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(71) Applicant: **KAWASAKI STEEL CORPORATION**
**No. 1-28, 1-chome Kitahonmachi-dori**
**Fukiai-ku Kobe-shi Hyogo 651(JP)**

Applicant: **DENKA CONSULTANT & ENGINEERING CO., LTD.**
**3 Nakase 1-chome**
**Chiba-shi, chiba-ken 261-01(JP)**

(72) Inventor: **Asada, Iwao, c/o Tokyo Main Office**
**Kawasaki Steel Co., 2-3, Uchisaiwai-cho**
**2-chome**
**Chiyoda-ku, Tokyo 100(JP)**
Inventor: **Honma, Takahisa, c/o Denka Cons & Eng. Co., Ltd**
**6-5, Goi-minamikaigan**
**Ichihara-shi, Chiba-ken 290(JP)**

(74) Representative: **Patentanwälte Grünecker, Kinkeldey, Stockmair & Partner**
**Maximilianstrasse 58**
**W-8000 München 22(DE)**

## (54) Blast furnace pulverized coal injection drying apparatus.

(57) The present invention relates to a blast furnace pulverized coal injection drying apparatus, comprising a hot gas generating furnace (4) and a ground drying mill (3) into which the gas generated in the hot gas generating furnace is introduced to grind and dry wet coal, wherein a branch pipe is placed on the exhaust gas pipe (7) of the ground drying mill (3) and is linked with the branch pipe with a dehumidifying apparatus (23), and the outlet pipe (24) of the dehumidifying apparatus (23) is connected with the outlet side of the hot gas generating furnace (4), whereby a high operational cost due to conventional use of nitrogen gas is reduced.

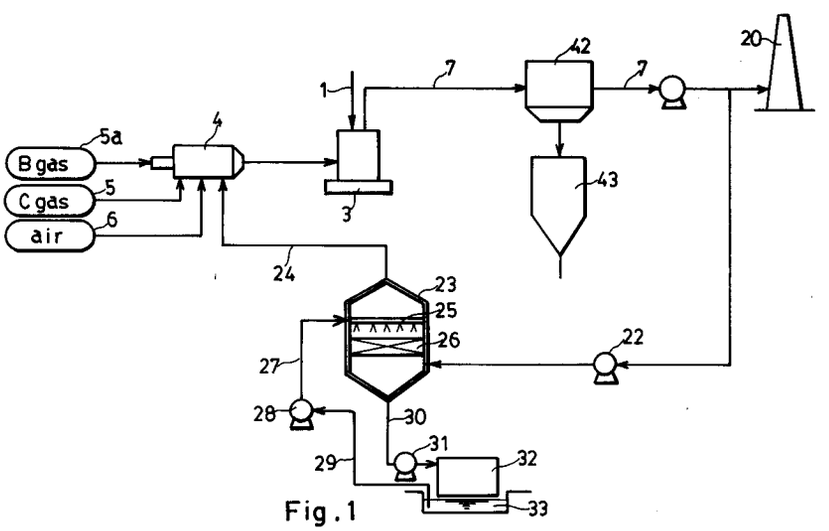


Fig.1

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## BACKGROUND OF INVENTION

### 1. Field of Invention

The present invention relates to a blast furnace pulverized coal injection (PCI) drying apparatus, more specifically to a blast furnace PCI drying apparatus employing and circulating a drying gas of a ground drying mill of the blast furnace PCI drying apparatus and having the circulating gas route equipped with a dehumidifying apparatus.

### 2. Prior Art

Fig. 2 shows a flow sheet of a blasting apparatus for blasting pulverized coal into a blast furnace.

Wet coal is fed through metallurgical coal bunker 101 and feed bin 102 into ground drying mill 103, where the wet coal is ground and dried in hot blast to be made into dried pulverized coal. The dried pulverized coal is then transported together with exhaust gas.

The drying gas of the ground drying mill is fed, after adding inert gas 107 as a cooling gas for temperature control to the exhaust gas generated by allowing B gas (blast furnace gas) 105a and/or C gas (coke oven gas) 105 to burn with combustion air 106. The drying gas is exhausted from ground drying mill 103 accompanying ground and dried pulverized coal, by drying wet coal in ground drying mill 103. The pulverized coal transported together with the gas is collected with cyclone 111 and bag filter 112, and is stored in pulverized coal storage hopper 113 of the blast furnace PCI apparatus. The exhaust gas separated from the pulverized coal is released from stack 120.

The pulverized coal stored in pulverized coal storage hopper 113 is transferred through intermediate tank 114 to injection tank 115. After pressurized by pressure gas 116, the pulverized coal is transferred through pulverized coal feed pipe 118 by carrier gas 117, and is then injected from a tuyere pipe into blast furnace 119.

As has been described above, because of the high temperature, it is required to cool the hot gas generated in hot gas generating furnace 104 for generation of the gas to be introduced into ground drying mill 103 of wet coal, the hot gas being for drying wet coal, so that a gas of a lower temperature is mixed together. The gas for cooling hot gas of a higher temperature should be inert gas scarcely containing oxygen, in order to prevent coal dust explosion of pulverized coal. As such inert gas, nitrogen gas, combustion exhaust gas and the like are used.

There is the technique that a part or the entire part of the exhaust gas exhausted from stack 120 of blast furnace PCI drying apparatus is introduced into a hot gas generating furnace by being circulated as inert gas by means of a fan, but such technique has been just applied to the initial or final stage of operation of the blast furnace PCI apparatus, because the water content in the circulating gas increases.

The problem concerning the use of nitrogen gas as inert gas for hot gas generating furnaces is an exceedingly high cost of its operation. On the other hand, the use of the exhaust gas after combustion is generally accompanied by the problems that the operation of the combustion apparatus is influential and the layout of a transporting piping route of the exhaust gas is difficult. The circulation of the exhaust gas of a blast furnace PCI drying apparatus causes the increase in the water content in the circulating gas, so the exhaust gas cannot be used constantly.

In order to solve these problems, in accordance with the present invention, a dehumidifying apparatus is placed on the route where the exhaust gas from a blast furnace PCI drying apparatus is circulated, and the exhaust gas after water is removed therefrom with the dehumidifying apparatus is used as inert gas.

## SUMMARY OF THE INVENTION

The object of the present invention is to provide an apparatus capable of collecting and circulating exhaust gas from an exhaust gas line of a blast furnace PCI drying apparatus with a fan and removing the water in the circulating gas in order that the resulting circulating gas can be used as inert gas for a hot gas generating furnace.

The present invention is a blast furnace PCI drying apparatus equipped with a hot gas generating furnace and a ground drying mill for grinding and drying wet coal by introducing the gas generated in a hot gas generating furnace, wherein a branch pipe is placed on a pipe of the exhaust gas after grinding and drying in a pulverized coal ground drying mill and is then linked with a dehumidifying apparatus, and the outlet pipe of the dehumidifying apparatus is connected with the outlet side of the hot gas generating furnace.

The outlet side of the hot gas generating furnace, referred to herein, means any part of the intermediate route to cool and introduce the gas generated from the hot gas generating furnace into the ground drying mill; in other words, it means that the vicinity of the outlet of the hot gas generating furnace, the intermediate route of the pipe from the hot gas generating furnace to the ground drying mill, and further the vicinity of the inlet of the ground drying mill may be satisfactory.

The term dehumidifying apparatus described above means an apparatus which can remove water from the exhaust gas from the ground drying mill, but is not necessarily an apparatus which decreases the relative humidity of the exhaust gas.

The dehumidifying apparatus may be satisfactorily composed of a scrubber performing the removal of the powder in the exhaust gas and the removal of the water in the exhaust gas by cooling the exhaust gas, on spraying water over the exhaust gas.

The present invention is the most characteristic in that in case that a branch pipe is placed in the exhaust gas line of a blast furnace PCI drying apparatus to circulate and use the exhaust gas, a dehumidifying apparatus is placed on the route of the branch pipe to prevent moisture increase in the circulating gas and to enable routine use of the exhaust gas as the circulating gas of the ground drying mill.

According to the present invention, self-completion is achieved in a blast furnace PCI drying apparatus, without bringing inert gas from other places.

That is, the increase in water concentration due to the circulation method is suppressed by the decrease in dew point and dewatering with a scrubber, while temperature control is achieved by the circulating gas employing hot gas from the hot gas generating furnace as inert gas.

## Brief Description of Drawings

Fig. 1 is the flow sheet of the example of the present invention, and Fig. 2 is the flow sheet of the blast furnace PCI apparatus.

## Description of Preferred Embodiments

Fig. 1 shows the flow sheet of the example of the present invention. Wet coal 1 as the raw material of a blast furnace PCI is fed into ground drying mill 3. In hot gas generating furnace 4, B gas (blast furnace gas) 5a and/or C gas (coke oven gas) 5 are burned with combustion air 6 to generate hot gas, which is then controlled of its temperature with cooling gas to be fed as hot blast into ground drying mill 3. The wet coal is dried and grinded in the ground drying mill while being ground, which is transported together with hot gas from exhaust pipe 7. Dried pulverized coal is collected in bag filter 42, and is stored in pulverized coal storage hopper 43. The exhaust gas separated from pulverized coal is released from stack 20.

There is placed branch pipe 21 for branching a part or the entire part of the exhaust gas of the blast furnace PCI drying apparatus from exhaust gas line 7, and the exhaust gas is aspirated with fan 22 and is introduced into dehumidifying apparatus 23. In the dehumidifying apparatus 23, the water in the raw material wet coal introduced in ground drying mill 3 is removed. The gas exhausted from the dehumidifying apparatus 23 is introduced through outlet pipe 24 of the dehumidifying apparatus to the outlet side of hot gas generating furnace 4, to control the temperature of hot gas being fed from hot gas generating furnace 4.

Thus, the exhaust gas of the blast furnace PCI drying apparatus is circulated as inert gas inside the blast furnace PCI drying apparatus.

In case that scrubber is used as dehumidifying apparatus 23, spray nozzle 25 and filling matter 26 are provided inside the scrubber, to cool the exhaust gas. By this cooling, excess water content in the exhaust gas is removed. The water after cooling the exhaust gas is fed to cooling tower 32, by means of hot water line 30 and hot water pump 31. The water cooled in cooling tower is stored in water pit 33, and is circulated to the spray nozzle through aspiration line 29 and cooling water pipe 27, by means of cooling water pump 28.

One example of material balance in case of using the apparatus of Example is shown in Table 1.

The water content of wet coal is about 1,500 kg/h, while the saturated water content of the gas at the scrubber inlet is about 22,500 kg/h and the saturated water content of the gas at the scrubber outlet is about 11,700 kg/h. Therefore, the scrubber has sufficient potential of drying wet coal, and the potential of the cooling tower is sufficiently high enough to remove the water content in wet coal.

Table 1

| | |
|---|---|
| Amount of B gas | 2,540 $Nm^3/h$ |
| Amount of C gas | 340 $Nm^3/h$ |
| Amount of air | 4,570 $Nm^3/h$ |
| Raw material wet coal | 24,600 kg/h |
| Water content of raw material % | 6 % |
| Water content in raw coal | 1,476 kg/h |
| Bag filter | |
| Amount of gas at outlet | 41,800 $Nm^3/h$ |
| Temperature at outlet | 90°C |
| (Amount of saturated water) | (27,628 kg/h) |
| Amount of gas in branch pipe | 32,220 $Nm^3/h$ |
| Ratio (Versus total amount of gas) | 77 % |
| Water content | 12,867 kg/h |
| Scrubber | |
| Amount of gas at inlet | 32,220 $Nm^3/h$ |
| Gas temperature at inlet | 85°C |
| Water content of gas at inlet (Amount of saturated water) | (22,566 kg/h) |
| Amount of gas at outlet | 30,740 $Nm^3/h$ |
| Gas temperature at outlet | 60°C |
| (Amount of saturated water) | (11,730 kg/h) |
| Amount of cooling water in circulation | 250 Ton/h |
| Temperature of cooling water | 25°C |
| Amount of lukewarm water | 250 Ton/h |
| Temperature of lukewarm water | 32°C |
| Cooling tower | 1,244 x $10^6$ Kcal/h |

## Claims

1. A blast furnace pulverized coal injection drying apparatus, comprising a hot gas generating furnace and a ground drying mill into which the gas generated in the hot gas generating furnace is introduced to grind and dry wet coal, wherein a branch pipe is placed on an exhaust gas pipe of the ground drying mill and is linked with a dehumidifying apparatus, and the outlet pipe of the dehumidifying apparatus is connected with the outlet side of the hot gas generating furnace.

2. The blast furnace pulverized coal injection drying apparatus according to claim 1, wherein the outlet pipe of the dehumidifying apparatus is connected to the vicinity of the outlet of the hot gas generating furnace.

3. The blast furnace pulverized coal injection drying apparatus according to claim 1, wherein the outlet pipe of the dehumidifying apparatus is connected to the intermediate route of the pipe introducing the gas generated in the hot gas generating furnace into the ground drying mill.

4. The blast furnace pulverized coal injection drying apparatus according to claim 1, wherein the outlet pipe of the dehumidifying apparatus is connected to the vicinity of the inlet of the ground drying mill, where the gas generated in the hot gas generating furnace is introduced.

5. The blast furnace pulverized coal injection drying apparatus according to claim 1, wherein the dehumidifying apparatus is a scrubber.

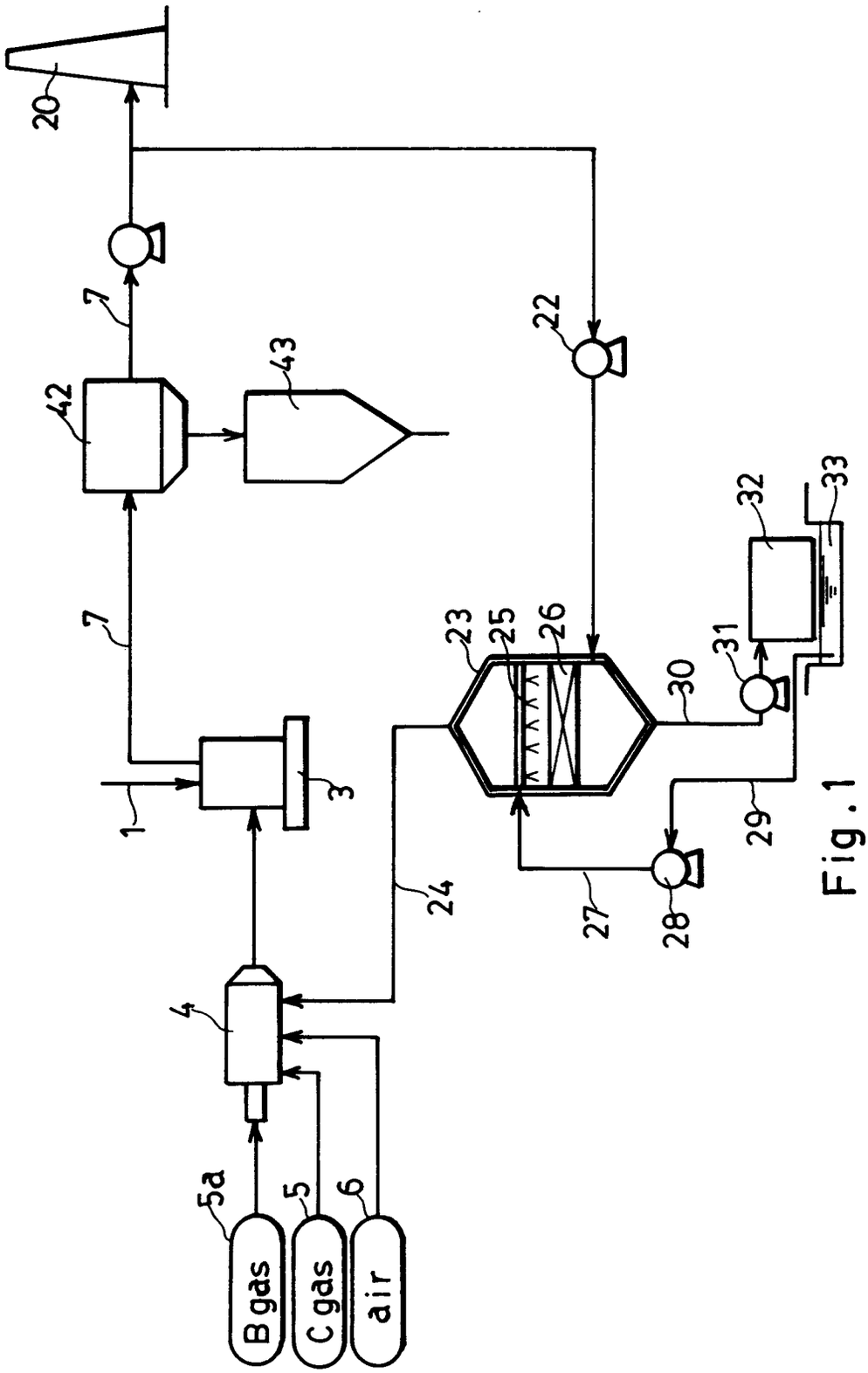
20
7
42
43
22
7
1
3
23
25
26
30
31
32
33
24
27
28
29
4
5a
5
6
B gas
C gas
air

Fig.1

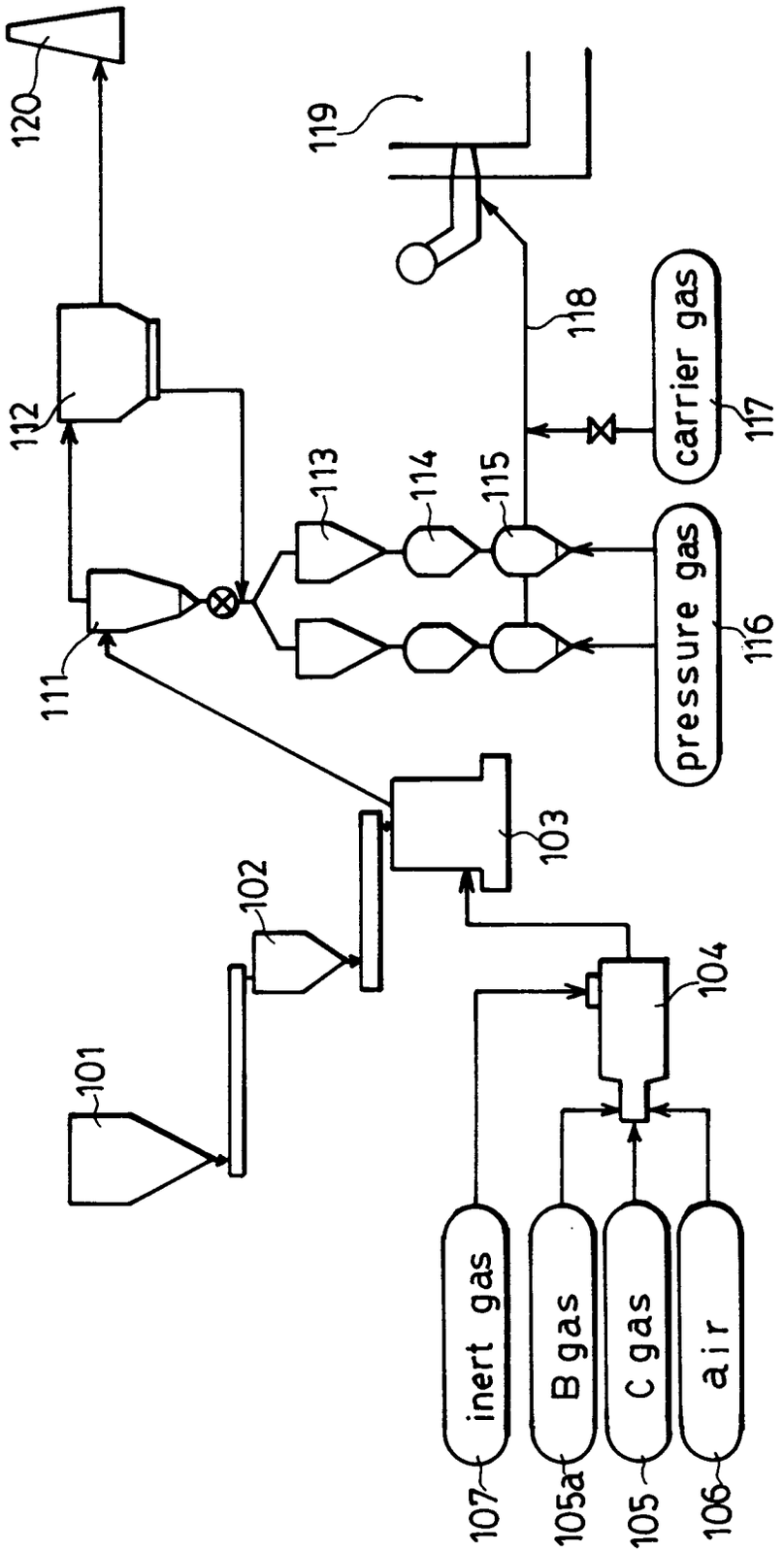
120
119
112
118
carrier gas
117
113
114
115
111
pressure gas
116
103
102
104
101
inert gas
B gas
C gas
air
107
105a
105
106

Fig. 2

European Patent Office

# EUROPEAN SEARCH REPORT

Application Number

**EP 91 11 2059**

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int. Cl.5) |
|---|---|---|---|
| X | US-A-3 306 238 (SAMUEL A BELL)<br>* claims 1-8; figure 1 * | 1,5 | C 21 B 5/00 |
| A | FR-A-2 531 724 (K.K.KOBE SEIKO SHO) | | |

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

C 21 B

The present search report has been drawn up for all claims

| Place of search | Date of completion of search | Examiner |
|---|---|---|
| The Hague | 12 September 91 | ELSEN D.B.A. |

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