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

(11) Publication number: **0 070 197**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: 82303692.6

(22) Date of filing: 14.07.82

(51) Int. Cl.³: **C 21 C 5/48**

(30) Priority: 15.07.81 JP 110576/81
17.07.81 JP 105440/81 U

(43) date of publication of application:
19.01.83 Bulletin 83/3

(84) Designated Contracting States:
BE DE GB IT NL

(71) Applicant: Nippon Steel Corporation
6-3 Ote-machi 2-chome Chiyoda-ku
Tokyo 100(JP)

(72) Inventor: Jono, Yutaka c/o Sakai Steel Factory
Nippon Steel Corporation 1, Chikko-Yawatamachi
Sakai-shi(JP)

(72) Inventor: Kanemoto, Michitaka c/o Sakai Steel Factory
Nippon Steel Corporation 1, Chikko-Yawatamachi
Sakai-shi(JP)

(72) Inventor: Kuboto, Tatsuyuki c/o Sakai Steel Factory
Nippon Steel Corporation 1, Chikko-Yawatamachi
Sakai-shi(JP)

(72) Inventor: Ooura, Toshiaki c/o Hirohata Steel Factory
Nippon Steel Corp. 1, Fujicho
Hirohata-ku Himeji-shi(JP)

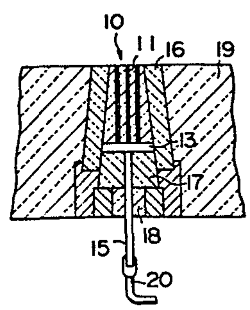
(72) Inventor: Kasuya, Yoshiyuki c/o Hirohata Steel Factory
Nippon Steel Corp. 1, Fujicho
Hirohata-ku Himeji-shi(JP)

(74) Representative: Nettleton, John Victor et al,
Abel & Imray Northumberland House 303-306 High
Holborn
London, WC1V 7LH(GB)

(54) **A nozzle assembly for bottom blown steel converter.**

(57) A bottom blowing nozzle assembly for use in refining of molten metal by blowing various gases from the bottom of a steel making furnace such as a steel converter containing the molten metal. The bottom blowing nozzle assembly has a plurality of thin metal nozzles embedded in a refractory block in a side-by-side relation at predetermined intervals so as to extend in the longitudinal direction of the refractory block. According to this arrangement, it is possible to remarkably improve the durability of the bottom blowing nozzle of the kind described.

FIG.3



EP 0 070 197 A1

A NOZZLE ASSEMBLY FOR BOTTOM BLOWN STEEL CONVERTER

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a gas blowing nozzle assembly for use in refining molten metal by blowing various gases from the bottom of a vessel containing the molten metal. More particularly, the invention is concerned with a bottom blowing nozzle assembly constituted by a plurality of metallic thin nozzle embedded in a block of a refractory material.

Description of the Prior Art

It is well known to promote the metallurgical reaction of molten steel in a steel making furnace, e.g. a steel converter, by blowing a gas such as Ar, N_2, CO_2, CO or the like (referred to simply as "gas" hereinafter) from the bottom of the furnace.

On the other hand, in the field of the oxygen blowing converters, there is a current attempt to blow carbon dioxide gas (referred to as "CO_2" hereinafter) through a bottom blowing nozzle while blowing oxygen (referred to as "O_2" hereinafter) from an upper nozzle. This attempt is advantageous in that the molten metal can be stirred and agitated strongly and that the CO_2 can be changed into combustible CO gas.

It is well known that, when CO_2 is blown into a steel converter from the bottom, a so-called mushroom 2 is formed just above the bottom blowing nozzle 1 as shown in Fig. 1. The mushroom 2 is a body formed by half-solidified molten metal, and is considered to have a central gas hole 3 and a number of small peripheral gas apertures 4. It is important to stably maintain this mushroom 2 because it is effective in protecting the bottom blowing nozzle 1 and the refractory structure 5 from the molten metal while ensuring smooth blowing of the gas. The mushroom 2, however, is generally unstable and weak and, hence, tends to be extinguished depending on the surrounding environmental conditions or, alternatively, liable to be solidified undesirably. Once the solidification of the mushroom takes place, the mushroom grows and becomes large to instantaneously block the bottom blowing nozzle or to cause other problems. Thus, it is quite difficult to suitably control and maintain the mushroom.

The present inventors have found through their experience that it is quite effective to reduce the diameter of the bottom blowing nozzle 1 to increase the linear velocity of CO_2 blown into the furnace, in order to maintain the mushroom stably while preventing the same from becoming large. The reduced diameter of the bottom blowing nozzle 1, however, tends to reduce the amount of blowing of CO_2 correspondingly so that, in some case, it is difficult to obtain the desired amount of blowing in CO_2. To overcome this problem, it is necessary to employ a large number of bottom blowing nozzles 1 in communication with the bottom of the converter, which resulting in a raised installation cost and difficulty in maintenance.

As is well known, the bottom blowing nozzle 1 is usually made of a high-grade refractory material having a good anti-spalling property as well as other properties, in order to withstand use under severe operating conditions. A typical example of such refractory material is a MgO-C system. When CO_2 gas is blown through a bottom blowing nozzle made of the refractory material of MgO-C system, the CO_2 undesirably reacts with C in the refractory material at high temperatures, for example, 1000°C or higher, whereas, at comparatively low temperature of less than 500°C, the MgO reacts with the CO_2 to form $MgCO_3$ thereby to seriously lower the strength of the refractory material, thus impractically shorten the life of the bottom blowing nozzle. Such results have been confirmed by the present inventors through various experiments.

The blowing of a gas is preferably made through a multiplicity of small apertures to form a numerous bubbles. To cope with this demand, according to a conventional method of making the gas blowing pipe, a multiplicity of fine steel wires were embedded in a refractory block and are withdrawn therefrom to leave a multiplicity of fine apertures in the refractory block. This method, however, suffers following drawbacks.

(1) It is necessary to withdraw the fine steel wires very carefully from the refractory block, for otherwise the small apertures cannot be formed precisely.

(2) If there is a bur or the like on the end of

the steel wire, the fine aperture is damaged during withdrawal of the steel wire.

(3) For ensuring sufficient strength of the refractory block, it is necessary to add coarse refractory grains to the refractory material. The refractory grains, however, are liable to be moved forcibly during the withdrawal of the steel wires to form voids which adversely affect the life of the refractory block. Therefore, with the steel-were withdrawal method, it has not been posible to add the coarse refractory grains and, hence, it has been impossible to obtain a gas blowing pipe having a sufficiently high strength.

SUMMARY OF THE INVENTION

The invention has been accomplished as a result of various studies and experiments conducted by the present inventors with the knowledge and experience explained above.

An object of the invention is to provide a bottom blowing nozzle assembly capable of maintaining the mushroom stably and blowing a gas efficiently while ensuring a remarkable improvement in the durability of the nozzle.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic illustration of a mushroom formed as a result of blowing of CO_2 gas;

Fig. 2 is a sectional view of a bottom blowing nozzle assembly in accordance with an embodiment of the invention;

Fig. 3 is a sectional view showing the state of mounting of the bottom blowing nozzle assembly;

Figs. 4 to 6 are plan views of bottom blowing nozzle assemblies having different forms of embedding metal nozzles;

Fig. 7 is a sectional view showing the state of mounting of the bottom blowing nozzle assembly;

Fig. 8 is a perspective view of another example of the metal nozzle; and

Figs. 9 and 10 are plan views of bottom blowing nozzle assemblies having different forms of embedding of the metal nozzles.

Throughout the drawings, the following reference numerals are used to denote the following parts or members. 1: bottom blowing nozzle, 2: mushroom, 3: gas blowing hole, 4: small gas apertures, 5: refractory bottom structure, 10: bottom blowing nozzle assembly, 11: thin metal nozzle, 12: refractory block, 13: bottom plate structure, 14: protecting sleeve, 15: gas supplying pipe, 16: tryere brick, 17: support brick, 18: base brick, 19: bottom brick wall, 20: gas supply equipment, 21: header pipe, 110: flattened thin metal nozzle, 110a: opening of flattened nozzle

DESCRIPTION OF THE PREFERRED EMBODIMENTS

According to the invention, there is provided a bottom blowing nozzle assembly having a plurality of thin metal nozzles embedded in a refractory block in parallel with one another and at a suitable interval. Peferred embodiments of the invention will be described hereinunder with reference to the accompanying drawings.

Fig. 2 is a side elevational view showing in section the construction of a bottom blowing nozzle assembly in accordance with an embodiment of the invention, while Fig. 3 is a side elevational view showing in section the manner of attaching the bottom blowing nozzle of the invention to the bottom of a converter. The bottom blowing nozzle assembly of the invention, generally designated by a reference numeral 10, has a plurality of thin metal nozzles 11 (referred to simply as "nozzles", hereinafter) embedded in a refractory block 12 in the longitudinal direction of the latter. In order to obtain a sufficiently high strength, the refractory block is made of refractory material composed of fine, medium and coarse refractory grains mixed at a suitable mixing ratio. The metal nozzles 11 are arrayed at a suitable internal ℓ without contacting adjacent ones.

The bottom blowing nozzle assembly 10 of this embodiment is provided at its bottom with a cavity 13a which serves as a header for the gas to be blown. A bottom plate structure 13 has a protecting sleeve 14 which stands upright therefrom in such a manner as to hold the lower peripheral edge of the refractory block 2.

The nozzles 11 are connected to the bottom plate structure 13 to which is also connected a gas supply pipe 15. The bottom blowing nozzle assembly 10 as a whole is mounted in the tuyere bricks 16 of the bottom of converter, and is fixedly held by the bottom brick wall 19 of the converter by means of supporting bricks 17 and base bricks 18.

In operation, CO_2 is supplied from an external gas supply equipment 20 to the bottom plate structure 13 through the gas supply pipe 15 and then into the converter through each nozzle 11. The nozzles 11 correspond, in area to a blowing port of a predetermined diameter and serve to separate CO_2 flowing therein from the refractory material 12 to prevent direct reaction between the refractory material 12 and CO_2. Thus, the nozzles 11 can be made of metal tubes such as carbon steel tubes, provided that the above-mentioned functions are performed without fail. According to the experience of the present inventors, however, the use of heat-resistant material such as stainless steel is preferred because the tip ends of the nozzles 11 are subjected to a high temperature during the use. In order to stably maintain the formed mushroom while preventing the same from growing larger, each metal nozzle 11 is made to have a small diameter of, for example, 3 to 5 mmϕ or less. It is effective also to maintain a high apparant flow velocity of about 1000 m/sec or higher.

The number of nozzles 11 embedded can be selected as desired in accordance with the required blowing rate which in turn is determined in accordance with various factors such as the volume of the converter, operating condition and so forth. For instance, the nozzles 11 are embedded in a side-by-side relation in the refractory block 12 in the manners shown in Figs. 4 to 6.

Fig. 8 shows another embodiment in which each of the nozzle 110 of the nozzle assembly has a flattened cross-section so as to present at its opening a slit 110a of an extremely small width. The flattened metal nozzles 110 may be embedded so as to extend in parallel with the diametrical central axis X of cross-section of the nozzle assembly as shown in Fig. 9 or, alternatively, arranged radially around the longitudinal axis Y as shown in Fig. 10. In the illustrated embodiment, the width "h" of the slit-like opening 110a is selected to be in a range between 0.5 and 2.0 mm, while the breadth "w" is selected between 50 and 200 mm. Such size of the slit-like opening ensures a good blowing effect by the blowing with CO_2 regardless of a change in the rate of blowing, and effectively prevented the moltem metal from coming into the slit-like opening 110a even when the rate of blowing of CO_2 was decreased. Thus, in this specification, the term thin metal nozzle is used to include the thin metal nozzle 110 worked to have a flattened shape to exhibit extremely narrow slit-like opening 110a.

As has been described, in the bottom blowing nozzle assembly 10 of the invention, the nozzles 11 keeps a predetermined diameter and the reaction between the refractory block 12 and CO_2 is avoided perfectly, so that it becomes possible to make full use of the advantages of high-grade refractory material such as of MgO-C system. In consequence, it becomes possible to attain a remarkable improvement in the durability of the bottom blowing nozzle assembly 10. In addition, since a multiplicity of thin metal nozzles 11 are embedded in a single nozzle assembly 10, it is possible to blow CO_2 at a greater rate than the convertional bottom blowing assembly with a single bottom blowing assembly. In addition, since each nozzle 11 discharges CO_2 at the required high linear velocity, it is possible to maximize the refining effect afforded by the blowing of CO_2.

The embodiment described hereinbefore is not exclusive. For instance, an equivalent effect is attained when CO_2 is substituted by an inert gas such as N_2, Ar or the like and when gases such as N_2, Ar, air or O_2 is added to CO_2. Provided that the number of the nozzles 11 embedded is small, the connection of the nozzles 11 embedded in the refractory block 12 to the CO_2 supply pipe 15 may be made through a header pipe 21 installed externally of the converter as shown in Fig. 7. Such a change is a matter of design choice. According to the experience of the present inventors, however, it is preferred to construct the bottom blowing nozzle assembly 10 to include a bottom plate structure 13 as shown in Figs. 2 and 3, from the view point of manufacture of the assembly. It is also preferred to construct the bottom blowing nozzle assembly 10 in such a manner that the nozzles 11 have a length slightly greater than the minimum usable thickness of the brick wall 19. By so doing, it is possible to minimize the pressure drop of the gas which inevitably takes place at an intermediate portion of the piping when thin metal nozzle 11 are used. Furthermore, it was confirmed that, according to this construction of the nozzle assembly, it is possible to obtain a good sealing of CO_2, i.e. to perfectly eliminate any leak of CO_2 from the refractory block 12 and the juncture of the nozzle 11.

An example of CO_2 blowing conducted using the bottom blowing nozzle assembly of the invention is described below.

Example

For refining 180 tons of molten pig iron, CO_2 was blown at a rate of 300 Nm^3/h and at a pressure of 9 Kg/cm^2. While the mean life of a conventional bottom blowing nozzle having a refractory block of MgO-C system in which the gas blowing hole is formed by piercing showed only a short mean life of 50 charges, the bottom blowing nozzle assembly in accordance with the invention showed a longer life in excess of 400 charges. It addition, it was confirmed that the initial blowing pressure of 9 Kg/cm^2 was maintained without being changed even at the end period of the life at the constant blowing rate of 300 Nm^3/h.

The diameter of the nozzle 11 used in this example was 3 mm ϕ, the number of nozzles 11 was 11 and the refractory block was made of an MgO-C system one.

As will be understood from the foregoing description, the bottom blowing nozzle assembly of the invention has a remarkably improved durability and is quite effective not only in stabilizing the mushroom but also in improving the refining effect.

WHAT IS CLAIMED IS:

1. A bottom blowing nozzle assembly comprising a plurality of thin metal nozzles embedded in a refractory block at a predetermined inerval so as to extend in the longitudinal direction of said refractory block.

2. A bottom blowing nozzle assembly according to claim 1, wherein said bottom blowing nozzle assembly is provided at its bottom with a cavity adapted to function as a header.

3. A bottom blowing nozzle assembly according to claim 1, wherein said bottom blowing nozzle assembly is mounted in the tuyere bricks at the bottom of a furnace vessel.

4. A bottom blowing nozzle assembly according to claim 1, wherein each of said thin metal nozzles is made of a cylindrical carbon steel tube or a stainless steel tube.

5. A bottom blowing nozzle assembly according to claim 1, wherein each of said thin metal nozzles is made of a carbon steel tube or a stainless steel tube having a flattened cross-section.

6. A bottom blowing nozzle assembly according to claim 1, wherein said refractory block is made of fine, medium and coarse refractory grains of MgO-C system mixed at a suitable mixing ratio.

FIG.1

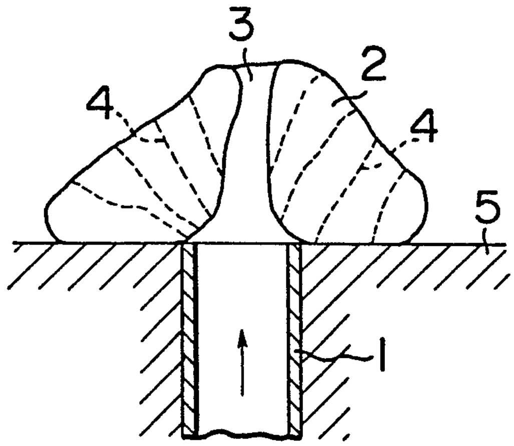


FIG.2

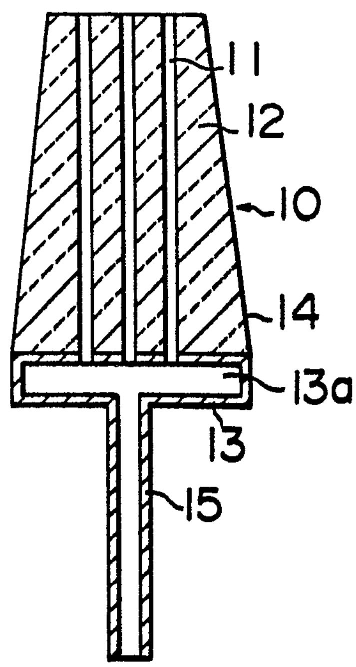


FIG.3

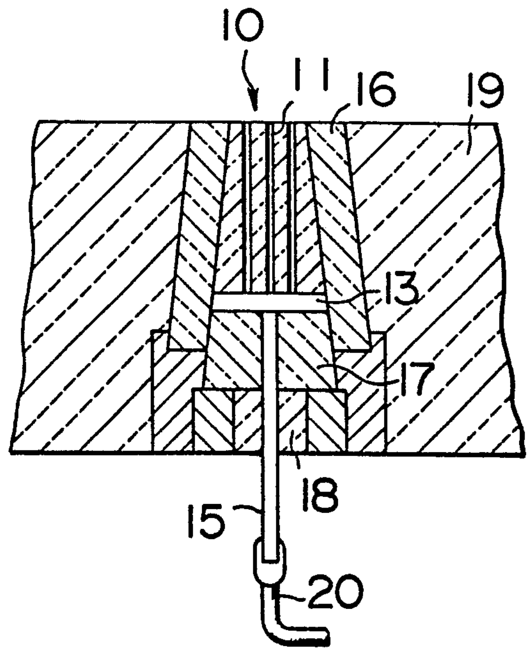


FIG.4

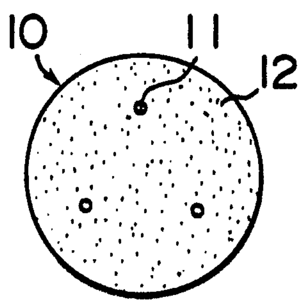


FIG.5

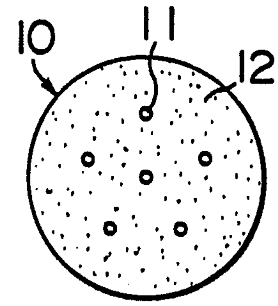


FIG.6

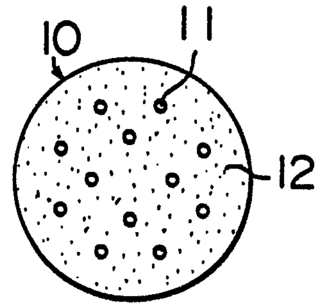


FIG. 7

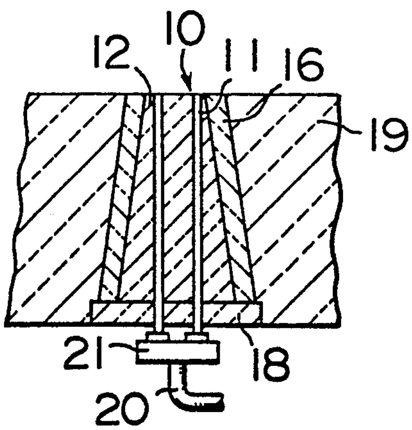


FIG. 8

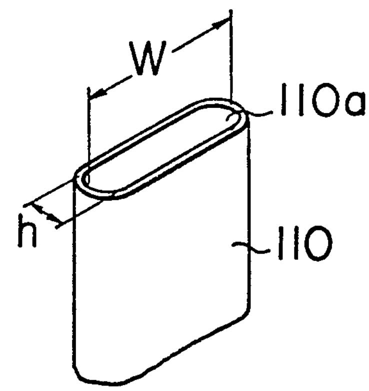


FIG. 9

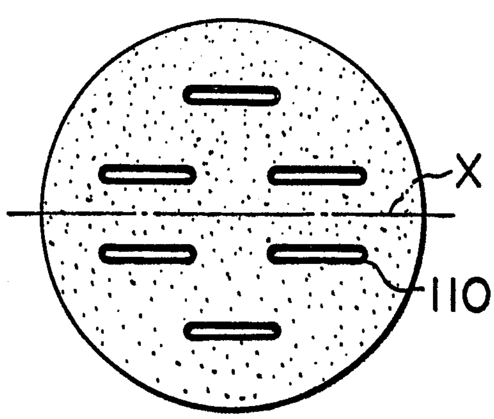
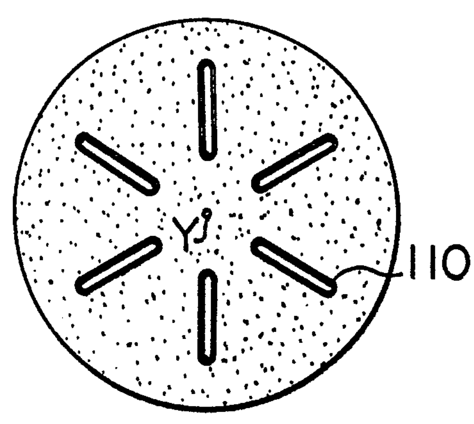


FIG. 10



0070197

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 82 30 3692.6

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. 3)
Y	LU - A - 81 208 (ARBED) * page 4 * & US - A - 4 340 208 --	1	C 21 C 5/48
Y	Patent Abstracts of Japan Vol. 5, Nr. 22, 10 February 1982 & JP - A - 55-149750 --	1	
Y	EP - A1 - 0 028 569 (CANADIAN LIQUID AIR) * page 12 * & US - A - 4.311 518 --	1	TECHNICAL FIELDS SEARCHED (Int.Cl. 3) C 21 C 5/48
Y	AT - B - 204 060 (M. VANDESTRICK) * fig. 1 * --	1	
Y	GB - A - 2 041 182 (KAWASAKI STEEL) * page 11 * --	1	
Y,P	GB - A - 2 069 671 (KAWASAKI STEEL) * pages 2, 3 * --	1	
Y	DE - C - 9 354 (M.H. KOPPMAYER) * page 1 * ----	1	

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
Y: particularly relevant if combined with another document of the same category
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: earlier patent document, but published on, or after the filing date
D: document cited in the application
L: document cited for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	30-09-1982	SUTOR