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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,

(54) Title: IMPROVED MOLTEN FUEL REACTOR COOLING AND PUMP CONFIGURATIONS

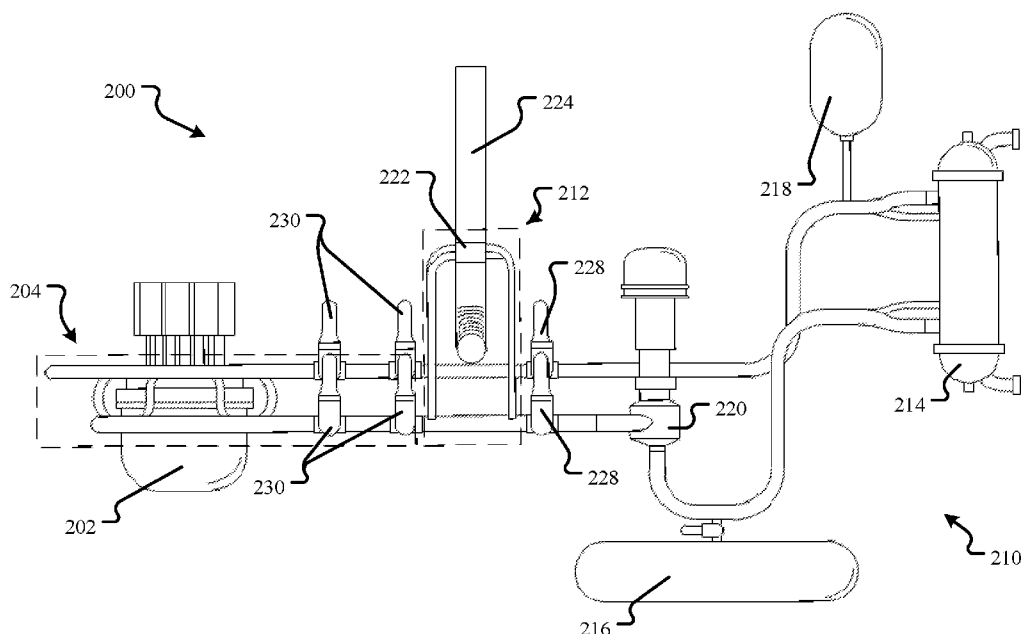


FIG. 2B

(57) Abstract: Configurations of molten fuel salt reactors are described that include an auxiliary cooling system which shared part of the primary coolant loop but allows for passive cooling of decay heat from the reactor. Furthermore, different pump configurations for circulating molten fuel through the reactor core and one or more in vessel heat exchangers are described.



CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, 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, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, 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, ST, 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).

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INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
 INV. G21C1/22 G21C3/24 G21C3/54
 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)
 G21C
 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, INSPEC, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 3 996 099 A (FAUGERAS PIERRE ET AL) 7 December 1976 (1976-12-07) abstract figures columns 2-3 -----	1-5
Y	US 4 342 721 A (POMIE PIERRE ET AL) 3 August 1982 (1982-08-03) the whole document -----	1-5
Y	GB 964 841 A (ATOMIC ENERGY AUTHORITY UK) 22 July 1964 (1964-07-22) the whole document -----	1-5
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Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

<p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"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</p> <p>"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</p> <p>"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</p> <p>"&" document member of the same patent family</p>
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Date of the actual completion of the international search 12 January 2018	Date of mailing of the international search report 23/01/2018
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Opitz-Coutureau, J

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2017/030457

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2013/116942 A1 (OTTAWA VALLEY RES ASSOCIATES LTD [CA]) 15 August 2013 (2013-08-15) abstract figures paragraphs [0030] - [0035] paragraph [0041] paragraphs [0045] - [0050] -----	6-26
X	US 4 045 286 A (BLUM JACQUES MARCEL ET AL) 30 August 1977 (1977-08-30) the whole document -----	6-26
X	US 2015/117589 A1 (KAMEI TAKASHI [JP] ET AL) 30 April 2015 (2015-04-30) the whole document -----	6-26

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2017/030457

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.:

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: 1-5

MSR with primary and auxiliary cooling system

2. claims: 6-26

MSR with impeller to circulate the fuel

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No PCT/US2017/030457

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
US 3996099	A	07-12-1976	FR 2296923 A1 US 3996099 A	30-07-1976 07-12-1976
US 4342721	A	03-08-1982	DE 2960715 D1 EP 0004218 A2 ES 478385 A1 FR 2419565 A1 JP S54126887 A US 4342721 A	26-11-1981 19-09-1979 16-10-1979 05-10-1979 02-10-1979 03-08-1982
GB 964841	A	22-07-1964	NONE	
WO 2013116942	A1	15-08-2013	AU 2013218764 A1 CA 2863845 A1 CN 104205237 A CN 107068206 A DK 2815404 T3 EA 201491488 A1 EP 2815404 A1 JP 2015510588 A KR 20140123089 A LT 2815404 T PT 2815404 T SG 11201404694T A WO 2013116942 A1	21-08-2014 15-08-2013 10-12-2014 18-08-2017 11-12-2017 30-01-2015 24-12-2014 09-04-2015 21-10-2014 27-12-2017 15-11-2017 30-10-2014 15-08-2013
US 4045286	A	30-08-1977	CH 596639 A5 DE 2558179 A1 GB 1494055 A US 4045286 A	15-03-1978 15-07-1976 07-12-1977 30-08-1977
US 2015117589	A1	30-04-2015	JP 5781013 B2 JP 2013250056 A US 2015117589 A1 WO 2013180029 A1	16-09-2015 12-12-2013 30-04-2015 05-12-2013