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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, IS, JP, KE, KG, KM, 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, 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.

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[Continued on next page]

(54) Title: TIME-VARYING FIELD EMISSION DEVICE

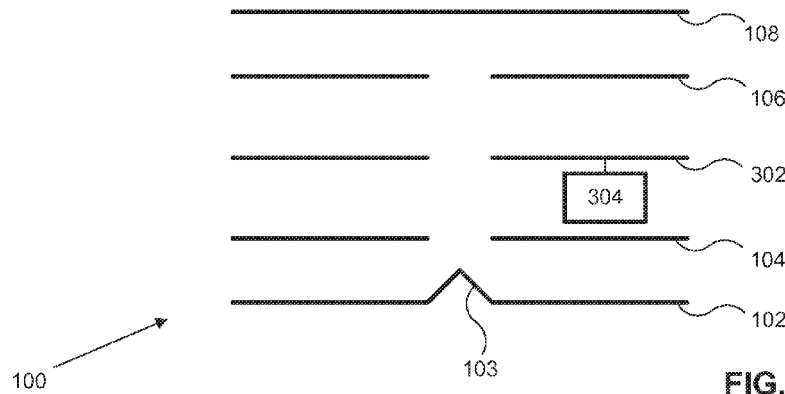
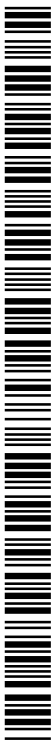


FIG. 3

(57) Abstract: A field emission device is configured as a heat engine, wherein the configuration of the heat engine is variable as a function of time.





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- *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/US13/38249

<p>A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - H01J 7/44, 35/00 (2013.01) USPC - 378/122, 257/10 According to International Patent Classification (IPC) or to both national classification and IPC</p>																				
<p>B. FIELDS SEARCHED</p> <p>Minimum documentation searched (classification system followed by classification symbols) IPC(8) Classification(s): H01J 7/44, 35/00, H01J*, B82Y* (2013.01) USPC Classification(s): 378/122, 378*, 257/10, 257*, 315*</p> <p>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched</p> <p>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); DialogPro (Derwent, INSPEC, NTIS, PASCAL, Current Contents Search, Dissertation Abstracts Online, Inside Conferences); IP.com; Google Scholar; KEYWORDS: time, vary*, field*, emission*, device*, suppressor, control*, grid, mesh, gate*, potential, voltage, signal, temperature, current</p>																				
<p>C. DOCUMENTS CONSIDERED TO BE RELEVANT</p> <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>Y</td> <td>US 7,157,849 B2 (SEON, H et al.) January 2, 2007; figure 4; column 4, lines 37-38, 49-65; column 5, lines 13-15, 30-36; column 7, line 58-67</td> <td>1-35</td> </tr> <tr> <td>Y</td> <td>US 8,018,169 B2 (JEONG, J et al.) September 13, 2011; claim 15</td> <td>1-23</td> </tr> <tr> <td>Y</td> <td>US 5,936,354 A (SMITH, R et al.) August 10, 1999; column 2, lines 46-47; column 3, lines 28-35; claims 1-3</td> <td>3-7, 18-35</td> </tr> <tr> <td>Y</td> <td>US 4,274,035 A (FUKUHARA, S et al.) June 16, 1981; claims 1 and 2</td> <td>8 and 9</td> </tr> <tr> <td>Y</td> <td>US 2,404,919 A (OVERBECK, W) July 30, 1946; figure 1; column 2, lines 7-11; column 5, lines 54-65; column 6, lines 1-7; claims 1-3</td> <td>10-16, 19, 20, 22, 23, 26-29, and 32-35</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	Y	US 7,157,849 B2 (SEON, H et al.) January 2, 2007; figure 4; column 4, lines 37-38, 49-65; column 5, lines 13-15, 30-36; column 7, line 58-67	1-35	Y	US 8,018,169 B2 (JEONG, J et al.) September 13, 2011; claim 15	1-23	Y	US 5,936,354 A (SMITH, R et al.) August 10, 1999; column 2, lines 46-47; column 3, lines 28-35; claims 1-3	3-7, 18-35	Y	US 4,274,035 A (FUKUHARA, S et al.) June 16, 1981; claims 1 and 2	8 and 9	Y	US 2,404,919 A (OVERBECK, W) July 30, 1946; figure 1; column 2, lines 7-11; column 5, lines 54-65; column 6, lines 1-7; claims 1-3	10-16, 19, 20, 22, 23, 26-29, and 32-35
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<p><input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/></p>																				
<p>* Special categories of cited documents:</p> <table border="0"> <tr> <td>"A" document defining the general state of the art which is not considered to be of particular relevance</td> <td>"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</td> </tr> <tr> <td>"E" earlier application or patent but published on or after the international filing date</td> <td>"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</td> </tr> <tr> <td>"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)</td> <td>"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</td> </tr> <tr> <td>"O" document referring to an oral disclosure, use, exhibition or other means</td> <td>"&" document member of the same patent family</td> </tr> <tr> <td>"P" document published prior to the international filing date but later than the priority date claimed</td> <td></td> </tr> </table>			"A" document defining the general state of the art which is not considered to be of particular relevance	"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	"E" earlier application or patent but published on or after the international filing date	"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	"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)	"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	"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family	"P" document published prior to the international filing date but later than the priority date claimed									
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<p>Date of the actual completion of the international search 30 October 2013 (30.10.2013)</p>		<p>Date of mailing of the international search report 05 NOV 2013</p>																		
<p>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</p>		<p>Authorized officer: Shane Thomas</p> <p>PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774</p>																		

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US13/38249

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:

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fee must be paid.

Group I: Claims 1-23 are directed toward an apparatus comprising a cathode, an anode, a first power source, an anode electric potential, a cathode electric potential, a gate, a second power source, a gate electric potential, electron emission, a suppressor, a third power source, a suppressor electric potential, circuitry, and a function of time.

Group II: Claims 24-35 are directed toward an apparatus comprising circuitry, a first signal, a heat engine, an anode, cathode, spacer region, gate, suppressor, circuitry, an output parameter, an anode electric potential, a gate electric potential, a suppressor electric potential, and a second signal.

-Continued Within the Next Supplemental Box-

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.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US13/38249

-***-Continued from Box No. III: Observations where unity of invention is lacking-***-

The inventions listed as Groups I-II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features.

The common technical features of Groups I and II are at least an apparatus comprising a cathode, an anode, an anode electric potential, a cathode electric potential, a gate, a gate electric potential, a suppressor, a suppressor electric potential, and circuitry. These common features are disclosed by US 5,386,172 A to Komatsu. Komatsu disclose an apparatus comprising a cathode (cathode 3, figure 21, column 20, lines 13-17), an anode (anode 7, figure 21, column 20, lines 13-17), an anode electric potential (anode voltage 27, figure 21, column 20, lines 41-46), a cathode electric potential (cathode 3 at ground potential, figure 21, column 20, lines 17-18), a gate (gate electrode 5, figure 21, column 20, lines 13-17), a gate electric potential (gate voltage 26, figure 21, column 20, lines 18-19), a suppressor (suppressor electrode 53, column 20, lines 14-17), a suppressor electric potential (suppressor electrode 53 at ground potential, figure 21, column 20, lines 17-18) and circuitry (cathode grounded type voltage amplifier circuit of figure 21, column 20, lines 10-63).

Since the common technical features are previously disclosed by the Komatsu reference, these common features are not special and so Groups I and II lack unity.