



(51) International Patent Classification:

B22D 13/06 (2006.01) *B22C 9/08* (2006.01)
B22D 13/10 (2006.01) *B22D 27/04* (2006.01)

(21) International Application Number:

PCT/US2014/020127

(22) International Filing Date:

4 March 2014 (04.03.2014)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

13/792,929 11 March 2013 (11.03.2013) US
14/169,665 31 January 2014 (31.01.2014) US

(71) Applicant: **ATI PROPERTIES, INC.** [US/US]; 1600 N.E. Old Salem Road, Albany, Oregon 97321 (US).

(72) Inventors: **FOLTZ, John, W., IV**; 740 11th Avenue SW, Albany, Oregon 97321 (US). **MARTINEZ-AYERS, Raul, A.**; 1521 NW North Heights Drive, Albany, Oregon 97321 (US). **FOSDICK, Aaron, L.**; 34418 Grenz Lane NE, Albany, Oregon 97321 (US).

(74) Agents: **GROSSELIN, John, E., III** et al.; 1000 Six PPG Place, Pittsburgh, Pennsylvania 15222 (US).

(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR,

KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

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))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(88) Date of publication of the international search report:

19 March 2015



(54) Title: ENHANCED TECHNIQUES FOR CENTRIFUGAL CASTING OF MOLTEN MATERIALS

(57) Abstract: Various enhanced features are provided for centrifugal casting apparatuses, rotatable assemblies, and molds for casting products from molten material. These enhanced features include, among others, tapered gate portions positioned adjacent to the cavities of a mold, extended and shared gating systems, and detachable mold structures for modifying the thermodynamic characteristics and behavior of molds during casting operations.

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2014/020127

A. CLASSIFICATION OF SUBJECT MATTER
 INV. B22D13/06 B22D13/10 B22C9/08 B22D27/04
 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)
 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 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.
X	JP H08 206807 A (MITSUBISHI MATERIALS CORP) 13 August 1996 (1996-08-13) abstract; figures 1-4 -----	1,6,7, 13,14, 36,38
X	JP H08 238555 A (HONDA MOTOR CO LTD) 17 September 1996 (1996-09-17) abstract; figures 1-8 ----- -/--	1,4,6,7, 13-15, 35,38

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

<p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"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</p> <p>"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</p> <p>"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</p> <p>"&" document member of the same patent family</p>
---	---

Date of the actual completion of the international search 15 January 2015	Date of mailing of the international search report 23/01/2015
--	--

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 Baumgartner, Robin
--	--

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2014/020127

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 196 39 514 C1 (ALD VACUUM TECHN GMBH [DE]; HERAEUS GMBH W C [DE]) 18 December 1997 (1997-12-18) abstract; figures 2,3,5,6 -----	1-3,5-8, 11-15, 17-19, 21-23, 26,27, 29,31, 32, 36-39, 42-45,47
X	EP 0 686 443 A1 (ALD VACUUM TECHN GMBH [DE]) 13 December 1995 (1995-12-13) column 9, lines 40-45; figures 1-7 -----	1,5-8, 14,17, 24-26, 34-36
A	US 6 443 212 B1 (CHOUDHURY ALOK [DE] ET AL) 3 September 2002 (2002-09-03) the whole document -----	1-27, 35-39, 42-47

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/020127

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.:

1-27, 35-39, 42-47

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 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: 1-4, 6, 7, 13-16, 35-38

Centrifugal casting apparatus / mold / method, with additional features of stacked cavities and relating to the geometry and structure of mold and cavity.

2. claims: 5, 8-12, 17-25, 39

Centrifugal casting apparatus / mold / method, with additional features of stacked cavities and relating to directional solidification, heat extraction, heat transfer

3. claims: 26, 27, 42-47

Centrifugal casting mold, with additional features to the geometry of the cavity.

4. claims: 28-33

Centrifugal casting mold, with additional features relating to directional solidification, heat extraction, heat transfer

5. claims: 40, 41

Centrifugal casting apparatus assembly method, with additional features relating to a wedge and sealing engagement of mold with the wedge

6. claims: 48-57

Centrifugal casting mold, with additional features to the geometry of the gate.

7. claims: 34, 58-61

Centrifugal casting mold, with additional features to extended gate and the cavity cavity is structured for producing a cast component capable of sub-division into multiple sub-components.

8. claims: 62, 63

Centrifugal casting mold, with additional features two two cavities having an entry port and a common gate

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

9. claims: 64-68

Centrifugal casting mold, with additional features of different materials of main body portion and back wall portion

10. claims: 69, 70

Centrifugal casting mold, with additional features of a slot formed adjacent to the entry port of the cavity

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No PCT/US2014/020127

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP H08206807	A	13-08-1996	NONE
JP H08238555	A	17-09-1996	NONE
DE 19639514	C1	18-12-1997	DE 19639514 C1 18-12-1997
			EP 0835705 A1 15-04-1998
			JP 3267906 B2 25-03-2002
			JP H1099955 A 21-04-1998
			US 6250366 B1 26-06-2001
			US 2001045267 A1 29-11-2001
EP 0686443	A1	13-12-1995	EP 0686443 A1 13-12-1995
			JP 3258201 B2 18-02-2002
			JP H08187570 A 23-07-1996
			US 5626179 A 06-05-1997
			US 5950706 A 14-09-1999
US 6443212	B1	03-09-2002	AT 244085 T 15-07-2003
			DE 19846781 A1 13-04-2000
			EP 0992305 A1 12-04-2000
			JP 2000117409 A 25-04-2000
			US 6443212 B1 03-09-2002