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(71) Applicant (for all designated States except US): HONEYWELL INTERNATIONAL, INC. [US/US]; 101 Columbia Road, Law Department, P.O. Box 2245, Morristown, New Jersey 07962-2245 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): SINGH, Rajiv R. [US/US]; 18 Foxfire Drive, Getzville, NY 14068 (US). WILSON, David P. [US/US]; 118 Waxwing Court, East Amherst, NY 14051 (US). HULSE, Ryan [US/US]; 220 Stuewe Road, Getzville, New York 14068 (US). ZYHOWSKI, Gary J. [US/US]; 26 Running Brook Drive, Lancaster, New York 14086 (US).

(74) Agent: SZUCH, Colleen; 101 Columbia Road, P.O. Box 2245, Morristown, NJ 07962-2245, (US).

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Declaration under Rule 4.17:

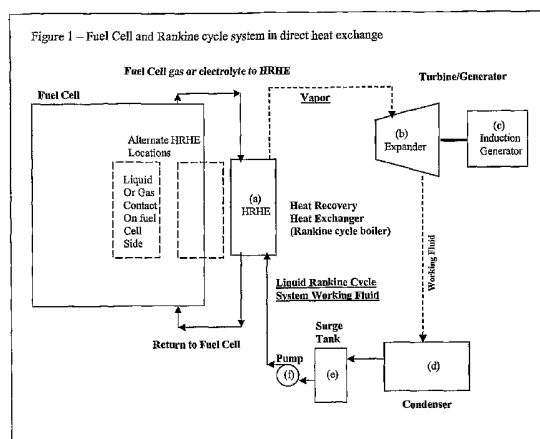
— of inventorship (Rule 4.17(iv))

Published:

— with international search report

[Continued on next page]

(54) Title: WORKING FLUIDS FOR THERMAL ENERGY CONVERSION OF WASTE HEAT FROM FUEL CELLS USING RANKINE CYCLE SYSTEMS



(57) Abstract: A process for recovering waste heat which comprises: (a) passing a liquid phase working fluid through a heat exchanger in communication with a process which produces the waste heat; (b) removing a vapor phase working fluid from the heat exchanger; (c) passing the vapor phase working fluid to an expander, wherein the waste heat is converted into mechanical energy; and (d) passing the vapor phase working fluid from the expander to a condenser, wherein the vapor phase working fluid is condensed to the liquid phase working fluid. The preferred working fluid is an organic Rankine cycle system working fluid comprising one or more compounds of Formula (I) (I) CR_y, wherein y is 3 or 4 and each R' is independently H, F, I, Br, substituted or unsubstituted C3 - C9 alkyl, substituted or unsubstituted C2-C9 alkoxy, substituted or unsubstituted fluoropolyether, substituted or unsubstituted C2-C9 alkenyl, substituted or unsubstituted aryl, substituted or unsubstituted C6-C9 alkylaryl, or substituted or unsubstituted C6-C9 alkenylaryl, provided said compound includes at least two carbon atoms, at least one fluorine atom, and no chloride atoms, and further provided that any OH substituted alkyl preferably has at least three carbon atoms.

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— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

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

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INTERNATIONAL SEARCH REPORT

PCT/US2005/025522

A. CLASSIFICATION OF SUBJECT MATTER
F01K25/08 C09K5/04 H01M8/00

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)
F01K C09K 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 practical, 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 6 374 907 B1 (TOUSIGNANT LEW A ET AL) 23 April 2002 (2002-04-23) cited in the application the whole document	1-7
X	US 4 876 855 A (YOGEV ET AL) 31 October 1989 (1989-10-31) cited in the application claims 1,3	1,5,10
X	US 5 118 360 A (LI ET AL) 2 June 1992 (1992-06-02) column 7, line 11 - line 26 column 9, line 45 - line 53 claims; examples	1-6, 9-15,17, 18
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☒ 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 document 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
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- *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

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Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Puetz, C

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 254 755 A (LI ET AL) 19 October 1993 (1993-10-19) column 10, line 27 - line 36 claims; examples	1-6
X	US 4 541 943 A (POWELL ET AL) 17 September 1985 (1985-09-17) the whole document	1-6, 16, 17
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A	WO 98/06791 A (ALLIEDSIGNAL INC) 19 February 1998 (1998-02-19) the whole document	1, 19
X	US 6 365 289 B1 (LEE JAMES H ET AL) 2 April 2002 (2002-04-02) cited in the application column 2, lines 24-27 column 4, lines 23-39 claims; figures	19, 20, 22, 28, 34
X	WO 2004/033859 A (ALPPS FUEL CELL SYSTEMS GMBH; CLAASSEN, DIRK, PETER; WANCURA, HERBERT) 22 April 2004 (2004-04-22) page 5, line 24 - page 6, line 22 figures 1, 1A, 5, 6 claims	19, 20, 22, 28, 34
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X	US 4 628 869 A (SYMSEK ET AL) 16 December 1986 (1986-12-16) claims	35
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 590 384 A (BRONICKI ET AL) 20 May 1986 (1986-05-20) the whole document -----	19,22
A	US 6 076 355 A (VEN ET AL) 20 June 2000 (2000-06-20) column 15, lines 22-47; claims -----	19,22
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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 allsearchable 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 reportcovers 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.:

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: 1-18

Organic working fluid comprising specific compounds of
general formula (I)

2. claims: 19-35

Processes for recovering waste heat or heat using an
unspecified working fluid

INTERNATIONAL SEARCH REPORT

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