(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 498 868 A1

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

(43) Date of publication:
19.06.2019 Bulletin 2019/25

(21) Application number: **16912783.4**

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

(51) Int Cl.:
C21B 7/16 *(2006.01)* ***F27B 1/16*** *(2006.01)*
F27D 25/00 *(2010.01)* ***F27D 3/16*** *(2006.01)*

(86) International application number:
PCT/KR2016/012250

(87) International publication number:
WO 2018/030585 (15.02.2018 Gazette 2018/07)

(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

(30) Priority: **11.08.2016 KR 20160102537**

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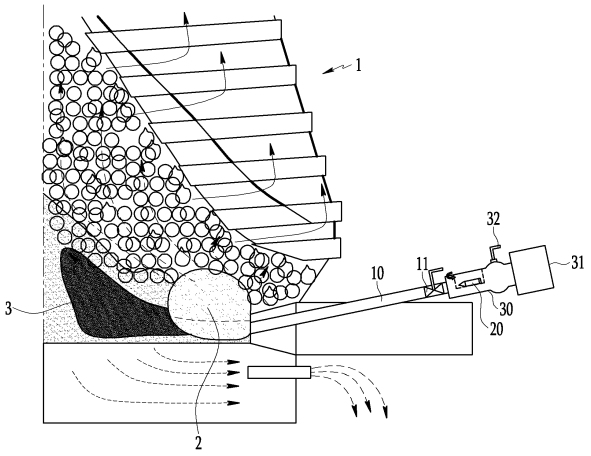
(54) **APPARATUS FOR REMOVING BIRD'S NEST IN BLAST FURNACE**

(57) Provided is an apparatus for removing a bird nest of a blast furnace, including a pulverized coal lance connected with a combustion zone inside the blast furnace to inject pulverized coal, a flux wired capsule supplied to the bird nest around the combustion zone through the pulverized coal lance to melt and remove the bird nest, and a high-pressure projectile installed to be connected with an end portion of the pulverized coal lance while accommodating the capsule to shoot the capsule to the bird nest using high-pressure nitrogen gas, in order to effectively remove the bird nest to improve a state of a reactor core by injecting a flux wired capsule into the bird nest accumulated on the reactor core of a furnace.

FIG. 1



EP 3 498 868 A1

Description

[Technical Field]

[0001] Disclosed is an apparatus for removing a bird nest that accumulates on a reactor core of a blast furnace.

[Background Art]

[0002] In general, an iron-making process of a blast furnace is a process of producing molten metal by charging iron ore as a raw material of the molten metal and cokes as fuel in a blast furnace and reducing and melting iron ore using high-temperature heat generated via combustion of the cokes and reduction gas.

[0003] In a blast furnace operation for injecting pulverized coal, as cokes is replaced by pulverized coal, a ratio of an ore thickness to a cokes thickness is increased to reduce combustion of cokes at a furnace lower part, and resultantly, sinking speed of charged materials in a furnace is degraded and, accordingly, as a retention time of cokes in a blast furnace is increased, the possibility of collision between cokes particles in a combustion zone is further increased, and in this case, pulverized cokes generated by mechanical wear via a violent crash reaction accumulate on a cokes layer at a predetermined position in the furnace. That is, a bird nest that is a layer charged with cokes is formed on a reactor core of a blast furnace. The bird nest accumulates around a combustion zone of the blast furnace reactor core.

[0004] Accordingly, to smoothly perform a blast furnace operation, reduction gas generated at a lower part of the blast furnace needs to be smoothly moved to an upper part of the blast furnace. To this end, a charged layer of cokes charged in the furnace needs to be in a sound state.

[0005] The sound state of the layer charged with cokes in the furnace means that the amount of powders less than 3 mm is low between charged layers and, accordingly, means that, when the powders less than 3 mm are removed, an air void is appropriately ensured to smoothly facilitate flow of reduction gas and flow of melted material in a furnace, such as molten metal and slag.

[0006] That is, a high-temperature and high-pressure counter flow reactor reduces sintered ore using CO gas that is a reducing agent obtained by combustion of cokes charged in a furnace with heat wind supplied from the lower part to produce molten metal. Gas formed in a combustion zone before a wind hole needs to be transmitted through a layer charged with cokes and to be uniformly spread in a radius direction and a vertical direction of the blast furnace, and to be prevented from channeling.

[0007] However, a large amount of powders generally accumulate on a reactor core part, and thus, gas does not penetrate into the center of the blast furnace.

[0008] As described above, to remove pulverized powders present in a zone of a layer with powers less than 3 mm, according to the prior art, the zone is blasted to remove the powders, but when such a method is used, there is a problem in that a large amount of powders are generated due to blasting. In addition, there is an attempt to inject ore or low melting point flux including oxygen through a wind hole to remove powders, but the possibility that injected materials act directly on the reactor core is low and, thus, air permeability/flowage are lowered to disadvantageously degrade a furnace state.

[DISCLOSURE]

[Technical Problem]

[0009] An exemplary embodiment of the present invention provides an apparatus for removing a bird nest of a blast furnace having advantages of effectively removing a bird nest by injecting a flux wired capsule into a bird nest that accumulates on a reactor core of a blast furnace to improve a state of a reactor core.

[Technical Solution]

[0010] According to an embodiment of the present invention, an apparatus for removing a bird nest of a blast furnace includes a pulverized coal lance connected with a combustion zone inside the blast furnace to inject pulverized coal, a flux wired capsule supplied to the bird nest around the combustion zone through the pulverized coal lance to melt and remove the bird nest, and a high-pressure projectile installed to be connected with an end portion of the pulverized coal lance while accommodating the capsule to shoot the capsule to the bird nest using high-pressure nitrogen gas.

[0011] The pulverized coal lance may further include a control valve installed between the pulverized coal lance and the high-pressure projectile to control a supplied high-pressure nitrogen gas amount.

[0012] The pulverized coal lance may further include a blow pipe connectively installed outside the pulverized coal lance to supply wind.

[0013] The high-pressure projectile may further include a high-pressure gas container for connectively installed to a rear side of the high-pressure projectile to accommodate and supply high-pressure nitrogen gas.

[0014] The high-pressure projectile may further include a control value installed between the high-pressure projectile and the high-pressure gas container to control an amount of the high-pressure nitrogen gas.

[0015] The high-pressure projectile may include a loader loading and shooting the plurality of capsules, and a cover installed in the loader to be open and closed.

[0016] The capsule may be molded of a plastic material and may be configured to accommodate a mill scale flux containing water or a hydrogen peroxide solution or a hydrogen peroxide aqueous solution therein.

[0017] The capsule may include a warhead installed in a front portion thereof to be inserted into the bird nest, a cylinder installed behind the warhead to contain a flux

therein, and a cap installed behind the cylinder to seal the cylinder.

[0018] The warhead and the cap may include sealing grooves formed on external circumferential surfaces thereof, respectively, and may be configured in such a way that sealing rings are installed at the sealing grooves, respectively, to seal the cylinder.

[0019] The cylinder may be configured as a large capacity cylinder connected with another cylinder.

[0020] The large capacity cylinder may include a flexible connection portion installed at an intermediate portion thereof to be bent during entrance into the bird nest.

[0021] The capsule may further include a position adjustment plate inserted into the warhead to adjust a proceeding position of the capsule.

[0022] The position adjustment plate may be selectively installed at up, down, left, and right sides of the warhead to adjust a proceeding position of the warhead through a load of the position adjustment plate and to adjust a destination point of the capsule in up, down, left, and right directions.

[Advantageous Effects]

[0023] According to the apparatus, a bird nest of a blast furnace reactor core may be effectively removed to prevent reduction in an output due to degradation in a wind amount generated due to deactivated reactor core and to lower a wind pressure and stabilize a furnace state by enhancing a state of the reactor core.

[0024] In addition, since pulverized powders of the bird nest reacts with a flux to remove the pulverized powders, efficiency of transmitting hot air may not be prevented from being lowered due to pulverized powders, thereby increasing an output.

[Description of the Drawings]

[0025]

FIG. 1 is a schematic diagram showing an apparatus for removing a bird nest of a blast furnace according to an exemplary embodiment.

FIG. 2 is a schematic diagram showing a structure of the apparatus for removing a bird nest of a blast furnace according to the present exemplary embodiment.

FIG. 3 is a schematic diagram showing a capsule of an apparatus for removing a bird nest according to the present exemplary embodiment.

FIG. 4 is a schematic diagram showing a configuration of a capsule according to the present exemplary embodiment.

FIG. 5 is a schematic diagram of a capsule according to another exemplary embodiment of the present exemplary embodiment.

FIG. 6 is a schematic diagram showing a state in which a position adjustment plate is installed in a capsule according to the present exemplary embodiment.

[Mode for Invention]

[0026] The technical terminology used herein is for the purpose of describing particular exemplary embodiments only and is not intended to be limiting of the present invention. Here, the singular expressions in the present specification include the plural expressions unless clearly specified otherwise in context. In the present specification, it should be understood that the terms, such as 'including' or 'having,' etc., are intended to indicate the existence of the features, regions, integers, steps, operations, components, and/or elements, and are not intended to preclude the possibility that other features, regions, integers, steps, operations, components, elements, and/or combinations thereof may exist or may be added.

[0027] Exemplary embodiments of the present invention are described in detail so as for those of ordinary skill in the art to easily implement with reference to the accompanying drawing. It will be easily understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention. Accordingly, as those skilled in the art would realize, the described embodiments may be modified in various different ways, all without departing from the spirit or scope of the present invention.

[0028] FIG. 1 is a schematic diagram showing an apparatus for removing a bird nest of a blast furnace according to an exemplary embodiment.

[0029] FIG. 2 is a schematic diagram showing a structure of the apparatus for removing a bird nest of a blast furnace according to the present exemplary embodiment.

[0030] FIGS. 1 and 2 disclose the apparatus for removing a bird nest of a blast furnace for effectively removing a bird nest 3 accumulated on a reactor core to activate a reactor core in a blast furnace 1.

[0031] The apparatus for removing a bird nest of a blast furnace according to the present exemplary embodiment may include a pulverized coal lance 10 connected with a combustion zone 2 inside the blast furnace 1 to inject pulverized coal, a flux wired capsule 20 that is supplied to the bird nest 3 around the combustion zone 2 through the pulverized coal lance 10 to melt and remove the bird nest 3, and a high-pressure projectile 30 that is installed to be connected with an end portion of the pulverized coal lance 10 while accommodating the capsule 20 to shoot the capsule 20 to the bird nest 3 using high-pressure nitrogen gas.

[0032] That is, the capsule 20 may be shot to the bird nest 3 accumulated on the reactor core through the high-pressure projectile 30 using high-pressure nitrogen gas to remove the bird nest 3 via a reaction between the flux in the capsule 20 and the bird nest 3.

[0033] The pulverized coal lance 10 put into the com-

bustion zone 2 of the blast furnace 1 may further include a control valve 11 that is installed between the pulverized coal lance 10 and the high-pressure projectile 30 to control a supplied high-pressure nitrogen gas amount, and may further include a blow pipe 12 that is connectively installed outside the pulverized coal lance 10 to supply wind.

[0034] Speed of injecting high-pressure nitrogen gas and the amount of the nitrogen gas may be controlled through the control valve 11 installed in the pulverized coal lance 10 to control shooting speed of the capsule 20 and may more effectively transmit wind to the pulverized coal lance 10 through the blow pipe 12 installed outside the pulverized coal lance 10.

[0035] The high-pressure projectile 30 for shooting the capsule 20 to the bird nest 3 may further include a high-pressure gas container 31 that is connectively installed to a rear side of the high-pressure projectile 30 to accommodate and supply high-pressure nitrogen gas, and may further include a control valve 32 installed between the high-pressure projectile 30 and the high-pressure gas container 31 to control the amount of high-pressure nitrogen gas.

[0036] The high-pressure projectile 30 may receive high-pressure nitrogen gas from the high-pressure gas container 31 installed at a rear side of the high-pressure projectile 30 to shoot the capsule 20, and may control the amount of gas supplied to the high-pressure projectile 30 from the high-pressure gas container 31 through the control valve 32.

[0037] The high-pressure projectile 30 may include a loader 33 for loading and shooting the plurality of capsules 20, and a cover 34 installed in the loader 33 to be open and closed, and thus, the plurality of capsules 20 may be shot to the bird nest 3 of a reactor core in a state in which the capsules 20 are loaded in the loader 33 through a structure of the high-pressure projectile 30, and the cover 34 to be open and closed may be installed to maintain air-tightness of the loader 33.

[0038] FIG. 3 is a schematic diagram showing a capsule of an apparatus for removing a bird nest according to the present exemplary embodiment.

[0039] FIG. 4 is a schematic diagram showing a configuration of a capsule according to the present exemplary embodiment.

[0040] As shown in FIGS. 3 and 4, the capsule 20 may be molded of a plastic material and may be configured to accommodate a mill scale flux containing water and a hydrogen peroxide solution or a hydrogen peroxide aqueous solution therein.

[0041] That is, a decomposition and exothermic reaction may proceed via a catalyst decomposition reaction with the bird nest 3 in the blast furnace 1 due to a material contained in the capsule 20, carbon in a pulverized powder may combust due to oxygen generated during decomposition, and the bird nest 3 may be removed by forming melt thereof to clean the bird nest 3.

[0042] The capsule 20 may be configured to include a warhead 21 installed in a front portion thereof to be inserted into the bird nest 3, a cylinder 22 installed behind the warhead 21 to contain a flux therein, and a cap 23 installed behind the cylinder 22 to seal the cylinder 22.

[0043] The warhead 21 and the cap 23 may include sealing grooves 21a and 23a formed on external circumferential surfaces thereof, respectively, and may be configured in such a way that sealing rings 21b and 23 are installed at the sealing grooves 21a and 23a, respectively, to seal the cylinder 22.

[0044] The air-tightness of the cylinder 22 may be maintained through the warhead 21 and cap 23, and the sealing rings 21b and 23b coupled thereto to stably put materials contained in the cylinder 22 into the bird nest 3.

[0045] Accordingly, the above configured capsule 20 may be shot into the bird nest 3 of the blast furnace 1 to remove the bird nest 3, and thus, the capsule 20 containing a mill scale flux along with a hydrogen peroxide solution may be continuously put into the bird nest 3 and may be mixed with pulverized powders of the bird nest 3 to remove the pulverized powders, and accordingly, a passage may be formed to allow gas to flow through the reactor core to overcome deactivation of the reactor core.

[0046] FIG. 5 is a schematic diagram of a capsule according to another exemplary embodiment of the present exemplary embodiment.

[0047] As shown in FIG. 5, the cylinder 22 may be configured as a large capacity cylinder 22a connected with another cylinder, and the large capacity cylinder 22a may include a flexible connection portion 22b installed at an intermediate portion thereof to be bent during entrance into the bird nest 3.

[0048] That is, the capsule 20 may have an optimum length of 200 mm to be injected through the pulverized coal lance 10, but when the large capacity cylinder 22a formed by increasing the length of the capsule 20 is used to inject a larger amount of materials, a problem is predicted to arise in that the materials are not transmitted through the bent pulverized coal lance 10 and the pulverized coal lance 10 clogs, and thus, to prevent the problem, the flexible connection portion 22b may be connectively formed in the intermediate portion of the large capacity cylinder 22a to allow materials to smoothly pass through the bent portion.

[0049] FIG. 6 is a schematic diagram showing a state in which a position adjustment plate is installed in a capsule according to the present exemplary embodiment.

[0050] As shown in FIG. 6, the capsule 20 may further include a position adjustment plate 24 that is inserted into the warhead 21 to adjust a proceeding position of the capsule 20, and the position adjustment plate 24 may be selectively installed at up, down, left, and right sides of the warhead 21 to adjust a proceeding position of the warhead 21 through a load of the position adjustment plate 24 and to adjust a destination point of the capsule 20 in up, down, left, and right directions.

[0051] That is, when a gap is formed in the warhead of the capsule 20 and the position adjustment plate 24

with a diameter equal to or less than the capsule 20 is inserted into the gap, gas in a furnace may act in a lower direction of the position adjustment plate 24 inserted into the warhead 21 while the capsule 20 proceeds, and thus, a position of the warhead 21 of the capsule 20 inserted into the bird nest 3 may be changed, thereby adjusting a destination of the capsule 20 in up, down, left, and right directions.

[0052] Accordingly, after the capsule 20 is positioned in the pulverized coal lance 10, the position of the position adjustment plate 24 inserted into the warhead 21 of the capsule 20 may be adjusted in up, down, left, and right directions to be moved to a target position of the bird nest 3, and then, the control valve 32 of the high-pressure projectile 30 may be open to put the capsule 20 into the bird nest 3 due to high-pressure nitrogen gas, and accordingly, a material for forming a mill scale flux contained in the capsule 20 may be uniformly distributed in up, down, left, and right direction rather than being concentrated and shot into one point.

[0053] Accordingly, when pulverized powders of the bird nest 3 are removed by the flux contained in the cylinder 22 of the capsule 20, ventilation resistance may be reduced and hot air blown through a wind hole may be deeply injected into a reactor core, and thus, gas and the flux may smoothly flow, a wind flow rate may be increased, and a wind pressure may be reduced to activate the reactor core.

[0054] Accordingly, the bird nest 3 of the reactor core of the blast furnace 1 may be effectively removed to prevent reduction in an output due to degradation in a wind amount generated due to deactivated reactor core and to lower a wind pressure by enhancing a state of the reactor core, and thus, since a furnace state may be stabilized and pulverized powders of the bird nest 3 may react with a flux to remove the pulverized powders, efficiency of transmitting hot air may be prevented from being lowered due to pulverized powders, thereby increasing an output.

[0055] While this invention has been illustrated and described in connection with what is presently considered to be practical exemplary embodiments, it is to be understood that the invention is implemented in various different forms by those of ordinary skill in the art. The prevent invention is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

Claims

1. An apparatus for removing a bird nest of a blast furnace, comprising:

   a pulverized coal lance connected with a combustion zone inside the blast furnace to inject pulverized coal;
   a flux wired capsule supplied to the bird nest around the combustion zone through the pulverized coal lance to melt and remove the bird nest; and
   a high-pressure projectile installed to be connected with an end portion of the pulverized coal lance while accommodating the capsule to shoot the capsule to the bird nest using high-pressure nitrogen gas.

2. The apparatus of claim 1, wherein:
   the pulverized coal lance further includes a control valve installed between the pulverized coal lance and the high-pressure projectile to control a supplied high-pressure nitrogen gas amount.

3. The apparatus of claim 2, wherein:
   the pulverized coal lance further includes a blow pipe connectively installed outside the pulverized coal lance to supply wind.

4. The apparatus of claim 1, wherein:
   the high-pressure projectile further includes a high-pressure gas container for connectively installed to a rear side of the high-pressure projectile to accommodate and supply high-pressure nitrogen gas.

5. The apparatus of claim 4, wherein:
   the high-pressure projectile further includes a control value installed between the high-pressure projectile and the high-pressure gas container to control an amount of the high-pressure nitrogen gas supplied.

6. The apparatus of claim 1, wherein:
   the high-pressure projectile includes a loader loading and shooting the plurality of capsules, and a cover installed in the loader to be open and closed.

7. The apparatus of claim 1, wherein:
   the capsule is molded of a plastic material and is configured to accommodate a mill scale flux containing water or a hydrogen peroxide solution or a hydrogen peroxide aqueous solution therein.

8. The apparatus of claim 7, wherein:
   the capsule includes a warhead installed in a front portion thereof to be inserted into the bird nest, a cylinder installed behind the warhead to contain a flux therein, and a cap installed behind the cylinder to seal the cylinder.

9. The apparatus of claim 8, wherein:
   the warhead and the cap include sealing grooves formed on external circumferential surfaces thereof, respectively, and are configured in such a way that sealing rings are installed at the sealing grooves, respectively, to seal the cylinder.

10. The apparatus of claim 8, wherein:

the cylinder is configured as a large capacity cylinder connected with another cylinder.

11. The apparatus of claim 10, wherein:
the large capacity cylinder includes a flexible connection portion installed at an intermediate portion thereof to be bent during entrance into the bird nest.

12. The apparatus of claim 8, wherein:
the capsule further includes a position adjustment plate inserted into the warhead to adjust a proceeding position of the capsule.

13. The apparatus of claim 12, wherein:
the position adjustment plate is selectively installed at up, down, left, and right sides of the warhead to adjust a proceeding position of the warhead through a load of the position adjustment plate and to adjust a destination point of the capsule in up, down, left, and right directions.

FIG. 1

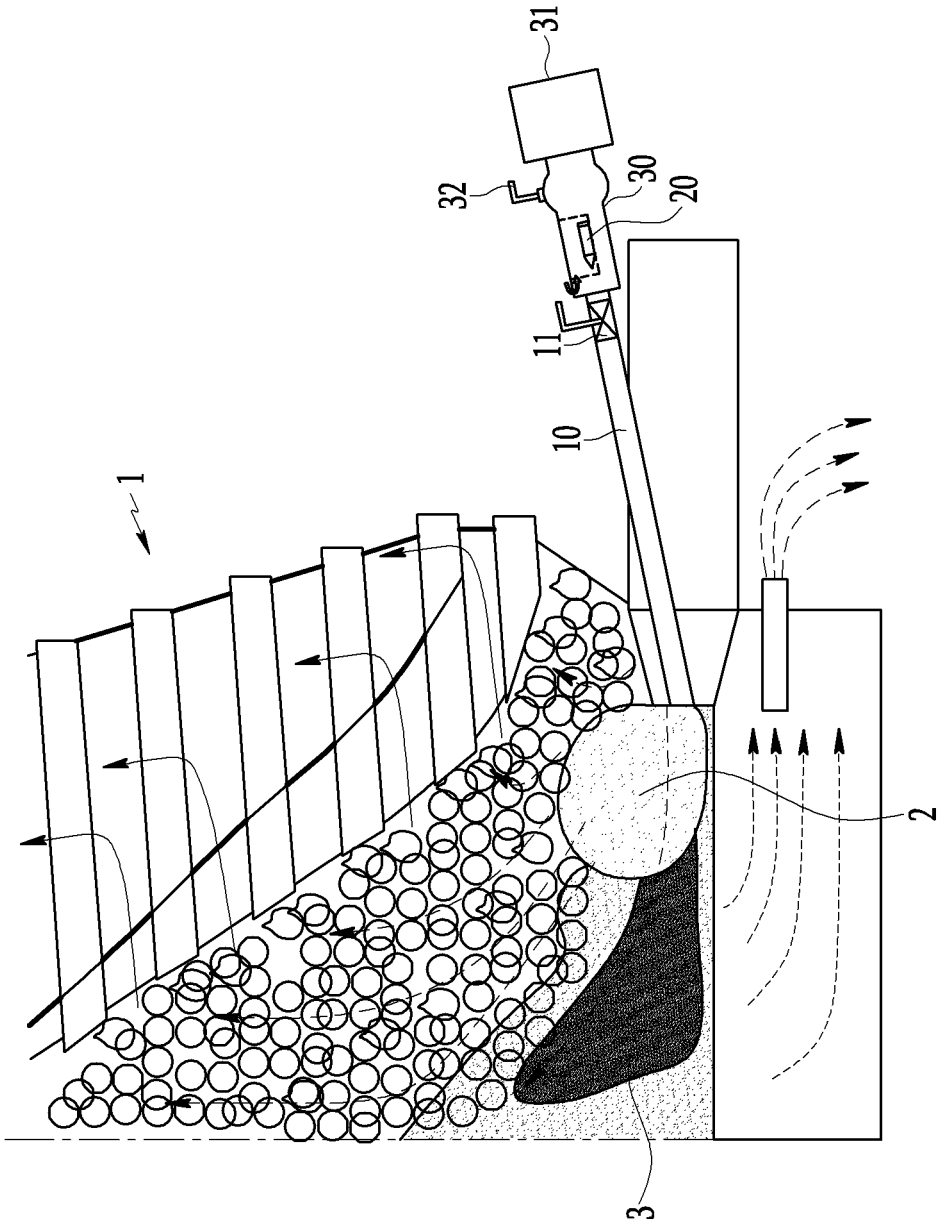


FIG. 2

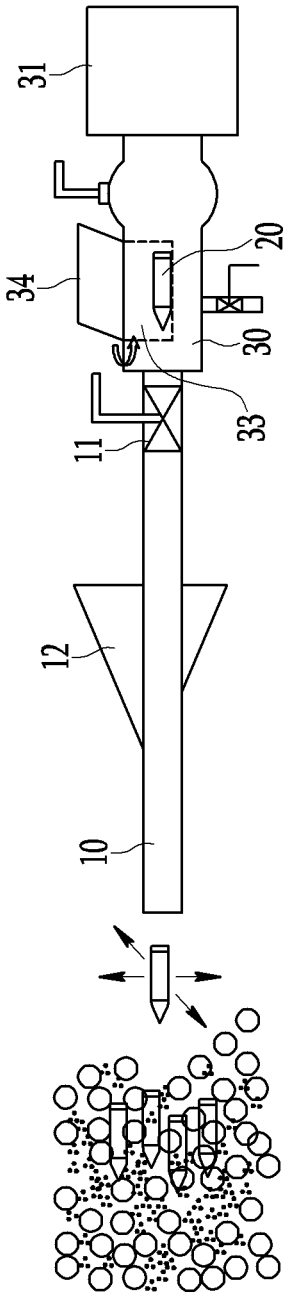


FIG. 3

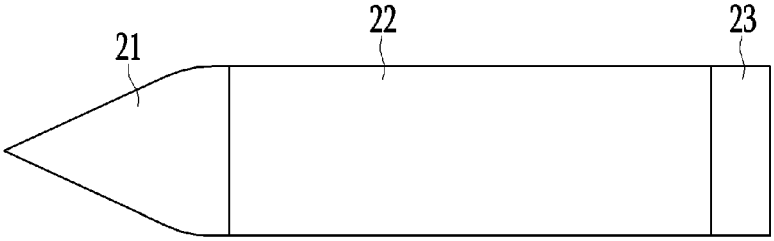


FIG. 4

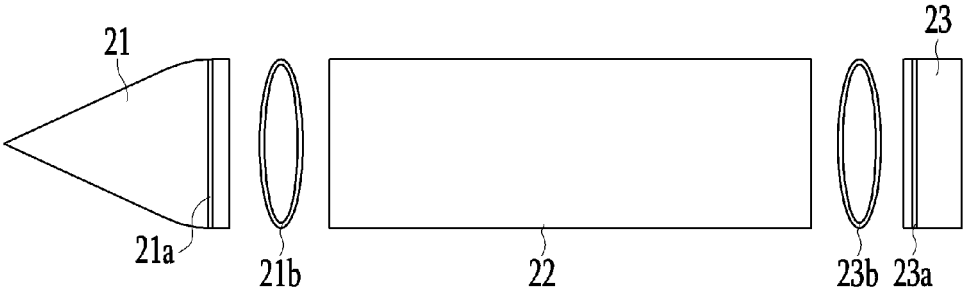


FIG. 5

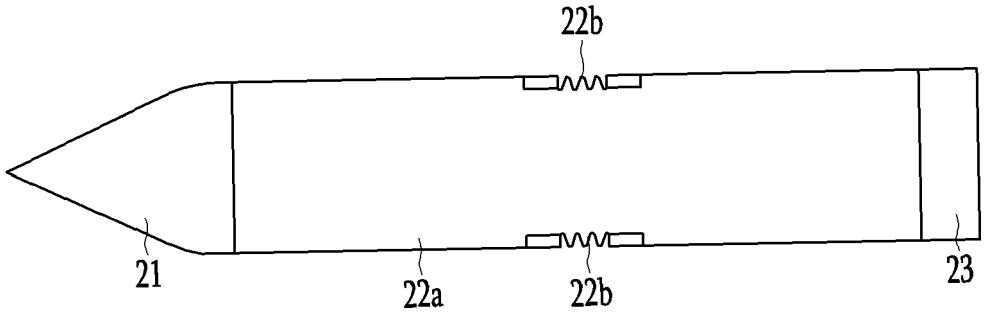


FIG. 6A

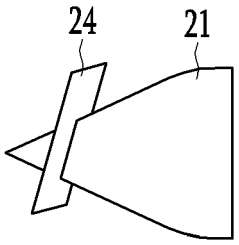


FIG. 6B

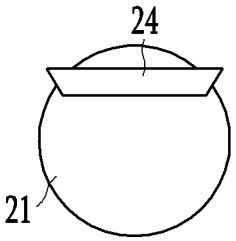


FIG. 6C

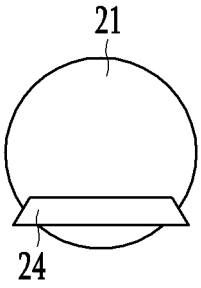


FIG. 6D

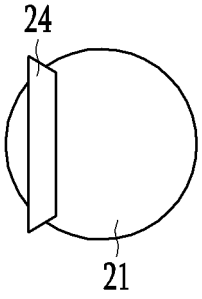
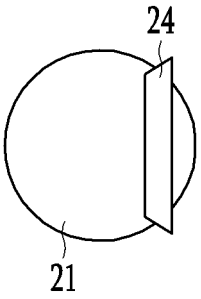


FIG. 6E



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2016/012250

A. CLASSIFICATION OF SUBJECT MATTER

C21B 7/16(2006.01)i, F27B 1/16(2006.01)i, F27D 25/00(2010.01)i, F27D 3/16(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)

C21B 7/16; C10L 10/04; C21B 5/00; C21B 7/00; C21B 7/24; F23B 90/00; C10L 9/10; F27B 1/16; F27D 25/00; F27D 3/16

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Utility models and applications for Utility models: IPC as above
Japanese Utility models and applications for Utility models: IPC as above

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

eKOMPASS (KIPO internal) & Keywords: bird nest, blast furnace, blast furnace, powdered coal, lance, capsule, firing zone, powder

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 10-1203651 B1 (POSCO) 27 November 2012 See paragraphs [0023]-[0035], claim 1 and figures 3-4.	1-2,4-6,8-10
Y		3,7
A		11-13
Y	KR 10-1267744 B1 (HYUNDAI STEEL COMPANY) 27 May 2013 See claim 2 and figure 1.	3
Y	KR 10-2012-0036174 A (OH, Mi Hye et al.) 17 April 2012 See abstract and claim 1.	7
A	JP 11-012617 A (NIPPON STEEL CORP.) 19 January 1999 See abstract, paragraph [0014], claim 1 and figures 1-2.	1-13
A	US 2007-0137539 A1 (NEUMEIR et al.) 21 June 2007 See abstract, paragraph [0029] and figure 1.	1-13

☐ 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
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"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	Date of mailing of the international search report
26 APRIL 2017 (26.04.2017)	**01 MAY 2017 (01.05.2017)**
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.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2016/012250

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