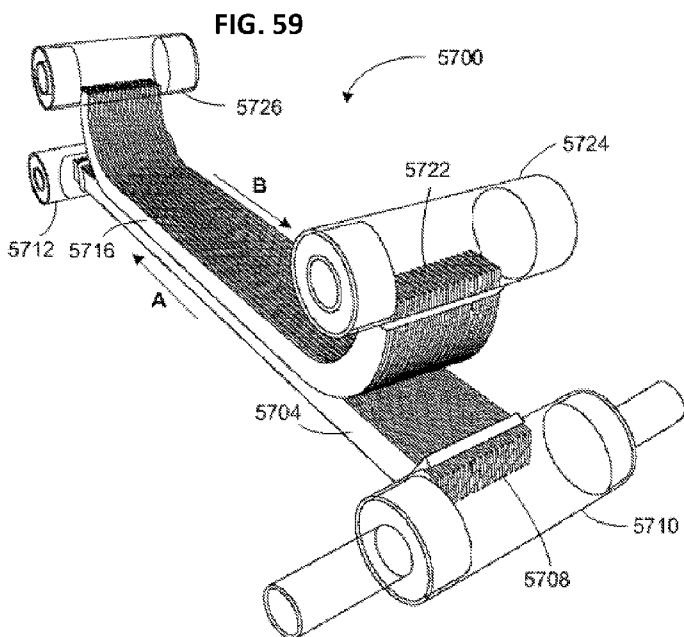




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[Continued on next page]

(54) Title: SYSTEM AND METHOD FOR STORING ENERGY



(57) Abstract: Embodiments of a system for storing and providing electrical energy are disclosed. Also disclosed are embodiments of a system for purifying fluid, as well as embodiments of a system in which energy storage and fluid purification are combined. The system may comprise a latent heat storage device, a sensible heat storage device, a vapor expander/compressor device mechanically coupled to a motor/generator device, a heat-exchanger, and a liquid pressurization and depressurization device. The devices are fluidly coupled in a closed-loop system, and a two-phase working fluid circulates therein. Embodiments of a method for operating the system to store and generate energy also are disclosed. Embodiments of a method for operating the system to purify fluid, as well as embodiments of a method for operating a combined energy storage and fluid purification system are disclosed. Embodiments of a method for operating the system to service an external thermal load are disclosed.





TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

**Published:**  
— *with international search report (Art. 21(3))*

**Declarations under Rule 4.17:**

— *of inventorship (Rule 4.17(iv))*

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24 April 2014

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US13/57646

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> IPC(8) - F28F 3/04 (2014.01) USPC - 165/46 According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b> Minimum documentation searched (classification system followed by classification symbols) IPC(8): F28F 1/10; F28F 3/04 (2014.01) USPC: 165/46, 177, 184 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) MicroPatent (US Granted, US Applications, EP-A, EP-B, WO, JP, DE-G, DE-A, DE-T, DE-U, GB-A, FR-A); Google; Google Scholar; ProQuest; IP.com; keywords: heat exchanger, micro channel, parallel tube, multiphase heat pipe, polyimide encapsulated heater, thin film heater, multiphase, cool, heat, air, coolant		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,012,767 A (SHEIKH RU et al.) May 7, 1991; figure 1; column 3, lines 10-40	1, 9
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Y		7, 8
Y	US 2010/0304227 A1 (KAH.M et al.) December 2, 2010; paragraphs [0023], [0058]	7, 8
A	US 2005/0028964 A1 (CLELAND J) February 10, 2005; figure 3	1-26
A	US 6,827,128 B2 (PHILPOTT M. I. et al.) December 7, 2004; entire document	1-26
A	US 3,327,776 A (BUTT A. G.) June 27, 1967; entire document	1-26
A	US 6,129,973 A (MARTIN P. M. et al.) October 10, 2000; entire document	1-26
A	US 6,059,024 A (RAMSHAW C. et al.) May 9, 2000; entire document	1-26
A	US 5,878,807 A (TAKAHASHI K.) March 9, 1999; entire document	1-26
<input type="checkbox"/> Further documents are listed in the continuation of Box C.		
* 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 20 January 2014 (20.01.2014)	Date of mailing of the international search report <div style="text-align: center; font-size: 1.5em; font-weight: bold;">07 FEB 2014</div>	
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: <div style="text-align: right;">Shane Thomas</div> PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774	

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US13/57646

## 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.: 27-60  
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:

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 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.:

### 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.