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- (71) Applicant (*for all designated States except US*): SASOL TECHNOLOGY (PTY) LTD [ZA/ZA]; 1 Sturdee Avenue, Rosebank, 2196 Johannesburg (ZA).
- (72) Inventors; and
- (75) Inventors/Applicants (*for US only*): PRICE, Julian, Graham [ZA/ZA]; 4 Melrose Place, Delius Street, 1911 Vanderbijlpark (ZA). TINDALL, Barry, Antony [ZA/ZA]; 125 Edge of the Vaal, Vaalpark, 9570 Sasolburg (ZA).
- (74) Agents: DUNLOP, Alan, J., S. et al.; Hahn & Hahn, Inc., 222 Richard Street, Hatfield, 0083 Pretoria (ZA).
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(54) Title: NATURAL GAS CONVERSION TO HYDROCARBONS AND AMMONIA

(57) Abstract: A process for the production of hydrocarbons and ammonia, and more particularly a process for optimising the production of hydrocarbons and ammonia using a combined hydrocarbon synthesis plant and ammonia synthesis plant. Synthesis gas exiting a reforming section of the hydrocarbon synthesis process is sent to a hydrogen extraction unit, where it is divided into a hydrogen-rich stream and a hydrogen-poor stream. The hydrogen-rich stream is then fed into an ammonia synthesis process. The hydrogen-poor stream may be returned to the hydrocarbon synthesis process or may be used as a fuel gas. The process reduces emission of CO₂ into the atmosphere, and requires only one reforming section and one air separation unit for both processes. Removal of hydrogen from the hydrocarbon synthesis process before the synthesis gas enters a Fischer-Tropsch reactor also lowers the H₂/CO ratio of the synthesis gas, therefore resulting in better hydrocarbon selectivity. Also claimed are hydrocarbons and ammonia produced according to the process.

INTERNATIONAL SEARCH REPORT

International Application No

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A. CLASSIFICATION OF SUBJECT MATTER

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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)

IPC 7 C01C C07C C10G C01B

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)

WPI Data, PAJ, EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0 342 610 A (AIR PROD & CHEM) 23 November 1989 (1989-11-23) the whole document ---	1-12, 17-24, 26-28
X	US 5 023 276 A (YARRINGTON ROBERT M ET AL) 11 June 1991 (1991-06-11) the whole document ---	13,14,25
Y	---	1-12, 17-24, 26-28
X	US 5 245 110 A (VAN DIJK CHRISTIAAN P ET AL) 14 September 1993 (1993-09-14) the whole document ---	13,14,25
A	---	1-12, 15-24, 26-28
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Patent family members are listed in annex.

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- *&* document member of the same patent family

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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

Zalm, W

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 770 578 A (KELLOGG M W CO) 2 May 1997 (1997-05-02) the whole document	16, 24-28
A	----- US 4 666 680 A (LEWIS JERRY L) 19 May 1987 (1987-05-19) -----	1-12, 17-23

INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT/ZA 00/00125

Patent document cited in search report	A	Publication date	Patent family member(s)	Publication date
EP 0342610	A	23-11-1989	US 4886651 A	12-12-1989
<hr/>				
US 5023276	A	11-06-1991	AT 61316 T	15-03-1991
			AU 572797 B	19-05-1988
			AU 1972883 A	05-04-1984
			CA 1217504 A	03-02-1987
			DE 3382193 D	11-04-1991
			DK 448383 A, B,	31-03-1984
			EP 0112613 A	04-07-1984
			ES 526076 D	01-03-1985
			ES 8503717 A	16-06-1985
			IN 161251 A	31-10-1987
			JP 59097501 A	05-06-1984
			KR 9109208 B	05-11-1991
			NO 833522 A, B,	02-04-1984
<hr/>				
US 5245110	A	14-09-1993	AU 662928 B	21-09-1995
			AU 2660492 A	27-04-1993
			CA 2119354 A	01-04-1993
			DE 69226438 D	03-09-1998
			DE 69226438 T	03-12-1998
			DK 604554 T	26-04-1999
			EP 0604554 A	06-07-1994
			NO 940996 A	18-05-1994
			US 5942203 A	24-08-1999
			WO 9306041 A	01-04-1993
<hr/>				
EP 0770578	A	02-05-1997	US 5736116 A	07-04-1998
			AU 701282 B	21-01-1999
			AU 6432496 A	01-05-1997
			BR 9605221 A	21-07-1998
			CA 2184126 A	26-04-1997
			JP 9165215 A	24-06-1997
			NO 964526 A	28-04-1997
<hr/>				
US 4666680	A	19-05-1987	AT 392628 B	10-05-1991
			AT 24185 A	15-10-1990
			AU 576214 B	18-08-1988
			AU 3813585 A	08-08-1985
			BR 8500393 A	10-09-1985
			CA 1327271 A	01-03-1994
			DK 38385 A	31-07-1985
			GB 2153382 A, B	21-08-1985
			IN 163324 A	10-09-1988
			JP 1811576 C	27-12-1993
			JP 5022641 B	30-03-1993
			JP 60186401 A	21-09-1985
			NL 8500238 A, B,	16-08-1985
			NO 850329 A, B,	31-07-1985
			NZ 210933 A	31-07-1987
			SU 1713420 A	15-02-1992
			ZA 8500527 A	06-04-1995