

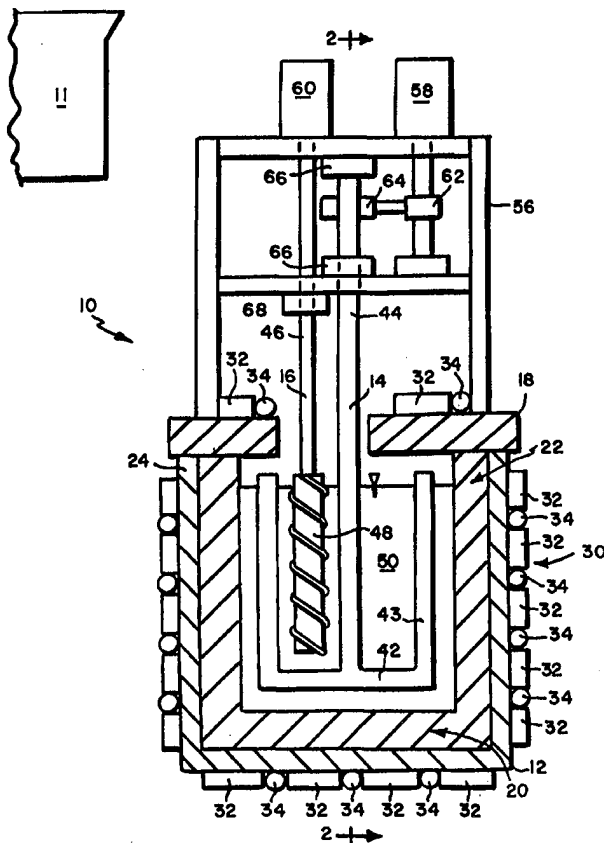


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup> :</b>  <b>C22 C 1/00, B22D 11/10</b>	<b>A3</b>	<b>(11) International Publication Number:</b> <b>WO 98/14624</b>  <b>(43) International Publication Date:</b> 9 April 1998 (09.04.98)
<b>(21) International Application Number:</b> PCT/US97/18016  <b>(22) International Filing Date:</b> 3 October 1997 (03.10.97)  <b>(30) Priority Data:</b> 08/726,099                      4 October 1996 (04.10.96)                      US  <b>(71) Applicant:</b> SEMI-SOLID TECHNOLOGIES, INC. [US/US]; Suite 210, 130 Brookline Street, Brookline, MA 02139 (US).  <b>(72) Inventors:</b> BROWN, Stuart, B.; 10 Julia Road, Needham, MA 02192 (US). MENDEZ, Patricio, F.; 143 Albany Street #412B, Cambridge, MA 02139 (US). RICE, Christopher, S.; 62 Spring Street #2L, Cambridge, MA 02141 (US). MYOJIN, Shinya; 11 Tufts Street #2, Cambridge, MA 02139 (US).  <b>(74) Agent:</b> PASTERNAK, Sam; Choate, Hall & Stewart, Ex- change Place, 53 State Street, Boston, MA 02109 (US).		<b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, UZ, VN, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims</i> <i>and to be republished in the event of the receipt of amendments.</i>  <b>(88) Date of publication of the international search report:</b> 11 June 1998 (11.06.98)

**(54) Title:** APPARATUS AND METHOD FOR SEMI-SOLID MATERIAL PRODUCTION**(57) Abstract**

An apparatus and process is provided for producing semi-solid material suitable for directly casting into a component wherein the semi-solid material is formed from a molten material and the molten material is introduced into a container. Semi-solid is produced therefrom by agitating, shearing, and thermally controlling the molten material. The semi-solid material is maintained in a substantially isothermal state within the container by appropriate thermal control and thorough three-dimensional mixing. Extending from the container is a means for removing the semi-solid material from the container, including a temperature control mechanism to control the temperature of the semi-solid material within the removing means.



***FOR THE PURPOSES OF INFORMATION ONLY***

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon	KR	Republic of Korea	PL	Poland		
CN	China	KZ	Kazakhstan	PT	Portugal		
CU	Cuba	LC	Saint Lucia	RO	Romania		
CZ	Czech Republic	LI	Liechtenstein	RU	Russian Federation		
DE	Germany	LK	Sri Lanka	SD	Sudan		
DK	Denmark	LR	Liberia	SE	Sweden		
EE	Estonia			SG	Singapore		

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 97/18016

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 6 C22C1/00 B22D11/10

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)

IPC 6 C22C B22D

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 practical, 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	EP 0 476 843 A (RHEO-TECHNOLOGY) 25 March 1992 see claims 1,5	1,13
Y	EP 0 719 606 A (AHRESTY CORPORATION) 3 July 1996 see the whole document	1,13
P,Y	EP 0 765 945 A (REYNOLDS METALS COMPANY) 2 April 1997 see the whole document	1,13
A	US 4 865 808 A (ICHIKAWA ET AL.) 12 September 1989 see the whole document	1,5,13

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in 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 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 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

8 April 1998

Date of mailing of the international search report

21/04/1998

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Lippens, M

# INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT/US 97/18016

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 476843 A	25-03-92	JP 4120224 A	21-04-92
		JP 4124233 A	24-04-92
		DE 69107387 D	23-03-95
		DE 69107387 T	14-06-95
		US 5144998 A	08-09-92
EP 719606 A	03-07-96	JP 8187547 A	23-07-96
EP 765945 A	02-04-97	US 5730198 A	24-03-98
US 4865808 A	12-09-89	JP 1584389 C	22-10-90
		JP 2007749 B	20-02-90
		JP 63242462 A	07-10-88
		JP 1096342 A	14-04-89
		JP 1780064 C	13-08-93
		JP 4031009 B	25-05-92
		US 4917359 A	17-04-90