



- (51) International Patent Classification:
B29C 67/20 (2006.01)
- (21) International Application Number:
PCT/US2014/043120
- (22) International Filing Date:
19 June 2014 (19.06.2014)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
61/837,110 19 June 2013 (19.06.2013) US
- (72) Inventor; and
- (71) Applicant : WAGGONER, Michael [US/US]; 7734 15th Ave NE, Seattle, Washington 98115 (US).
- (74) Agent: HAUGEN, James; 4020 148th Ave NE, Suite D, Redmond, Washington 98052 (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, CL, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: REDUCED DENSITY THERMOPLASTICS

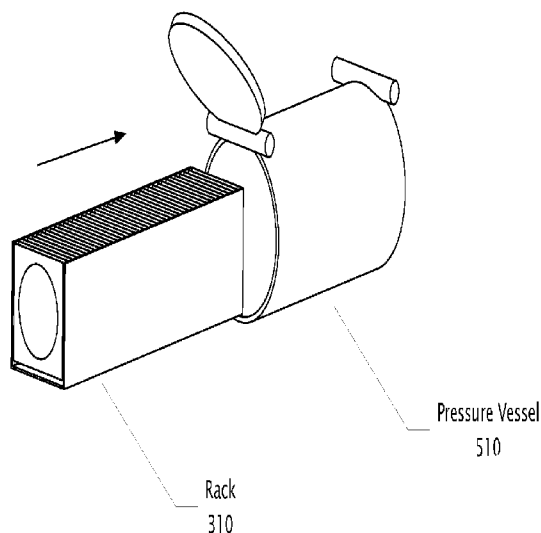


Figure 5

(57) Abstract: The instant application discloses, among other things, ways to manufacture reduced density thermoplastics. A rapid foaming process which may create a polymer product by saturating thermoplastic sheet or preforms, heating, and then forming into final shape, is described. The polymer product may include an integral solid skin. This method may be utilized with any thermoplastic. The material handling, saturation methods, and end products are also described.





Published:

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

- *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))*

2 April 2015

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 14/43120

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - B29C 67/20 (2015.01)

CPC - B29C 44/5636

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 67/20 (2015.01)

CPC: B29C 44/5636

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

USPC: 264/321, 320, 319, 33.1, 50, 54

CPC: B29C 44/5636, B29K 2105/04

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

PatBase(Full-text: AU BE BR CA CH CN DE DK EP ES FI FR GB IN JP KR SE TH TW US WO); Google Scholar (Articles and Patents);

Search Terms Used: (polylactic acid) PLA polylactide "lacti"; mask* selectiv* pattern*; foam*; absorb* saturat*; solid state; pressure vessel* chamber* contain*

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X		3, 4, 21
--	US 3,389,199 A (Bushnell et al.) 01 June 1962 (01.06.1962) figs. 1-3 and column 4, lines 23-35	-----
Y		1, 14, 17, 18
Y	US 8,080,194 B2 (Nadella et al.) 20 December 2011 (20.12.2011) fig. 9 and column 7, lines 47-67	1, 5-9, 12-20
Y	US 2007/0179253 A1 (Matsuoka et al.) 02 August 2007 (02.08.2007) para [0060]	5-9, 12-20
Y	US 7,501,175 B2 (Branch et al.) 15 September 2005 (15.09.2005) para [0054]	19, 20

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

07 January 2015 (07.01.2015)

Date of mailing of the international search report

05 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:

Lee W. Young

PCT Helpdesk: 571-272-4300
PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 14/43120

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:

-----Please 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.:
1, 3-9, and 12-21
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.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 14/43120

Continuation of Box III Lack of Unity:

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: Claim 1, directed to a method of saturating a polymer sheet
Group II: Claim 2, directed to a method of creating a saturated polymer sheet
Group III: Claims 3-4, directed to a method of heating a saturated polymer sheet
Group IV: Claims 5-9, directed to a method of creating a saturated thermoplastic sheet
Group V: Claims 10-11, directed to methods of recovering scrap from solid state foaming
Group VI: Claims 12-20, directed to a method of producing low density thermoplastic parts
Group VII: Claim 21, directed to a thermoplastic structure

The inventions listed as Groups I-VII 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 at least a method of placing a blank in a masking device and loading into a pressure vessel, which is not present in any of Groups II-VII.

Group II includes creating a plurality of molten forms in a pressure vessel, which is not present in any of Groups I or III-VII.

Group III includes heating the sheet and masking device, which is not present in any of Groups I-II or IV-VII.

Group IV includes exposing the thermoplastic sheet to high pressure inert gas in the presence of a solvent, which is not present in any of Groups I-III or V-VII.

Group V includes collecting and grinding up saturated scrap foam, which is not present in any of Groups I-IV or VI-VII.

Group VI includes holding the portion against the mold, which is not present in any of Groups I-V or VII.

Group VII includes a thermoplastic structure with an asymmetric low density core, which is not present in any of Groups I-VI.

Groups I and II share the technical features of placing polymer into a pressure vessel. Groups I and III share the technical features of placing a polymer sheet/blank in a masking device.

However, these shared technical features do not represent a contribution over the prior art, as shown as being anticipated by US 6,323,251 to Perez et al. (hereinafter Perez): Perez discloses loading a polymer (thermoplastic substrate, column 6, line 60) into a pressure vessel (pressure vessel, column 6, line 46) for batch process foaming (see column 6, line 45-column 7, line 26). Perez further discloses placing a polymer sheet/blank in a masking device (column 4, line 47-59; column 16, line 65 to column 17, line 5).

Therefore, Groups I-VII lack unity under PCT Rule 13.