

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
23 February 2006 (23.02.2006)

PCT

(10) International Publication Number
WO 2006/019549 A3

- (51) International Patent Classification:
G06F 19/00 (2006.01)
- (21) International Application Number:
PCT/US2005/023592
- (22) International Filing Date: 1 July 2005 (01.07.2005)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
60/589,690 21 July 2004 (21.07.2004) US
- (71) Applicant (for all designated States except US): GEN-
ERAL MOTORS CORPORATION [US/US]; Legal
Staff-Mail Code 482-C23-B21, P.O. Box 300, Detroit, MI
48265-3000 (US).
- (72) Inventor: KANG, Jun-Mo; 2365 Timbercrest Court, Ann
Arbor, Mi 48105 (US).
- (74) Agent: MARRA, Kathryn, A.; General Motors Corpora-
tion, Legal Staff-Mail Code 482-C23-B21, P.O. Box 300,
Detroit, MI 48265-3000 (US).
- (81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,

AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN,
CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI,
GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE,
KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA,
MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ,
OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL,
SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC,
VN, YU, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,
ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),
European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI,
FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT,
RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA,
GN, GQ, GW, ML, MR, NE, SN, TD, TG).

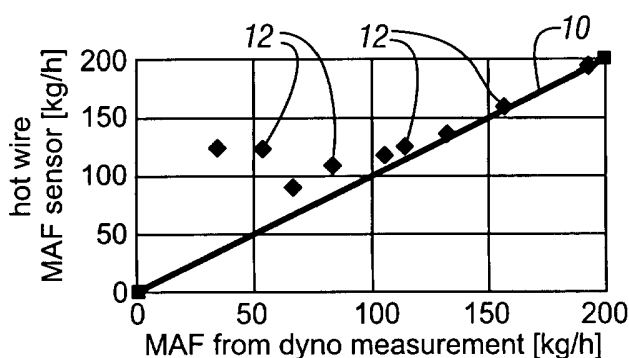
Published:

- with international search report
- before the expiration of the time limit for amending the
claims and to be republished in the event of receipt of
amendments

(88) Date of publication of the international search report:
17 August 2006

For two-letter codes and other abbreviations, refer to the "Guid-
ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.

(54) Title: ESTIMATION OF OXYGEN CONCENTRATION IN THE INTAKE MANIFOLD OF AN UNTHROTTLED LEAN
BURN ENGINE



(57) Abstract: A method of estimating oxygen concentra-
tion in the intake of a lean burn engine is accomplished dur-
ing throttled operation by repeatedly combining determined
air/fuel ratio and intake mass air flow and estimated cylinder
mass flow and exhaust gas recirculation flow in a state ob-
server, which calculates exhaust and intake burned gas frac-
tions and resulting percent oxygen in the intake manifold.
During unthrottled operation, estimation is corrected by an
adaptive disturbance estimator, which operates to correct all
input disturbances under conditions of higher EGR and to
correct only MAF flow values under lower EGR conditions.
Steps for operation of the state observer and for determining
or estimating input conditions to the state observer are set

WO 2006/019549 A3

forth.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US05/23592

A. CLASSIFICATION OF SUBJECT MATTER
 IPC: **G06F 19/00(2006.01)**

USPC: 701/114
 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)
 U.S. : 701/114, 101, 103, 108, 109; 123/480, 478, 492, 568.16, 568.21

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
 NONE

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,205,260 A (TAKAHASHI et al) 27 April 1993 (27.04.1993), see entire document.	1-7
A	US 6,360,726 B1 (JAVATHERIAN) 26 March 2002 (26.03.2002), see entire document.	1-7
A,P	US 6,871,134 B2 (LANGE et al) 22 March 2005 (22.03.2005), see entire document.	1-7
A,T	US 2006/0054134 A1 (HENN et al) 16 March 2006 (16.03.2006), see entire document.	1-7

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

* Special categories of cited documents:	"T"
"A" document defining the general state of the art which is not considered to be of particular relevance	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
"E" earlier application or patent published on or after the international filing date	"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
"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)	"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
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 19 June 2006 (19.06.2006)	Date of mailing of the international search report 29 JUN 2006
--	---

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 Jose Dees Telephone No. 571-272-1604
---	---

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US05/23592

Continuation of B. FIELDS SEARCHED Item 3:

US-PGPUB, USPAT, IPO, JPO, DERWENT, IBM_TDB

Search Terms: ((etimat\$4) and (intake adj manifold adj oxygen adj concentration) and (engine) and (observer) and (ratio) and (mass adj air adj flow) and exhaust adj gas adj recirculation) and (pressure)).clm.