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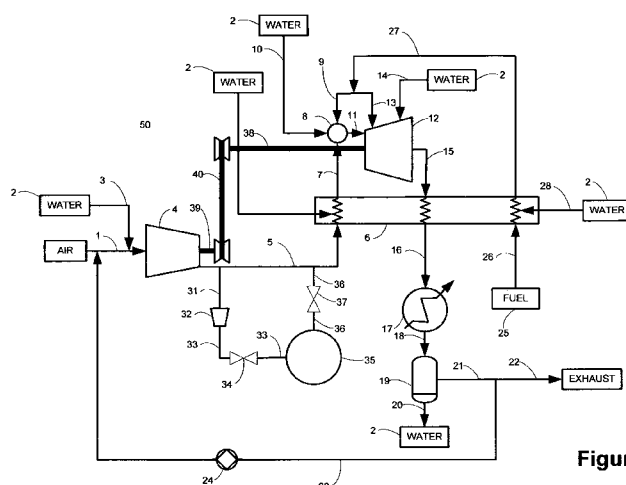


Figure 1

(57) Abstract: An internal combustion engine in which the power output is controlled by modulating at least one of the compression ratio, expansion ratio, ratio of expansion rate to compression rate, air to fuel ratio, and steam to air ratio. Continuous isobaric catalytic combustion followed by isothermal expansion and the use of separate compressor and expander devices are used. Control dynamically maximizes fuel efficiency for the given power demand conditions. Power output is controlled by modulating flame temperature and/or pressure instead of by throttling. Lean combustion, high compression ratio, exhaust heat recuperation, and high power density and fuel economy are provided. External cooling is minimized or eliminated. Insulation of the engine effectively reduces energy losses to friction. Interchangeable use of gasoline, hydrogen and ammonia at high fuel efficiency is made possible for transitional periods of fuel availabilities. An injector suitable for isothermal expansion is provided.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2010/001601**A. CLASSIFICATION OF SUBJECT MATTER****F02B 33/34(2006.01)i, F02D 15/00(2006.01)i, F02M 25/025(2006.01)i, F02B 47/02(2006.01)i, F02B 43/10(2006.01)i, F02M 25/10(2006.01)i, F02M 15/00(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)

F02B 33/34; F02B 33/22; F01K 23/10; F01K 23/04; F02G 5/04; F02G 5/02; F01K 25/00; F01B 31/02; F02C 6/00

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) & Keywords:compressor, heat exchanger, combustion, chamber, expander, injection, air, fuel, water, heat, engine

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6314925 B1 (BRITTON; RICHARD BERKELEY) 13 November 2001 See abstract and fig.1	1-7
A	US 5894729 A (PROESCHEL; RICHARD A.) 20 April 1999 See claim 1 and fig.1	1-7
A	US 2005-0257523 A1 (RICHARD PROESCHEL) 24 November 2005 See abstract and fig.6	1-7
A	US 5337554 A (BERTELS; PIETER F. M.) 16 August 1994 See abstract and fig.1	1-7
A	JP 2007-138715 A (TOYOTA MOTOR CORP) 07 June 2007 See claim 1 and fig.1	1-7



Further documents are listed in the continuation of Box C.



See patent family annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6314925 B1	13.11.2001	None	
US 5894729 A	20.04.1999	None	
US 2005-0257523 A1	24.11.2005	US 7028476 B2	18.04.2006
US 5337554 A	16.08.1994	EP 0489270 A1	10.06.1992
		EP 0489270 B1	24.04.1996
JP 2007-138715 A	07.06.2007	None	