



(11) **EP 1 957 681 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention
of the grant of the patent:
20.02.2013 Bulletin 2013/08

(51) Int Cl.:
C21C 7/10 (2006.01) C22B 9/04 (2006.01)

(21) Application number: **05814356.1**

(86) International application number:
PCT/PL2005/000078

(22) Date of filing: **21.11.2005**

(87) International publication number:
WO 2007/021207 (22.02.2007 Gazette 2007/08)

(54) **SNORKELS FOR VACUUM DEGASSING OF STEEL**

DURCHLAUFROHR ZUM ENTGASEN VON SCHMELZFLUESSIGEM STAHL

SCHNORCHELS POUR DÉGAZAGE SOUS VIDE DE L ACIER

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI
SK TR**

(74) Representative: **Warzybok, Tadeusz**
Biuro Patentowe "INICJATOR" Sp.z o.o.,
ul. Zolkiewskiego 7B/1
35-203 Rzeszow (PL)

(30) Priority: **16.08.2005 PL 37663305**

(56) References cited:
BE-A1- 879 518 GB-A- 2 299 344
US-A- 3 521 873 US-A- 5 024 421

(43) Date of publication of application:
20.08.2008 Bulletin 2008/34

(73) Proprietor: **Zakłady Magneztowe "Ropczyce" S.A.**
39-100 Ropczyce (PL)

- **PATENT ABSTRACTS OF JAPAN** vol. 011, no. 106 (C-414), 3 April 1987 (1987-04-03) -& JP 61 253318 A (NIPPON STEEL CORP), 11 November 1986 (1986-11-11)
- **PATENT ABSTRACTS OF JAPAN** vol. 1996, no. 12, 26 December 1996 (1996-12-26) -& JP 08 218113 A (NIPPON STEEL CORP), 27 August 1996 (1996-08-27)
- **RATHNER R ET AL: "ENTWICKLUNG VON SPUELEMENTEN FUER ENTGASUNGSGEFAESSE. DEVELOPMENT OF PURGE ELEMENTS FOR DEGASSING UNITS" RADEX RUNDSCHAU, GRAEFELFING, DE, no. 4, December 1990 (1990-12), pages 365-376, XP002056363**

(72) Inventors:

- **CZAPKA, Zbigniew**
PL-39-100 Ropczyce (PL)
- **CESARZ, Włodzimierz**
PL-39-100 Ropczyce (PL)
- **DARLAK, Marian**
PL-39-100 Ropczyce (PL)
- **SIWIEC, Jozef**
39-126 Zagorzyce (PL)

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 1 957 681 B1

Description

[0001] The subject of his invention are the snorkels for recirculating vacuum-degassing of steel.

[0002] The process of vacuum degassing of steel in steel ladle has the purpose of reducing the content harmful gasses dissolved in steel as hydrogen, oxygen, nitrogen, as well as decarbourizing and raising steel purity, thus improving its mechanical properties.

[0003] Many methods of vacuum degassing of steel are known, among them the RH recirculating vacuum-degassing process consisting in metal circulation through a vacuum chamber of an RH degasser equipped with a ladle for liquid steel, provided with a metal-drawing snorkel that contains an inert gas supply pipe and a recirculating snorkel. During the steel degassing process both snorkels are inserted into liquid steel in the ladle that is situated below the chamber of the degasser unit. Besides, the RH degasser is equipped with chute for alloying additions, a burner hole and, in its upper section, a gas-suction duct and a pipe for vacuum creation in the chamber.

[0004] The vacuum-chamber throat, located in its lower section, consists of separate ceramic rings connected to the metal-drawing and recirculating snorkels, located coaxially to each other and their internal refractory lining is made of several layers of ceramic blocks arranged next to each other in one circumferential line.

[0005] Once the snorkels are inserted in molten steel, liquid steel is drawn from the ladle to the vacuum chamber of the RH unit, whereby the steel is circulated due to inert gas, preferably argon, being supplied through metal-drawing snorkel. By raising up and expanding, the inert gas pumps liquid steel into vacuum chamber through the metal-drawing snorkel, wherefrom, after its degassing, the steel returns to the ladle through the other, recirculating snorkel. Liquid steel is drawn only up to the level of the barometric pressure column which depends on external pressure and the pressure in the vacuum chamber.

[0006] The US patent 5024421 reveals a steel degasser snorkel for circulating molten metal from a ladle to a vacuum vessel that has a two-part steel casing in form of a sleeve with external flange, with its internal surface provided with flanged keystones, on which pressure grout and refractory bricks, connected with the grout, are supported. These ceramic blocks form the internal lining of the steel casing and are arranged in annular layers, connected with each other so as to create a monolithic set of steel degassing snorkel only to the level of the steel casing, whereas the monolith does not cover the rings of the throat of the vacuum chamber of degasser unit.

[0007] Patents JP51253318A, JP08218113A and US 3521873 disclose also the methods of cooling of snorkels for vacuum degassing of steel consisting in blowing air or gas through a gap created between two steel casings of those snorkels.

[0008] The external refractory lining of snorkels, as

used in known equipment for vacuum-degassing of steel, has a relatively short service life because of concrete-dissolving chemical corrosion that takes place in their service as a result of direct contact with the liquid layer of slag and having a destructive effect on the refractory lining of snorkels. In order to reduce the corrosive wear of monolithic Al_2O_3 -base concrete layer of snorkels the concrete surface is sprayed with alkaline mass during time breaks between consecutive steel melting cycles. Thus, a layer of material that protects the concrete against direct contact with liquid slag is created.

[0009] The above mentioned snorkels have a steel casing, which holds the internal and external parts of ceramic working lining. However, in case of long times of the process and short time periods between consecutive degassings, the temperature increments of that casing after each degassing add up during the sequence and the consequential excessive rise of casing temperature leads to its significant expansion and deformation. The expansion of casing as a result of high temperature causes clearly noticeable cracks in monolithic lining. The above described phenomena have also a negative effect on the internal working lining of the snorkel because its steel casing holds the internal part of its working lining. High-temperature deformation of steel casing causes a loosening of the lining of magnesia-chromite blocks, thus accelerating the erosion at the joints between those blocks and the rings formed of them.

[0010] The purpose of his invention was to eliminate the above mentioned drawbacks and inconveniences of known metal-drawing and recirculating snorkels and those of the cooperating vacuum-chamber throat rings.

[0011] The essence of the novel snorkels for recirculating vacuum-degassers of steel consists in manufacturing of metal-drawing and recirculating snorkels, as well as vacuum-chamber throat rings in degassers, as monolithic sets, in which ceramic blocks of the internal lining are made of several layers of rings bound together with similar overlapping blocks, with perforation being made in the external refractory concrete lining of those monolithic sets. Favorably, the steel casings of both snorkels are provided with cooling system(s), preferably gas cooling system(s).

[0012] Connecting the throat ring with snorkel to form a single monolith, in which ceramic blocks of the external lining overlap each other has caused a significant raising of mechanical strength of those monoliths compared to separate rings of throats and snorkels with ceramic blocks arranged one next to the other in several ring-shaped layers.

[0013] Making of perforation in external refractory concrete surface of snorkel has enlarged the contact surface for the sprayed protective mass with concrete surface, thus providing the potential for applying a thicker protective layer onto external concrete lining of snorkel(s) for vacuum degassing of steel while ensuring also good adherence and holding of sprayed alkaline mass on the external surface of the snorkel. On the other hand, intro-

ducing of (pipe) cooling system into steel casing of snorkel, constituting a monolith with the throat ring, prevented excessive temperature increments and consequential cracks of the protective mass.

[0014] The object of his invention is shown in examples of its embodiments in the drawing where fig. 1 is a perspective view of either metal-drawing or recirculating snorkel with perforated surface of external refractory lining of the recirculating vacuum-degasser of steel, fig. 2 is a perspective view of the steel casing of the snorkel shown in fig. 1 with an arrangement/system of cooling pipes, and fig. 3 is a perspective view of a fragment of vacuum chamber of the recirculating vacuum-degasser of steel in axial cross-section.

[0015] The throat 1 of the vacuum chamber 2 of the recirculating vacuum-degasser of steel is provided with metal-drawing snorkel 3 and recirculating snorkel 4. Each of these snorkels, 3 and 4, is made as the monolith, 5 and 6, consisting of steel casing 7 with refractory lining 8 on its external surface and a sleeve element 9 of refractory ceramic blocks 10 located inside of that casing, so that the sleeve element 9 covers a set of pipes of the gas cooling system 11 mounted on the internal surface of the steel casing 7 and projecting above its upper face by a dimension L which is equal to approx. 40 % of its total height H. Besides, external refractory lining 8 of the steel casing 7 is provided with perforation 12 all over its surface, whereas the refractory ceramic blocks 10 of the sleeve element 9 are arranged alternately next to each other so that they form overlaps 13 with the neighboring ceramic blocks 10.

Claims

1. Snorkels of recirculating vacuum-degasser of steel installed in the lower section of the vacuum chamber of the degasser unit, one of which is the metal-drawing snorkel equipped with a pipe supplying inert gas to ladle and the other is a recirculating snorkel, the upper section of said vacuum chamber being provided with chute for alloying additions, burner hole as well as a duct for gas-suction and for vacuum creation in the chamber, internal and external linings of said snorkels being held by steel casings cooled with air or gas, the ceramic blocks of internal lining being made of several layers of rings interconnected with similar overlapping blocks, wherein said metal-drawing snorkel (3) and said recirculating snorkel (4) and rings of the throat (1) of said vacuum chamber (2) of said degasser unit are made as monolithic sets (5) and (6).
2. Snorkels as claimed in Claim 1 wherein the external refractory lining (8) of the metal-drawing snorkel (3) and the recirculating snorkel (4) in both of monolithic sets (5) and (6) are provided with perforation (12).

3. Snorkels as claimed in Claim 1 or Claim 2 wherein the steel casings (7) of the metal-drawing snorkel (3) and the recirculating snorkel (4) in both monolithic sets (5) and (6) are provided on their internal surface with pipe cooling system (11) for cooling them preferably with gas.

Patentansprüche

1. Stutzen der Einrichtung zur Vakuum-Entgasung von Stahl mittels Rezirkulationsverfahren, im unteren Teil der Vakuumkammer dieser Einrichtung eingebaut, von denen einer ein Saugstutzen, der das Inertgas zum Kessel zuleitet, und anderer Rückförderstutzen ist und im oberen Teil mit der Vakuumkammer mit der Beschickungsrinne für Legierungsadditiven, Brennerloch und darüber situiertem Kanal für Gasabsaugen und Vakuumbildung in der Kammer ausgestattet ist, wobei interne und äußere Auskleidungen dieser Stutzen durch Stahlgehäuse mit Luft- oder Gaskühlung gehalten werden, keramische Blöcke der internen Auskleidung aus mehreren Schichten von Ringen verbunden mit ähnlichen überschneidenden Blöcken bestehen, **dadurch gekennzeichnet, dass** Saugstutzen (3) und Rückförderstutzen (4) sowie Ringe der Auskrugung (1) der Vakuumkammer (2) dieser Einrichtung als monolithische Gruppen (5) und (6) ausgeführt sind.
2. Stutzen nach Anspruch 1 **dadurch gekennzeichnet, dass** äußere feuerfeste Auskleidung (8) des Saugstutzens (3) und des Rückförderstutzens (4) in beiden monolithischen Gruppen (5) und (6) mit der Perforierung (12) ausgestattet ist.
3. Stutzen nach Anspruch 1 oder 2 **dadurch gekennzeichnet, dass** Stahlgehäuse (7) des Saugstutzens (3) und des Rückförderstutzens (4) in beiden monolithischen Gruppen (5) und (6) an der inneren Fläche mit Rohrkühlsystem (11), vorzugsweise mit Gas, ausgestattet sind.

Revendications

1. Les tubes plongeurs de dégazage pour le traitement sous vide d'acier, montés dans la partie inférieure de la chambre à vide du dégazeur, dont l'un est montant équipé d'un conduit d'amenée du gaz inerte vers une poche et l'autre est descendant ; dans sa partie supérieure la chambre à vide est équipée d'un glissoir de descente d'éléments d'addition, d'un orifice du brûleur et au-dessus de ceux derniers, d'un canal d'évacuation du gaz et de production du vide dans cette chambre, et avec cela, le garnissage des plongeurs intérieur et extérieur sont soutenus par les blindages d'acier refroidis par air ou par gaz ; les lingo-

tins de céramique du garnissage intérieur se composent de plusieurs couches de colliers liés avec les lingotins clames **caractérisés en ce que** le plongeur d'aspiration (3) et le plongeur descendant (4) ainsi que les colliers d'une gorge (1) de la chambre à vide (2) de ce dégazeur sont réalisés comme des ensembles monolithiques (5) et (6). 5

2. Les plongeurs selon la revendication 1 **caractérisés en ce que** le garnissage extérieur réfractaire (8) du plongeur montant (3) et du plongeur descendant (4) dans les deux ensembles monolithiques (5) et (6) présente des perforations (12). 10

3. Les plongeurs selon la revendication 1 ou 2 **caractérisés en ce que** les blindages d'acier (7) du plongeur montant (3) et du plongeur descendant (4) dans les deux ensembles monolithiques (5) et (6) sont équipés, sur la surface intérieure, d'un système de refroidissement à tubes (11), de préférence au gaz. 15 20

25

30

35

40

45

50

55

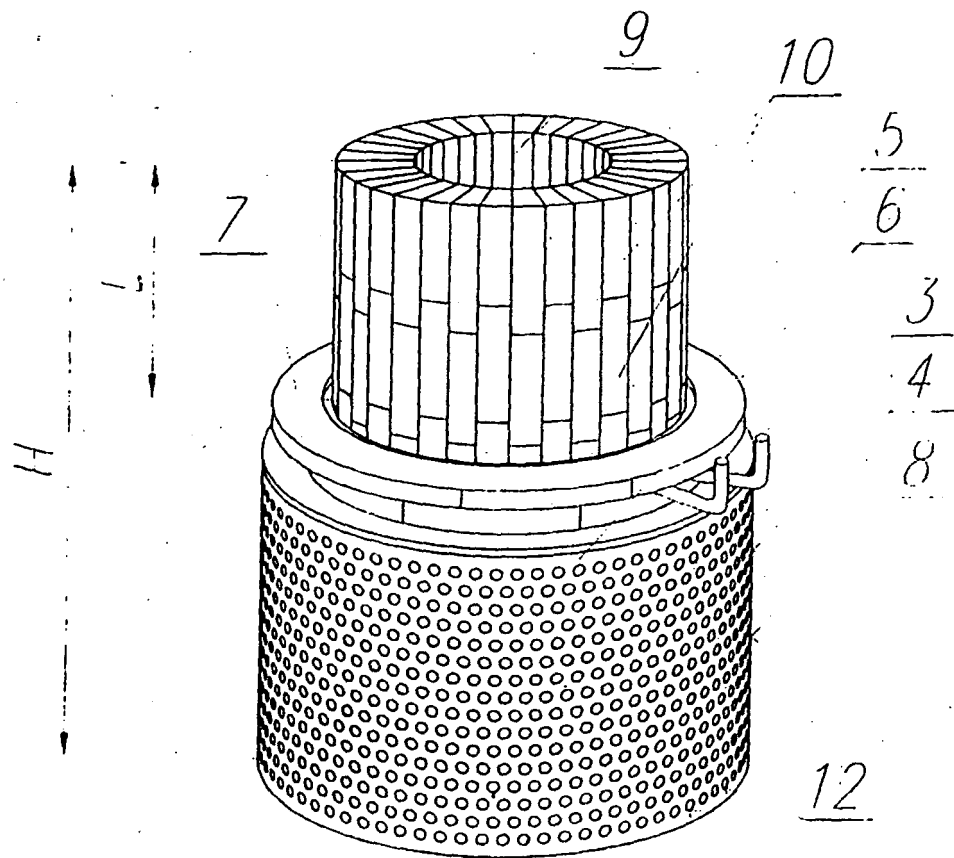


Fig. 1

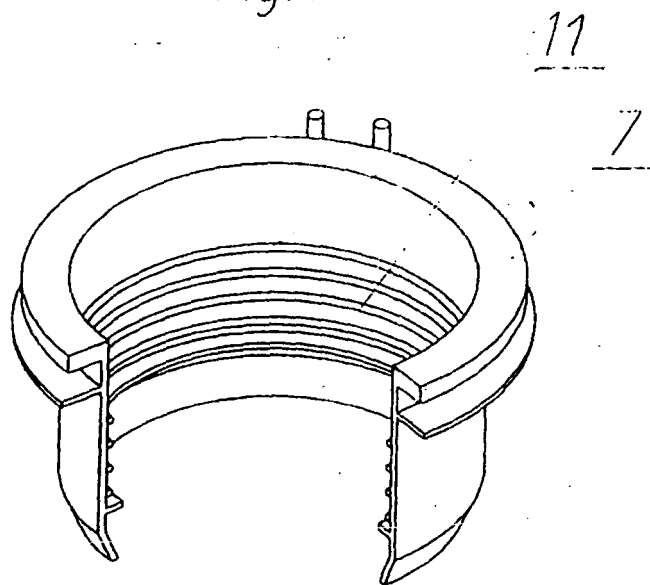


Fig. 2

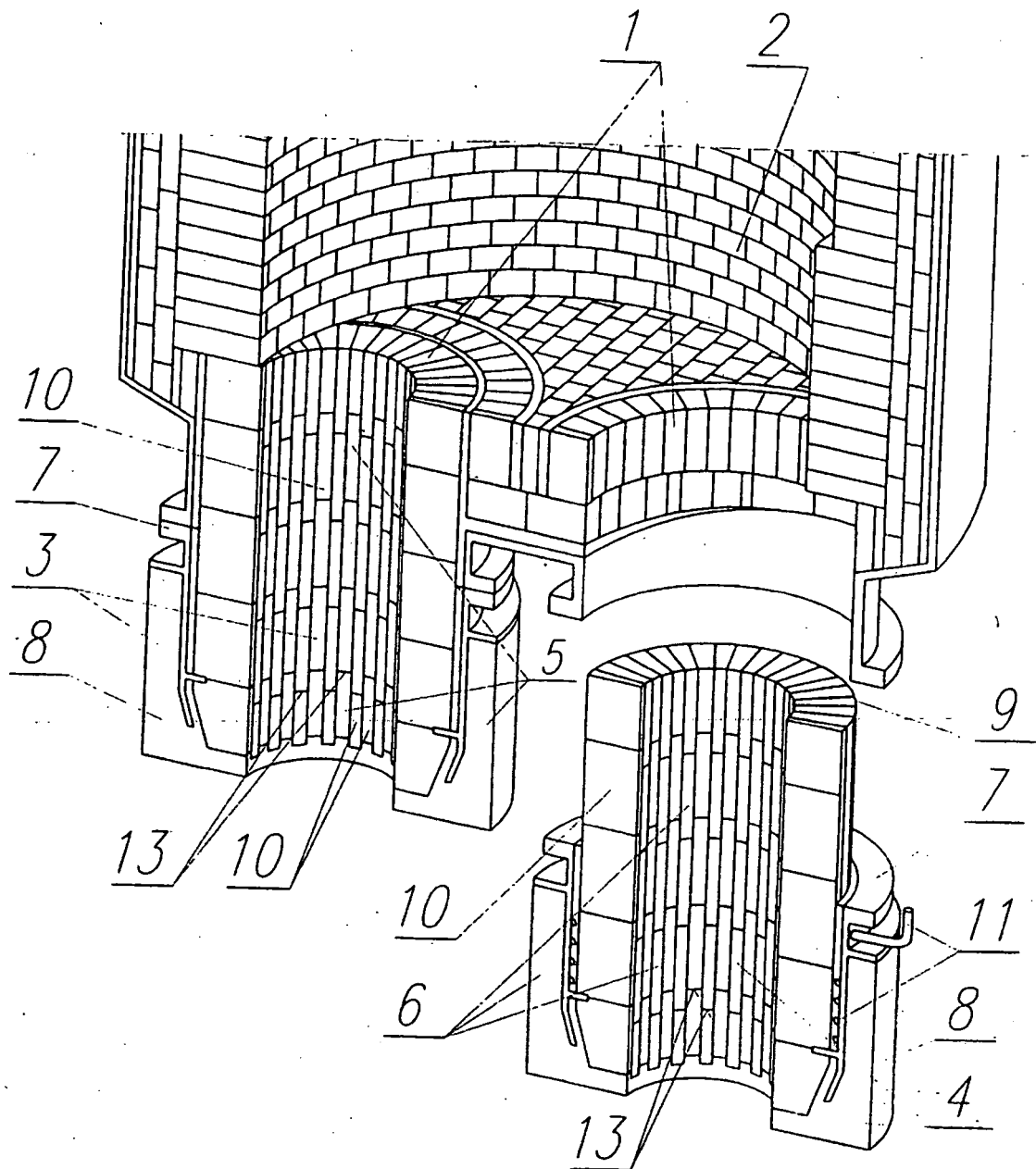


Fig. 3

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 5024421 A [0006]
- JP 51253318 A [0007]
- JP 08218113 A [0007]
- US 3521873 A [0007]