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(72) Inventors:

- **OKAMOTO Shingo**
Tokyo 100-0011 (JP)
- **YAMASAKO Yoshinori**
Tokyo 100-0011 (JP)
- **SHIMIZU Satoru**
Tokyo 100-0011 (JP)

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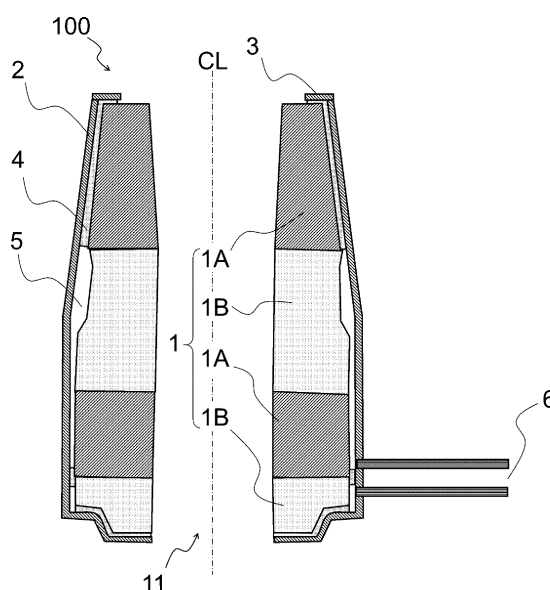
(74) Representative: **Hoffmann Eitle
Patent- und Rechtsanwälte PartmbB
Arabellastraße 30
81925 München (DE)**

(71) Applicant: **JFE Steel Corporation**
Tokyo 100-0011 (JP)

(54) **GAS BLOWING-UP NOZZLE AND CONTINUOUS CASTING METHOD**

(57) A gas-blowing upper nozzle that can prevent a gas leak and a continuous casting method using this nozzle are provided. The gas-blowing upper nozzle includes a refractory (1) including a gas-permeable material (1B), and a metal case (2) surrounding an outer circumference of the refractory (1), and has an upper-end metal case (3) that extends inward from an upper end part of the metal case (2). An upper end of a sealing mortar part (4) between the refractory (1) and the metal case (2) is covered by the upper-end metal case (3). In the continuous casting method, this gas-blowing upper nozzle is installed at the bottom of a tundish, and molten steel is poured from the tundish into a mold through the gas-blowing upper nozzle while an inert gas is blown into the gas-permeable material.

[Fig. 1]



Description

Technical Field

[0001] The present invention relates to a gas-blowing upper nozzle that is provided at the bottom of a tundish and used in hot working, and to a continuous casting method using this nozzle.

Background Art

[0002] In conventional continuous casting of molten steel, clogging of a gas-blowing upper nozzle being used often occurs as inclusions, such as alumina (Al_2O_3), in molten steel adhere to and accumulate on the inner wall of the nozzle. When nozzle clogging occurs, the clogging substance comes off while the molten steel is being poured and gets mixed into the cast slab, or a non-uniform flow of the molten steel inside the nozzle occurs due to the clogging, thus leading to troubles related to the quality of the cast slab.

[0003] One measure to prevent nozzle clogging is to blow in an inert gas through the nozzle and make the inclusions float and separate so as to prevent the inclusions from adhering to and clogging the nozzle. Gas blowing in continuous casting nozzles is usually performed in an upper nozzle installed in a tundish, a sliding plate, and an immersion nozzle connected under the sliding plate, or the like.

[0004] For gas blowing in a gas-blowing upper nozzle, a porous gas-permeable material or a ventilation hole penetrating a refractory is sometimes used. In the case where a porous gas-permeable material is used, the nozzle is often composed of a refractory 1 combining a non-gas-permeable material 1A and a gas-permeable material 1B as shown in Fig. 4 (a). An outer circumference of a gas-blowing upper nozzle 100 is kept gastight by a metal case 2. The inert gas is introduced through an inert-gas introduction pipe 6 installed at a lateral lower part of the gas-blowing upper nozzle 100. Part of this inert gas is introduced to the part of an upper gas-permeable material 1B through a gas flow passage, i.e., a gas pool 5 provided between a refractory outer circumference of the non-gas-permeable material 1A and the metal case 2. Then, this inert gas is blown into a flow of molten steel flowing down a through-hole 11 of the gas-blowing upper nozzle 100. The rest of the inert gas is blown into the flow of molten steel flowing down the through-hole 11 of the gas-blowing upper nozzle 100 through a lower gas-permeable material 1B. Here, it is feared that a predetermined amount of inert gas may fail to be blown into the flow of molten steel flowing down the inside of the gas-blowing upper nozzle as the gas leaks through the gap between the outer circumference of the refractory 1 and the metal case 2 of the gas-blowing upper nozzle 100. Therefore, the refractory outer circumference of the non-gas-permeable material 1A and the metal case 2 are bonded together by a sealing mortar part 4 or the like to

prevent a gas leak.

[0005] On the other hand, sealability between the refractory 1 and the metal case 2 provided on the outer circumference has been a conventional problem. For example, if sealing between the refractory 1 and the metal case 2 is interrupted, the inert gas leaks through the outer circumference of the refractory 1 and leaks out into the molten steel from a bed part of the tundish. As a result, a sufficient amount of inert gas to be blown into the molten steel passing through the through-hole 11 of the gas-blowing upper nozzle 100 cannot be secured. A cast slab that has been cast in such a state falls outside the specifications.

[0006] Fig. 4 (b) is an enlarged schematic view of part B indicated by the dash-double-dot line in Fig. 4 (a), i.e., the periphery of an upper end part of the gas-blowing upper nozzle 100. Fig. 4 (b) shows a state where the upper end of the metal case 2 has opened due to thermal deformation (indicated by the arrow). As continuous casting is repeated, the metal case 2 of the upper nozzle reaches a high temperature and thermally expands due to heat transfer from the molten steel. In the process, the upper end of the metal case 2 opens away from the refractory 1 as indicated by the arrow by pushing an upper-nozzle setting mortar 10. When the metal case 2 deforms in this way, a gap is left between the sealing mortar part 4 and the metal case 2. A gas leak is likely to occur through this gap. The cause of the phenomenon of an inert gas leak is that, as a gap is left between the metal case 2 and the refractory 1 as described above, the sealability of the sealing mortar part 4 decreases and a leak path is formed. Whether a gas leak has occurred can be grasped by detecting a change in the pressure (back pressure) of gas blowing. The back pressure decreases when a gas leak occurs. Therefore, in the case where gas blowing is performed during continuous casting, a system is established that monitors the back pressure of the gas being blown in and determines that there is an abnormality when the back pressure has decreased.

[0007] To prevent such a gas leak as described above, various improvements have been hitherto made. For example, the technologies disclosed in Patent Literatures 1 and 2 use a thermally expandable mortar that fills the gap left between the metal case and the gas-permeable material due to thermal expansion of the metal case. According to these Patent Literatures, the coefficient of thermal expansion is generally high in the metal case and low in the refractory. Due to heating during the use of the nozzle, expansion of the metal case becomes large compared with the outer circumference of the nozzle refractory, thus leaving a gap between the outer circumference of the nozzle refractory and the metal case, through which the gas leaks. As a countermeasure for this, these technologies use the expandable mortar to prevent a gas leak.

[0008] Further, the technologies disclosed in Patent Literatures 3 and 4 inhibit thermal expansion of the metal case by increasing a restraining force. According to

Patent Literature 3, a flexible refractory sealing material is disposed on an outer circumferential part of the metal case to restrain the metal case from deforming due to thermal expansion by the refractory sealing material and thereby inhibit thermal deformation. In Patent Literature 4, spiral fins are attached to an outer circumferential part of the metal case to thereby enhance the restraining force on the metal case.

Citation List

Patent Literature

[0009]

Patent Literature 1: Japanese Patent Laid-Open No. 2011-256079

Patent Literature 2: Japanese Patent Laid-Open No. 2006-175482

Patent Literature 3: Japanese Patent Laid-Open No. 2016-36811

Patent Literature 4: Japanese Patent Laid-Open No. 2017-94386

Summary of Invention

Technical Problem

[0010] However, the above-described conventional technologies have the following problems.

[0011] In the technologies disclosed in Patent Literatures 1 and 2, even when the thermal expansion rate of the mortar between the metal case and the gas-permeable material is increased, the mortar is limited in its amount of thermal expansion. There is a problem that if the metal case expands beyond the amount of expansion of the mortar, a gas leak through the gap between the metal case and the refractory cannot be completely prevented. Another problem is that when a foamable material is used to increase the thermal expansion rate of the mortar as in Patent Literature 2, the density of the mortar itself decreases and its sealability decreases.

[0012] The method of physically inhibiting the thermal expansion of the metal case by increasing the restraining force on the metal case as in the technologies disclosed in Patent Literatures 3 and 4 also have the following problems. The method of wrapping a flexible refractory seal around the outer circumference of the metal case as in Patent Literature 3 is expected to have a reducing effect on thermal deformation of the metal case for the part where the refractory sealing material is wrapped, but cannot restrict the thermal expansion at the other portions. Further, if the refractory seal is wrapped around the entire metal case, the adhesion between the upper nozzle and the surrounding square brick decreases, so that the upper nozzle shifts up and down, which may increase the risk of a steel leak. Thus, this method cannot be called adequate as a gas leak inhibiting method. The method of

installing fins on the outer circumference of the metal case as in Patent Literature 4 can be expected to have a reducing effect on thermal deformation of the entire metal case. However, if the fins have such dimensions as to come into contact with the square brick during the work of setting the upper nozzle inside the surrounding square brick, the fins may cause damage to the square brick itself. Thus, there is a problem that the work of inserting the upper nozzle becomes difficult. On the other hand, if the outside diameter of the fins is designed to be smaller than the inside diameter of the square brick, this raises a problem that the strength increasing effect is so small that thermal expansion of the metal case cannot be completely inhibited.

[0013] The present invention aims to solve the above-described conventional problems and provide a technology that can prevent the occurrence of a gas leak when blowing in an inert gas through a gas-blowing upper nozzle during continuous casting of molten steel. Here, a gas leak refers to an outflow of an inert gas to a part other than the gas-permeable material through the gap between the refractory and the metal case provided on the outer circumference of the gas-blowing upper nozzle.

25 Solution to Problem

[0014] A gas-blowing upper nozzle according to the present invention that advantageously solves the above-described problems includes a refractory (1) including a gas-permeable material (1B), and a metal case (2) surrounding an outer circumference of the refractory (1). This gas-blowing upper nozzle is characterized in that it has an upper-end metal case (3) that extends inward from an upper end part of the metal case (2), and that an upper end of a sealing mortar part (4) between the refractory (1) and the metal case (2) is covered by the upper-end metal case (3).

[0015] In the gas-blowing upper nozzle according to the present invention, the following could be more preferable solutions:

- (a) that an extension length of the upper-end metal case (3) is not smaller than a thickness of a joint between the metal case (2) and a square brick (8); and
- (b) that a leading end of the extending upper-end metal case (3) is within such a range as to be concealed by being held between a flat top end of the refractory (1) and an upper-nozzle-top refractory (9).

[0016] A continuous casting method according to the present invention that advantageously solves the above-described problems is characterized in that any one of the above-described gas-blowing upper nozzles is installed at the bottom of a tundish, and that molten steel is poured from the tundish into a casting mold through the gas-blowing upper nozzle while an inert gas is blown into the gas-permeable material.

Advantageous Effects of Invention

[0017] Configured as has been described above, the gas-blowing upper nozzle according to the present invention can offer the following advantages: The gas-blowing upper nozzle is formed by the refractory including the gas-permeable material and the metal case having the upper-end metal case. Even when a gap occurs at the joint between the refractory and the metal case due to thermal deformation of the metal case, the upper-end metal case that is disposed so as to conceal the joint at the top end of the upper nozzle serves to physically interrupt a gas leak path. Thus, a gas leak can be prevented. In the continuous casting method according to the present invention, molten steel is poured from the tundish into the mold through this gas-blowing upper nozzle, so that continuous casting can be performed without a gas leak and a favorable quality of a cast slab can be maintained.

Brief Description of Drawings

[0018]

[Fig. 1] Fig. 1 is a vertical sectional view of a gas-blowing upper nozzle according to one embodiment of the present invention.

[Fig. 2] Fig. 2 (a) is a schematic sectional view of the gas-blowing upper nozzle of the embodiment as installed in a tundish, and Fig. 2 (b) is a partially enlarged sectional view of part A of Fig. 2 (a).

[Fig. 3] Fig. 3 is a conceptual sectional view showing a state where a metal case of the gas-blowing upper nozzle of the embodiment has thermally expanded.

[Fig. 4] Fig. 4 (a) is a schematic sectional view of a conventional gas-blowing upper nozzle as installed in a tundish, and Fig. 4 (b) is a partially enlarged sectional view of part B of Fig. 4 (a) and is a conceptual sectional view showing a state where a metal case has thermally expanded.

[Fig. 5] Fig. 5 is a graph evaluating a status of a gas leak when continuous casting is performed using the gas-blowing upper nozzle of the embodiment, as compared with a conventional example.

Description of Embodiments

[0019] An embodiment of the present invention will be specifically described below. Each drawing is schematic and may differ from the reality. The following embodiment presents examples of a device and a method for embodying the technical idea of the present invention, and is not intended to restrict the configuration to the one to be described below. Thus, various changes can be made to the technical idea of the present invention within the technical scope described in the claims.

[0020] Fig. 1 is a view showing a vertical section of a gas-blowing upper nozzle according to one embodiment

of the present invention. A refractory 1 inside a gas-blowing upper nozzle 100 has a through-hole 11 through which molten steel flows along a rotational axis (symmetrical axis) CL, and has a shape of a hollow, thick-walled rotating body. The through-hole 11 flares out toward an upper part. The refractory 1 has a flat part at its top end (upper end). In the example of Fig. 1, the refractory 1 is composed of a combination of a non-gas-permeable material 1A and a gas-permeable material 1B. The gas-permeable material 1B can be disposed at an arbitrary position. From the position where the gas-permeable material 1B is disposed, a gas can be blown into molten steel passing through the through-hole 11. The non-gas-permeable material 1A can also be disposed at an arbitrary position. In the case where gas blowing is to be performed separately from two upper and lower positions as in Fig. 1, separate blowing can be performed by disposing the non-gas-permeable material 1A at a boundary portion of the gas-permeable material 1B. When there is no particular need for performing separate gas blowing, a structure in which the refractory 1 is entirely composed of the gas-permeable material 1B can be adopted without any problem.

[0021] A supply path of an inert gas to the gas-permeable material 1B is configured as follows. First, the inert gas is introduced into the gas-blowing upper nozzle 100 through an inert-gas introduction pipe 6. Then, the inert gas reaches the gas-permeable material 1B by passing through a gas pool 5 provided between the refractory 1 and a substantially cylindrical metal case 2 covering an outer circumference of the refractory 1. While the gas pool 5 is provided between the refractory 1 and the metal case 2 in the example of Fig. 1, it is also possible to form the gas pool 5 by providing a slit in the refractory 1. In this embodiment, however, the structure in which the gas pool 5 is provided between the refractory 1 and the metal case 2 as in Fig. 1 can reap the advantages of the embodiment more remarkably.

[0022] The inert gas having reached the gas pool 5 needs to entirely pass through the gas-permeable material 1B and be blown into the molten steel. That the inert gas leaks to the outside of the gas-blowing upper nozzle 100 through a portion other than the gas-permeable material 1B is called a gas leak. When a gas leak occurs, a sufficient amount of inert gas fails to be supplied to the molten steel inside the hollow part of the gas-blowing upper nozzle 100. Therefore, a sufficient improving effect on the purity of the molten steel cannot be achieved. This can result in quality problems with a cast slab that has been cast. To prevent such a gas leak, a sealing mortar part 4 is disposed between the refractory 1 and the metal case 2. The sealing mortar part 4 fills the gap between the refractory 1 and the metal case 2 other than the gas pool 5. The sealing mortar part 4 serves to prevent the inert gas from leaking to the outside of the gas-blowing upper nozzle 100.

[0023] Fig. 2 (a) shows a schematic view of the gas-blowing upper nozzle 100 of the embodiment as set

inside a tundish. The circumference of the gas-blowing upper nozzle 100 is surrounded by a tundish iron shell 7, a square brick 8, and an upper-nozzle-top refractory 9. The gas-blowing upper nozzle 100 is restrained by each of the materials surrounding it. An upper-nozzle setting mortar 10 is disposed at a joint between the square brick 8 and the metal case 2 as a way to leave no gap. A restraining force on the gas-blowing upper nozzle 100 is secured by a bonding force among the square brick 8, the upper-nozzle setting mortar 10, and the metal case 2.

[0024] Fig. 2 (b) shows a close-up of an upper end part of the gas-blowing upper nozzle 100 in part A of Fig. 2 (a) circled by the dash-double-dot line. In this embodiment, the gas-blowing upper nozzle 100 has an upper-end metal case 3 that extends inward from an upper end part of the metal case 2. In this configuration, an upper end of the sealing mortar part 4 (joint part) between the refractory 1 and the metal case 2 is covered by the upper-end metal case 3. An outer circumference of the upper end of the metal case 2 and the upper-end metal case 3 may be coupled together by, for example, welding or caulking, or the metal case 2 and the upper-end metal case 3 may be integrally formed by draw forming etc. It is preferable that the upper-end metal case 3 have an annular shape along a flat part at the top end of the refractory 1. The upper-end metal case 3 is disposed at the upper end part of the gas-blowing upper nozzle 100 so as to create a state where the upper-end metal case 3 and the metal case 2 on the outer circumference of the upper nozzle are coupled together without a gap. Thus, even when the metal case 2 undergoes thermal deformation, a gas leak through the joint between the refractory 1 and the metal case 2 can be prevented. That is, even when thermal deformation as shown in Fig. 3 (indicated by the arrow) occurs, a gas leak path formed at the joint between the refractory 1 and the metal case 2 is blocked by the upper-end metal case 3 and the sealing mortar part 4, and thus the gas leak path can be physically interrupted. In this case, the limit length to which the metal case 2 opens due to thermal deformation depends on the thickness of the joint between the metal case 2 and the square brick 8. Therefore, to provide a gas leak preventing effect even when the metal case 2 undergoes maximum thermal deformation, it is preferable that the extension length of the upper-end metal case 3 be not smaller than the thickness of the joint between the metal case 2 and the square brick 8. When coming into direct contact with the molten steel, the upper-end metal case 3 melts and can no longer retain its shape. Therefore, it is preferable that the extension length of the upper-end metal case 3 be at a maximum within such a range that the upper-end metal case 3 is concealed by being held between the flat top end of the refractory 1 of the gas-blowing upper nozzle and the upper-nozzle-top refractory 9. Here, the extension length of the upper-end metal case 3 is the length in a radial direction in a cylindrical coordinate system with the rotational axis CL as a central axis.

[0025] The refractory 1 is, for example, a high-alumina

material. The metal case 2 and the upper-end metal case 3 are made of metal, and, for example, carbon steel, alloy steel, stainless steel, cast steel, cast iron, titanium, and titanium alloy are suitably used. For the sealing mortar part 4 and the upper-nozzle setting mortar 10, for example, a high-alumina water-kneaded mortar that has been adjusted to appropriate consistency can be used. The thickness of the joint between the metal case (2) and the square brick (8) is about 1 to 5 mm. The range of being held between the flat top end of the refractory 1 of the gas-blowing upper nozzle 100 and the upper-nozzle-top refractory 9 is about 5 to 20 mm as a length in the radial direction from the rotational axis CL.

[0026] In a continuous casting method as another embodiment of the present invention, the gas-blowing upper nozzle 100 of the above-described embodiment is disposed at the bottom of the tundish as shown in Fig. 2. Then, the inert gas introduced through the inert-gas introduction pipe 6 is passed through the gas-permeable material 1B into the molten steel flowing down the through-hole 11. The molten steel inside the tundish is poured into a mold through a sliding nozzle and an immersion nozzle as necessary in addition to the gas-blowing upper nozzle 100. By performing continuous casting using the gas-blowing upper nozzle 100 of the above-described embodiment, even when sequence casting is continuously performed, a gas leak attributable to deformation due to thermal expansion of the metal case 2 of the gas-blowing upper nozzle 100 can be prevented. As for the range that the upper-end metal case 3 covers the top end of the gas-blowing upper nozzle 100, the top end need be covered such that the sealing mortar part 4 that is the joint between the refractory 1 and the metal case 2 is not exposed to the outside regardless of thermal deformation of the metal case 2. This configuration can prevent a gas leak.

[0027] Fig. 5 shows a result of performing continuous casting with the gas-blowing upper nozzle of the embodiment shown in Fig. 1 and Fig. 2 and the conventional gas-blowing upper nozzle shown in Fig. 4 installed at the bottom of the tundish, and conducting an evaluation as to whether there was a gas leak based on a back pressure of the inert gas blown into the gas-blowing upper nozzles. Whether a gas leak has occurred can be determined by monitoring the back pressure of the inert gas being introduced into the gas-blowing upper nozzle. Specifically, when the inert gas is normally blown into the molten steel through the gas-permeable material 1B, the back pressure of the inert gas is subjected to a resistant pressure that is the sum of a static pressure of the molten steel and permeation resistance of the gas-permeable material 1B, and this resistant pressure appears as a back pressure. However, when a gas leak occurs, at least the permeation resistance of the gas-permeable material 1B does not occur, so that the back pressure decreases. Therefore, whether a gas leak had occurred was determined based on whether the back pressure had decreased, and the effects of the gas-blowing upper nozzle of the embodi-

ment and the conventional gas-blowing upper nozzle were examined.

[0028] Here, a threshold value of the back pressure used for the determination depends on the casting facility and the operation rate, and therefore need be optimized for individual continuous casters. In the continuous caster used for the determination this time, the determination was performed with a decrease in the back pressure of about 30% from the back pressure at normal times being called a decrease in the back pressure. As shown in Fig. 5, when the conventional gas-blowing upper nozzle (conventional example: N = 1012) was used, the incidence rate of a decrease in the back pressure was 0.018. By contrast, adopting the embodiment (example of present invention: N = 107) successfully prevented a decrease in the back pressure, i.e., the occurrence of a gas leak.

Industrial Applicability

[0029] The gas-blowing upper nozzle and the continuous casting method of the present invention allow continuous casting to be performed while an inert gas having been blown in is blown into molten steel without a gas leak, so that a favorable quality of a cast slab can be maintained, which makes the present invention industrially useful.

Reference Signs List

[0030]	30
100 Gas-blowing upper nozzle (upper nozzle)	
1 Refractory	
1A Non-gas-permeable material	
1B Gas-permeable material	35
2 Metal case	
3 Upper-end metal case	
4 Sealing mortar part	
5 Gas pool (gas flow passage)	
6 Inert-gas introduction pipe	40
7 Tundish iron shell	
8 Square brick	
9 Upper-nozzle-top refractory	
10 Upper-nozzle setting mortar	
11 Through-hole	45
CL Rotational axis (symmetrical axis)	

Claims

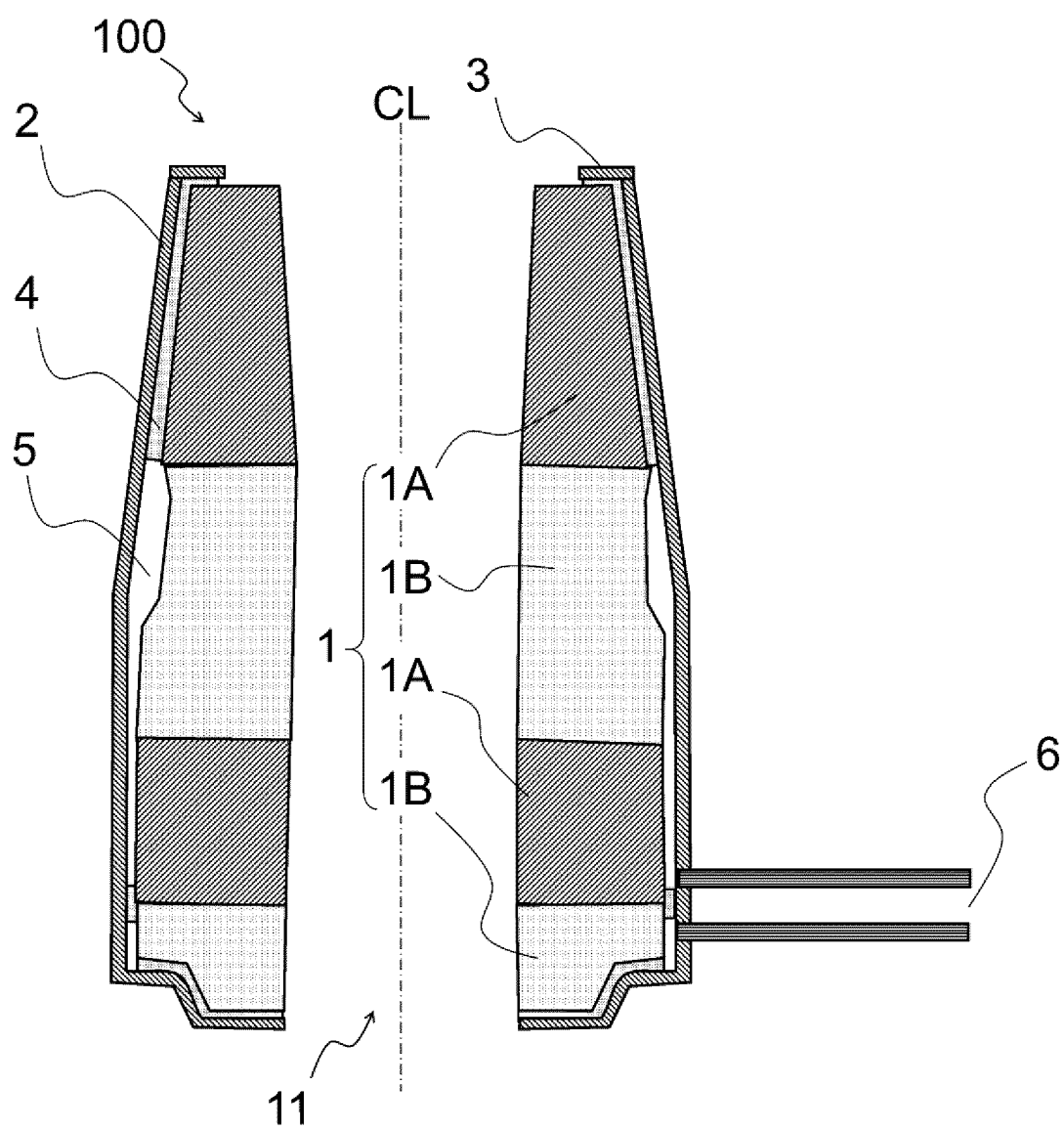
1. A gas-blowing upper nozzle comprising:
 - a refractory (1) including a gas-permeable material (1B); and
 - a metal case (2) surrounding an outer circumference of the refractory (1), **characterized in that:**

the gas-blowing upper nozzle has an upper-

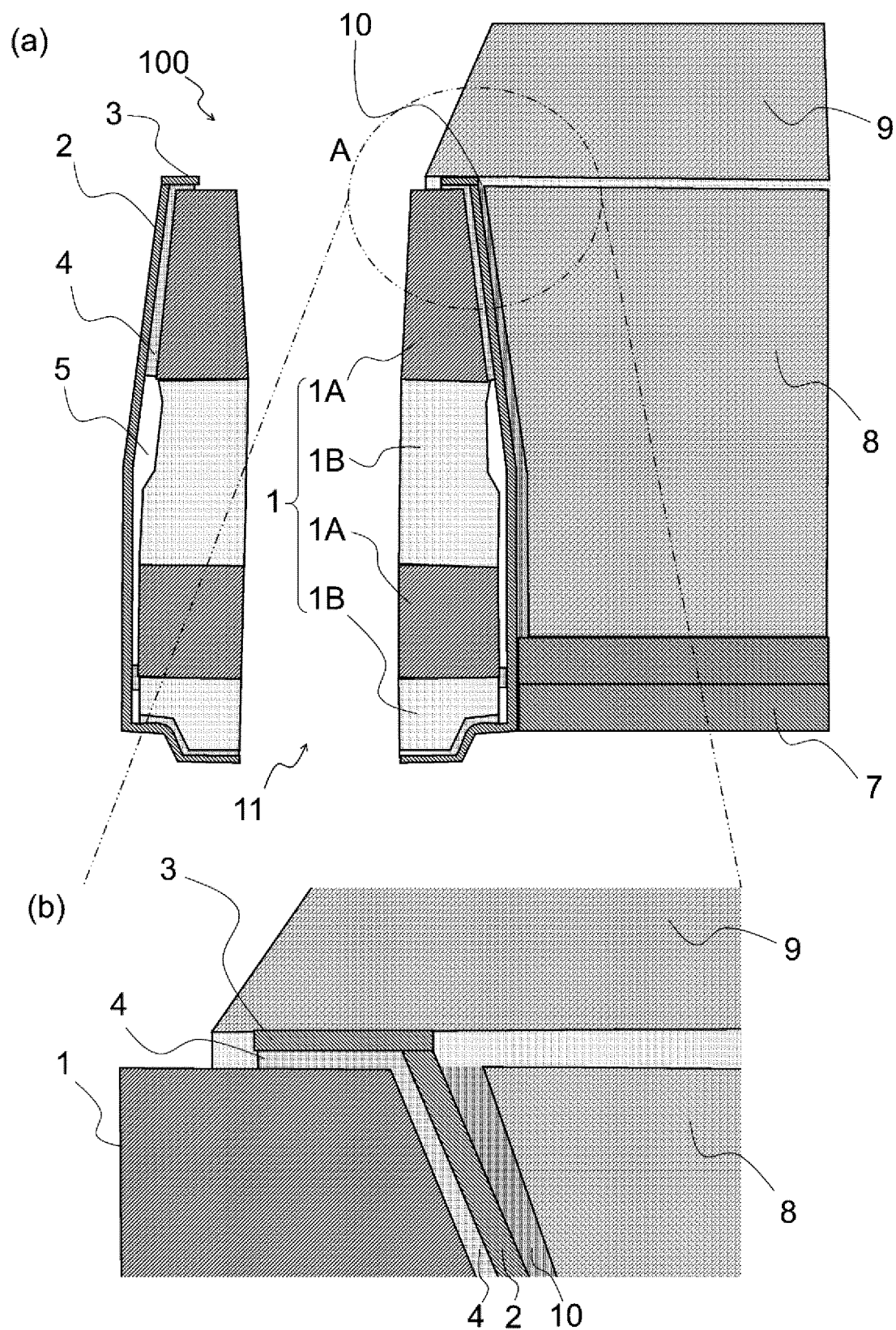
end metal case (3) that extends inward from an upper end part of the metal case (2); and an upper end of a sealing mortar part (4) between the refractory (1) and the metal case (2) is covered by the upper-end metal case (3).

2. The gas-blowing upper nozzle according to claim 1, wherein an extension length of the upper-end metal case (3) is not smaller than a thickness of a joint between the metal case (2) and a square brick (8).
3. The gas-blowing upper nozzle according to claim 2, wherein a leading end of the extending upper-end metal case (3) is within such a range as to be concealed by being held between a flat top end of the refractory (1) and an upper-nozzle-top refractory (9).
4. A continuous casting method **characterized in that** the gas-blowing upper nozzle according to any one of claims 1 to 3 is installed at a bottom of a tundish, and that molten steel is poured from the tundish into a mold through the gas-blowing upper nozzle while an inert gas is blown into the gas-permeable material.

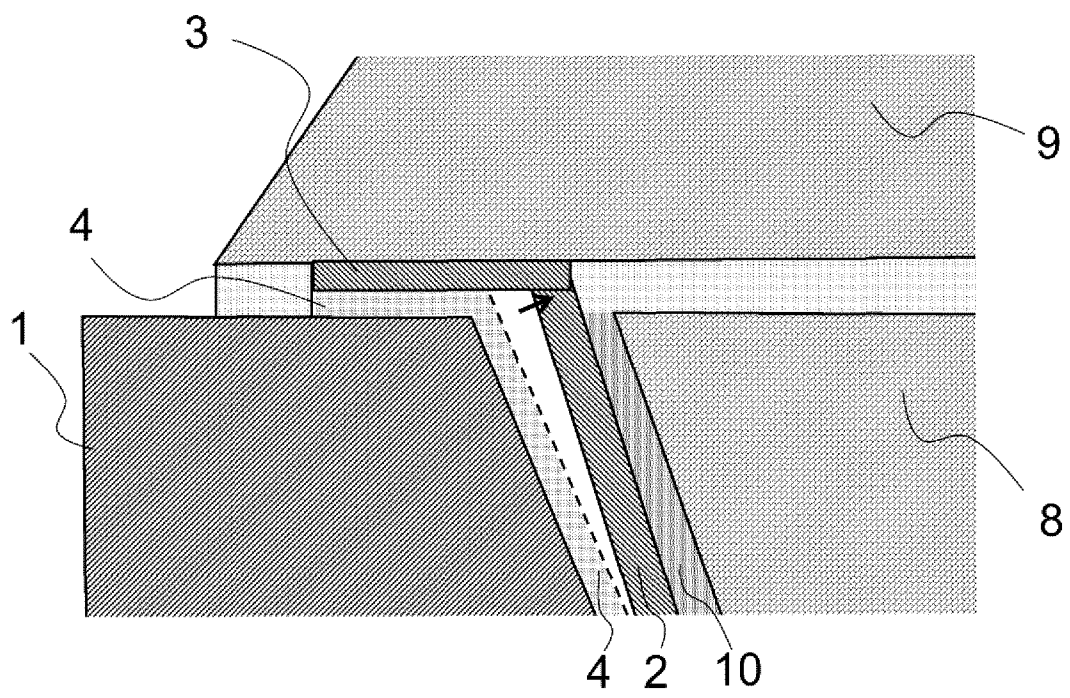
[Fig. 1]



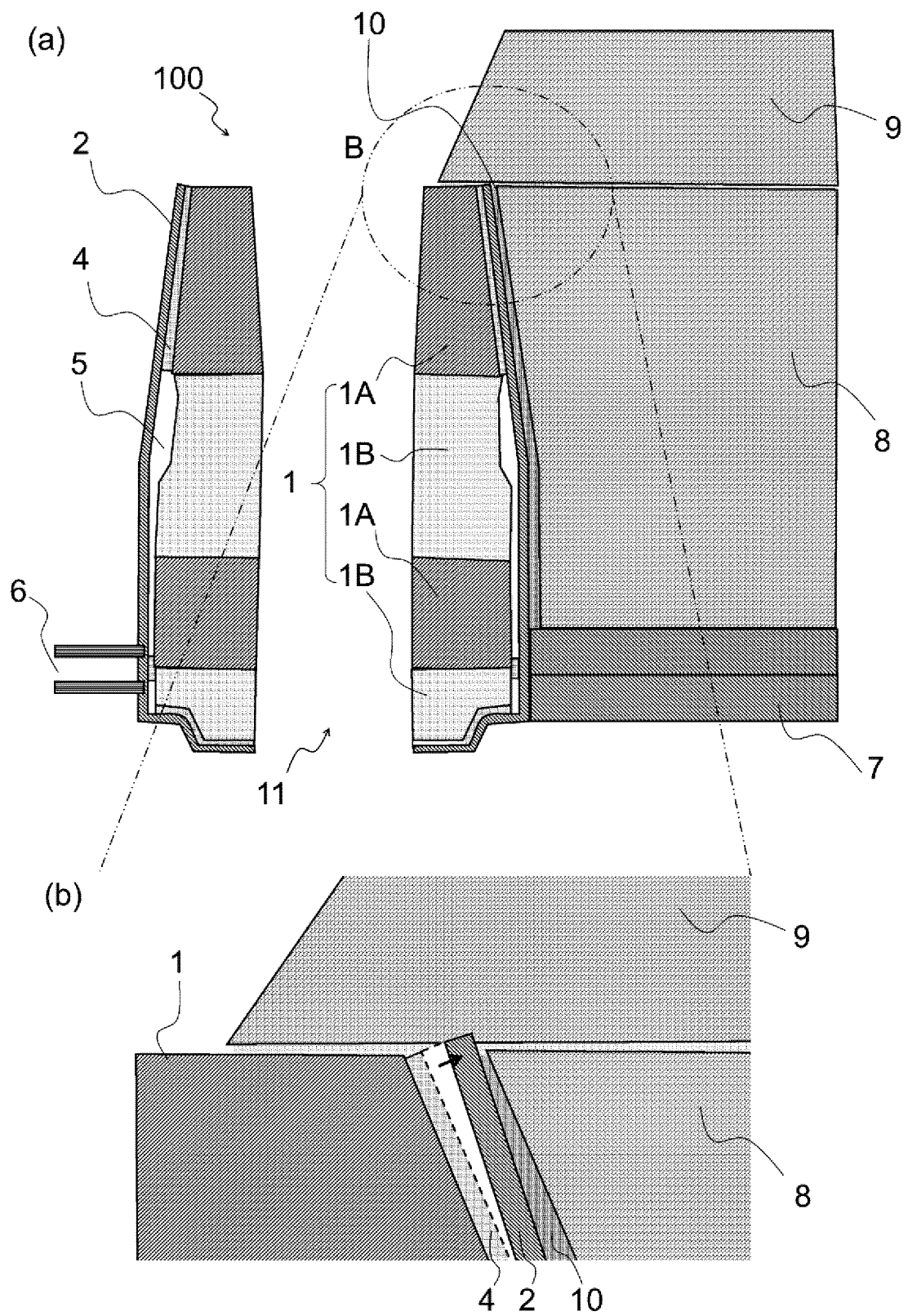
[Fig. 2]



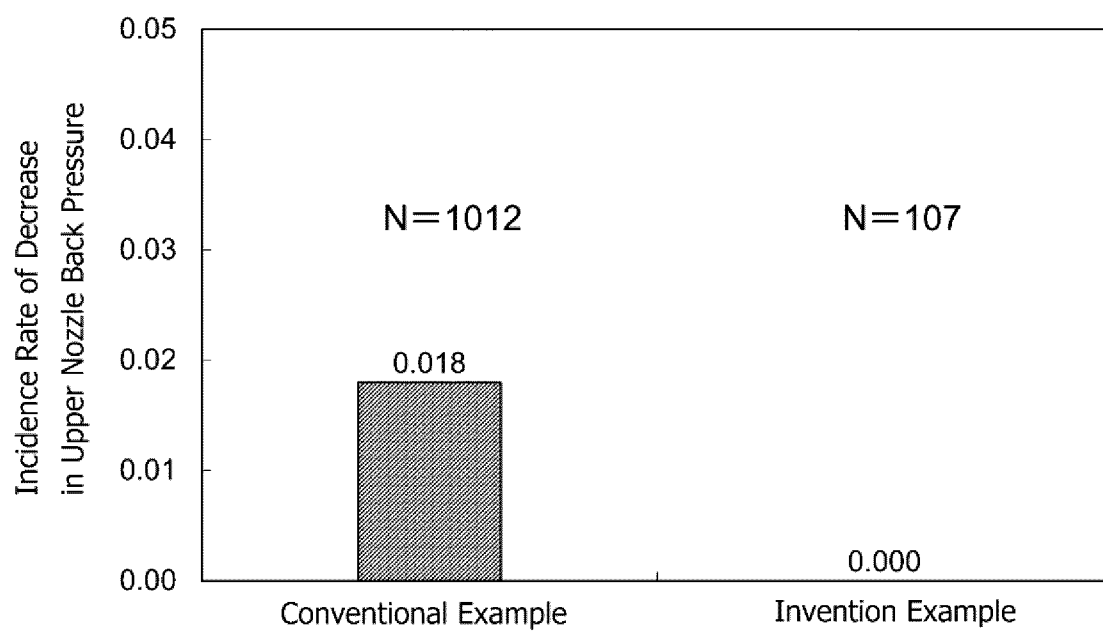
[Fig. 3]



[Fig. 4]



[Fig. 5]



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2023/018626

A. CLASSIFICATION OF SUBJECT MATTER

B22D 11/10(2006.01)i; **B22D 41/58**(2006.01)i

FI: B22D11/10 360C; B22D11/10 320D; B22D41/58

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)

B22D11/10; B22D41/58

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
 Published unexamined utility model applications of Japan 1971-2023
 Registered utility model specifications of Japan 1996-2023
 Published registered utility model applications of Japan 1994-2023

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 101530/1990 (Laid-open No. 42351/1991) (SHINAGAWA WHITE BRICK CO., LTD.) 22 April 1991 (1991-04-22), p. 1, line 15 to p. 11, line 5, fig. 1-6	1-4
Y	JP 2001-334360 A (SHINAGAWA REFRACT CO., LTD.) 04 December 2001 (2001-12-04) paragraphs [0011]-[0017], fig. 1, 2, 4	1-4
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 179647/1988 (Laid-open No. 84859/1989) (NIPPON KOKAN K.K.) 06 June 1989 (1989-06-06), p. 5, line 8 to p. 8, line 19, fig. 1, 2	3

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

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Date of the actual completion of the international search

21 July 2023

Date of mailing of the international search report

01 August 2023

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2023/018626

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 3-42351 U1	22 April 1991	(Family: none)	
JP 2001-334360 A	04 December 2001	(Family: none)	
JP 1-84859 U1	06 June 1989	(Family: none)	

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- JP 2006175482 A [0009]
- JP 2016036811 A [0009]
- JP 2017094386 A [0009]