



- (51) International Patent Classification:
B21J 5/00 (2006.01) *B22F 3/105* (2006.01)
- (21) International Application Number:
PCT/US2016/022331
- (22) International Filing Date:
14 March 2016 (14.03.2016)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
62/132,613 13 March 2015 (13.03.2015) US
- (71) Applicant: **ALCOA INC.** [US/US]; Alcoa Corporate Center, 201 Isabella Street, Pittsburgh, PA 15212-5858 (US).
- (72) Inventors: **KILMER, Raymond, J.**; 80 Fair Oaks Drive, Pittsburgh, PA 15238 (US). **SAMPLE, Vivek**; 5110 Baker Lane, Murrysville, PA 15668 (US). **FULTON, Erin, J.**; 210 Brandywine Drive, Irwin, PA 15642 (US). **BURG, James, T.**; 303 Lincoln Avenue, Verona, PA 15147 (US). **BOGAN, Eric, G.**; 102 Gerner Road, Cabot, PA 16023 (US). **BREM, Jason, C.**; 225 Glenview Drive, New Kensington, PA 15068 (US). **SPEER, Robert, J.**; 325 Delberta Road, Upper Burrell, PA 15068 (US). **LEITH, William, B.**; 932 Pleasant Valley Drive, Apollo, PA 15613 (US). **CARDINALE, Michael**; 415 Muffley Hollow Road, Apollo, PA 15613 (US). **GACKA, Philip**; 4650 Keswick Court, Allison Park, PA 15101 (US).
- (74) Agent: **BROOKINS, Irene, L.**; Greenberg Traurig LLP, c/o Alcoa Technical Center, 100 Technical Drive, Alcoa Center, PA 15069-0001 (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, 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, ST, 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))

[Continued on next page]

(54) Title: METHODS OF PRODUCING WROUGHT PRODUCTS WITH INTERNAL PASSAGES

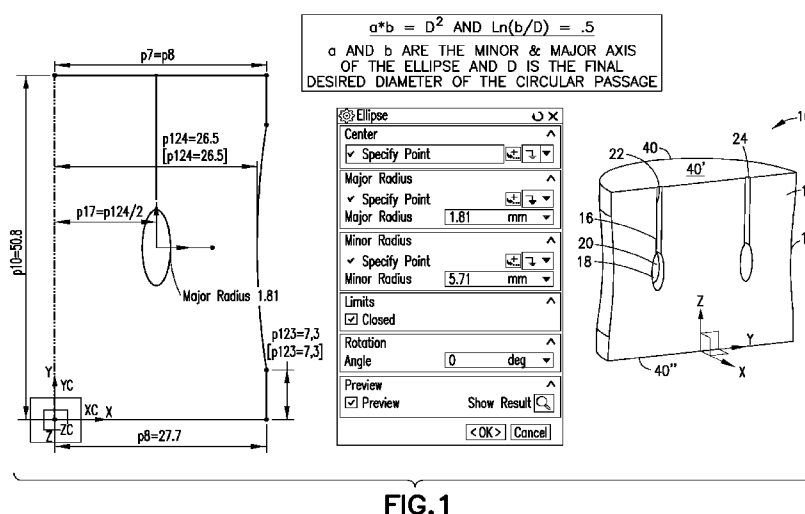


FIG. 1

(57) **Abstract:** Various methods are disclosed for additively manufacturing a feedstock material to create an AM preform, wherein the AM preform is configured with a body having an internal passage defined therein, wherein the internal passage further includes at least one of a void and a channel; inserting a filler material into the internal passage of the AM preform; closing the AM preform with an enclosure component such that the filler material is retained within the internal passage of the AM preform; and deforming the AM preform to a sufficient amount to create a product having an internal passage therein, wherein the product is configured with wrought properties for that material via the deforming step.

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

3 November 2016

- *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))*

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2016/022331

A. CLASSIFICATION OF SUBJECT MATTER

INV. B21J5/00 B22F3/105
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)

B21J B22F C21D B33Y

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.
Y	US 2013/039799 A1 (BONO ERIC S [US] ET AL) 14 February 2013 (2013-02-14) paragraphs [0019], [0024], [0034], [0049], [0050], [0051], [0053] - [0057], [0063]; figure 1 -----	1-21
Y	EP 2 551 040 A1 (EADS DEUTSCHLAND GMBH [DE]; EADS UK LTD [GB]) 30 January 2013 (2013-01-30) paragraphs [0012], [0021], [0033], [0041], [0042], [0045]; figure 1 -----	1-19
Y	US 2015/013144 A1 (BUSH DUSTIN M [US] ET AL) 15 January 2015 (2015-01-15) paragraphs [0003], [0028], [0034] ----- -/-	6-10,13, 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

"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

20 September 2016

Date of mailing of the international search report

29/09/2016

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

Charvet, Pierre

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2016/022331

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2013/098575 A1 (DI SERIO EMILE THOMAS [FR] ET AL) 25 April 2013 (2013-04-25) paragraph [0049]; claim 4; figures -----	20,21
Y	CN 1 861 296 A (HUAZHONG SCIENCE & TECH UNIV [CN]) 15 November 2006 (2006-11-15) page 6, lines 10-14; figure 1 -----	20,21

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/022331

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.:

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: 1-19

The subject-matter of independent claim 1 is a method for producing wrought products with internal passages.

2. claims: 20, 21

The subject-matter of independent claim 20 is a method for producing wrought products with internal passages.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2016/022331

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2013039799 A1	14-02-2013	US 2013039799 A1	14-02-2013
		WO 2013020217 A1	14-02-2013
EP 2551040 A1	30-01-2013	EP 2551040 A1	30-01-2013
		WO 2013013814 A2	31-01-2013
US 2015013144 A1	15-01-2015	AU 2014287260 A1	21-01-2016
		CA 2915299 A1	15-01-2015
		CN 105358270 A	24-02-2016
		EP 3019291 A1	18-05-2016
		KR 20160028469 A	11-03-2016
		US 2015013144 A1	15-01-2015
		US 2016193649 A1	07-07-2016
		US 2016207092 A1	21-07-2016
		WO 2015006447 A1	15-01-2015
US 2013098575 A1	25-04-2013	BR 112012025340 A2	28-06-2016
		CN 102917815 A	06-02-2013
		EP 2555886 A1	13-02-2013
		ES 2505499 T3	10-10-2014
		FR 2958193 A1	07-10-2011
		HR P20140914 T1	07-11-2014
		JP 5850910 B2	03-02-2016
		JP 2013523457 A	17-06-2013
		PT 2555886 E	26-09-2014
		RU 2012146973 A	20-05-2014
		US 2013098575 A1	25-04-2013
		WO 2011124836 A1	13-10-2011
CN 1861296 A	15-11-2006	NONE	