PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :		(11) International Publication Number:	WO 92/13932
C10M 127/02	A1	(43) International Publication Date:	20 August 1992 (20.08.92)

(21) International Application Number: PCT/AU92/00034

(22) International Filing Date: 4 February 1992 (04.02.92)

(30) Priority data:

PK 4425	4 February 1991 (04.02.91)	AU
PK 9259	4 November 1991 (04.11.91)	AU
PK 9994	13 December 1991 (13.12.91)	AU
PL 0531	23 January 1992 (23.01.92)	AU

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(81) Designated States: AT, AT (European patent), AU, BB, BE (European patent), BF (OAPI patent), BG, BJ (OAPI patent), BR, CA, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CI (OAPI patent), CM (OAPI patent), CS, DE, DE (European patent), DK, DK (European patent), ES, ES (European patent), FI, FR (European patent), GA (OAPI patent), GB, GB (European patent), GN (OAPI patent), GR (European patent), HU, IT (European patent), JP, KP, KR, LK, LU, LU (European patent), MC (European patent), MG, ML (OAPI patent), MN, MR (OAPI patent), MW, NL, NL (European patent), NO, PL, RO, RU, SD, SE, SE (European patent), SN (OAPI patent), TD (OAPI patent), TG (OAPI patent), US.

Published
With international search report.

(54) Title: LUBRICATING OIL COMPOSITION

(57) Abstract

The specification describes lubricating oil compositions containing a medium molecular weight paraffin (MMWP). The medium molecular weight paraffins disclosed include those having from 10 to 20 carbon atoms. Compositions containing from 0.1 % to 2 % by volume are disclosed. The MMWP reduces varnishing, sludging, production of chemical byproducts and glazing. It also improves seal life and extends the life of lubricating oil compositions containing it.

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LUBRICATING OIL COMPOSITION

The present invention relates to lubricating oil compositions.

When two metal surfaces move over each other, considerable heat is evolved due to friction. The function of a lubricant is to separate the two rubbing surfaces by a film thereby greatly reducing the coefficient of friction. If this film fails, the frictional heat produced may melt the surfaces causing them to weld together or seize. When conditions are such that a continuous thick (>0.001 in.) film of lubricant separates the solid surfaces at all points, then frictional resistance is controlled by the viscosity of the lubricant. This is referred to as "hydrodynamic lubrication". Under conditions of high speed or high load, thick lubricant films may be absent or incomplete and lubrication of the parts is effected by layers of adsorbed polar molecules. This situation is referred to as "boundary lubrication". Metal surfaces, which are covered by films of metal oxides, are highly polar and hence are not readily "wetted" by non polar hydrocarbon oils. Used alone, hydrocarbon oils are

therefore poor lubricants in these circumstances. Lubricants therefore contain additives which either react with metal surfaces or are adsorbed on the surfaces thereby allowing oil to wet the surface or providing boundary lubrication, thus preventing direct metal to metal contact.

Apart from certain speciality products and synthetic oils, the vast bulk of lubricants are based upon hydrocarbons derived from petroleum.

Crude oils contain a number of broad classes of hydrocarbons, the proportions of which vary greatly from oil to oil.

(a) Branched alkanes. These include iso- and anteiso alkanes, and linear derivates of isoprene such as phytane and pristane and degradation products from molecules such as carotene. These compounds have low melting points and so confer low pour points on lubricating oils. They are also stable to degradation by heat and oxygen and have high viscosity indexes, so this iso-paraffin group is the preferred feedstock for lube oil manufacture.

(b) n-Alkanes. The paraffins have similar properties to the iso-paraffins, except that, due to their higher melting points, they raise the pour point of a lube oil.

(c) Cycloalkanes. The naphthenics contain five-membered and six-membered rings with alkyl side chains. They lower the pour point of an oil but they have a low viscosity index.

(d) Aromatics. These are derivatives of benzene, naphthalene and other fused ring systems with alkyl side chains. This group has a low viscosity index and poor thermal stability.

(e) Sulphur compounds. This group forms a substantial proportion of many crudes, especially those from parts of the Middle East. It has similar properties to aromatics, but are usually even less stable.

In order to prepare a suitable lube oil base stock, a manufacturer will select feeds which have appropriate molecular weight ranges and are rich in the desired classes of hydrocarbons (iso-paraffins), and low in aromatics, ONS compounds, and paraffins so that production costs can be kept low. Crudes such as those from Pennyslvania which are ideal for lube oil manufacture are being depleted, so now most manufacturers use a feed stock mix which is carefully selected to meet the product mix required by the market. Some manufacturers upgrade their feedstock by using a severe hydrogenation/hydrogenolysis process called hydrocracking to remove sulphur, aromatics, and to open rings and crack larger molecules.

The residue from the primary distillation of selected crude oils which are rich in iso-paraffins is distilled at reduced pressure (a few mm of Hg) in the presence of steam. Most usually, three fractions are obtained: two distillate cuts and the residue or bottoms. Typical cuts are shown in the table below.

Lubricating Oil Fractions

Fraction	No. of C atoms	Molecular Weight	Boiling Range °C (Plant conditions)
Light (Low viscosity)	22-36	300-500	370-500
Medium (medium viscosity)	29-45	400-600	450-550
Heavy (high viscosity)	43 →	600 →	>500(residue)

The desired oily alkane material is extracted from the viscous bottoms product from the vacuum tower using liquid propane (high pressure, 65°C) in a propane de-asphalting plant. The more polar, high molecular weight polycyclic aromatics are less soluble in liquid propane than are the alkane (paraffin) components and are removed

as a hard sludge. Evaporation of the propane leaves the heaviest grade of lubricating oil which is usually referred to as "bright stock".

Each of the lube oil fractions is next treated with a solvent system which selectively removes much of the aromatic and O, N, S material. Phenol and more recently furfural have been widely used in elaborate multistage counter current equipment for this purpose. The immiscible, slightly polar solvent selectively extracts the more polar aromatic material from the hydrocarbon mixture.

n-Alkanes (normal paraffins), which have higher melting points than branched alkanes of similar molecular weight, must be removed to decrease the low temperature viscosity of the lubricating oil. This is accomplished by taking the oil up in a suitable solvent such as a methylethylketone-toluene mixture and chilling 5-10°C below the required pour point. The n-alkanes are precipitated as "slack wax" which is separated by continuous filtration.

The final stage in manufacture of the base stocks is hydrogenation to convert small amounts of dark-coloured unsaturated material into saturated material and to remove sulphur from sulphur compounds present in the oil.

Lubricating oils are finally prepared by blending base stocks to give oil of the desired viscosity range, then introducing many additives to improve the life and performance of the oil.

The chemical composition of lubricating oils derived from crude oil is particularly complex. Normally lubricating oils contain a high proportion of naphthenic or paraffinic compounds. The hydrocarbons comprising a typical lubricating oil may have from 20 to 70 carbon atoms. Usually the hydrocarbons contained in lubricating oil have very few olefinic bonds. However there may be a significant proportion of hydrocarbons exhibiting aromatic unsaturation. A further description of base lubricating oils can be found in an article by D.V. Brock published in "Lubricant Engineering" Volume 43 pages 184-185 March 1987.

Minor improvements in the performance of a lubricating oil can yield significant economic benefits far

in excess of the cost of the additive that provides the improved performance. The present invention is based on the discovery that the performance of lubricating oil compositions can be significantly improved by the addition of small amounts of a medium molecular weight paraffin to lubricating oil.

Accordingly the present invention provides a lubricating oil composition containing an effective quantity of a medium molecular weight paraffin (MMWP). The medium molecular weight paraffin may comprise from 10 to 20 carbon atoms, from 10 to 19 carbon atoms or from 10 to 17 carbon atoms but preferably it comprises from 10 to 15 carbon atoms. The composition may contain as little as 0.1% by volume of MMWP for an improvement in performance to be observed. Preferably however the lubricating oil composition of the present invention contains from 0.5% to 1% by volume of a MMWP. Best results have been obtained with about 0.6% by volume MMWP.

MMWP's are normally derived from the processing of crude oils. Normally they are produced during the initial atmospheric distillation of a crude oil and are characterised as hydrocarbons having a boiling point in the range from 150 to 335°C.

The compositions of the present invention may be prepared as compositions ready for use or as concentrates for premixing or mixing in situ e.g. in the sump of an engine. Concentrates may contain as much as 25% of the additive. The effective amount of additive required depends on the ultimate purpose for its inclusion and may also depend upon the additive selected.

A MMWP of particular interest is one known as "Shellsol T". Shellsol T is characterised as a solvent having the following properties-:

Property	Test Method	Unit	Specification	Typical Value
Distillation Ranges, IBP DP	ASTM D1078	°C	 180 min 205 max	 180.2 202.5
Flash Point	IP 170	°C	-	57.5
Aniline Point	ASTM D611	°C	78-83	80
Density @ 15°C	ASTM D1298	kg/ litre	0.765-0.775	0.769
Composition Paraffins Naphthenes Aromatics		%m		 >99.8 <0.1 <0.1

Other products of particular interest are those from the Shellsol series as well as Shell P874, Shell P878 and Ondina Oil 15. Shell P874 and P878 are technical white oils comprising a mixture of paraffins and naphthenes.

Paraffins of medium molecular weight include dodecane, hexadecane, octadecane and cosane.

The lubricating oil compositions of the present invention are based on lubricating oil compositions that are normally commercially available. These compositions may include various additives such as dispersants, detergents, oxidation inhibitors, foam inhibitors, pour point depressants and viscosity improvers. A discussion of the function and formulation of lubricating oil compositions can be found in the "Handbook of Lubrication" Theory and Practice of Tribology Volume 1 edited by E. Richard Booser and published by CRC Press in 1983, the contents of which are incorporated herein by reference.

The composition of the present invention may also be incorporated into a grease composition with corresponding improvements in performance. Grease compositions normally comprise a metallic soap and a lubricating oil.

International Patent Application No. PCT/US89/05467 discloses lubricating oil compositions containing minute quantities of kerosene, the purpose of which is to carry silicone antifoam formulations into solution in a lubricating oil composition. However the quantities of medium molecular weight paraffins contained in the composition would be insufficient to be effective in the performance of the present invention. Normally the MMWP needs to comprise at least 0.1% to 0.5% by volume of the lubricating oil composition to be effective. Furthermore kerosenes frequently contain substantial proportions of aromatics which may negate the effect of the medium molecular weight paraffin.

The compositions of the present invention provide a number of significant advantages over the existing formulations. These include the following.

1. A noticeable reduction in varnishing;
2. A reduction in sludging;
3. Reduced production of harmful chemical by-products such as acids;
4. Improved seal life particularly seals in gear boxes, differentials and engines;
5. Reduced glazing especially when used in the preferred range;
6. Extended life of the lubricating oil; and
7. Reduced coefficient of friction of surfaces to which it is applied.

The present invention also includes within its scope methods for any one or more of the following:

a. reducing varnishing in an engine;
b. reducing sludging in an engine;
c. reducing the production of harmful chemical by-products in an engine;
d. improving seal life in an engine; and
e. reducing glazing in an engine

by incorporating an effective amount of a medium molecular weight paraffin into lubricating oil used in the engine.

Benefits provided by the present invention are illustrated by the accompanying comparative examples.

Example 1

The performance of the compositions of the present invention was compared with the performance of the compositions without the additive of the present invention using a pin on ball testing machine. The pin on ball testing machine comprises an electric motor driving a single shaft through a set of pulleys. A rotatable disc having a diameter of approximately 4cm is attached to the shaft and is rotated at a speed of 1200 - 1500 rpm. A separate shaft is pivoted at one end of the apparatus so that a hardened steel bearing element can be applied to the rotating disc. A torque wrench type configuration fitted to the pivoted shaft is used to determine the load applied to the rotating disc by the hardened steel bearing element.

Lubricant under test was applied to the bearing surface by splashing lubricant from a bath held at a base of the rotating disc. At all times during the test a continuous film of lubricant was in contact with the bearing.

A series of seven oil samples was tested with the apparatus both with and without the addition of the additive. Samples including the additive contained additive in the ratio of 1:80 additive to base lubricating oil composition.

The test procedure was as follows. With the disc rotating, a piece of coarse wet and dry emery paper was used to smooth any imperfections and score marks from the rotating disc prior to test. The bearing was moved to ensure a fresh unmarked surface was available for contact with the rotating disc. Prepared samples were poured into an oil bath containing approximately 20 to 40 mls and held in close contact at the base of the rotating disc which picked oil up and carried it across the bearing surface. The bearing fixed to the pivoted shaft was lowered onto the rotating lubricated disc and allowed to settle in. A continuous load was manually applied to the handle of the pivoted shaft. The load was maintained and gradually increased until the bearing surfaces began to squeal. At the point when squealing commenced, the torque applied was

measured in ft.lb units. The results are set out in Table 1.

TABLE 1

RESULTS FOR OIL ADDITIVE ASSESSMENT

Sample	Applied Torque, ft.lb	
	Without Additive	With Additive
1. Shell XMO	80-100	150-160
2. Shell Marine Oil	125	160
3. BP Engine Oil	80-110	140-150
4. BP Gear Oil	70	140
5. BP Grease	130	160
6. Caltex CXT	50	150
7. Esso Tiger	80	150

The additive used in this experiment was "Youngs 303" which is a lubricating oil used in cleaning guns. Gas chromatographic analysis of Youngs 303 revealed that it is a mixture of a lubricating oil and another hydrocarbon fraction of slightly higher boiling point than kerosene. The kerosene like fraction had major components of carbon chain length 11 to 13. The kerosene like fraction comprised approximately 50% of the "Youngs 303".

The results demonstrate that the oil additive provides enhanced performance under the harsh boundary lubrication conditions utilised.

Example 2

The performance of the lubricating oil compositions of the present invention were tested against a base lubricating oil composition in a V8 Caterpillar engine (Model 3408) of 450 horsepower. The results of the test are set out in Table 2. The additive used was Shellsol T in the ratio of 1:160 by volume.

TABLE 2

Test Results V8 CAT Engine							
Test I				**Test II (with additive)**			
Time -Mins	Burn Rate/ Hr	Horse Power	R.P.M.	Time -Mins	Burn Rate/ Hr	Horse Power	R.P.M.
5	61.7	221	2183	5	61.3	222	2184
10	61.7	221	2183	10	61.3	222	2184
15	61.7	221	2183	15	61.3	222	2184
20	61.7	221	2183	20	61.3	222	2184

The results of the test demonstrate that the lubricating oil composition of the present invention increases the power output of the motor and increases fuel efficiency.

Example 3

A test using a BP lubricating oil as a base was performed on a Holden V8 engine. The additive used was Shellsol T in the ratio 1:160. The results are illustrated in Table 3.

TABLE 3

Holden 253 V8 Using B.P. Oil.

	WITHOUT ADDITIVE		WITH ADDITIVE	
	L/IDLE	650	775	775
5	H/IDLE	-	-	-
	H/P	-	-	-
	TORQUE	110	110	-
	W/TEMP	85	95	85
	OIL/TEMP	-	-	-
10	OIL/PRESS	120	100	-
	E/VACUUM	-	-	-

The dynamometer consistently indicated that the lubricating oil compositions of the present invention resulted in an idle speed that was consistently 125 rpm 15 greater than that for the base lubricating oil.

Example 4

The lubricating oil composition of the present invention was compared with a base lubricating oil over a range of engine speeds. The additive used was 20 Shellsol T in the ratio 1:160. The engine used was a Caterpillar (Model 3406) six cylinder 400 horsepower engine. The results of the test are shown in Tables 4 and 5. Table 4 illustrates the performance of the engine using the base lubricating oil composition and Table 5 25 illustrates the performance of the same engine using a lubricating oil composition of the present invention.

TABLE 4

	Specifications	Test Figures Without Additive
Low Idle R.P.M.	750	758
High Idle R.P.M.	2280	2307
Full Load R.P.M.	2100	2100
Rack Setting	1.15	
Boost Pressure	33 "	
B.S.F.C.	.357	
H.P. Setting	347	
Lube Oil Pressure at High Idle		
Lube Oil Pressure at Low Idle		

RPM	H.P.	GPH FUEL RATIO	BOOST	EXHAU -ST TEMP.	FUEL PRESS	WATER TEMP.	OIL TEMP.	OIL PRES
2300	9		8	333	230	89.3	100.9	445
2200	223		26	365	220	88.9	100.9	420
*2100	315		45	401	220	89.7	100.3	415
2000	326		44	381	220	90.2	100.1	410
1900	322		43	377	220	90.1	100.1	405
1800	320		43	377	220	89.4	99.6	400
1700	315		41	385	220	89.6	98.6	400
1600	309		30	401	220	90.6	98.7	400
1500	297		27	423	220	90.6	99.2	400
1400	287		25	456	220	89.7	98.5	395

TABLE 5

	Specifications	Test Figures With Additive
Low Idle R.P.M.	750	772
High Idle R.P.M.	2280	2304
Full Load R.P.M.	2100	2100
Rack Setting		
Boost Pressure		
B.S.F.C.		
H.P. Setting		
Lube Oil Pressure at High Idle		
Lube Oil Pressure at Low Idle		

RPM	H.P.	GPH FUEL RATIO	BOOST	EXHAU -ST TEMP.	FUEL PRESS	WATER TEMP.	OIL TEMP.	OIL PRES
*2309	38		6	292	230	88.0	94.9	450
*2200	231		24	334	220	89.5	96.9	440
*2100	317		45	404	220	90.6	100.3	420
2000	326		44	398	220	90.0	99.5	410
1900	322		43	390	220	89.4	99.7	400
1800	320		41	386	220	89.9	99.8	400
*1700	318		40	394	220	88.9	98.7	400
*1600	310		30	410	220	89.5	98.9	400
*1500	299		26	440	220	88.7	98.2	400
1400	284		25	467	220	88.9	97.2	390

The results illustrate that the lubricating oil composition of the present invention produces an increase in power output of 2 to 3 horsepower at low revs and at full load.

Example 5

Engine Test illustrating anti-varnish benefits:

When added to a 4 litre 6 cylinder engine, which had done over 130,000 kms, and which was beginning to "breathe" noticeably - due to "varnishing", and after approximately 4,000 kms running with an oil change after 2,000 kms with additive, all "breathing" ceased, as observed with the naked eye. The additive used was Shell Sol T in the ratio of 1:160. Combustion was noticeably steadier and more even.

The same experiment was performed with another engine of similar age, and the same results were achieved.

Oil leaks from each of the motors were also reduced and in particular around the crankshaft protrusions.

With the additive included in further oil changes - the result of "no breathing" was continued indefinitely, with the benefit of cleaner oil, next to no oil burning and better running.

Of course along with this other benefits were observed such as improved fuel efficiency, increased engine performance and reduced engine wear.

CLAIMS:

1. A lubricating oil composition containing an effective amount of a medium molecular weight paraffin.

2. A lubricating oil composition containing from 0.1% to 2% by volume of a medium molecular weight paraffin comprising from 10 to 21 carbon atoms.

3. A lubricating oil composition according to claim 2 wherein the lubricating oil composition contains from 0.5% to 1% by volume of the medium molecular weight paraffin.

4. A lubricating oil composition according to any one of the preceding claims wherein the medium molecular weight paraffin comprises from 10 to 15 carbon atoms.

5. A lubricating oil composition according to claim 1 or claim 2 wherein the medium molecular weight paraffin comprises greater than 99.8% paraffins, has a flash point of 57.5°C, an aniline point in the range from 78 to 83°C and a density in the range from 0.765 to 0.775 kgm/litre.

6. A lubricating oil composition according to claim 5 wherein the medium molecular weight paraffin is Shellsol T.

7. A grease composition comprising a suitable soap and a lubricating oil composition wherein the lubricating oil composition contains an effective amount of a medium molecular weight paraffin.

8. A grease composition according to claim 7 wherein the medium molecular weight paraffin comprises from 0.1% to 2% by volume of the lubricating oil composition.

9. A grease composition according to claim 8 wherein the medium molecular weight paraffin comprises from 0.5% to 1% by volume of the lubricating oil composition.

10. A grease composition according to claim 8 wherein the medium molecular weight paraffin comprises greater than 99.8% paraffins, has a flash point of 57.5°C and an aniline point in the range from 78 to 83°C and a density in the range from 0.765 to 0.775 kgm/litre.

11. A grease composition according to claim 10 wherein the medium molecular weight paraffin is Shellsol T.

12. A grease composition according to claim 8 or claim 9 wherein the medium molecular weight paraffin comprises from 10 to 15 carbon atoms.

INTERNATIONAL SEARCH REPORT

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent classification (IPC) or to both National Classification and IPC

Int. Cl.[5] C10M 127/02

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC5	C10M 127/02, 105/02, 105/04, 101/02
IPC3	C10M 1/02, 1/04, 1/16, 3/10

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

AU : IPC as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category*	Citation of Document, [11] with indication, where appropriate of the relevant passages [12]	Relevant to Claim No [13]
X	US,A, 4737537 (SCHWABE et al) 12 April 1988 (12.04.88) See column 1 lines 9-64, column 2 lines 24-28.	(1-4,7-10,12)
X Y	DD,A, 209846 (VEB PETROLCHEMISCHES KOMBINAT SCHWEDT) 23 May 1984 (23.05.84) See page 3 lines 11-36.	(1-4) (7-10,12)
X Y	EP,A, 332433 (W.R. GRACE & CO. - CONN.) 13 September 1989 (13.09.89) See column 3 lines 26-35, claims 1-2,6,13.	(1-4) (7-10,12)
X Y	GB,A, 2224287 (NIPPON OIL CO. LTD) 2 May 1990 (02.05.90) See page 4 lines 3-7, page 14 lines 19-27.	(1,7) (2-4,8-10,12)
X	DD,A, 280545 (AKADEMIE DER WISSENSCHAFTEN DDR) 11 July 1990 (11.07.90) (continued)	(1)

* Special categories of cited documents : [10]

"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

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"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

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
8 May 1992 (08.05.92)	14 May 1992 (14.05.92)
International Searching Authority	Signature of Authorized Officer
AUSTRALIAN PATENT OFFICE	G. CARTER

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

X	Derwent Abstract Accession no. 92299B/51, Class L02, SU,A, 655544 (AS KAZA PETRO NATUR) 9 April 1977 (09.04.77)	(1,7)
X	Derwent Abstract Accession no. 89-118959/16, Class P51, JP,A, 01-065194 (IDEMITSU KOSAN KK) 10 March 1989 (10.03.89)	(1)
X	Derwent Abstract Accession no. 84-240081/39, Class V03, JP,A, 59-142292 (ALPS ELECTRIC KK) 15 August 1984 (15.08.84)	(1)
X	Derwent Abstract Accession no. 84-104339/17, Class H07 L01, JP,A, 59-047297 (MATSUSHITA ELEC WORKS) 16 March 1984 (16.03.84)	(1)
A	US,A, 4023980 (PRILLIEUX et al) 17 May 1977 (17.05.77)	
A	GB,A, 1572794 (SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V.) 6 August 1980 (06.08.80)	

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [1]

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claim numbers ..., because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim numbers ..., because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim numbers ..., because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4a

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [2]

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category*	Citation of Document, [11] with indication, where appropriate of the relevant passages [12]	Relevant to Claim No [13]
A	Patents Abstracts of Japan, C-603, page 107, JP,A, 01-48896 (FURUKAWA ALUM CO LTD) 23 February 1989 (23.02.89)	
A	Patents Abstracts of Japan, C-26, page 152, JP,A, 55-90590 (MATSUMURA SEKIYU KENKYUSHO K.K.) 9 July 1980 (09.07.80)	
A	Patents Abstracts of Japan, C-84, page 57, JP,A, 56-120798 (MITSUBISHI DENKI K.K.) 22 September 1981 (22.09.81)	

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL APPLICATION NO. PCT/AU 92/00034

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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