COMMONWEALTH of AUSTRALIA

PATENTS ACT 1952

APPLICATION FOR A STANDARD PATENT

xxxx
We TOSHIBA CERAMICS CO., LTD., of 26-2 Nishi-Shinjuku 1-chome, Shinjuku-ku, Tokyo, Japan and SUMITOMO METAL INDUSTRIES, LTD. of 15 Kitahama 5-chome, Higashi-ku, Osaka-shi, Osaka-fu, Japan

hereby apply for the grant of a Standard Patent for an invention entitled:

A NOZZLE FOR DISCHARGING MOLTEN METAL USED IN A CASTING DEVICE

which is described in the accompanying ~~provisional~~ complete specification.

Details of basic application(s):—

Number	Convention Country	Date
220691/87	JAPAN	September 3, 1987
279132/87	JAPAN	November 6, 1987

APPLICATION ACCEPTED AND AMENDMENTS ALLOWED 30.11.89

The address for service is care of DAVIES & COLLISON, Patent Attorneys, of 1 Little Collins Street, Melbourne, in the State of Victoria, Commonwealth of Australia.

Dated this 1st day of September 1988.

To: THE COMMISSIONER OF PATENTS

.....
(a member of the firm of DAVIES & COLLISON for and on behalf of the Applicant).

Davies & Collison, Melbourne and Canberra.

Insert title of invention.

In support of the Application made for a patent for an invention entitled: "A NOZZLE FOR DISCHARGING MOLTEN METAL USED IN A CASTING DEVICE"

Insert full name(s) and address(es) of declarant(s) being the applicant(s) or person(s) authorized to sign on behalf of an applicant company.

I/We Kuniaki Watanabe of Toshiba Ceramics Co.,Ltd. of 26-2 Nishi-Shinjuku 1-chome,Shinjuku-ku, Tokyo, Japan and Mitsuo Yano of Sumitomo Metal Industries,Ltd. of 15 Kitahama 5-chome, Higashi-ku,Osaka-shi, Osaka-fu, Japan

do solemnly and sincerely declare as follows :-

Cross out whichever of paragraphs 1(a) or 1(b) does not apply

1(a) relates to application made by individual(s)

1(b) relates to application made by company; insert name of applicant company.

1. (a) I/We am/are the applicant for the patent

or (b) I am authorized by TOSHIBA CERAMICS CO.,LTD. AND SUMITOMO METAL INDUSTRIES, LTD. respectively

the applicant.S..... for the patent to make this declaration on its/their behalf.

Cross out whichever of paragraphs 2(a) or 2(b) does not apply

2(a) relates to application made by inventor(s)

2(b) relates to application made by company(s) or person(s) who are not inventor(s); insert full name(s) and address(es) of inventors.

2. (a) I am/We are the actual inventor of the invention

or (b) (1) Kazuhide KAWAI

(2) Hiroyuki MORI

(3) Satoshi OYA

(4) Seiya SUGITA

(5) Morio KAWASAKI

(6) Norifumi KASAI

See overleaf for inventors addresses

I/We are the actual inventorS..... of the invention and the facts upon which the applicant..... is/are entitled to make the application are as follows :-

State manner in which applicant(s) derive title from inventor(s)

The actual inventors have assigned the invention to the said applicants.

Cross out paragraphs 3 and 4 for non-convention applications. For convention applications, insert basic country(s) followed by date(s) and basic applicant(s).

3. The basic applicationS..... as defined by Section 141 of the Act was/were made

in Japan on the 3rd September, 1987

by Toshiba Ceramics Co.,Ltd. and Sumitomo Metal Industries Ltd.

in Japan on the 6th November, 1987

by Toshiba Ceramics Co.,Ltd. and Sumitomo Metal Industries Ltd.

in ..... on the .....

by .....

4. The basic applicationS..... referred to in paragraph 3 of this Declaration was/were the first application..S..... made in a Convention country in respect of the invention the subject of the application.

Insert place and date of signature.

Declared at Tokyo, Japan this 16th day of August, 1988

Signature of declarant(s) (no attestation required)

TOSHIBA CERAMICS CO., LTD.

Kuniaki WATANABE, General Manager of Patent Division

Kuniaki Watanabe

Note: Initial all alterations.

Insert place and date of signature.

Declared at Tokyo, Japan this 16th day of August, 1988

Signature of declarant(s) (no attestation required)

SUMITOMO METAL INDUSTRIES, LTD.

Mitsuo YANO, Manager of Patent Section

Mitsuo Yano

Note: Initial all alterations.

Inventors addresses

(1) 77-2 Kitano, Kamiyata-cho,
Nishio-shi, Aichi-ken, Japan

(2) 123 Shiroyama, Kawatana-cho
Higashi-Sonogi-gun, Nagasaki-ken,
Japan

(3) 52 Komukai, Ogawa-cho, Anjo-shi,
Aichi-ken, Japan

(4) 38-1 Kamisawato, Ogakie-cho,
Kariya-shi, Aichi-ken, Japan

(5) 1-1-20 Takamagahara, Kashima-machi, Kashima-gun,
Ibaraki-ken, Japan

(6) 203-12 Miyatsudai, Kashima-machi,
Kashima-gun, Ibaraki-ken, Japan

(12) PATENT ABRIDGMENT (11) Document No. AU-B-21761/88
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 593997

(54) Title
A NOZZLE FOR DISCHARGING MOLTEN METAL USED IN A CASTING DEVICE

International Patent Classification(s)
(51)[4] B22D 041/08 C04B 035/48

(21) Application No. : 21761/88 (22) Application Date : 01.09.88

(30) Priority Data

(31) Number	(32) Date	(33) Country
62-220691	03.09.87	JP JAPAN
62-279132	06.11.87	JP JAPAN

(43) Publication Date : 11.05.89

(44) Publication Date of Accepted Application : 22.02.90

(71) Applicant(s)
TOSHIBA CERAMICS CO., LTD.; SUMITOMO METAL INDUSTRIES, LTD.

(72) Inventor(s)
KAZUHIDE KAWAI; HIROYUKI MORI; SATOSHI OYA; SEIYA SUGITA; MORIO KAWASAKI; NORIFUMI KASAI

(74) Attorney or Agent
DAVIES & COLLISON, MELBOURNE

(56) Prior Art Documents
AU 77182/87 C04B 35/48
EP 193751

(57) Claim

1. A molten metal discharge nozzle for a casting device, wherein at least an inner surface portion defining a nozzle bore of the nozzle is made of a refractory comprising CaO and SiO_2, and optionally Al_2O_3,

the ratio of said CaO to said SiO_2, being from 0.18 to 1.86, and

the Al_2O_3 content of said portion being not more than 10 wt% of the total sum weight of said CaO and SiO_2.

2. A nozzle according to claim 1, wherein said SiO_2 is partially replaced by Si.

COMMONWEALTH OF AUSTRALIA

PATENT ACT 1952

COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE 593997

CLASS INT. CLASS

Application Number:
Lodged:

Complete Specification Lodged:
Accepted:
Published:

Priority:

Related Art:

NAME OF APPLICANT: TOSHIBA CERAMICS CO., LTD. and SUMITOMO METAL INDUSTRIES, LTD.

ADDRESS OF APPLICANT: 26-2 Nishi-Shinjuku 1-chome, Shinjuku-ku Tokyo, Japan and 15 Kitahama 5-chome, Higashi-ku, Osaka-shi Osaka-fu, Japan, respectively.

NAME(S) OF INVENTOR(S) KAZUHIDE KAWAI NORIFUMI KASAI
HIROYUKI MORI
SATOSHI OYA
SEIYA SUGITA
MORIO KAWASAKI

ADDRESS FOR SERVICE: **DAVIES & COLLISON, Patent Attorneys 1 Little Collins Street, Melbourne, 3000.**

COMPLETE SPECIFICATION FOR THE INVENTION ENTITLED:

A NOZZLE FOR DISCHARGING MOLTEN METAL USED IN A CASTING DEVICE

The following statement is a full description of this invention, including the best method of performing it known to us :-

BACKGROUND OF THE INVENTION

The present invention relates to a nozzle for discharging molten metal used in a casting device.

Alumina-graphite and zirconia-graphite have been popularly used as the material of the nozzles for discharging molten metal such as a submerged nozzle for continuous discharging. These materials show high corrosion resistance against molten steel, but they have the defect that they tend to invite deposition of base metal because of their high heat conductivity. Especially in the case of steel with high aluminum content such as aluminum killed steel, there tends to take place blockage of a nozzle bore of the nozzle due to deposition of aluminum oxides such as Al_2O_3, necessitating interruption of casting operation.

Countermeasures such as improvement of preheating conditions and heat insulation have been taken, with an appreciable effect, against the blockage due to the deposition of the base metal.

On the other hand, for preventing the blockage due to aluminum oxides, there is employed a slit type

submerged nozzle in which a porous refractory is provided on an inner surface portion defining the nozzle bore to introduce an inert gas through the porous refractory. This slit type submerged nozzle, however, has the following problems.

Since it is difficult to provide slits close to a discharging port of molten steel, it is hardly possible to prevent the deposition of metal and the blockage at the area near the discharging port. Also, carbon content of the porous refractory is gradually oxidized away while SiO_2 is reacted with the C-CO reducing atmosphere to become SiO and dissipated in that form as the discharging operation is conducted repeatedly. This results in an increased gas permeability of the porous refractory, making it difficult to control the permeation rate of inert gas. Further, increased feed of inert gas encourages formation of pinholes in the cast steel.

Many attempts have been made for preventing the blockage by improving the nozzle material. For instance, Japanese Patent Application Kokai (Laid-Open) No. 57-71860 proposes a method in which a CaO-graphite type refractory is used and the nozzle component is reacted with Al_2O_3 in molten steel to produce a $CaO-Al_2O_3$ type low-melting material to thereby use away Al_2O_3 which is inclined to deposit on the inner surface.

However, the $CaO-Al_2O_3$ type materials don't always form a low-melting material; a high-melting material may be formed, which may become the core of a deposition of Al_2O_3 and this may expedite blockage of the nozzle.

SUMMARY OF THE INVENTION

In accordance with the present invention there is provided a molten metal discharge nozzle for a casting device, wherein at least an inner surface portion defining a nozzle bore of the nozzle is made of a refractory comprising CaO and SiO_2, and optionally Al_2O_3,

the ratio of said CaO to said SiO_2, being from 0.18 to 1.86, and

the Al_2O_3 content of said portion being not more than 10 wt% of the total sum weight of said CaO and SiO_2.

In the nozzle of the present invention, the CaO to SiO_2 ratio in the inner surface portion is specified to 0.18-1.86, whereby even if Al_2O_3 should be deposited on the inner surface, it will typically react with CaO and SiO_2 to form a compound having a melting point lower than the molten steel temperature and will fuse away in the molten steel, so that there can be obtained a nozzle which is safe from blockage in a wide range of working conditions.

When the ratio of CaO to SiO_2 is outside said range, the desired low-melting liquid phase may not be produced effectively and instead high-melting point calcium aluminate may be produced from a solid phase reaction of Al_2O_3 and CaO, and such high-melting compound may serve as the core for the deposition of Al_2O_3. When the content of Al_2O_3 exceeds 10 wt% of the total sum weight of CaO and SiO_2, the nozzle itself may be reduced in melting point because of the reaction of Al_2O_3 with CaO and SiO_2 and may become vulnerable to damage by fusion.

Al_2O_3 deposited on the inner surface of this invention during the casting operation will generally undergo a chemical reaction with CaO and SiO_2 to form a

liquid phase having a melting point below 1,500°C. This liquid phase is borne away with molten steel, so that there is reduced deposition and accumulation of Al_2O_3 on the inner surface.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a sectional view showing an embodiment of a nozzle of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiments of the present invention will be described by way of example only with reference to the accompanying drawings and tables.

In the drawing, a body portion 13 is composed of a conventional refractory material (comprised principally of Al_2O_3 and C) and an inner surface portion 12 defining a nozzle bore 14 contains CaO and SiO_2 in the specified ratio. The composition of the portion 12 and the ratio of CaO to SiO_2 in the nozzles of Examples 11 to 19 are shown in Table 1. Those in the nozzles of Comparative Examples 11 to 13 are also shown in Table 1 for comparison.

Each of these nozzles is mounted to the same tundish and subjected to continuous casting of aluminium killed steel under the same conditions. After the casting operation, the narrowing rate of the nozzle bore 14 across the A-A section (FIG. 1) of each of the nozzles is measured and shown in the bottommost rank of Table 1.

As seen from the table, the narrowing rate in the nozzles of Examples 11 to 19 according to this invention is less than 1/3 of that in the nozzles of Comparative Examples 11 to 13, indicating the excellent effect to prevent the blockage according to this invention.

In the nozzles of this invention, SiO_2 may be partly replaced with Si. The same effect as described above can be obtained in this case since Si is oxidized into SiO_2 on the inner surface.

While the present invention has been described in conjunction with advantageous embodiments, it will be apparent to those skilled in the art that modifications and variations may be resorted to without departing from the spirit and scope of the invention. For example, regarding the composition of the inner surface portion, it

is possible to use other materials than those used in Example 11 to 19 provided that the specific condition (the content of Al_2O_3 should be less than 10 wt% of the total sum weight of SiO_2 and CaO) is met.

Table 1

		Example 11	Example 12	Example 13	Example 14	Example 15	Example 16	Example 17	Example 18	Example 19	Comp. Example 11	Comp. Example 12	Comp. Example 13
Composition (wt%)	ZrO_2	68	67.5	66.5	40	63.5	60	55	50	27	40	17	0
	C	20	20	20	20	20	20	20	20	20	20	20	30
	SiO_2	10	10	10	30	10	10	10	10	25	10	10	15
	CaO	2.0	2.5	3.5	10	6.5	10	15	18	25	30	53	0
	Al_2O_3	0	0	0	0	0	0	0	2	3	0	0	55
CaO/SiO_2		0.20	0.25	0.35	0.33	0.65	1.0	1.5	1.8	1.0	3.0	5.3	0
Nozzle bore narrowing rate (%)		15	10	8	6	6	6	12	14	6	57	48	52

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1. A molten metal discharge nozzle for a casting device, wherein at least an inner surface portion defining a nozzle bore of the nozzle is made of a refractory comprising CaO and SiO_2, and optionally Al_2O_3,

the ratio of said CaO to said SiO_2, being from 0.18 to 1.86, and

the Al_2O_3 content of said portion being not more than 10 wt% of the total sum weight of said CaO and SiO_2.

2. A nozzle according to claim 1, wherein said SiO_2 is partially replaced by Si.

3. A nozzle according to claim 1 substantially as hereinbefore described with reference to the drawings and/or Examples.

DATED this 23rd day of November 1989.

Fig.1