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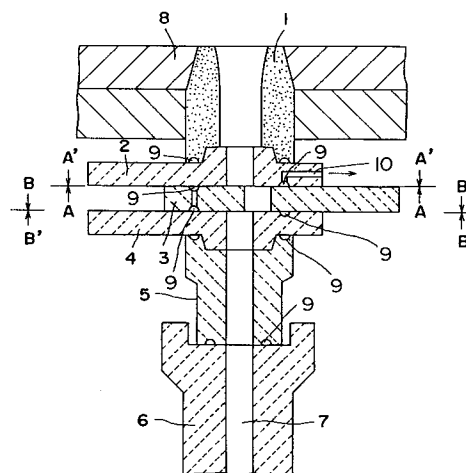
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Lewald**Isartorplatz 6 Postfach 26 02 47****W-8000 München 26(DE)**(54) **AIR INTERCEPTIVE STRUCTURE IN FIRE RESISTANT STRUCTURE.**

(57) A structure for ensuring air interception for molten steel in a fire-resistant structure such as a sliding nozzle device having a molten steel outpouring port, in which, in a fire-resistant structure having a fire-resistant material provided with a nozzle hole (7) for downward flow of molten steel, a groove (9) for air venting is formed around the nozzle hole, the groove being of an air venting structure to communicate with a passage (10) leading to an outside air venting device, whereby an air pressure is positively reduced to be negative at the joining surfaces of the fire-resistant materials and external air is completely prevented from entering the nozzle hole through the joining parts.

FIG. 1

[FIELD OF ART]

This invention relates to an air interceptive structure in a refractory structure, such as a nozzle device for steelmaking, and in particular, a sliding nozzle device used for the treatment of pure steel.

[BACKGROUND OF THE INVENTION]

According to one process for casting molten steel refined in a converter, electric furnace, etc., the molten steel is received in a ladle, and is continuously cast through a tundish.

In order to make a cast product of pure steel, it is very important to prevent steel oxidation as caused by contact with open air during casting. A casting process in which steel is isolated from open air is called an air-isolated casting process.

One air-isolated casting process is carried out by feeding molten steel through a tube called a shroud, or through a submerged nozzle, to prevent it from exposure to open air while it flows down.

If a sliding nozzle device is used to control the downward flow of molten steel, however, air is drawn in through the joints of bricks in the device, or through the joints between the shroud or the submerged nozzle and the sliding nozzle device. No satisfactory isolation from air can, therefore, be achieved by the air-isolated casting process employing only the shroud or the submerged nozzle.

There have been various solutions proposed regarding the problem of the air drawn in through the joints as is hereinabove pointed out. For example, Japanese Patent Laid-Open Application No. 62-50070 proposes the use of a sliding nozzle device having a wholly closed structure defining a closed atmosphere into which an inert gas, such as argon, is blown, and Japanese Patent Laid-Open Application No. 61-3653 proposes the evacuation of such a closed chamber.

A large-scale apparatus is, however, required for carrying out any of the methods which have hitherto been proposed, and none of the methods can produce a satisfactory result of isolation, despite the apparatus employed. The joints of the shroud or the submerged nozzle are, among other things, so constructed as to make it practically impossible to define a closed environment to prevent the molten steel to be cast from exposure to air. The joints of the refractories forming the shroud or the submerged nozzle are formed by mortar or sealing material, but as the downward flow of the molten steel creates a considerably high negative pressure in the bore of the sliding nozzle device through which the molten steel is caused to flow down, no satisfactory sealing effect can be expected from the mortar or sealing material alone.

It is a first object of this invention to provide a

structure which ensures the isolation of molten steel from air in a refractory structure, such as a sliding nozzle device having a molten steel outlet.

It is a second object of this invention to provide a device which is simple in construction, particularly in the construction of suction piping and other related equipment, and yet ensures the isolation of molten steel from air in a refractory structure.

[DISCLOSURE OF THE INVENTION]

This invention relates to a structure for intercepting air in a refractory structure comprising refractory materials having a nozzle bore for downward flow of molten steel, in which a groove for venting air is formed around the nozzle bore, and communicated with a passage leading to an outside air venting device.

It also provides a simple structure for venting air which comprises one or more passages formed in a member composed of refractory materials and having a nozzle bore, and leading to an outside air venting device, the member having grooves formed around the nozzle bore and communicated with the passages leading to the outside device.

The grooves for venting air which are formed in the refractory materials surrounding the nozzle bore work effectively creating a negative pressure in the joints of the refractory materials. Thus, there is no invasion of air into the nozzle bore through the joints of the refractory materials.

When a sliding nozzle is employed, the nozzle bore defined by plate bricks can be filled with molten steel, if the nozzle bore is placed at a negative pressure which is higher than that which is created by the control of its flow rate, and which is in the level of say, 10 to 70 cm Hg.

As a consequence, it is possible to eliminate any lack of uniformity in the flow of molten steel injected into a mold, or tundish, and thereby prevent any entrainment of inclusions that might otherwise occur.

According to this invention, therefore, the use of appropriately shaped bricks enables a considerably high level of reliability in the air-isolated casting of molten steel at low cost, and the connecting holes to which the exhaust grooves formed in the joint surfaces are connected provide a simple device.

[BRIEF DESCRIPTION OF DRAWINGS]

Fig. 1 shows a sliding nozzle device comprising three plates including a slidable middle plate, and embodying this invention;

Figs. 2(a), 2(b) and 2(c) are top plan views of air venting grooves according to this invention as taken along the lines A-A, B-B, and A'-A' or B'-B'.

B', respectively, of Fig. 1;

Fig. 3 is a top plan view of another form of grooves formed in a slidable middle plate; and Figs. 4 and 5 show still other embodiments.

[DESCRIPTION OF THE PREFERRED EMBODIMENT]

The invention will now be described with reference to a sliding nozzle device embodying it.

Fig. 1 shows a sliding nozzle device which is located under an upper nozzle 1 provided at the bottom of a tundish 8, and comprises a stationary upper plate 2, a slidable middle plate 3 and a stationary lower plate 4, and under which a lower nozzle 5 and a submerged nozzle 6 are mounted.

The joint between each two adjoining refractory structures as described above is provided with at least one U-shaped groove 9 extending about a nozzle bore 7 formed substantially in the center thereof.

Figs. 2(a), 2(b) and 2(c) are top plan views of the plates 2, 3 and 4, respectively, as taken along the lines A-A, B-B, and A'-A' or B'-B', respectively, of Fig. 1, and showing the grooves 9 formed therein. The U-shaped grooves are so positioned that the grooves of the stationary upper plate 2 and the slidable middle plate 3 are communicated with each other, while those of the slidable middle plate 3 and the stationary lower plate 4 are also communicated with each other, when molten steel is caused to flow.

Fig. 3 shows a circular groove 9 as an example of modification.

Each groove 9 is associated with a piece of brick having an exhaust hole 10 and can be evacuated by a vacuum pump mounted outside, though not shown, so that the air tending to invade through the joint between the upper nozzle 1 and the stationary upper plate 2, between the stationary upper plate 2 and the slidable middle plate 3, between the slidable middle plate 3 and the stationary lower plate 4, between the stationary lower plate 4 and the lower nozzle 5, or between the lower nozzle 5 and the submerged nozzle 6 may be drawn out through the exhaust hole 10 which is partially connected to the groove 9 by the vacuum pump before it enters the nozzle bore 7.

Figs. 4 and 5 show still more embodiments. Fig. 4 is a top plan view of a slidable middle plate 3 constituting a modified form of the plate structure shown in Fig. 1 or 3, and having a bore connecting grooves 9 with an exhaust hole 10. Fig. 5 is a sectional view of an assembly of the slidable middle plate 3 shown in Fig. 4, and stationary upper and lower plates 2 and 4.

As shown in these figures, the grooves 9₂ and 9₃ formed in the stationary upper and lower plates,

respectively, and extending about the nozzle bore 7 are communicated with the hole 11 extending through the slidable middle plate 3, and with the passage 10 formed in the stationary upper plate 2 and leading to an outside air venting device, when the slidable middle plate 3 has been caused to slide to open the nozzle bore 7.

This structure makes it sufficient to provide only one passage of the nature shown at 10 in Fig. 3, and thereby enables the simplification of the related piping, while a plurality of holes 10 are required of the structure shown in Fig. 1.

[INDUSTRIAL FEASIBILITY]

This invention is applicable not only to a sliding nozzle device comprising three plates as hereinabove described by way of example, but also to a device comprising two plates including a slidable lower plate, or combination of a plate (or plates) and a shroud or a submerged nozzle. Moreover, it is not limited to a sliding nozzle device, but is also applicable to any other nozzle, or pipe, or device for handling molten metal which need be isolated from the open air.

Claims

1. A refractory structure so constructed as to intercept air, said structure comprising members made of a refractory material and having a nozzle bore, said members having grooves formed about said nozzle bore for venting air, said grooves being communicated with passages leading to an outside air venting device.
2. A refractory structure so constructed as to shut out air, said structure comprising members made of a refractory material and having a nozzle bore, said members having grooves formed about said nozzle bore for venting air, and a connecting hole for communicating with said grooves, said hole being communicated with a passage leading to an outside air venting device.

FIG. 1

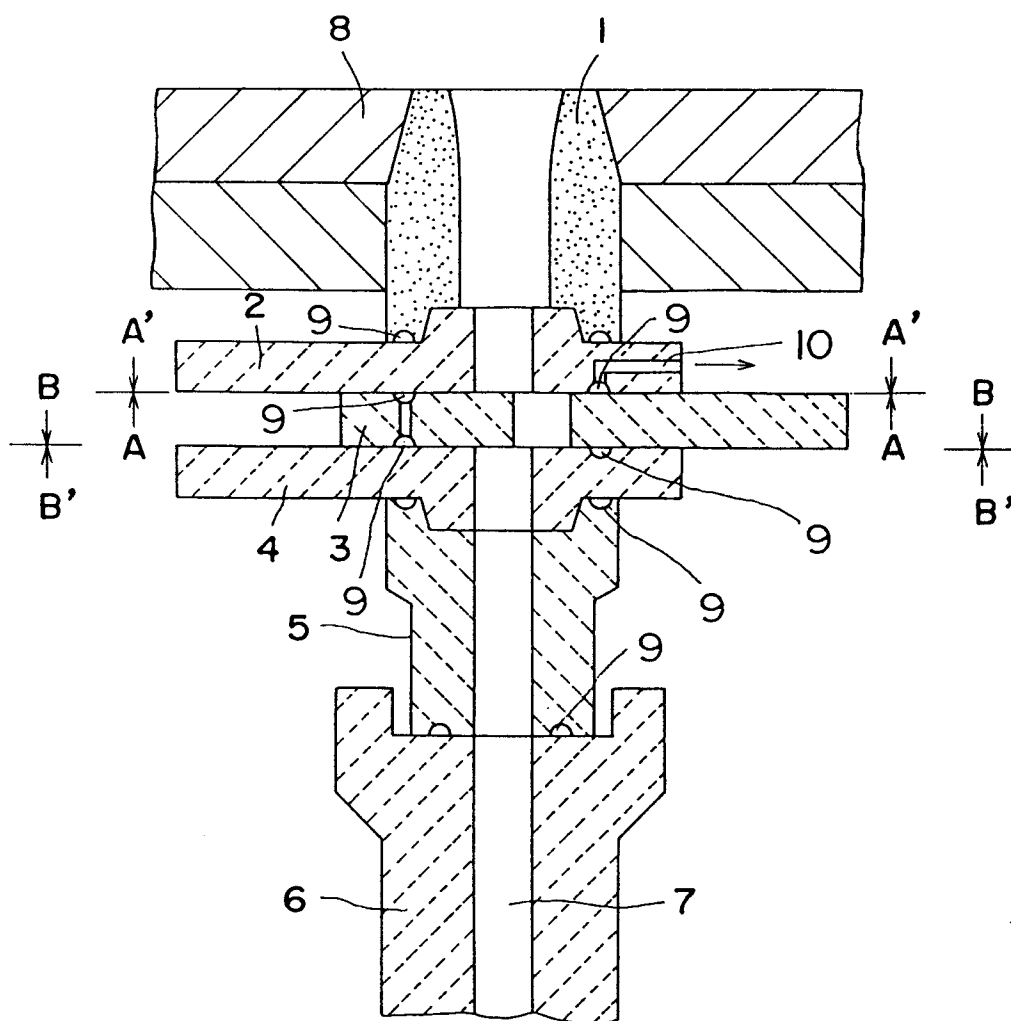


FIG. 2

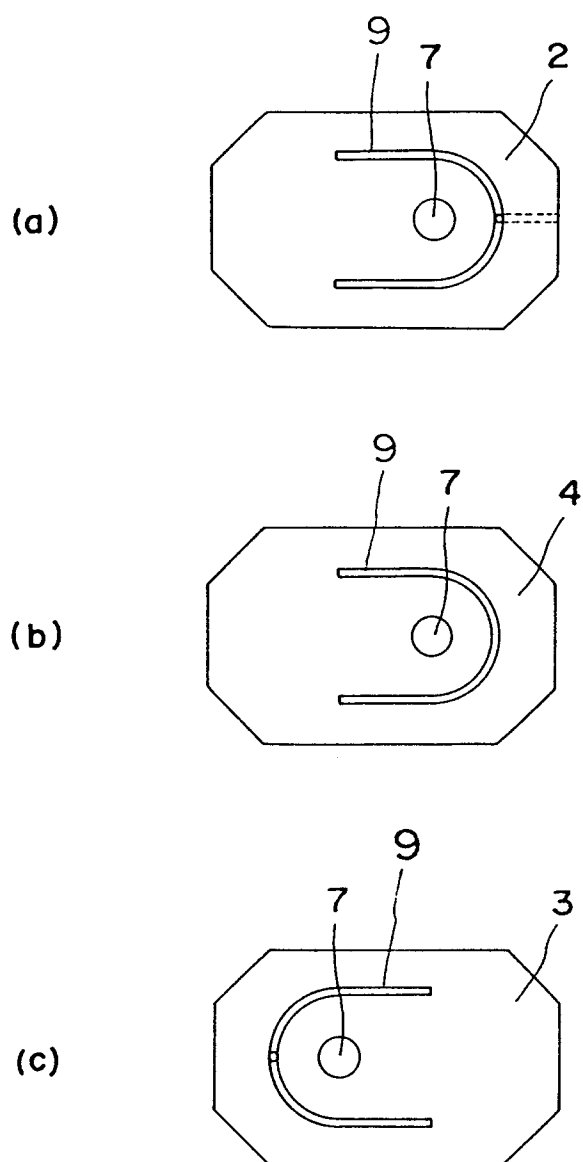


FIG. 3

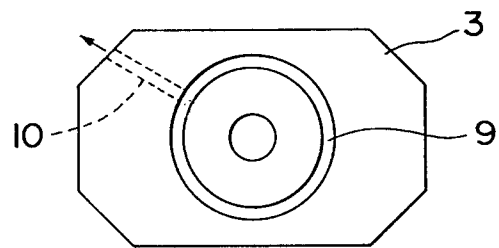


FIG. 4

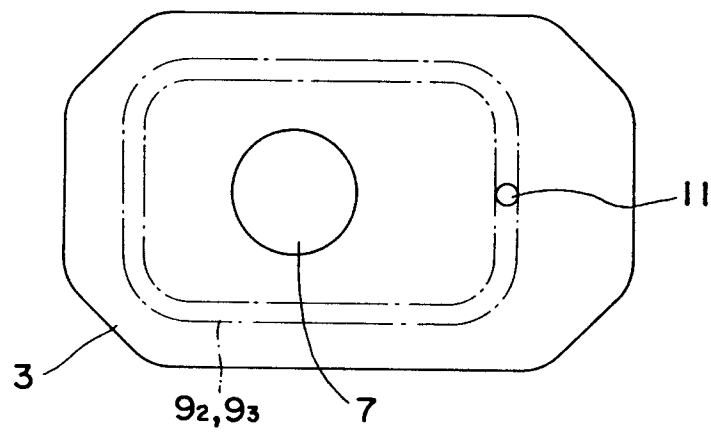
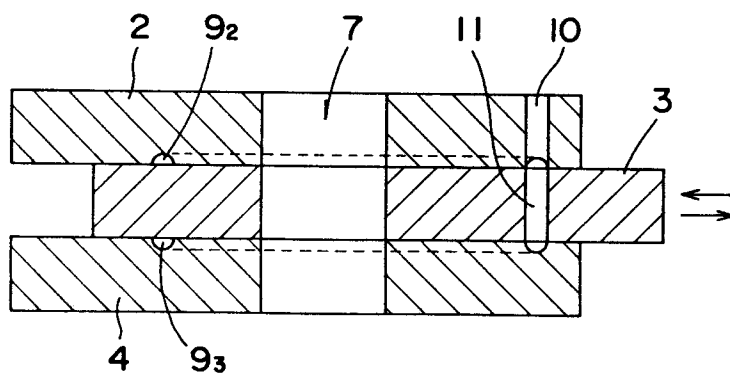


FIG. 5



INTERNATIONAL SEARCH REPORT

International Application No PCT/JP91/01060

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int. Cl ⁵ B22D11/10		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
IPC	B22D11/10, 41/42	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
Jitsuyo Shinan Koho 1926 - 1991 Kokai Jitsuyo Shinan Koho 1971 - 1991		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹		
Category [*]	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
Y	JP, A, 01-309768 (Kawasaki Steel Corp.), December 14, 1989 (14. 12. 89), Claim 1 (Family: none)	1, 2
Y	JP, U, 50-83312 (Shinagawa Refractories Co., Ltd.), July 17, 1975 (17. 07. 75), Claim, Fig. 3 (Family: none)	1, 2
[*] Special categories of cited documents: ¹⁰ "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "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 "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		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
November 4, 1991 (04. 11. 91)	November 5, 1991 (05. 11. 91)	
International Searching Authority	Signature of Authorized Officer	
Japanese Patent Office		