

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
22 November 2007 (22.11.2007)

PCT

(10) International Publication Number
WO 2007/131850 A3

(51) International Patent Classification:

F25J 1/02 (2006.01)

(21) International Application Number:

PCT/EP2007/053681

(22) International Filing Date: 16 April 2007 (16.04.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

06113923.4 15 May 2006 (15.05.2006) EP

(71) Applicant (for all designated States except US): **SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V.** [NL/NL]; Carel van Bylandtlaan 30, NL-2596 HR The Hague (NL).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **JAGER, Marco Dick** [NL/NL]; Carel van Bylandtlaan 16, NL-2596 HR The Hague (NL).

(74) Agent: **SHELL INTERNATIONAL B.V.**; Intellectual Property services, PO Box 384, NL-2501 CJ The Hague (NL).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM,

AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, 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, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, 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, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:

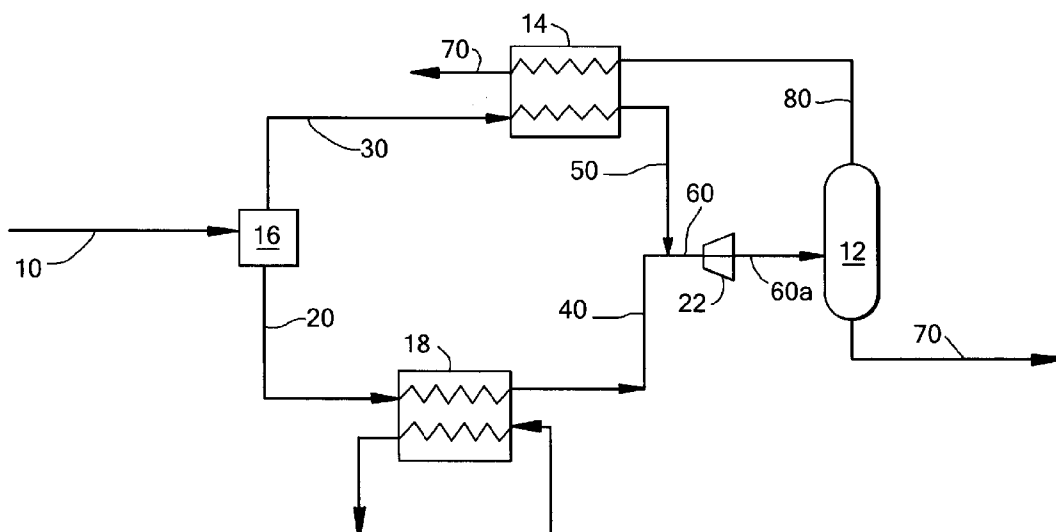
— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))

Published:

— with international search report
— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

[Continued on next page]

(54) Title: METHOD AND APPARATUS FOR LIQUEFYING A HYDROCARBON STREAM



(57) Abstract: A method of liquefying a hydrocarbon stream such as natural gas from a feed stream, the method at least comprising the steps of: (a) providing a feed stream (10); (b) dividing the feed stream (10) of step (a) to provide at least a first feed stream (20) comprising at least 90 mass% of the initial feed stream (10), and a second feed stream (30); (c) liquefying the first feed stream (20) of step (b) at a pressure between 20-100 bar to provide a first liquefied natural gas (LNG) stream (40); (d) cooling the second feed stream (30) of step (b) to provide a cooled feed stream (50); (e) combining the first LNG stream (40) of step (c) with the cooled feed stream (50) of step (d) to provide a combined LNG stream (60); (f) reducing the pressure of the combined LNG stream (60) of step (e); and (g) passing the combined LNG stream (60) of step (f) through a flash vessel (12) to provide a product LNG stream (70) and a gaseous stream (80).

WO 2007/131850 A3



(88) Date of publication of the international search report:

10 January 2008

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2007/053681

A. CLASSIFICATION OF SUBJECT MATTER

INV. F25J1/02

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)

F25J

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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 548 629 A (CHIU CHEN-HWA [US]) 22 October 1985 (1985-10-22) column 4, line 23 - line 27 column 4, line 66 - column 5, line 21; figure	1-6, 9-12
X	PARADOWSKI H ET AL: "HIGH EFFICIENCY 6 MTPA LNG TRAIN DESIGN VIA TWO DIFFERENT MIXED REFRIGERANT PROCESSES" AICHE NATIONAL MEETING, 10 March 2002 (2002-03-10), pages 245-247, XP009052299 figures 3.1, 3.2	1-6, 9-12
Y	US 4 541 852 A (NEWTON CHARLES L [US] ET AL) 17 September 1985 (1985-09-17) column 4, line 47 - column 5, line 7; figure	1-12

☒ 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 document 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

30 October 2007

Date of mailing of the international search report

16/11/2007

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Göritz, Dirk

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2007/053681

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6 658 892 B2 (FANNING ROBERT A [US] ET AL) 9 December 2003 (2003-12-09) paragraph [0028]; figure 2 -----	1-12
Y	US 6 378 330 B1 (MINTA MOSES [US] ET AL) 30 April 2002 (2002-04-30)	1-12
X	figure 5 -----	1-5, 7-9, 11, 12

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2007/053681

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 4548629	A	22-10-1985	GB 2147984 A	22-05-1985
US 4541852	A	17-09-1985	AU 553337 B2	10-07-1986
			AU 3848285 A	22-08-1985
			CA 1233406 A1	01-03-1988
			DE 3582343 D1	08-05-1991
			DK 52385 A	14-08-1985
			EP 0153649 A2	04-09-1985
			ES 8607523 A1	01-11-1986
			ES 8702635 A1	16-03-1987
			JP 1050830 B	31-10-1989
			JP 1563166 C	12-06-1990
			JP 60191175 A	28-09-1985
			NO 850467 A	14-08-1985
			OA 7944 A	31-01-1987
US 6658892	B2	09-12-2003	RU 2304746 C2	20-08-2007
			US 2003154739 A1	21-08-2003
US 6378330	B1	30-04-2002	NONE	