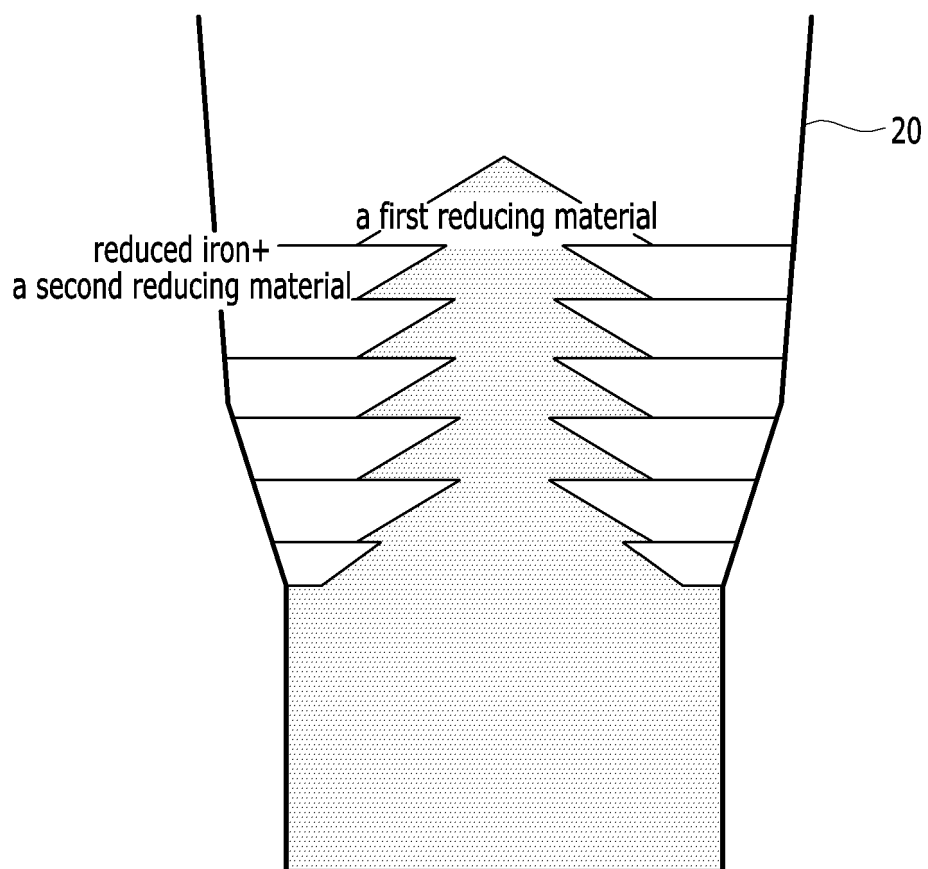
【Figure 1】



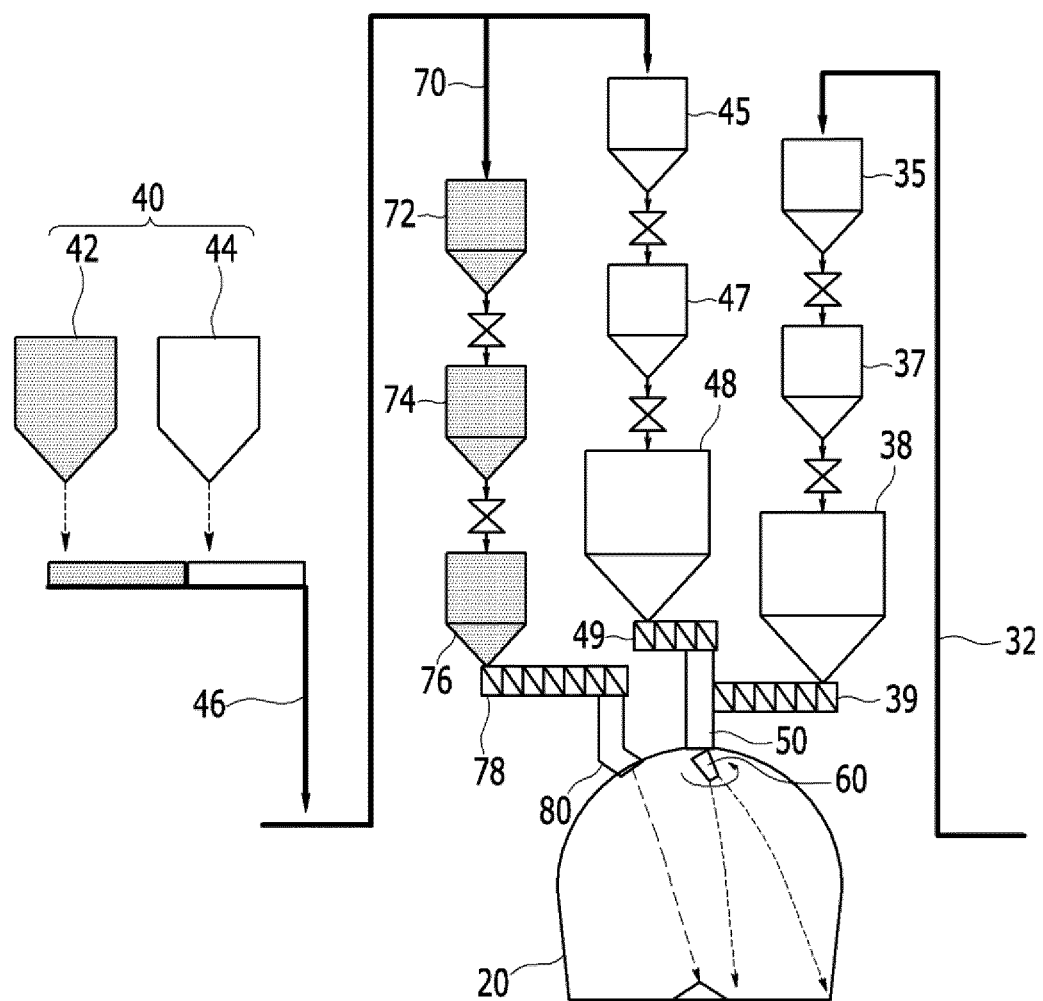
【Figure 2】



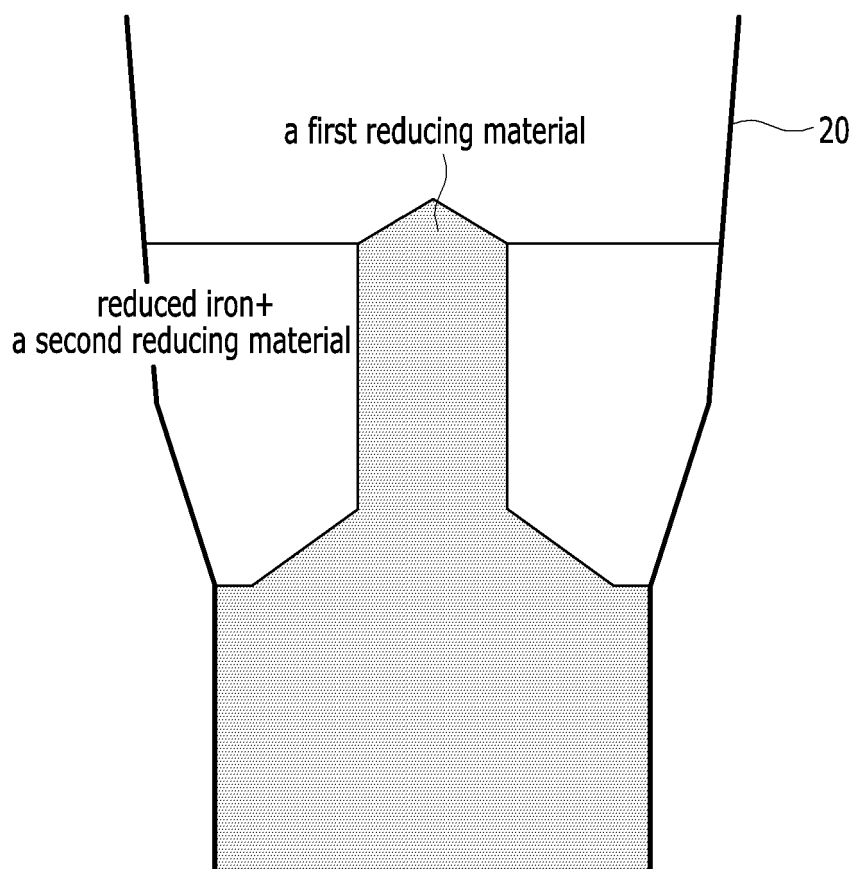
【Figure 3】



【Figure 4】



【Figure 5】



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2017/006682

A. CLASSIFICATION OF SUBJECT MATTER

C21B 13/14(2006.01); C21B 13/00(2006.01);

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)

C21B 13/14; C21B 7/18; C21B 5/00; C21B 13/00; C21B 11/00; C21B 13/06

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: blast furnace, blast furnace, reducing agent, breeze, cokes, carbonization, non-carbonization, molten iron

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 10-1621057 B1 (POSCO) 13 May 2016 See paragraphs [0045]-[0059], claim 1 and figure 1.	2-7,9-14
A		1,8
Y	KR 10-2002-0024969 A (POSCO) 03 April 2002 See abstract, claim 2 and figures 2, 3a.	2-7,9-14
A	KR 10-0711777 B1 (POSCO) 25 April 2007 See claims 1, 5 and figures 1-2.	1-14
A	JP 06-207209 A (SUMITOMO METAL IND., LTD.) 26 July 1994 See paragraphs [0012]-[0013] and claim 1.	1-14
A	KR 10-2014-0129872 A (POSCO) 07 November 2014 See paragraphs [0010], [0027] and claims 1, 5.	1-14

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

28 SEPTEMBER 2017 (28.09.2017)

Date of mailing of the international search report

29 SEPTEMBER 2017 (29.09.2017)

Name and mailing address of the ISA/KR


 Korean Intellectual Property Office
 Government Complex-Daejeon, 189 Seonsa-ro, Daejeon 302-701,
 Republic of Korea

Facsimile No. +82-42-481-8578

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/KR2017/006682

Patent document cited in search report	Publication date	Patent family member	Publication date
KR 10-1621057 B1	13/05/2016	CN 106011355 A	12/10/2016
KR 10-2002-0024969 A	03/04/2002	NONE	
KR 10-0711777 B1	25/04/2007	NONE	
JP 06-207209 A	26/07/1994	NONE	
KR 10-2014-0129872 A	07/11/2014	KR 10-1481125 B1	12/01/2015

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