

(43) International Publication Date
30 September 2010 (30.09.2010)(51) International Patent Classification:
F25J 3/02 (2006.01)(21) International Application Number:
PCT/GB2010/050488(22) International Filing Date:
23 March 2010 (23.03.2010)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0905124.4 25 March 2009 (25.03.2009) GB(71) Applicant (for all designated States except US): **COST-
AIN OIL, GAS & PROCESS LIMITED** [—/GB]; Cost-
ain House, Styal Road, Wythenshawe, Manchester, Greater
Manchester M22 5WN (GB).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **JOHNSON, Grant**
[GB/GB]; Costain Oil, Gas & Process Limited, Costain
House, Styal Road, Wythenshawe, Manchester M22 5WN
(GB). **TOMLINSON, Terence** [GB/GB]; Costain Oil, Gas
& Process Limited, Costain House, Styal Road, Wythen-
shawe, Manchester M22 5WN (GB). **PHILLIPS, Lee,**
Alan [GB/GB]; Costain, Oil, Gas & Process Limited, Cost-
ain House, Styal Road, Wythenshawe, Manchester M22
5WN (GB).(74) Agent: **HAMER, Christopher**; Mathys & Squire LLP,
120 Holborn, London, Greater London EC1N 2SQ (GB).(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, 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, PE, PG, PH, PL, PT, RO, RS, RU, 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, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,

[Continued on next page]

(54) Title: PROCESS AND APPARATUS FOR SEPARATION OF HYDROCARBONS AND NITROGEN

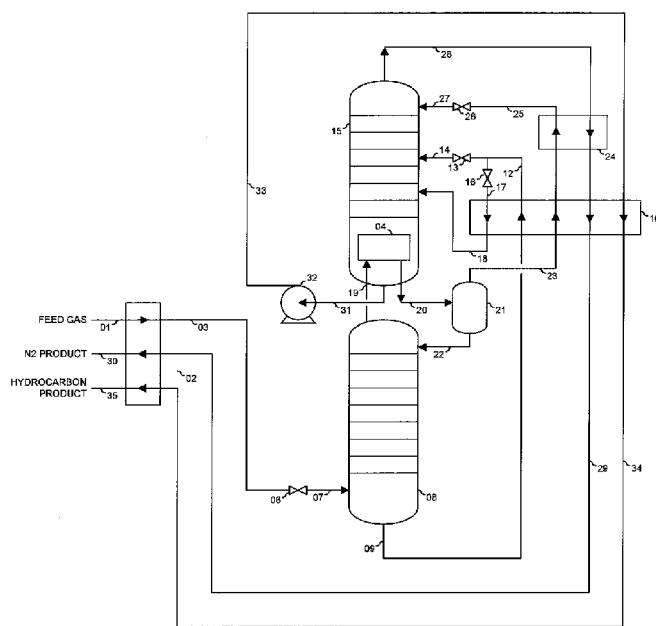


FIGURE 2

(57) **Abstract:** The invention provides a process and apparatus for the separation of nitrogen from a gaseous feed comprising a mixture of hydrocarbons and nitrogen gas, the process comprising the steps of: (i) cooling (02) and at least partially condensing the gaseous feed (01); (ii) feeding the cooled and at least partially condensed feed from step (i) to a first fractionation (08) to produce an overhead vapour stream (19) having an enriched nitrogen content and a condensed product (09) having a reduced nitrogen content which is subjected to a second fractionation (15), which comprises reboil (04), at a lower pressure than the first fractionation; (iii) partially condensing (04) the overhead vapour stream, and separating (21) to provide a liquid stream (22), which is used to provide reflux to the first fractionation, and a separated vapour stream (23), which is condensed (10) to provide reflux (27) to the second fractionation; and (iv) sub-cooling (10) the condensed product of the first fractionation and dividing the resulting sub-cooled product into at least two streams: a first stream (14) being expanded (13) and fed to the second fractionation, and a second stream (17) being expanded (16) and reheated in heat exchange (10) with the separated vapour stream (23) from step (ii) before being fed to the second fractionation; (v) removing a hydrocarbon product stream (31) low in nitrogen from the second fractionation; and (vi) removing a nitrogen rich stream (28) from the second fractionation.



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, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

— *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:

4 April 2013

Published:

— *with international search report (Art. 21(3))*

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2010/050488

A. CLASSIFICATION OF SUBJECT MATTER
INV. F25J3/02
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)
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 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	HEALY M J ET AL: "UK nitrogen removal plants starts up", OIL AND GAS JOURNAL, PENNWELL, HOUSTON, TX, US, 1 February 1999 (1999-02-01), pages 36-41, XP001539433, ISSN: 0030-1388	1-7, 9-11, 17-30, 32,34
Y	page 40; figure 9	8,12-16, 30,31,33
Y	----- EP 1 110 588 A1 (AIR LIQUIDE [FR]) 27 June 2001 (2001-06-27) paragraphs [0046] - [0048], [0051]; figure 3 ----- -/--	8,12-16



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 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

29 January 2013

Date of mailing of the international search report

06/02/2013

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

Göritz, Dirk

INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2010/050488

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 6 449 984 B1 (PARADOWSKI HENRI [FR]) 17 September 2002 (2002-09-17) figure 2 -----	1-7,9, 11-13, 17-34
Y	US 3 631 683 A (TANZ HEINER ET AL) 4 January 1972 (1972-01-04) figures -----	1-7,9, 11-13, 17-34
Y	US 3 818 714 A (ETZBACH V ET AL) 25 June 1974 (1974-06-25) figure 2 -----	12,13
A	US 5 771 714 A (EMLEY RAE LYNN [US] ET AL) 30 June 1998 (1998-06-30) figure -----	1,8, 12-16,29

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2010/050488

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1110588	A1	27-06-2001	CA 2329490 A1 23-06-2001
			EP 1110588 A1 27-06-2001
			FR 2802825 A1 29-06-2001
			JP 2001221567 A 17-08-2001
			US 2002017111 A1 14-02-2002
US 6449984	B1	17-09-2002	BR 0205687 A 22-07-2003
			EP 1273860 A2 08-01-2003
			FR 2826969 A1 10-01-2003
			NO 20030581 A 16-04-2003
			US 6449984 B1 17-09-2002
			WO 03004951 A1 16-01-2003
US 3631683	A	04-01-1972	DE 1601257 B 01-10-1970
			US 3631683 A 04-01-1972
US 3818714	A	25-06-1974	DE 2110417 A1 21-09-1972
			FR 2128674 A1 20-10-1972
			US 3818714 A 25-06-1974
US 5771714	A	30-06-1998	NONE