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- (71) **Applicant: MATTERFAB CORP.** [US/US]; 9136 S. Front Nine Drive, Bloomington, IN 47401 (US).
- (72) **Inventors: BURRIS, Matthew;** 9136 S. Front Nine Drive, Bloomington, IN 47401 (US). **DOLGNER, Andrew;** 9136 S. Front Nine Drive, Bloomington, IN 47401 (US).
- (74) **Agent: SCHOX, Jeffrey;** 500 3rd Street, Suite 515, San Francisco, CA 94107 (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.
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[Continued on nextpage]

(54) **Title:** LASER SINTERING APPARATUS AND METHODS

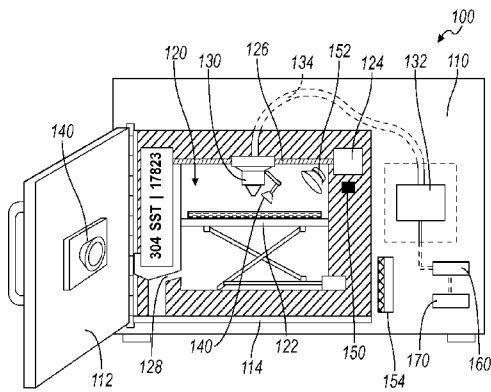


FIG. 1A

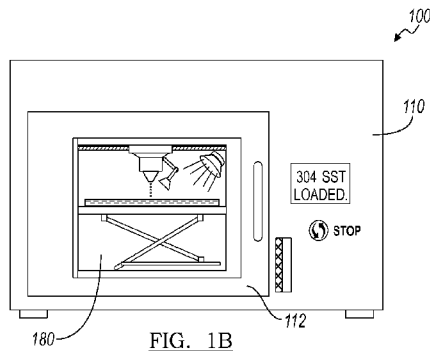


FIG. 1B

(57) **Abstract:** One variation of a method for detecting a temperature at a laser sintering site within a field of view of an image sensor within a laser sintering device includes: based on a selected fuse temperature for a laser sintering build material, setting a first shutter speed for the image sensor, the first shutter speed corresponding to a detectable range of temperatures including an anticipated temperature at the laser sintering site; at a first time, capturing a first digital image of the laser sintering site with the image sensor at a first shutter speed; and correlating a light intensity of a pixel within the first digital image with a first temperature at the laser sintering site at the first time based on the first shutter speed.

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- *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

14/020903.16 US
International application No.

PCT/US 14/28585

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - C04B 35/64; B29C 35/02 (2014.01)
CPC - G05D 23/2716; B29C 35/0288
 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)
CPC - G05D 23/2716; B29C 35/0288

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC; 219/121.65, 121.66

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PubWEST (USPT,PGPB,JPAB,EPAB); Google
Search Terms: Laser sintering temperature control feedback monitor detect imager imaging camera time fusion data model shutter speed exposure time intensity energy pixel

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6,815,636 B2 (Chung et al.) 09 November 2004 (09.11.2004), entire document especially abstract, col 5, ln 25-55, col 6, ln 40-55, col 6, ln 5-30 and col 7, ln 5-25	1-17
Y	US 6,350,326 B1 (McCay et al.) 26 February 2002 (26.02.2002), entire document especially abstract, col 15, ln 30-50	1-17
A	US 2009/0206065 A1 (Kruth et al.) 20 August 2009 (20.08.2009), entire document	1-17

Further documents are listed in the continuation of Box C.

* 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 but 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 28 August 2014 (28.08.2014)	Date of mailing of the international search report 18 SEP 2014
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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: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774
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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 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 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.:
1-17

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.

Box III: 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: claims 1-17: directed to a method for detecting a temperature at a laser sintering site.

Group II: claims 18-23 and 34-43: directed to an apparatus for manufacturing.

Group III: claims 24-33: directed to a method for controlling construction of a part over a build platform within a laser sintering device.

The inventions listed as Groups I-III do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Group I includes the special technical features of based on a selected fuse temperature for a laser sintering build material, setting a first shutter speed for the image sensor, corresponding to a detectable range of temperatures comprising an anticipated temperature at the laser sintering site; retrieving data from a material supply cartridge coupled to a laser sintering device and based on the data, selecting an emissivity of a material within the material supply cartridge, which are not required by Groups II-III.

Group II includes the special technical features of a build chamber comprising a build platform; an actuator arranged within the build chamber and over the build platform; a laser output optic supported by the actuator; a housing containing the build chamber, the actuator, and the laser output optic and defining an aperture into the build chamber; an opaque door coupled to the housing and configured to close the aperture; an image sensor arranged within the housing and directed toward the laser sintering site; and a display arranged on an exterior surface of the opaque door and configured to render images output by the image sensor substantially in real-time, which are not required by Groups I and III.

Group III includes the special technical features of setting a lamp within the build chamber to an off state; detecting electromagnetic radiation within the build chamber based on an output of an optical sensor within the build chamber; in response to detection of electromagnetic radiation above a threshold flux, interrupting construction of the part within the build chamber; in response to detection of electromagnetic radiation below the threshold flux, setting the lamp to an on state to illuminate the build chamber; and rendering the digital image on a digital display arranged on an exterior surface of the laser sintering device, which are not required by Groups I-II.

Groups I-III share the technical features of a laser sintering device within a field of view of an image sensor, the image sensor capturing a digital image of a laser sintering site.

Groups I and II share the technical features of at a first time, capturing a first digital image of the laser sintering site with the image sensor at a first shutter speed; and correlating a light intensity of a pixel within the first digital image with a first temperature at the laser sintering site at the first time based on the emissivity of the material and the first shutter speed.

Groups II and III share the technical feature of an image sensor arranged within a build chamber.

However, these shared technical features do not represent a contribution over the prior art of US 6,815,636 B2 to Chung et al. (hereinafter 'Chung') (09 Nov 2004), which discloses a laser sintering device within a field of view of an image sensor, the image sensor arranged within a build chamber and capturing a digital image of a laser sintering site (abstract, col 6, ln 5-15); at a first time, capturing a first digital image of the laser sintering site with the image sensor at a first shutter speed (col 6, ln 5-30 and col 7, ln 5-25); and correlating a light intensity of a pixel within the first digital image with a first temperature at the laser sintering site at the first time based on the emissivity of the material and the first shutter speed (col 6, ln 5-30 and col 7, ln 5-25).

As the above method and system was known, as evidenced by the teaching of Chung, this cannot be considered a special technical feature that would otherwise unify the groups.

Groups I-III therefore lack unity under PCT Rule 13 because they do not share a same or corresponding special technical feature.