



(51) International Patent Classification:

F02B 23/10 (2006.01) F02M 25/07 (2006.01)  
F02B 11/00 (2006.01) F02G 5/02 (2006.01)  
F02D 19/08 (2006.01)

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, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, 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.

(21) International Application Number:

PCT/US2012/037674

(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, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

(22) International Filing Date:

12 May 2012 (12.05.2012)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

61/485,570 12 May 2011 (12.05.2011) US  
61/494,370 7 June 2011 (07.06.2011) US  
61/534,017 13 September 2011 (13.09.2011) US

Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- of inventorship (Rule 4.17(iv))

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Published:

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

(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, 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, IS, JP, KE, KG, KM, KN, KP, KR,

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

28 March 2013

(54) Title: MIXED-MODE COMBUSTION METHODS ENABLED BY FUEL REFORMERS AND ENGINES USING THE SAME

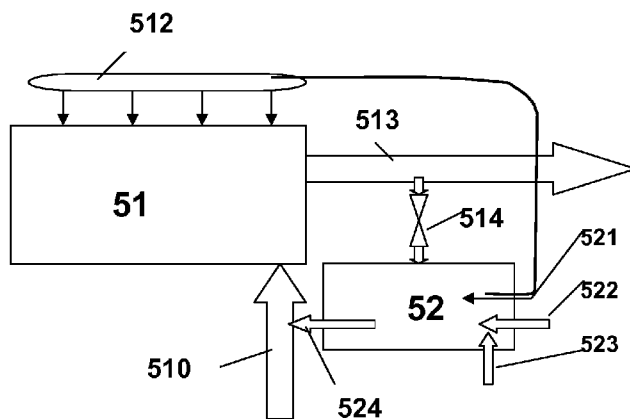


FIG. 5

(57) Abstract: Disclosed here is an adaptive mixed-mode combustion method, which is mainly for internal combustion engines, either compression ignition or spark ignition, or mixed-mode engines using both compression ignition and spark ignition. The combustion method is composed of steps of partially charging fuel reformates through intake ports, or charging fuels with high ignition temperature through intake ports, wherein it has adaptive means to introduce fuels into combustion chamber space through both intake port fuel charge and direct fuel injections, based on engine loads and speeds, to produce a separate twin triangular heat release curves to effectively reduce emissions and fuel consumptions. A combustion engine using the disclosed combustion method is also provided. A corresponding method and fuel reformer of using exhaust energy for fuel reforming is also disclosed. Also disclosed is a rotating fuel reformer, comprising a rotating catalyst block to accelerate the fuel reforming rate and reduce the reformer weight and catalyst usage. The reformer also has devices to pressurize and atomize fuel through centrifugal forces.



**A. CLASSIFICATION OF SUBJECT MATTER***F02B 23/10(2006.01)i, F02B 11/00(2006.01)i, F02D 19/08(2006.01)i, F02M 25/07(2006.01)i, F02G 5/02(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)

F02B 23/10; F02D 41/34; F02M 21/02; F02B 11/00; F02M 27/02; F02B 51/00

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) &amp; Keywords: internal combustion engine, fuel reformer, multi injection, injection timing.

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	WO 2011-008706 A2 (HOU, DEYANG et al.) 20 January 2011 See the abstract, claim 1	1-3,6-9 4-5,10-29
Y A	JP 2006-291901 A (TOYOTA MOTOR CORP.) 26 October 2006 See the abstract, paragraphs 0015-0022, 0025-0031, figure 1	1-3,6-9 4-5,10-29
A	US 7487763 B2 (MIYASAKA YOSHIO) 10 February 2009 See the abstract, column 4 lines 29-39, figure 1	1-29
A	JP 2001-221109 A (NILES PARTS CO., LTD.) 17 August 2001 See the abstract, paragraph 0030, figure 1	1-29

 Further documents are listed in the continuation of Box C. See patent family annex.

\* Special categories of cited documents:

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"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

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"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

"&amp;" document member of the same patent family

Date of the actual completion of the international search

29 NOVEMBER 2012 (29.11.2012)

Date of mailing of the international search report

**30 NOVEMBER 2012 (30.11.2012)**

Name and mailing address of the ISA/KR

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**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/US2012/037674**

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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