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DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
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MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM,
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Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

Published:

- with international search report (Art. 21(3))
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(54) Title: ULTRASONIC PROBES WITH GAS OUTLETS FOR DEGASSING OF MOLTEN METALS



FIG. 1A

(57) Abstract: Ultrasonic probes containing a plurality of gas delivery channels are disclosed, as well as ultrasonic probes containing recessed areas near the tip of the probe. Ultrasonic devices containing these probes, and methods for molten metal degassing using these ultrasonic devices, also are disclosed.



INTERNATIONAL SEARCH REPORT

International application No
PCT/US2014/065912

A. CLASSIFICATION OF SUBJECT MATTER
 INV. C22B9/05 C22B21/06
 ADD.
 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)
 C22B

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
 EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2012/042751 A1 (RUNDQUIST VICTOR F [US] ET AL) 23 February 2012 (2012-02-23) the whole document	1-14
A	WO 2011/127402 A1 (RUNDQUIST VICTOR F [US]; GILL KEVIN S [US]) 13 October 2011 (2011-10-13) the whole document	1-14
A	US 5 656 236 A (WAITE PETER D [CA] ET AL) 12 August 1997 (1997-08-12) the whole document	1-14

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
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- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "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

Date of the actual completion of the international search 19 February 2015	Date of mailing of the international search report 16/06/2015
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Swiatek, Ryszard
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2012042751	A1	23-02-2012	
		AU 2012323256 A1	16-05-2013
		CA 2850023 A1	18-04-2013
		CN 103889598 A	25-06-2014
		EP 2747906 A2	02-07-2014
		JP 2015501205 A	15-01-2015
		KR 20150000458 A	02-01-2015
		US 2012042751 A1	23-02-2012
		US 2014123812 A1	08-05-2014
		WO 2013055778 A2	18-04-2013

WO 2011127402	A1	13-10-2011	
		CN 103038372 A	10-04-2013
		EP 2556176 A1	13-02-2013
		KR 20130091640 A	19-08-2013
		US 2011247456 A1	13-10-2011
		US 2014008848 A1	09-01-2014
		WO 2011127402 A1	13-10-2011

US 5656236	A	12-08-1997	
		AU 693846 B2	09-07-1998
		CA 2181037 A1	10-08-1995
		DE 742842 T1	31-08-2000
		DE 900853 T1	31-08-2000
		DE 29522318 U1	18-10-2001
		DE 29522319 U1	25-10-2001
		DE 69526684 D1	13-06-2002
		DE 69526684 T2	07-11-2002
		DE 69530630 D1	05-06-2003
		DE 69530630 T2	26-02-2004
		EP 0742842 A1	20-11-1996
		EP 0900853 A1	10-03-1999
		EP 1132487 A1	12-09-2001
		ES 2173537 T3	16-10-2002
		ES 2193996 T3	16-11-2003
		JP 4050311 B2	20-02-2008
		JP H09508441 A	26-08-1997
		NO 963250 A	04-10-1996
		NO 20014930 A	04-10-1996
		US 5527381 A	18-06-1996
		US 5593634 A	14-01-1997
		US 5656236 A	12-08-1997
		WO 9521273 A1	10-08-1995
		ZA 9500889 A	13-10-1995

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/065912

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-14

Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-14

Ultrasonic device comprising a probe comprising two or more gas delivery channels

2. claims: 15-24

Ultrasonic device comprising a recessed region near the tip of the probe
