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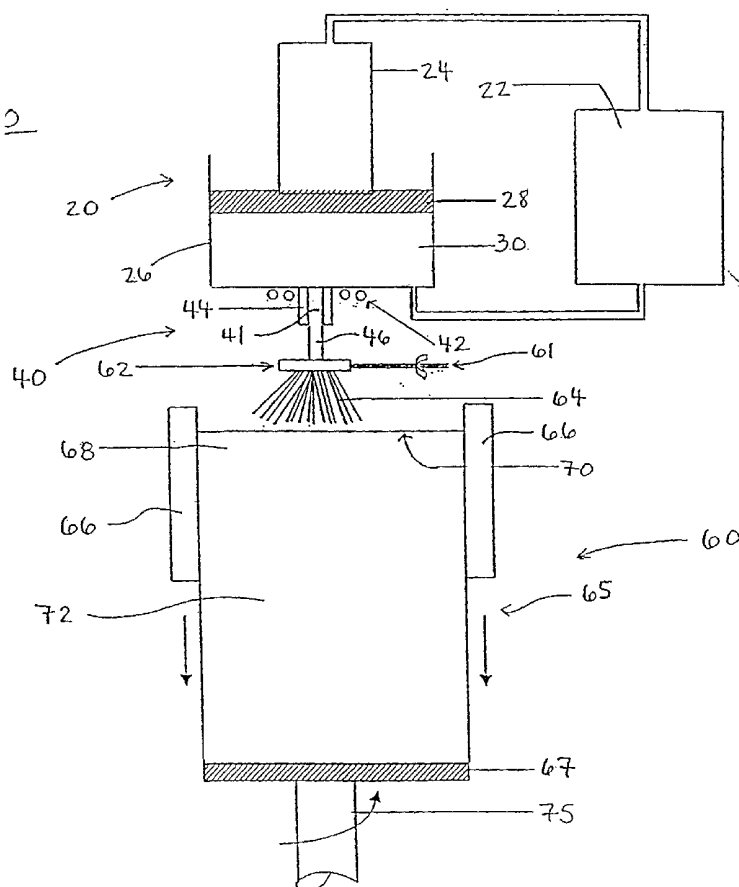
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CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH,  
GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC,  
LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW,  
MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK,

[Continued on next page]

(54) Title: REFINING AND CASTING APPARATUS AND METHOD



(57) Abstract: A method for refining and casting metals and metal alloys includes melting and refining a metallic material and then casting the refined molten material by a nucleated casting technique. The casting metals and metal alloys is refined by a melting and refining apparatus (20), and the refined molten material is provided to the atomizing nozzle (62) of a nucleated casting apparatus (60) through a transfer apparatus (40) adapted to maintain the purity of the molten refined material. The melting and refining apparatus (20), the transfer apparatus (40), and the nucleated casting apparatus (60) are in serial fluid communication.

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*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US01/47043

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : H05B 3/60; C22B 21/06

US CL : 373/42; 75/680

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)

U.S. : Please See Continuation Sheet

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

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.
X	US 5,749,938 A (COOMBS) 12 May 1998, see the entire reference.	19 and 24-25
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Y		20-23
Y	US 5,348,566 A (SAWYER et al) 20 September 1994, see the entire reference.	20-23
X	US 5,649,992 A (CARTER, Jr. et al) 22 July 1997, see Figures 2 and 4.	19-25
A	US 5,310,165 A (BENZ et al) 10 May 1994, see the entire reference.	1-45
A	US 5,325,906 A (BENZ et al) 05 July 1994, see the entire reference.	1-45
A	US 5,381,847 A (ASHOK et al) 17 January 1995, see the entire reference.	1-45
A	US 5,527,381 A (WAITE et al) 18 June 1996, see the entire reference.	1-45
A	US 4,931,091 a (WAITE et al) 05 June 1990, see the entire reference.	1-45

☒ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:	"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
"A" document defining the general state of the art which is not considered to be of particular relevance	"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
"E" earlier application or patent published on or after the international filing date	"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
"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)	"&" document member of the same patent family
"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	

Date of the actual completion of the international search

13 February 2002 (13.02.2002)

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## INTERNATIONAL SEARCH REPORT

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### C. (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3,737,305 A (BLAYDEN et al) 05 June 1973, see the entire reference.	1-45

## INTERNATIONAL SEARCH REPORT

International application No.

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### Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

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

1. ☐ Claim Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claim 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. ☐ Claim Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

### Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:  
Please See Continuation 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 fee, this Authority did not invite payment of any additional fee.
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.:

#### Remark on Protest

☐  
☒

The additional search fees were accompanied by the applicant's protest.

No protest accompanied the payment of additional search fees.

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US01/47043

### **BOX II. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING**

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claim(s) 1-18 and 26-45, drawn to a method of producing a preform and product produced by such method.

Group II, claim(s) 19-25, drawn to an apparatus or an electroslog remelting apparatus.

### **Continuation of B. FIELDS SEARCHED Item 1:**

373/4, 7, 11, 42-45, 56, 59, 66, 68, 69, 77, 79, 85, 110, 112; 75/10.1, 10.14, 10.24, 332, 337, 412, 680, 681, 708; 427/216; 164/46, 53, 270.1, 423, 463, 900; 266/201, 202, 212, 225; 222/590, 592, 603; 210/773.

### **Continuation of B. FIELDS SEARCHED Item 2:**