

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
22 June 2006 (22.06.2006)

PCT

(10) International Publication Number
WO 2006/065366 A3

- (51) International Patent Classification:
H01M 10/44 (2006.01) B60K 1/00 (2006.01)
- (21) International Application Number:
PCT/US2005/039057
- (22) International Filing Date: 31 October 2005 (31.10.2005)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
11/009,526 10 December 2004 (10.12.2004) US
- (71) Applicant (for all designated States except US): GEN-
ERAL MOTORS CORPORATION [US/US]; Legal
Staff, P.O. Box 300, Detroit, MI 48265-3000 (US).
- (72) Inventor: KOLODZIEJ, Jason, R.; 349 Countess Drive,
West Henrietta, NY 14586 (US).
- (74) Agent: BROOKS, Cary, W.; General Motors Corpora-
tion, 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, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV,
LY, 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.

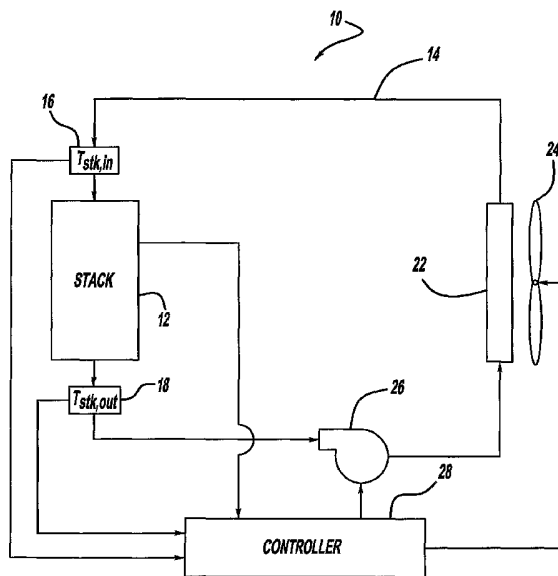
(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,
ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),
European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI,
FR, GB, GR, HU, IE, IS, IT, LT, 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

(88) Date of publication of the international search report:
21 December 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: NONLINEAR THERMAL CONTROL OF A PEM FUEL CELL STACK



(57) Abstract: A temperature control scheme for a fuel cell stack thermal sub-system in a fuel cell system (10) that uses a non-linear thermal model and disturbance rejection to provide an optimum stack temperature. The thermal sub-system includes a coolant loop directing a cooling fluid through the fuel cell stack (12), a pump (26) for pumping the cooling fluid through the coolant loop, and a radiator (22) for cooling the cooling fluid outside of the fuel cell stack (12). The system includes a controller (28) for controlling the speed of the pump (26) so as to maintain the temperature of the stack at a desired temperature. The controller uses the thermal model to anticipate a temperature of the cooling fluid out of the fuel cell stack (12) to control the speed of the pump (26).

WO 2006/065366 A3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US05/39057

A. CLASSIFICATION OF SUBJECT MATTER

IPC: H01M 10/44(2006.01);B60K 1/00(2006.01)

USPC: 320/101;180/65.3;429/24

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. : 320/101; 180/65.3; 429/24

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

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

EAST, STN

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6,651,761 B1 (HROVAT et al.) 25 November 2003 (25.11.2003), the whole disclosure	1-22

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents:		"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
"A"	document defining the general state of the art which is not considered to be of particular relevance	"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
"E"	earlier application or patent published on or after the international filing date	"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
"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)	"&"	document member of the same patent family
"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		

Date of the actual completion of the international search

16 August 2006 (16.08.2006)

Date of mailing of the international search report

20 SEP 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

Pia F. Tibbits *Pia F. Tibbits*
Telephone No. 571/272-2086