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- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM,

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Declarations under Rule 4.17:

— of inventorship (Rule 4.17(iv))

Published:

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

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

8 May 2014

(54) Title: AERATED FIBER CEMENT BUILDING PRODUCTS AND METHODS OF MAKING THE SAME

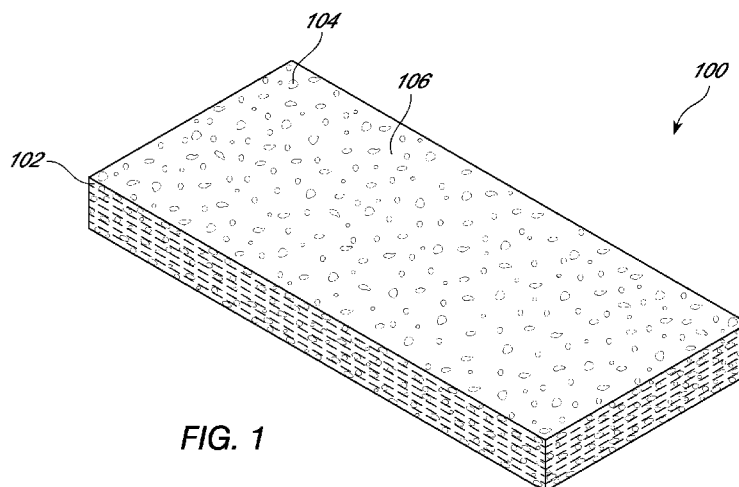


FIG. 1

(57) Abstract: Disclosed herein are low density fiber cement articles, such as fiber cement building panels and sheets, comprised of multiple overlaying fiber cement substrate layers having small and uniform entrained air pockets distributed throughout. Also disclosed herein are air entrainment systems and methods for manufacturing aerated low density fiber cement panels or sheets with consistent air void content and uniform air void distribution. Also disclosed herein are air entrainment technologies adapted to work in conjunction with the Hatschek process to produce aerated fiber cement articles having controlled air void content and distribution.



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 12/35593

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - B28B 1/50; B28B 11/04 (2012.01)

USPC - 156/153; 156/264

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)
USPC - 156/153; 156/264

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC - all classes (keyword delimited)
B28B 1/50; B28B 11/04 (2012.01)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PubWEST (USPT, PGPUB, EPAB, JPAB); Google Scholar/Patent
Search terms - cement, fiber, layered, air, voids, closed, cell, Peng

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,002,620 A (King) 26 March 1991 (26.03.1991); entire document, especially Fig. 1, cols. 2 and 3	1-8
Y	US 6,485,560 B1 (Scherer et al.) 26 November 2002 (26.11.2002); col 13, ln 26-29; col 1, ln 64- col 2, ln 17	1-8
Y	US 6,716,293 B2 (Taymourian et al.) 06 April 2004 (06.04.2004); entire document, especially abstract and col. 3	5
Y	US 2008/0141908 A1 (Peng et al.) 19 June 2008 (19.06.2008); entire document, especially para. [0031] and abstract	6
Y	US 2004/0168615 A1 (Luo et al.) 02 September 2004 (02.09.2004); entire document, especially [para. 0017]	7
Y	US 4,872,913 A (Dunton et al.) 10 October 1989 (10.10.1989); entire document, especially cols. 2 and 3	1-8

☐ 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

"G" document member of the same patent family

Date of the actual completion of the international search

02 September 2012 (02.09.2012)

Date of mailing of the international search report

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Name and mailing address of the ISA/US

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 12/35593

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:

The following claim groups were found:

Group I: Claims 1-8

Group II: Claims 9-13

Group III: Claims 14-16

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: is drawn to a building article comprising: a plurality of thin overlaying fiber cement substrate layers, each of said overlaying fiber cement substrate layer is bonded to an adjacent overlaying substrate layer thereby forming a fiber cement matrix; and a plurality of air voids defined by air pockets entrained in the fiber cement matrix such that the air voids are formed directly in the fiber cement matrix with no material separating the air voids from the fiber cement matrix, said air voids being dispersed uniformly throughout the fiber cement matrix. See extra 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. 1-8.

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
Information on patent family members

International application No.
PCT/US 12/35593

Continued from Box No. III Observations where unity of invention is lacking

matrix to reduce the density of the fiber cement matrix such that the cumulative volume of the air voids is greater than 3% of the volume of the fiber cement matrix, said air voids having an average diameter greater than 20 microns.

Group II: is drawn to a fiber cement formulation, comprising: a hydraulic binder; cellulose fibers; and an air entrainment agent, said air entrainment agent comprises 0.1 %-2% by weight.

Group III: is drawn to a method of entraining air in a fiber cement panel comprising multiple overlays of substrate layers, the method comprises: creating air bubbles in an aqueous fiber cement slurry; depositing said fiber cement slurry as thin fiber cement films on a plurality of sieve cylinders that are rotated through the fiber cement slurry, wherein the air bubbles are distributed uniformly in the thin fiber cement films; transferring a series of sequential layers of the thin fiber cement films to a belt so as to build a thicker fiber cement layer; removing water from the thicker fiber cement layer; and curing said thicker fiber cement layer.

The inventions listed in the above-mentioned groups 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:

Groups I-III lack unity of invention, because even though the inventions of these groups require the technical features of fiber cement and entrained air, these technical features are not special technical features as they do not make a contribution over the prior art in view of US 5,002,620 A1 to King, which discloses fiber cement (col 1, ln 38-44; abstract) and entrained air (col 3, ln 13-16).

Groups I and II lack unity of invention, because even though the inventions of these groups require the technical features of a plurality of thin overlaying fiber cement substrate layers and entrained air bubbles, these technical features are not special technical features as they do not make a contribution over the prior art in view of US 5,002,620 A1 to King, which discloses plurality of thin overlaying fiber cement substrate layers (col 4, ln 17-19; abstract; figure 1) and entrained air bubbles (col 3, ln 9-12).

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