

(51) International Patent Classification:
B29C 67/00 (2006.01)(21) International Application Number:
PCT/US2014/065874(22) International Filing Date:
17 November 2014 (17.11.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/908,952 26 November 2013 (26.11.2013) US
62/035,641 11 August 2014 (11.08.2014) US

(71) Applicant: EIP SYSTEMS, INC. [US/US]; 304 Nottingham Drive, Chapel Hill, North Carolina 27517 (US).

(72) Inventors: DESIMONE, Joseph M.; 304 Nottingham Drive, Chapel Hill, North Carolina 27517 (US). SAMULSKI, Edward T.; 413 Deming Road, Chapel Hill, North Carolina 27514 (US). ERMOSHKIN, Alexander; 440 Robin Road, Chapel Hill, North Carolina 27516 (US). DESIMONE, Philip M.; 304 Nottingham Drive, Chapel Hill, North Carolina 27517 (US).

(74) Agent: MYERS BIGEL SIBLEY & SAJOVEC, P.A.; P.O. Box 37428, Raleigh, North Carolina 27627 (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.

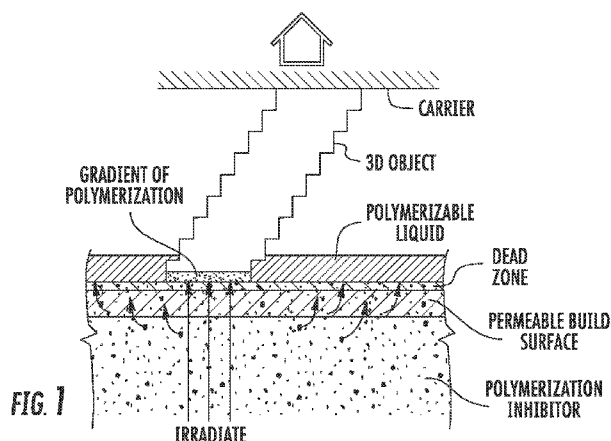
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, 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).

Published:

— with international search report (Art. 21(3))

(88) Date of publication of the international search report:
29 October 2015

(54) Title: RAPID 3D CONTINUOUS PRINTING OF CASTING MOLDS FOR METALS AND OTHER MATERIALS



(57) Abstract: A method of forming a three-dimensional object useful as a casting mold is carried out by providing a carrier and an optically transparent member having a build surface, the carrier and the build surface defining a build region therebetween; filling the build region with a liquid photocurable ceramic resin; irradiating the build region through the optically transparent member to form a solid polymer from the polymerizable liquid and advancing the carrier away from the build surface to form the three-dimensional object from the solid polymer, while also concurrently with the irradiating and/or advancing steps: (i) continuously maintaining a dead zone of polymerizable liquid in contact with the build surface, and (ii) continuously maintaining a gradient of polymerization zone between the dead zone and the solid polymer and in contact with each thereof. Apparatus for carrying out the method is also described.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2014/065874

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - B29C 67/00 (2015.01)

CPC - B29C 67/0066 (2015.01)

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(8) - B29C 67/00, 67/02; G03F 7/00, 7/004, 7/09, 7/11, 7/20 (2015.01)

CPC - B29C 67/0051, 67/0055, 67/0062, 67/0066; G03F 7/0037, 7/20 (2015.01) (keyword delimited)

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

USPC - 264/401; 425/174.4; 430/270.1

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PatBase, Google Patents, Google, YouTube

Search terms used: eipi systems, 3d, object, inhibited, polymerization, curing, carrier

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2013/0292862 A1 (JOYCE) 07 November 2013 (07.11.2013) entire document	1-4, 29-33, 48, 74, 91-94, 109, 110
Y	US 2003/0173713 A1 (HUANG) 18 September 2003 (18.09.2003) entire document	1-4, 48, 74, 91-94, 110
Y	US 2010/0323301 A1 (TANG) 23 December 2010 (23.12.2010) entire document	29-33, 74, 109, 110
A	US 2008/0063867 A1 (SCHLIENGER et al) 13 March 2008 (13.03.2008) entire document	1-4, 29-33, 48-50, 74-76, 91-94, 109-112

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

* 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

27 January 2015

Date of mailing of the international search report

19 FEB 2015

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents

P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-273-3201

Authorized officer:

Blaine R. Copenheaver

PCT Helpdesk: 571-272-4300

PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2014/065874

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.: 5-28,34-47,51-73,77-90,95-108,113-124, 124A
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:

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 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.