



US009410064B2

(12) **United States Patent**
Nappa et al.

(10) **Patent No.:** **US 9,410,064 B2**
(45) **Date of Patent:** **Aug. 9, 2016**

(54) **COMPOSITIONS COMPRISING
FLUOROOLEFINS AND USES THEREOF**

(71) Applicant: **CHEMOURS COMPANY FC LLC**,
Wilmington, DE (US)

(72) Inventors: **Mario Joseph Nappa**, Newark, DE
(US); **Barbara Haviland Minor**, Elkton,
MD (US); **Allen Capron Sievert**,
Elkton, MD (US)

(73) Assignee: **THE CHEMOURS COMPANY FC,
LLC**, Wilmington, DE (US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/603,740**

(22) Filed: **Jan. 23, 2015**

(65) **Prior Publication Data**

US 2015/0135745 A1 May 21, 2015

Related U.S. Application Data

(62) Division of application No. 14/539,341, filed on Nov.
12, 2014, which is a division of application No.
13/850,338, filed on Mar. 26, 2013, now Pat. No.
8,911,640, which is a division of application No.
13/286,765, filed on Nov. 1, 2011, now Pat. No.
8,425,795, which is a division of application No.
12/696,793, filed on Jan. 29, 2010, now Pat. No.
8,070,976, which is a division of application No.
11/589,588, filed on Oct. 30, 2006, now Pat. No.
7,708,903.

(60) Provisional application No. 60/732,581, filed on Nov.
1, 2005.

(51) **Int. Cl.**
C09K 5/04 (2006.01)
F25B 1/00 (2006.01)
F25B 39/02 (2006.01)
C07C 21/18 (2006.01)
F25B 45/00 (2006.01)

(52) **U.S. Cl.**
CPC **C09K 5/045** (2013.01); **C07C 21/18**
(2013.01); **C09K 5/04** (2013.01); **F25B 1/00**
(2013.01); **F25B 39/02** (2013.01); **F25B 45/00**
(2013.01); **C09K 2205/126** (2013.01); **C09K**
2205/22 (2013.01); **C09K 2205/40** (2013.01)

(58) **Field of Classification Search**
CPC **C09K 5/045**; **C09K 2205/22**; **C09K**
2205/126
USPC **252/67**
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,931,840	A	4/1960	Marquis
2,996,555	A	8/1961	Rausch
3,683,009	A	8/1972	Middleton
3,723,318	A	3/1973	Butler
3,884,828	A	5/1975	Butler
4,126,631	A	11/1978	Krespan et al.
4,788,352	A	11/1988	Smutny
5,037,573	A	8/1991	Merchant
5,254,280	A	10/1993	Thomas et al.
5,421,192	A	6/1995	Henry
5,516,946	A	5/1996	Jackson et al.
5,532,419	A	7/1996	Van Der Puy et al.
5,616,275	A	4/1997	Chisolm et al.
5,679,875	A	10/1997	Aoyama et al.
5,714,655	A	2/1998	Yamamoto et al.
5,736,063	A	4/1998	Richard et al.
5,744,052	A	4/1998	Bivens
5,788,886	A	8/1998	Minor et al.
5,897,299	A	4/1999	Fukunaga
5,969,198	A	10/1999	Thenappan et al.
6,053,008	A	4/2000	Arman et al.
6,065,305	A	5/2000	Arman et al.
6,076,372	A	6/2000	Acharya et al.
6,111,150	A	8/2000	Sakyu et al.
6,176,102	B1	1/2001	Novak et al.
6,258,292	B1	7/2001	Turner
6,300,378	B1	10/2001	Tapscott
6,426,019	B1	7/2002	Acharya et al.
6,858,571	B2	2/2005	Pham et al.
6,969,701	B2	11/2005	Singh et al.
7,708,903	B2	5/2010	Sievert et al.
8,012,368	B2	9/2011	Nappa et al.
8,070,976	B2	12/2011	Nappa et al.
2003/0042463	A1	3/2003	Arman et al.

(Continued)

FOREIGN PATENT DOCUMENTS

CN	1083474	C	4/2004
EP	0 670 295	A1	9/1995

(Continued)

OTHER PUBLICATIONS

Chemical Abstracts, vol. 119, No. 10, Sep. 6, 1993, Columbus, Ohio,
US; abstract No. 98469, Fujiwara et. al. "2-trifluoromethyl-3,3,3-
trifluoropropene" XP002431016.

Grzyll, L. R., et al., "Development of Nontoxic Heat Transport Fluids
for Habitat Two-Phase Thermal Control Systems", Energy Con-
version Engineering Conference, 1996. IECEC 96., Proceedings of the
31st Intersociety Washington, DC; Aug. 11-16, 1996, New York, NY;
IEEE vol. 2, pp. 1506-1511 (Aug. 11, 2006).

Haszeldine, R. N., et al., "Free-Radical Additions to Unsaturated
Systems. Part SVII. Reaction of Trifluoroiodomethane with Mixtures
of Ethylene and Vinyl Fluoride and of Ethylene and Propene", Chem-
istry Department, University of Manchester Institute of Science and
Technology, Manchester M60 1QD, J. Chem. Soc. (C), 1970, pp.
414-421 (1970).

(Continued)

Primary Examiner — John Hardee

(57) **ABSTRACT**

The present invention relates to fluoroolefin compositions.
The fluoroolefin compositions of the present invention are
useful as refrigerants or heat transfer fluids and in processes
for producing cooling or heat. Additionally, the fluoroolefin
compositions of the present invention may be used to replace
currently used refrigerant or heat transfer fluid compositions
that have higher global warming potential.

13 Claims, No Drawings