(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
9 February 2012 (09.02.2012)

PCT

(10) International Publication Number
WO 2012/017023 A1

(51) International Patent Classification:
C10M 107/02 (2006.01) *C10N 30/02* (2006.01)
C10M 169/04 (2006.01) *C10N 30/10* (2006.01)
C10N 20/02 (2006.01) *C10N 40/25* (2006.01)

(21) International Application Number:
PCT/EP2011/063397

(22) International Filing Date:
3 August 2011 (03.08.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10305858.2 3 August 2010 (03.08.2010) 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) Inventors; and
(75) Inventors/Applicants *(for US only)*: **GERMAINE, Gilbert Robert Bernard** [FR/FR]; Route departementale no. 3, F-76650 Petit Couronne (FR). **WEDLOCK, David John** [GB/GB]; Pool Lane, Ince, Chester Cheshire CH2 4NU (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, QA, 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, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, 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, ML, MR, NE, SN, TD, TG).

Declarations 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 (Art. 21(3))*

WO 2012/017023 A1

(54) **Title**: LUBRICATING COMPOSITION

(57) **Abstract**: The present invention provides a lubricating composition comprising a base oil and one or more additives, wherein the base oil comprises a residual Fischer-Tropsch derived base oil and wherein the lubricating composition has a kinematic viscosity at 0°C (according to ASTM D 445) of above 16.3 cSt.

LUBRICATING COMPOSITION

The present invention relates to a lubricating composition comprising a base oil and one or more additives for particular use in the crankcase of an engine.

In order to formulate engine oils having a high kinematic viscosity at 100°C (such as SAE xW-50 and SAE xW-60 grades of the so-called SAE J300 Specifications as revised in January 2009; SAE stands for Society of Automotive Engineers) a formulator typically has the choice of using mineral bright stock or heavy poly-alpha olefins (heavy PAOs; heavy PAOs typically have a kinematic viscosity at 100°C of above 20 cSt).

A problem of the use of mineral bright stock, a residual mineral base oil, is the inherently lower quality thereof, resulting in e.g. limited oxidation stability. A problem of the use of heavy PAOs is the inherent high cost thereof. Attempts have been made in the past to solve this problem by combining the desirable cost-effectiveness of lighter distillate GTL base oils with a minimal amount of heavy PAO.

It is an object of the present invention to minimize one or more of the above problems.

It is another object of the present invention to provide alternative lubricating compositions, in particular for use in the crankcase of an engine, in particular as SAE xW-50 and SAE xW-60 or even heavier formulations, more in particular SAE 20W-50 and SAE 20W-60 and heavier formulations.

One or more of the above or other objects can be obtained by the present invention by providing a

lubricating composition comprising a base oil and one or more additives, wherein the base oil comprises a residual Fischer-Tropsch derived base oil and wherein the lubricating composition has a kinematic viscosity at 100°C (according to ASTM D 445) of above 16.3 cSt.

It has now surprisingly been found according to the present invention that suitable lubricating compositions (in particular engine oils) having a high kinematic viscosity at 100°C (such as SAE xW-50 and xW-60 formulations) can be formulated, without the need of using mineral bright stock or heavy poly-alpha olefins (PAOs).

An advantage of the present invention is that the lubricating compositions have surprisingly low Noack volatility values (according to ASTM D 5800), in some embodiments as low as below 3.5 wt.%.

There are no particular limitations regarding the base oil used in lubricating composition according to the present invention (provided that the base oil comprises at least a residual Fischer-Tropsch derived base oil and provided that the requirements in respect of the lubricant composition according to the present invention are met), and various conventional mineral oils, synthetic oils as well as naturally derived esters such as vegetable oils may be conveniently used.

The base oil used in the present invention may - in addition to the residual Fischer-Tropsch derived base oil - conveniently comprise mixtures of one or more mineral oils and/or one or more synthetic oils; thus, according to the present invention, the term “base oil” may refer to a mixture containing more than one base oil, including at least one residual Fischer-Tropsch derived base oil. Mineral oils include liquid petroleum oils and solvent-treated or acid-treated mineral lubricating oil of the

paraffinic, naphthenic, or mixed paraffinic/naphthenic type which may be further refined by hydrofinishing processes and/or dewaxing.

Suitable base oils for use in the lubricating oil composition of the present invention are Group I-III mineral base oils (preferably Group III), Group IV poly-alpha olefins (PAOs), Group II-III Fischer-Tropsch derived base oils (preferably Group III) and mixtures thereof.

By “Group I”, “Group II” “Group III” and “Group IV” base oils in the present invention are meant lubricating oil base oils according to the definitions of American Petroleum Institute (API) for categories I, II, III and IV. These API categories are defined in API Publication 1509, 15th Edition, Appendix E, April 2002.

Fischer-Tropsch derived base oils are known in the art. By the term “Fischer-Tropsch derived” is meant that a base oil is, or is derived from, a synthesis product of a Fischer-Tropsch process. A Fischer-Tropsch derived base oil may also be referred to as a GTL (Gas-To-Liquids) base oil. Suitable Fischer-Tropsch derived base oils that may be conveniently used as the base oil in the lubricating composition of the present invention are those as for example disclosed in EP 0 776 959, EP 0 668 342, WO 97/21788, WO 00/15736, WO 00/14188, WO 00/14187, WO 00/14183, WO 00/14179, WO 00/08115, WO 99/41332, EP 1 029 029, WO 01/18156 and WO 01/57166.

Synthetic oils include hydrocarbon oils such as olefin oligomers (including polyalphaolefin base oils; PAOs), dibasic acid esters, polyol esters, polyalkylene glycols (PAGs), alkyl naphthalenes and dewaxed waxy isomerates. Synthetic hydrocarbon base oils sold by the Shell Group under the designation "Shell XHVI" (trade mark) may be

conveniently used.

Poly-alpha olefin base oils (PAOs) and their manufacture are well known in the art. Preferred poly-alpha olefin base oils that may be used in the lubricating compositions of the present invention may be derived from linear C_2 to C_{32}, preferably C_6 to C_{16}, alpha olefins. Particularly preferred feedstocks for said poly-alpha olefins are 1-octene, 1-decene, 1-dodecene and 1-tetradecene.

There is a strong preference for using a Fischer-Tropsch derived base oil over a PAO base oil, in view of the high cost of manufacture of the PAOs. Thus, preferably, the base oil contains more than 50 wt.%, preferably more than 60 wt.%, more preferably more than 70 wt.%, even more preferably more than 80 wt.%. most preferably more than 90 wt.% Fischer-Tropsch derived base oil. In an especially preferred embodiment less than 10 wt.%, preferably less than 5 wt.%, more preferably not more than 2 wt.%, of the base oil is not a Fischer-Tropsch derived base oil.

It is preferred that the lubricating composition according to the present invention contains less than 20 wt.%, preferably less than 10 wt.%, more preferably less than 5 wt.%, of a PAO base oil, based on the total weight of the composition.

It is even more preferred that 100 wt% of the base oil is based on one or more Fischer-Tropsch derived base oils.

The total amount of base oil incorporated in the lubricating composition of the present invention is preferably present in an amount in the range of from 60 to 99 wt.%, more preferably in an amount in the range of from 65 to 90 wt.% and most preferably in an amount in the range of from 70 to 85 wt.%, with respect to the total

weight of the lubricating composition.

The compositions of the present invention comprise a residual Fischer-Tropsch base oil. As used herein the term "residual base oil" means a base oil where the initial boiling point can be fixed in a high vacuum column, at the heavy end or bottom end, but where the final boiling point is a resultant of the feedstock being distilled. Such final boiling point would exceed the thermal cracking temperature of the feedstock even under vacuum conditions.

A residual Fischer-Tropsch base oil gives a viscosity grade in the same range as mineral brightstock, yet while being residual, does not suffer from the compositional/ performance limitations of mineral brightstocks. A residual Fischer-Tropsch base oil is highly paraffinic with low aromatics content, high inhibited oxidational stability and of the same order of viscosity as a heavy PAO.

Typically the lubricating composition according to the present invention comprises a residual Fischer-Tropsch derived base oil having a kinematic viscosity at 100°C (according to ASTM D445) of at least 15 cSt and preferably above 18 cSt; preferably, this residual Fischer-Tropsch derived base oil has a kinematic viscosity at 100°C of below 30 cSt. Of course, the lubricating composition according to the present invention may contain one or more further Fischer-Tropsch derived base oils having a lower kinematic viscosity at 100°C, such as about 3, 5 and 8 cSt.

As mentioned above, the lubricating composition according to the present invention has a kinematic viscosity at 100°C of above 16.3 cSt. Preferably, the lubricating composition according to the present

invention has a kinematic viscosity at 100°C of above 21.9 cSt, more preferably above 23.0 cSt. Typically, the kinematic viscosity at 100°C of the lubricating composition according to the present invention is below 30.0 cSt, such as below 26.1 cSt.

Preferably, the dynamic viscosity at -15°C (according to ASTM D 5293) of the lubricating composition according to the present invention is below 9500 cP (1 cP is the same as 1 mPa.s), preferably below 8000 cP, more preferably below 7500 cP, even more preferably below 7000 cP. Typically, the dynamic viscosity at -15°C of the lubricating composition is above 5000 cP, preferably above 6000 cP.

Preferably, the dynamic viscosity at -20°C (according to ASTM D 5293) of the lubricating composition according to the present invention is above 7000 cP (1 cP is the same as 1 mPa.s), preferably above 8000 cP, more preferably above 9000 cP, even more preferably above 10000 cP. Typically, the dynamic viscosity at -20°C of the lubricating composition is below 15000 cP, preferably below 14000 cP.

Preferably, the high temperature, high shear viscosity ("HTHS"; according to ASTM D 4683) of the lubricating composition according to the present invention is above 3.7 cP, preferably above 4.5 cP, more preferably above 5.0 cP, or even as high as above 5.5 or 6.0 cP. Typically, the HTHS is below 8.0 cP.

Typically, the Noack volatility (according to ASTM D 5800) of the lubricating composition according to the present invention is between 1 and 15 wt.%, preferably below 14 wt.% and more preferably below 10.0 wt.%. According to an especially preferred embodiment according to the present invention, the Noack volatility is below

6.0 wt.%, more preferably below 5.0 wt.% or even as low as below 4.0 or below 3.5 wt.%.

The lubricating composition according to the present invention further comprises one or more additives such as anti-oxidants, anti-wear additives, dispersants, detergents, overbased detergents, extreme pressure additives, friction modifiers, viscosity index improvers, pour point depressants, metal passivators, corrosion inhibitors, demulsifiers, anti-foam agents, seal compatibility agents and additive diluent base oils, etc.

As the person skilled in the art is familiar with the above and other additives, these are not further discussed here in detail. Specific examples of such additives are described in for example Kirk-Othmer Encyclopedia of Chemical Technology, third edition, volume 14, pages 477-526.

Preferably the lubricating composition according to the present invention contains less than 1.0 wt.% of a Viscosity Index improver concentrate, based on the total weight of the composition. Most preferably, the composition is free of Viscosity Index improver concentrate.

Preferably, the lubricating composition contains at least 0.1 wt.% of a pour point depressant. As an example, alkylated naphthalene and phenolic polymers, polymethacrylates, maleate/fumarate copolymer esters may be conveniently used as effective pour point depressants. Preferably not more than 0.3 wt.% of the pour point depressant is used.

The lubricating compositions of the present invention may be conveniently prepared by admixing the one or more additives with the base oil(s).

The above-mentioned additives are typically present

in an amount in the range of from 0.01 to 35.0 wt.%, based on the total weight of the lubricating composition, preferably in an amount in the range of from 0.05 to 25.0 wt.%, more preferably from 1.0 to 20.0 wt.%, based on the total weight of the lubricating composition.

Preferably, the composition contains at least 9.0 wt.%, preferably at least 10.0 wt.%, more preferably at least 11.0 wt% of an additive package comprising an anti-wear additive, a metal detergent, an ashless dispersant and an anti-oxidant.

The lubricating compositions according to the present invention may be so-called “low SAPS” (SAPS = sulphated ash, phosphorus and sulphur), “mid SAPS” or “regular SAPS” formulations.

For Passenger Car Motor Oil (PCMO) engine oils the above ranges mean:

- a sulphated ash content (according to ASTM D 874) of up to 0.5 wt.%, up to 0.8 wt.% and up to 1.5 wt.%, respectively;
- a phosphorus content (according to ASTM D 5185) of up to 0.05 wt.%, up to 0.08 wt.% and typically up to 0.1 wt.%, respectively; and
- a sulphur content (according to ASTM D 5185) of up to 0.2 wt.%, up to 0.3 wt.% and typically up to 0.5 wt.%, respectively.

For Heavy Duty Diesel Engine Oils the above ranges mean:

- a sulphated ash content (according to ASTM D 874) of up to 1 wt.%, up to 1 wt.% and up to 2 wt.%, respectively;
- a phosphorus content (according to ASTM D 5185) of up to 0.08 wt.% (low SAPS) and up to 0.12 wt.% (mid SAPS), respectively; and
- a sulphur content (according to ASTM D 5185) of up to

0.3 wt.% (low SAPS) and up to 0.4 wt.% (mid SAPS), respectively.

The present invention is described below with reference to the following Examples, which are not intended to limit the scope of the present invention in any way.

Examples

Lubricating Oil Compositions

Various engine oils for use in a crankcase engine were formulated.

Table 1 indicates the properties for the base oils used. Table 2 indicates the composition and properties of the fully formulated SAE 20W-50, SAE 20W-60 and "20W-70" engine oil formulations that were tested (SAE xW-70 grades do not exist yet; "XW-70" and "20W-70" are meant to refer to heavier grades than SAE xW-60 and SAE 20W-60, respectively); the amounts of the components are given in wt.%, based on the total weight of the fully formulated formulations.

"Base oil 1" was a Fischer-Tropsch derived base oil ("XHBO") having a kinematic viscosity at 100°C (ASTM D445) of approx. 19 cSt (mm2s-1).

"Base oil 2" was a Fischer-Tropsch derived base oil ("XHBO") having a kinematic viscosity at 100°C (ASTM D445) of approx. 17 cSt (mm2s-1).

Base oils 1 and 2 may be conveniently manufactured by the process described in e.g. US 7 354 508 B2, the teaching of which is hereby incorporated by reference.

"Base oil 3" was a commercially available PAO base oil having a kinematic viscosity at 100°C (ASTM D445) of 7.83 cSt. Base oil 3 is commercially available from e.g. ExxonMobil Chemicals (Brussels, Belgium) under the trade designation "PAO 8".

"Base oil 4" was a commercially available PAO base oil having a kinematic viscosity at 100°C (ASTM D445) of 40.33 cSt. Base oil 4 is commercially available from e.g. ExxonMobil Chemicals (Brussels, Belgium) under the trade designation "PAO 40".

All tested engine oil formulations contained a combination of one more base oils, an additive package, a Viscosity Index improver concentrate and optionally a pour point depressant, which additive packages were the same in all tested compositions.

The additive package contained a combination of additives including anti-oxidants, a zinc-based anti-wear additive, an ashless dispersant, an overbased detergent mixture and about 10 ppm of an anti-foaming agent.

The Viscosity Index improver concentrate contained a conventional polymeric viscosity modifier (Infineum SV-151 [a styrene-hydrogenated isoprene diblock polymer]; available from Infineum Additives (Milton Hill, Abingdon, UK) dissolved in a mixture of Shell XHVI base oil and an ester base stock).

The pour point depressant was a conventional polyalkyl methacrylate (PAMA) pour point depressant, commercially available from Evonik Rohmax Additives GmbH (Darmstadt, Germany) under the trade designation "Viscoplex® 6-054".

The compositions of Example 1-7 were obtained by mixing the base oils with the additive packages and pour point depressant, using conventional lubricant blending procedures.

Table 1

	Base oil 1 (XHBO 1)	Base oil 2 (XHBO 2)	Base oil 3 (PAO 8)	Base oil 4 (PAO 40)
Kinematic viscosity at 40°C[1] [cSt]	131.9	122.8	46.5	400.6
Kinematic	19.0	17.2	7.8	40.3

viscosity at 100°C[1] [cSt]				
VI Index[2]	163	153	138	151
Pour point[3] [°C]	-30	-36	-66	-45

[1]According to ASTM D 445

[2]According to ASTM D 2270

[3]According to ASTM D 5950

Table 2

Component [wt.%]	Example 1 (20W-60)	Example 2 (20W-60)	Example 3 (20W-60)	Example 4 ("20W-70")	Example 5 (20W-60)	Example 6 (20W-60)	Example 7 (20W-50)
Base oil 1(XHBO 1)	77.3	86.6	72.3	67.3	72.3	-	-
Base oil 2(XHBO 2)	-	-	-	-	-	77.3	87.3
Base oil 3 (PAO 8)	-	-	-	-	5.0	-	-
Base oil 4 (PAO 40)	-	-	5.0	10.0	-	-	-
Additive package	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Viscosity Index improver concentrate	10.0	0.7	10.0	10.0	10.0	10.0	-
Pour point depressant	0.2	0.2	0.2	0.2	0.2	0.2	0.2
TOTAL	100	100	100	100	100	100	100
Properties of total composition							
Kinematic viscosity at 100°C[1] [cSt]	25.3	23.6	25.9	26.6	24.3	22.8	21.1
Dynamic viscosity at -15°C[2] [cP]	7398	8769	7711	7733	6758	5551	6825
Dynamic viscosity at -20°C[2] [cP]	12689	15241	13295	13448	11507	10091	12382
HTHS[3] [cP]	6.5	6.5	6.7	n.d.	6.4	n.d.	n.d.
Noack volatility[4] [wt.%]	2.9	2.3	3.1	n.d.	3.1	n.d.	n.d.

[1]According to ASTM D 445

[2]According to ASTM D 5293. NB 1 cP (centiPoise) = 1 mPa.s (milliPascal.second)

[3]According to ASTM D 4683

[4]According to ASTM D 5800

n.d. = not determined

Discussion

As can be seen from Table 2, the present invention surprisingly allows to formulate lubricating compositions such as engine oils having a high kinematic viscosity at 100°C (such as SAE xW-50, SAE xW-60 and "xW-70" grades), without the need of using mineral bright stock or heavy poly-alpha olefins (PAOs).

The lubricating composition according to the present invention have surprisingly low Noack volatility values, as low as below 3.5 wt.%.

C L A I M S

1. A lubricating composition comprising a base oil and one or more additives, wherein the base oil comprises a residual Fischer-Tropsch derived base oil and wherein the lubricating composition has a kinematic viscosity at 100°C (according to ASTM D 445) of above 16.3 cSt.

2. Lubricating composition according to claim 1, wherein the lubricating composition has a kinematic viscosity at 100°C of above 21.9 cSt.

3. Lubricating composition according to claim 1 or 2, wherein the lubricating composition has a dynamic viscosity at -15°C (according to ASTM D 5293) of below 9500 cP.

4. Lubricating composition according to any one of claims 1 to 3, wherein the lubricating composition has a dynamic viscosity at -20°C (according to ASTM D 5293) of above 7000 cP.

5. Lubricating composition according to any one of claims 1 to 4, wherein the composition has a high temperature, high shear viscosity (“HTHS”; according to ASTM D 4683) of above 3.7 cP.

6. Lubricating composition according to any one of claims 1 to 5, wherein the composition has a Noack volatility (according to ASTM D 5800) of below 15 wt.%, preferably below 14 wt.%.

7. Lubricating composition according to any one of claims 1 to 6, wherein the base oil contains more than 50 wt.%, preferably more than 60 wt.%, more preferably more than 70 wt.%, even more preferably more than 80 wt.%, most preferably more than 90 wt.% residual Fischer-Tropsch derived base oil.

8. Lubricating composition according to any one of claims 1 to 7, wherein the composition contains less than 10 wt.%, preferably less than 5 wt.%, of a PAO base oil, based on the total weight of the composition.

9. Lubricating composition according to any one of claims 1 to 8, wherein the composition contains less than 1.0 wt.% of a Viscosity Index improver concentrate, based on the total weight of the composition.

10. Lubricating composition according to any one of claims 1 to 9, wherein the lubricating composition comprises a residual Fischer-Tropsch derived base oil having a kinematic viscosity at 100°C of above 15 cSt, preferably above 18 cSt.

11. Lubricating composition according to claim 10, wherein the residual Fischer-Tropsch derived base oil has a pour point (according to ASTM D 5950) of below -6°C.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2011/063397

A. CLASSIFICATION OF SUBJECT MATTER
INV. C10M107/02 C10M169/04
ADD. C10N20/02 C10N30/02 C10N30/10 C10N40/25

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)
C10M

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, 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	WO 2007/003623 A1 (SHELL INT RESEARCH [NL]; WEDLOCK DAVID JOHN [GB]) 11 January 2007 (2007-01-11) page 2, lines 18-25; page 7, lines 11-28; page 28, lines 1-5;.claims 1,2,15-17; example 2; tables 1-5 -----	1-11
X	US 2005/133407 A1 (ABERNATHY SUSAN M [US] ET AL) 23 June 2005 (2005-06-23) paragraphs [0002], [0011], [0014], [0016], [0017], [0040], [0066], [0107], [0119]; claims 13,15-19,23,27,31; examples 4,11,12 ----- -/--	1-11

[X] Further documents are listed in the continuation of Box C.

[X] 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	Date of mailing of the international search report
31 August 2011	08/09/2011

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Renoth, Heinz

2

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2011/063397

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 2008/053868 A1 (KLEIJWEGT PETER [NL] ET AL) 6 March 2008 (2008-03-06) paragraphs [0002], [0004], [0005], [0006], [0012], [0013], [0042], [0043]; claims 1,6,19; example 8; tables 3,4	1,3-6, 8-11
X	WO 00/14183 A1 (EXXON RESEARCH ENGINEERING CO [US]) 16 March 2000 (2000-03-16) cited in the application page 2, lines 8-10; page 8, lines 6-12;.claims 1,4-7,19,20; tables 5,9	1,3,5, 7-9
X	WO 01/57166 A1 (MOBIL OIL CORP [US]) 9 August 2001 (2001-08-09) cited in the application page 12, lines 8-17; page 14, lines 19-23; page 39, lines 11-13; page 45, lines 8-29;.claims 1,25-29; examples 1-4,10,19,20; tables 8,14	1,3,5, 7-9
A	US 2004/178118 A1 (ROSENBAUM JOHN [US] ET AL) 16 September 2004 (2004-09-16) paragraphs [0002], [0005], [0011] - [0013], [0053], [0054]; claims 1,4,5,21,35,36	1-11

2

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2011/063397

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2007003623 A1	11-01-2007	AU 2006264979 A1	11-01-2007
		AU 2006264985 A1	11-01-2007
		CA 2613073 A1	11-01-2007
		CA 2613085 A1	11-01-2007
		CN 101213278 A	02-07-2008
		CN 101213271 A	02-07-2008
		EP 1899443 A1	19-03-2008
		EP 1902117 A2	26-03-2008
		WO 2007003617 A2	11-01-2007
		JP 2009511644 A	19-03-2009
		JP 2008545032 A	11-12-2008
		US 2009203835 A1	13-08-2009
		US 2009111936 A1	30-04-2009
		ZA 200710190 A	31-12-2008
		ZA 200710191 A	31-12-2008
US 2005133407 A1	23-06-2005	AU 2004312303 A1	21-07-2005
		BR PI0417998 A	27-04-2007
		CN 1906273 A	31-01-2007
		GB 2409461 A	29-06-2005
		JP 2007516337 A	21-06-2007
		NL 1027827 C2	09-05-2006
		NL 1027827 A1	27-06-2005
		WO 2005066314 A1	21-07-2005
		ZA 200605618 A	28-11-2007
US 2008053868 A1	06-03-2008	NONE	
WO 0014183 A1	16-03-2000	AT 302253 T	15-09-2005
		AU 758867 B2	03-04-2003
		AU 5574699 A	27-03-2000
		CA 2340774 A1	16-03-2000
		DE 69926768 D1	22-09-2005
		DE 69926768 T2	08-06-2006
		EP 1114127 A1	11-07-2001
		ES 2247825 T3	01-03-2006
		HK 1040257 A1	12-05-2006
		JP 4573436 B2	04-11-2010
		JP 2002524609 A	06-08-2002
		NO 20011125 A	24-04-2001
		TW 523545 B	11-03-2003
		US 6103099 A	15-08-2000
WO 0157166 A1	09-08-2001	AR 027363 A1	26-03-2003
		AU 777201 B2	07-10-2004
		AU 2977601 A	14-08-2001
WO 0157166 A1		BR 0107986 A	22-10-2002
		CA 2399489 A1	09-08-2001
		CN 1398292 A	19-02-2003
		EP 1252279 A1	30-10-2002
		JP 2003528169 A	24-09-2003
		KR 20020074226 A	28-09-2002
		MX PA02007524 A	28-01-2003
		NO 20023676 A	04-10-2002
		TW 585907 B	01-05-2004
		US 7067049 B1	27-06-2006
		ZA 200205676 A	13-11-2003

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2011/063397

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2004178118 A1	16-09-2004	AU 2004219695 A1	23-09-2004
		BR PI0408212 A	14-02-2006
		CN 1829788 A	06-09-2006
		GB 2417037 A	15-02-2006
		JP 2006519910 A	31-08-2006
		WO 2004081145 A2	23-09-2004
		ZA 200507317 A	28-03-2007