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(71) Applicant: **THE AEROSPACE CORPORATION**
[US/US]; 2350 E. El Segundo Blvd., El Segundo, CA
90245 (US).

(72) Inventor: **WELLE, Richard, P.**; 16351 Grenoble Lane,
Huntington Beach, CA 92649 (US).

(74) Agent: **HOLMES, Peter, L.**; Henricks, Slavin & Holmes
LLP, 840 Apollo Street, Suite 200, El Segundo, CA 90245
(US).

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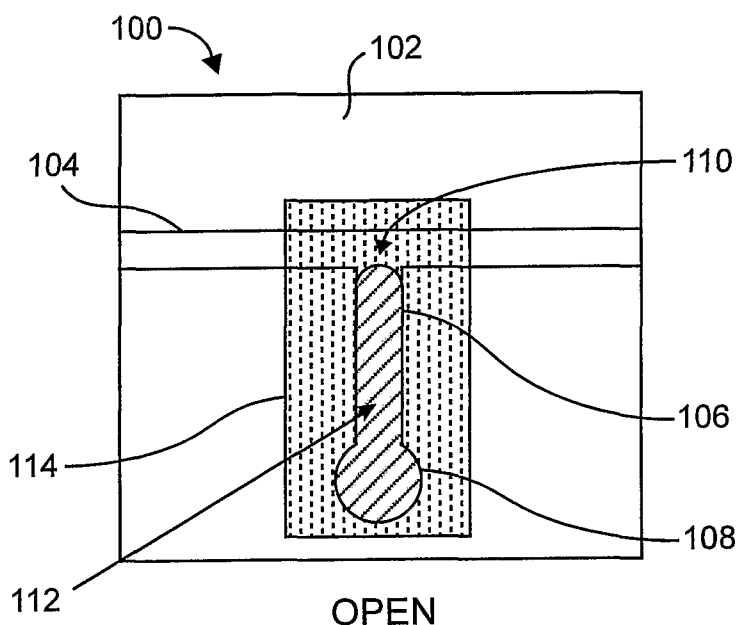
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ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.*

(54) Title: PHASE-CHANGE VALVE APPARATUSES



(57) Abstract: A valve apparatus includes a substrate, a main flow channel formed in the substrate, a control channel formed in the substrate such that the main flow channel and the control channel meet at a junction, a bi-phase material within the control channel, a heating element adjacent the control channel and the junction, the heating element being controllable to generate sufficient energy to cause the bi-phase material to transition from a solid phase to a liquid phase, and a pumping mechanism for forcing the bi-phase material either into or out of the junction when the bi-phase material is in the liquid phase.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US05/15978

A. CLASSIFICATION OF SUBJECT MATTER

IPC: **F16K 31/00**(2006.01)

USPC: 251/11,62,89;137/72,341

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. : 251/11,62,89;137/72,341

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6,561,479 B1 (ELDRIDGE) 13 May 2003 (13.05.2003), See entire document.	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 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

18 July 2007 (18.07.2007)

Date of mailing of the international search report

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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

Eric Keasel

Telephone No. (571)-273-8300

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US05/15978

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:
Please See Continuation 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 additional fees, this Authority did not invite payment of any 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.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US05/15978

BOX III. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING

This application contains claims directed to more than one species of the generic invention. These species are deemed to lack unity of invention because they are not so linked as to form a single general inventive concept under PCT Rule 13.1.

In order for more than one species to be examined, the appropriate additional examination fees must be paid. The species are as follows:

Species I: Figures 1-7D.
Species II: Figures 8-9.
Species IV: Figures 12-13.
Species V: Figures 14A-15B.
Species VI: Figures 16A-17B..

The claims are deemed to correspond to the species listed above in the following manner:

Species I: Figures 1-7D, claims 1-20.
Species II: Figures 8-9, claims 21-23.
Species IV: Figures 12-13, claims 24-26.
Species V: Figures 14A-15B, claims 27-29.
Species VI: Figures 16A-17B, claims 30-32.

The following claim(s) are generic: None.

The species listed above do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, the species lack the same or corresponding special technical features for the following reasons: The common features among the species are the substrate, a main flow channel and bi-phase. These features do not define a contribution which each of the claimed inventions, considered as a whole, makes over the prior art.