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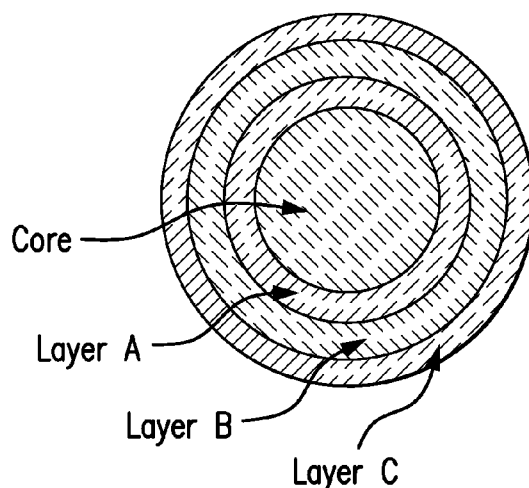
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[Continued on next page]

(54) Title: EXTRUSION PROCESS FOR PROPPANT PRODUCTION

**FIG. 1**

(57) **Abstract:** An extrusion method and apparatus are described for producing ceramics, glass, glass-ceramics, or composites suitable for use as proppants. The method includes forming one or more green body materials, extruding the green body materials to form a green body extrudate, separating and shaping the green body extrudate into individual green bodies, and sintering the green bodies to form proppants. The apparatus includes a means for forming an intimate mixture of green body materials, means to produce a green body extrudate, means for separating and shaping the green body extrudate into individual green bodies, and means to sinter the green green bodies to form proppants.



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, ML, MR, NE, SN, TD, TG).

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A. CLASSIFICATION OF SUBJECT MATTER**B28B 3/20(2006.01)i, B28B 3/22(2006.01)i, C03B 17/00(2006.01)i**

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)

B28B 3/20; E21B 47/00; E21B 43/267; B29C 47/92; C09D 5/33; B32B 5/16; C04B 35/78; B32B 15/02; C09D 1/00; C09K 8/80

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: proppant, extrusion, green body extrudate

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2007-0202318 A1 (Russell J. Smith et al.) 30 August 2007. See the entire document.	1-75
A	US 2009-0288820 A1 (Andrew R. Barron et al.) 26 November 2009. See the entire document.	1-75
A	US 2009-0051063 A1 (Henrik Stang et al.) 26 February 2009. See the entire document.	1-75
A	US 2010-0203336 A1 (Ming Liang Shiao et al.) 12 August 2010. See the entire document.	1-75
PA	US 2011-0146985 A1 (Yuming Xie et al.) 23 June 2011. See the entire document.	1-75
PA	US 2011-0160104 A1 (Shanghua Wu et al.) 30 June 2011. See the entire document.	1-75



Further documents are listed in the continuation of Box C.



See patent family annex.

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"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

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Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007-0202318 A1	30.08.2007	AU 2006-210470 A1	10.08.2006
		AU 2006-210470 B2	20.01.2011
		AU 2007-282111 A1	14.02.2008
		CA 2593969 A1	10.08.2006
		CA 2593969 C	19.07.2011
		CA 2659669 A1	14.02.2008
		CN 101115906 A	30.01.2008
		CN 101115906 C0	30.01.2008
		CN 101522856 A	02.09.2009
		EP 1856374 A1	21.11.2007
		EP 1856374 B1	02.11.2011
		EP 2047061 A2	15.04.2009
		EP 2292894 A1	09.03.2011
		KR 10-2009-0035732 A	10.04.2009
		US 2006-0177661 A1	10.08.2006
		US 2007-0166541 A1	19.07.2007
		US 2008-0135245 A1	12.06.2008
		US 2009-0032253 A1	05.02.2009
		US 2009-0038798 A1	12.02.2009
		US 2009-0065208 A1	12.03.2009
		US 2009-0137433 A1	28.05.2009
		US 2011-0077176 A1	31.03.2011
		US 7459209 B2	02.12.2008
		US 7491444 B2	17.02.2009
		US 7867613 B2	11.01.2011
		US 7883773 B2	08.02.2011
		US 7887918 B2	15.02.2011
		US 7914892 B2	29.03.2011
		US 8012533 B2	06.09.2011
		US 8075997 B2	13.12.2011
		WO 2006-084236 A1	10.08.2006
		WO 2008-018966 A2	14.02.2008
		WO 2008-018966 A3	14.02.2008
US 2009-0288820 A1	26.11.2009	AR 071860 A1	21.07.2010
		CA 2725088 A1	28.01.2010
		CN 102099545 A	15.06.2011
		EA 201071331 A1	30.06.2011
		EP 2307666 A2	13.04.2011
		MX 2010012463 A	07.12.2010
		US 8168570 B2	01.05.2012
		WO 2010-011402 A2	28.01.2010
		WO 2010-011402 A3	10.09.2010
US 2009-0051063 A1	26.02.2009	AU 2005-289384 A1	06.04.2006
		AU 2005-289384 B2	13.05.2010
		EP 1793973 A1	13.06.2007
		EP 1793973 A4	15.07.2009
		JP 2008-514459 A	08.05.2008

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2012/022147

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		WO 2006-034557 A1	06.04.2006
US 2010-0203336 A1	12.08.2010	CA 2688340 A1	04.12.2008
		EP 2165028 A2	24.03.2010
		EP 2165028 A4	26.10.2011
		WO 2008-147972 A2	04.12.2008
		WO 2008-147972 A3	29.01.2009
US 2011-0146985 A1	23.06.2011	US 8178476 B2	15.05.2012
		WO 2011-078985 A1	30.06.2011
US 2011-0160104 A1	30.06.2011	WO 2011-082102 A1	07.07.2011