



- (51) International Patent Classification:
C09K 5/04 (2006.01)
- (21) International Application Number:
PCT/US2016/029104
- (22) International Filing Date:
25 April 2016 (25.04.2016)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
62/158,152 7 May 2015 (07.05.2015) US
- (71) Applicant: **THE CHEMOURS COMPANY FC, LLC** [US/US]; 1007 Market Street, Wilmington, Delaware 19801 (US).
- (72) Inventors: **KONTOMARIS, Konstantinos**; 702 Abbey Road, Wilmington, Delaware 19808 (US). **NAPPA, Mario Joseph**; 3 Oakridge Court, Newark, Delaware 19711 (US). **SPOORMAKER, Tom**; Iepenzoom 1, 3355CH Papendrecht (NL). **KRAUSE, Karl R**; 572 Unionville Road, Kennett Square, Pennsylvania 19348 (US). **SISK, Michael A**; 10 Wineberry Drive, Hockessin, Delaware 19707 (US).
- (74) Agent: **TUCKER, N. Lynn**; Patent Legal Group, 7028-1, 1007 Market Street, Wilmington, Delaware 19801 (US).
- (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, IR, IS, JP, KE, KG, KN, KP, KR, 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).

Published:

- 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))

- (88) Date of publication of the international search report:
1 December 2016

(54) Title: COMPOSITIONS COMPRISING 1,1,2,2-TETRAFLUOROETHANE AND USES THEREOF

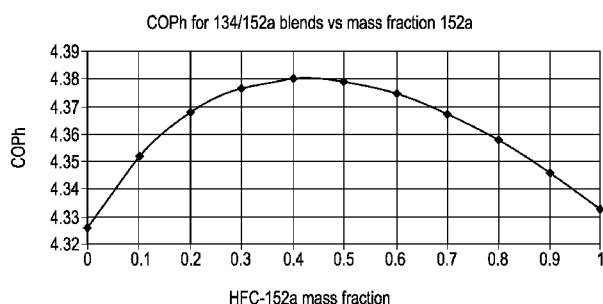


FIG. 2

(57) Abstract: The present disclosure relates to compositions comprising 1,1,2,2-tetrafluoroethane and at least one additional compound selected from the group consisting of 1,1-difluoroethane, 1,2-difluoroethane, 1,1,1-trifluoroethane, difluoromethane, octafluorocyclobutane, 1,1,1,2,3,4,4,4-octafluoro-2-butene, 1,1,1,2,3,3,3-heptafluoropropane, 1,1,3,3,3-pentafluoropropene, 1,1,1,2,2-pentafluoropropane, 1,2,3,3,3-pentafluoropropene, pentafluoroethane, chlorodifluoromethane, 2-chloro-1,1,1,2-tetrafluoroethane, 1-chloro-1,1,2,2-tetrafluoroethane, methyl chloride, chlorofluoromethane, 1,2-dichloro-1,1,2,2-tetrafluoroethane, 1,1-dichloro-1,2,2,2-tetrafluoroethane, 1,1-difluoroethylene, and 1,1,2-trifluoroethylene and combinations thereof. These compositions are useful as refrigerants, heat transfer compositions, thermodynamic cycle (e.g. heating or cooling cycle) working fluids, aerosol propellants, foaming agents (blowing agents), solvents, cleaning agents, carrier fluids, displacement drying agents, buffing abrasion agents, polymerization media, foaming agents for polyolefins and polyurethane, gaseous dielectrics, power cycle working fluids, extinguishing agents, and fire suppression agents in liquid or gaseous form.



INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/029104

A. CLASSIFICATION OF SUBJECT MATTER INV. C09K5/04 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) C09K		
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, 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 A	US 5 470 442 A (MAHLER BARRY A [US] ET AL) 28 November 1995 (1995-11-28) column 1, lines 6-26; example 2 -----	1,4-8, 14-25 2,3,9-13
X	US 2015/083957 A1 (MINOR BARBARA HAVILAND [US] ET AL) 26 March 2015 (2015-03-26) paragraphs [0003], [0007] - [0010], [0041], [0096], [0101]; tables 2,6 -----	1-25
X	CN 102 676 120 A (UNIV ZHEJIANG; ZHEJIANG QUHUA FLUORINE CHEMICAL CO LTD) 19 September 2012 (2012-09-19) paragraphs [0006], [0007]; claims; examples ----- -/--	1-3, 6-12, 14-25
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> 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 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 1 November 2016		Date of mailing of the international search report 08/11/2016
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 Martinez Marcos, V

INTERNATIONAL SEARCH REPORT

International application No PCT/US2016/029104

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 2013/104575 A1 (KONTOMARIS KONSTANTINOS [US]) 2 May 2013 (2013-05-02) paragraphs [0002], [0083], [0092], [0096] -----	1-7, 14-25
X	WO 99/25786 A1 (ALLIED SIGNAL INC [US]) 27 May 1999 (1999-05-27) page 1, lines 6-26 page 3, line 1 - page 4, line 2; tables 1-2 page 5, lines 1-7 -----	1,2,4-7, 14-25
X	US 5 762 818 A (MINOR BARBARA HAVILAND [US] ET AL) 9 June 1998 (1998-06-09) column 2, lines 19-36 column 12, lines 39-47; example 4; table 1 -----	1,4-7, 14-25
X	WO 2014/197290 A1 (CHEMOURS CO FC LLC) 11 December 2014 (2014-12-11) page 1, lines 5-6 page 11, line 8 - page 12, line 32 page 35, lines 6-10; figures -----	1-7, 14-25

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/029104

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.:
9-11(completely); 1-8, 12-25(partially)

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: 9-11(completely); 1-8, 12-25(partially)

A composition comprising 1,1,2,2-tetrafluoroethane and at least one additional compound selected from the group consisting of 1,1-difluoroethane; and methods, processes and uses thereof

2. claims: 1, 2, 4-8, 12-25(all partially)

A composition comprising 1,1,2,2-tetrafluoroethane and at least one additional compound selected from the group consisting of 1,2-difluoroethane; and methods, processes and uses thereof

3. claims: 1, 2, 4-8, 12-25(all partially)

A composition comprising 1,1,2,2-tetrafluoroethane and at least one additional compound selected from the group consisting of 1,1,1-trifluoroethane; and methods, processes and uses thereof

4. claims: 1, 2, 4-8, 12-25(all partially)

A composition comprising 1,1,2,2-tetrafluoroethane and at least one additional compound selected from the group consisting of difluoromethane; and methods, processes and uses thereof

5. claims: 1, 2, 4-8, 12-25(all partially)

A composition comprising 1,1,2,2-tetrafluoroethane and at least one additional compound selected from the group consisting of octafluorocyclobutane; and methods, processes and uses thereof

6. claims: 1-8, 12-25(all partially)

A composition comprising 1,1,2,2-tetrafluoroethane and at least one additional compound selected from the group consisting of following HFOs:
1,1,1,2,3,4,4,4-octafluoro-2-butene, 1,1,3,3,3-pentafluoropropene, 1,2,3,3,3-pentafluoropropene and combinations thereof; and methods, processes and uses thereof

7. claims: 1, 2, 4-8, 12-25(all partially)

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

A composition comprising 1,1,2,2-tetrafluoroethane and at least one additional compound selected from the group consisting of following fluoropropanes:
1,1,1,2,3,3,3-heptafluoropropane,
1,1,1,2,2-pentafluoropropane and combinations thereof; and methods, processes and uses thereof

8. claims: 1-8, 12-25(all partially)

A composition comprising 1,1,2,2-tetrafluoroethane and at least one additional compound selected from the group consisting of pentafluoropropene, and combinations thereof; and methods, processes and uses thereof

9. claims: 1-8, 12-25(all partially)

A composition comprising 1,1,2,2-tetrafluoroethane and at least one additional compound selected from the group consisting of following chlorinated compounds:
chlorodifluoromethane, 2-chloro-1,1,1,2-tetrafluoroethane, 1-chloro-1,1,2,2-tetrafluoroethane, methyl chloride, chlorofluoromethane, 1,2-dichloro-1,1,2,2-tetrafluoroethane, 1,1-dichloro-1,2,2,2-tetrafluoroethane, and combinations thereof; and methods, processes and uses thereof

10. claims: 1, 2, 4-8, 12-25(all partially)

A composition comprising 1,1,2,2-tetrafluoroethane and at least one additional compound selected from the group consisting of following fluoroethylenes:
1,1-difluoroethylene, and 1,1,2-trifluoroethylene and combinations thereof; and methods, processes and uses thereof

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2016/029104

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5470442	A	28-11-1995	AU 3104995	A 25-09-1995
			BR 9507409	A 07-10-1997
			CA 2184474	A1 14-09-1995
			CN 1143945	A 26-02-1997
			DE 69513960	D1 20-01-2000
			DE 69513960	T2 27-07-2000
			EP 0749407	A1 27-12-1996
			JP H09510214	A 14-10-1997
			US 5470442	A 28-11-1995
			WO 9524370	A1 14-09-1995

US 2015083957	A1	26-03-2015	AR 057792	A1 19-12-2007
			AU 2006342814	A1 08-11-2007
			BR PI0621498	A2 13-12-2011
			CA 2642689	A1 08-11-2007
			CN 101415793	A 22-04-2009
			CN 103254875	A 21-08-2013
			EP 2004773	A2 24-12-2008
			EP 2314656	A2 27-04-2011
			EP 2316902	A2 04-05-2011
			JP 5777566	B2 09-09-2015
			JP 5980272	B2 31-08-2016
			JP 2009532520	A 10-09-2009
			JP 2012184435	A 27-09-2012
			JP 2012229422	A 22-11-2012
			JP 2014237828	A 18-12-2014
			KR 20090007377	A 16-01-2009
			MY 152132	A 15-08-2014
			RU 2008142994	A 10-05-2010
			US 2008230738	A1 25-09-2008
			US 2009249809	A1 08-10-2009
			US 2009249864	A1 08-10-2009
			US 2009250650	A1 08-10-2009
			US 2009255285	A1 15-10-2009
			US 2009272931	A1 05-11-2009
			US 2009277194	A1 12-11-2009
			US 2009278072	A1 12-11-2009
			US 2011204279	A1 25-08-2011
US 2014283537	A1 25-09-2014			
US 2015083957	A1 26-03-2015			
US 2016137898	A1 19-05-2016			
WO 2007126414	A2 08-11-2007			

CN 102676120	A	19-09-2012	NONE	

US 2013104575	A1	02-05-2013	AR 090395	A1 12-11-2014
			AU 2012332174	A1 24-04-2014
			CN 104080878	A 01-10-2014
			EP 2773716	A1 10-09-2014
			JP 2015501414	A 15-01-2015
			KR 20140096087	A 04-08-2014
			SG 11201401890T	A 29-05-2014
			TW 201329404	A 16-07-2013
			US 2013104575	A1 02-05-2013
			WO 2013067447	A1 10-05-2013

WO 9925786	A1	27-05-1999	AU 1594099	A 07-06-1999
			WO 9925786	A1 27-05-1999

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No PCT/US2016/029104

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5762818	A	09-06-1998	NONE	
WO 2014197290	A1	11-12-2014	AU 2014275262 A1 CA 2914402 A1 CN 105637059 A EP 3004277 A1 JP 2016529334 A KR 20160014692 A TW 201510204 A US 2016137895 A1 WO 2014197290 A1	10-12-2015 11-12-2014 01-06-2016 13-04-2016 23-09-2016 11-02-2016 16-03-2015 19-05-2016 11-12-2014