



- (51) International Patent Classification:
H01M 8/04 (2006.01) *H01M 8/10* (2006.01)
- (21) International Application Number:
PCT/GB2014/051380
- (22) International Filing Date:
2 May 2014 (02.05.2014)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
1307959.5 2 May 2013 (02.05.2013) GB
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- (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, BN, 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, IR, IS, JP, KE, KG, KN, KP, KR, 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, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, 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.
- (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, KM, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: A FUEL CELL SYSTEM

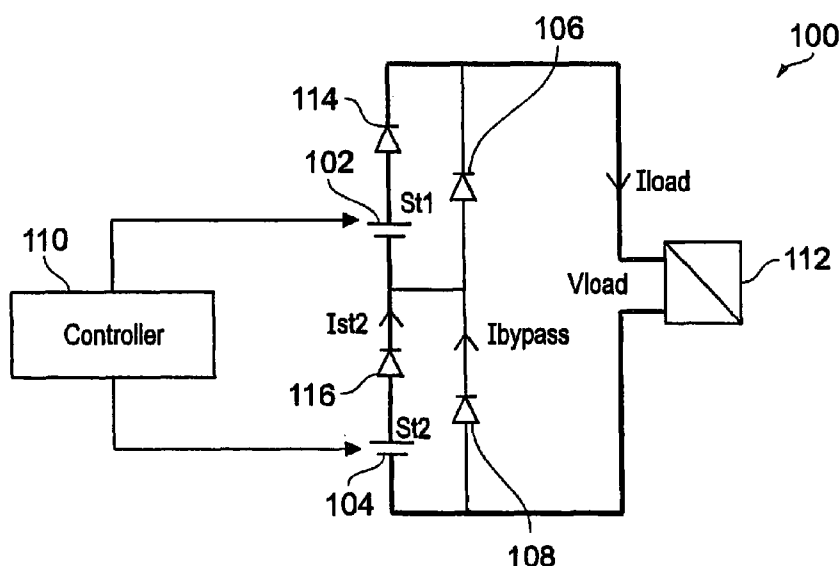


FIG. 1

(57) Abstract: A fuel cell system (100) comprises a first fuel cell stack (102), a second fuel cell stack (104) in series with the first fuel cell stack (102), and a first rectifier (106) in parallel with the first fuel cell stack (102). The fuel cell system (100) also comprises a controller (110) configured to modulate air flow through the first fuel cell stack (102) independent of current demand on the fuel cell system (100) to provide rehydration intervals that increase the hydration levels of the first fuel cell stack (102).

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

31 December 2014

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2014/051380

A. CLASSIFICATION OF SUBJECT MATTER

INV. H01M8/04 H01M8/10
ADD.

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)

H01M

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)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/042243 A1 (BAI LIJUN [US] ET AL) 22 February 2007 (2007-02-22) paragraph [0039] paragraph [0041] paragraph [0043] - paragraph [0046] paragraph [0050] - paragraph [0051] paragraph [0053] paragraph [0056] paragraph [0066]	1-20
A	JP 2005 203254 A (MITSUBISHI MATERIALS CORP; KANSAI ELECTRIC POWER CO) 28 July 2005 (2005-07-28) abstract	1-20



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"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)

"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

"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

"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

"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

"&" document member of the same patent family

Date of the actual completion of the international search

29 August 2014

Date of mailing of the international search report

19/11/2014

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2014/051380

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-20

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-20

A device, a method and a computer program the device comprising: a first fuel cell stack;a second fuel cell stack in series with the first fuel cell stack;a first rectifier in parallel with the first fuel cell stack; and a controller configured to modulate air flow through the first fuel cell stack independent of current demand on the fuel cell system to provide rehydration intervals that increase the hydration levels of the first fuel cell stack, the method in addition comprising: modulating air flow through the first fuel cell stack independently of current demand on the fuel cell system to provide rehydration intervals that increase the hydration levels of the first fuel cell stack. The computer program comprises steps to carry out the method of claim 15 on the device of claim 1.

2. claims: 21-23

A computer program, which when run on a computer, causes the computer to:start a rehydration operation of a fuel cell stack in a fuel cell system when one or more of the following criteria are satisfied:g) a fuel cell stack core temperature is greater than a minimum core temperature threshold;h) a fuel cell stack core temperature is less than a maximum core temperature threshold;i) an ambient air temperature is less than a maximum ambient air temperature threshold;j) a current drawn from the fuel cell system is greater than a minimum current threshold;k) a current drawn from the fuel cell system is less than a maximum current threshold; andl) a signal from a load device, or an application associated with the load device, to indicate that fan pulsing is prohibited has not been received.

3. claims: 24-26

A computer program, which when run on a computer, causes the computer to:stop a rehydration operation of a fuel cell stack in a fuel cell system when one or more of the following criteria are satisfied:vi. a stack voltage has not dropped by a voltage drop threshold amount within a first threshold period of time during the rehydration operation;vii. a core temperature is greater than a maximum core temperature threshold during the rehydration operation;viii. a current drawn from the fuel cell stack to an external load falls below a minimum current threshold during the rehydration operation;ix. a current drawn from the fuel cell stack to an external load is greater than a maximum current threshold during the rehydration operation; andx. a signal from a load device, or an application

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

associated with the load device, to indicate that an
immediate delivery of power is required has been received

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2014/051380

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007042243	A1	22-02-2007	NONE

JP 2005203254	A	28-07-2005	NONE
