

(19) World Intellectual Property
Organization
International Bureau



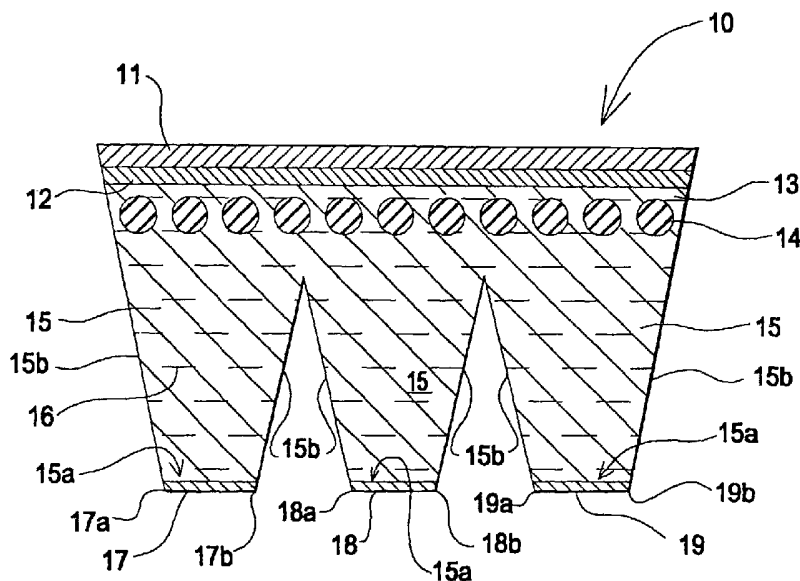
(43) International Publication Date
5 February 2004 (05.02.2004)

PCT

(10) International Publication Number
WO 2004/011822 A1

- (51) International Patent Classification⁷: F16G 5/20, 1/28
- (21) International Application Number:
PCT/US2003/021986
- (22) International Filing Date: 14 July 2003 (14.07.2003)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
60/399,512 29 July 2002 (29.07.2002) US
- (71) Applicant: THE GATES CORPORATION [US/US];
900 South Broadway, Denver, CO 80209 (US).
- (72) Inventor: SEDLACEK, Douglas, R.; 7383 S. Quince
Court, Englewood, CO 80112 (US).
- (74) Agent: THURNAU, Jeffrey; The Gates Corporation, Mail
Stop: 31-4-1-A3, 900 S. Broadway, Denver, CO 80209
(US).
- (81) Designated States (*national*): AE, AG, AL, AM, AT, AU,
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,
CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH,
GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC,
LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW,
MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE,
SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC,
VN, YU, ZA, ZM, ZW.
- (84) Designated States (*regional*): European patent (AT, BE,
BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU,
IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR).
- 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
- 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.*

(54) Title: BELT



(57) Abstract: A belt having an elastomeric body and tensile cords. The belt (10) comprises a rib or ribs (15) extending in an endless direction. A polyethylene layer (17, 18, 19) is attached to each rib tip to change a coefficient of friction.

WO 2004/011822 A1

Title

Belt

5 Field of the Invention

The invention relates to a belt and more particularly, to a belt having a polyethylene layer applied to a rib tip to minimize a pulley engagement noise and improve stability.

10

Background of the Invention

V-ribbed power transmission belts generally operate in rotating pulleys. The belt engages and disengages from each pulley during each rotation. Each engagement process includes a movement of the belt into a pulley groove having a radial component. Such radial component results in the belt partially sliding into a pulley groove. Noise can be caused by such sliding engagement as a rib edge engages the sides of the pulley groove.

20 Frictional modifiers are known in the art to minimize noise. Frictional modifiers can include additives such as waxes, oils, graphite, molybdenum disulfide, PTFE, mica, talc, fibers and various blends and equivalents thereof. These additives are each added to the rubber compound during manufacturing. Each of these is added to the belt body elastomeric during compounding, resulting in portions of the body having frictional modifiers where no frictional modifiers are required. This adds complexity and cost to the belt manufacturing process.

35 Application of a layer to a tooth crest is known. However, the material comprises fabric and is used to strengthen each tooth. The fabric is not used as a frictional modifier, although it may reduce friction. However, it may produce the undesirable effect of

stiffening the belt, and/or temperature thereby decreasing belt life.

Representative of the art is U.S. patent no. 4,011,766 (1977) to Waugh which discloses a fabric layer
5 defining a crest of a tooth.

Reference is also made to copending U.S. application serial number 10/121,556 filed April 12, 2002 which discloses a toothed belt having a UHMWPE jacket.

It is desirable to have a frictional modifier which
10 only need be applied to the part of the belt needing such. What is needed is a belt having a thermoplastic material attached to a rib tip to minimize a pulley engagement noise. What is needed is a belt having polyethylene attached to a rib tip to reduce a pulley
15 engagement noise. The present invention meets these needs.

Summary of the Invention

The primary aspect of the present invention is to
20 provide a belt having a thermoplastic material attached to a rib tip to minimize a pulley engagement noise.

Another aspect of the invention is to provide a belt having polyethylene attached to a rib tip to reduce a pulley engagement noise.

25 Other aspects of the invention will be pointed out or made apparent by the following description of the invention and the accompanying drawings.

The invention comprises a belt having an elastomeric body and tensile cords. The belt comprises a rib or ribs
30 extending in an endless direction. A polyethylene layer is attached to each rib tip to change a coefficient of friction.

Brief Description of

Fig. 1 is a cross sectional view of an inventive belt.

Fig. 2 is a cross sectional view of an alternate
5 embodiment.

Detailed Description of the Invention

Fig. 1 is a cross sectional view of an inventive belt. Belt 10 comprises a v-belt or multi-ribbed v belt.
10 A multi-ribbed v-belt is depicted having ribs 15, although the belt may comprise a single rib 15 as well.

Belt 10 comprises an elastomeric body 13 with tensile members or cords 14 embedded therein. The tensile members 14 extend parallel to a longitudinal
15 axis. Tensile members 14 may comprise any material known in the belt art, including polyester, nylon, aramid and their equivalents, or a combination of two or more.

A profile comprises ribs 15 extending parallel to an endless direction of the belt body 13.

20 Fibers 16 are embedded in the matrix of the elastomeric body 13 and ribs 15. Fibers 16 decrease rib surface sloughing and chatter. The fibers may include aramid, carbon, polyester, polyethylene, fiberglass, nylon and blends and equivalents thereof. Other organic
25 fibers may include wool, silk, hemp, cotton, and blends and equivalents thereof. The amount of fibers used in the rib elastomeric may be in the range of approximately 0.01 to 40 parts fiber per hundred parts of rubber (PHR). The present embodiment utilizes approximately 22 parts
30 cotton fiber per hundred parts of rubber. The fibers have a diameter in the range of approximately 0.016mm to 0.021mm and a length in the range of approximately 0.0+ to 6mm. The inventive belt may also be manufactured

without use of fibers 16 embedded
body.

Layers 11, 12 comprise a thermoplastic material. By way of example and not of limitation, each layer 11, 12
5 may also substantially comprise polyethylene, polypropylene, polyester, polyamide, polyvinylidene chloride and any equivalents or combinations thereof. Thermoplastic layer 12 is joined to body 13 by use of any
10 suitable cure, chemical adhesive or molding process known in the art. Although the preferred embodiment uses a peroxide cure process, thermoplastic layer 12 may also be joined to body 13 using chemical adhesives known in the art, as well as by molding. In the case of polyethylene, layer 11, 12, are each compatible with and co-curable
15 with ethylene propylene rubbers via peroxide cure. The polyethylene used in the disclosed embodiment has a molecular weight up to approximately 250,000 g/mole.

Body 13 and ribs 15 may comprise thermoset elastomeric material such as EPDM (ethylene-propylene diene
20 rubber), HNBR (hydrogenated acrylonitrile-butadiene rubber), PU (polyurethane), CR (chloroprene rubber), SBR (styrene-butadiene rubber), NBR (nitrile rubber), plus any equivalents or combinations of two or more of the foregoing, or, any other elastomeric material used in power transmission
25 belts to which thermoplastic material may be attached.

Layer portion 17, 18, 19 are each attached to a rib tip 15a. Each layer portion 17, 18, 19 acts as a frictional modifier to minimize an engagement noise between the belt and a pulley groove, particularly in
30 situations of pulley misalignment. Each of layer portions 17, 18, 19 may, by way of example and not of limitation, comprise polyethylene, polypropylene, polyester, polyamide, polyvinylidene chloride and any equivalents or combinations thereof. Layer portions 17,
35 18, 19 are each initially joined to the portion which

will become each rib 15 as a fabrication of the belt by use of any suitable cure, chemical adhesive or molding process known in the art. Although the preferred embodiment uses a peroxide cure process, layer portions 17, 18, 19 may each also be joined to belt 10 and rib 15 using chemical adhesives known in the art and by molding. In the case of polyethylene, layer portions 17, 18, 19 are compatible with and co-curable with ethylene propylene rubbers via peroxide cure. The polyethylene used in the disclosed embodiment has a molecular weight up to approximately 250,000 g/mole.

Belt 10 is manufactured using methods known in the art. Each of the layers of the belt is laid up on a mandrel and cured. Once cured the belt is cut or ground to the final multi-ribbed or v-belt profile. A single thermoplastic layer is ground or cut during formation of the rib or ribs, thereby forming layer portions 17, 18, 19 on the tip 15a of each rib 15.

Since the belt profile is ground or cut, rib sides 15b have no layer covering and instead only comprise an exposed portion of the elastomeric belt body 13. As a result, the torque carrying capacity of the belt is not affected.

In operation, the inventive belt minimizes or eliminates noise associated with engagement of the belt with a pulley groove. Each layer portion 17, 18, 19 has a coefficient of friction less than that of the elastomeric material of which ribs 15 are comprised, thereby allowing each rib initial ease of engagement with a pulley groove.

More particularly, an edge of each layer portion 17a, 17b, 18a, 18b, 19a, 19b, each attached to a respective rib edge, come into initial contact with a

pulley groove. As the belt furthe
layer portion edges 17a, 17b, 18a, 18b, 19a, 19b allow
each rib to slide into a pulley groove without noise.
Such noise is otherwise caused by the rib edge
5 elastomeric material having a stick-slip engagement with
each pulley groove.

The inventive belt has successfully demonstrated
noiseless operation for multi-ribbed pulley misalignments
of up to approximately 3°. Pulley misalignment is the
10 measure of an angular difference between the planes of
two pulleys upon which the belt is trained. When a
polyethylene layer portion 17 is present on a single rib
belt, for example, it minimizes a tendency of the single
rib v-belt to 'roll' out of a single pulley groove. In
15 cases of extreme misalignment this is caused by
engagement of the rib edge with a pulley edge. Prior art
single rib belts have a tendency to roll out of a pulley
groove when misalignment exceeds approximately 4.5°. However,
the inventive belt will not roll out of a pulley
20 groove until the misalignment exceeds approximately 5.5°,
an increase of approximately 22%.

Fig. 2 is a cross sectional view of an alternate
embodiment. Belt 20 has a toothed profile and as such
may be suitable for use in a synchronous belt drive, for
25 example. Belt 20 comprises tensile members or cords 23
embedded in elastomeric belt body 22. Tensile cords 23
extend in an endless direction and comprise the same
materials as described for tensile members 14 herein.
Teeth 25 extend transversely to a belt length. Fibers 26
30 are embedded within the belt body 22. Belt body 22
comprises the same materials as described for belt body
13 herein.

Overcord layer 21 is attached to the top of the
belt. Undercord layer 24 is attached to the teeth.

Layers 21 and 24 each comprise by way
of limitation, polyethylene, polypropylene, polyester,
polyamide, polyvinylidene chloride and any equivalents or
combinations thereof. Layers 21, 24 are each joined to
5 the belt during fabrication by use of any suitable cure,
chemical adhesive or molding process known in the art.
Although the preferred embodiment uses a peroxide cure
process, layers 21, 24 may also be attached to belt 20
using chemical adhesives known in the art and by molding.
10 In the case of layers 21, 24, comprising polyethylene,
each is compatible with and co-curable with ethylene
propylene rubbers via peroxide cure. The polyethylene
used in the disclosed embodiment has a molecular weight
up to approximately 250,000 g/mole. Layers 21, 24 may
15 also comprise different materials as between each layer,
for example, layer 21 may comprise polyester while layer
24 comprises polyethylene. Other combinations of layer
materials are possible as well.

Although forms of the invention have been described
20 herein, it will be obvious to those skilled in the art
that other variations may be made in the construction and
relation of parts without departing from the spirit and
scope of the invention described herein.

Claims

I claim:

1. A belt comprising:
an elastomeric body;
5 a tensile member extending along the belt in a longitudinal direction;
the body having a rib extending in an endless direction; and
a thermoplastic layer attached to the rib.
- 10 2. The belt as in claim 1, wherein the thermoplastic layer is selected from polyethylene, polypropylene, polyester, polyamide, polyvinylidene chloride or a combination of any
15 two or more of the foregoing.
3. The belt as in claim 2, wherein the elastomeric body is selected from HNBR, EPDM, SBR, NBR, PU, CR or a combination of any two or more of the
20 foregoing.
4. The belt as in claim 3, wherein the thermoplastic layer is applied to a rib edge.
- 25 5. The belt as in claim 4 further comprising a plurality of ribs.
6. The belt as in claim 3, wherein the thermoplastic material is attached to a rib tip.
- 30 7. A belt comprising:
an elastomeric body;
a tensile member extending along the belt in a longitudinal direction;

the body having a rib extending in a longitudinal direction; and
a member attached to a rib edge.

- 5 8. The belt as in claim 7, wherein the member is selected from polyethylene, polypropylene, polyester, polyamide, polyvinylidene chloride or a combination of any two or more of the foregoing.
- 10 9. The belt as in claim 8, wherein the elastomeric body is selected from HNBR, EPDM, SBR, NBR, PU, CR or a combination of any two or more of the foregoing.
- 15 10. The belt as in claim 9 further comprising a plurality of ribs.
11. The belt as in claim 9 further comprising fibers.
- 20 12. A belt comprising:
 an elastomeric body;
 a tensile member extending along the belt in a longitudinal direction;
25 the body having teeth, the teeth oriented transverse to an endless direction; and
 a thermoplastic layer attached to the teeth.
- 30 13. The belt as in claim 12, wherein the thermoplastic layer is selected from polyethylene, polypropylene, polyester, polyamide, polyvinylidene chloride or a combination of any two or more of the foregoing.

14. The belt as in claim 3, where the body is selected from HNBR, EPDM, SBR, NBR, PU, CR or a combination of any two or more of the foregoing.

1 / 1

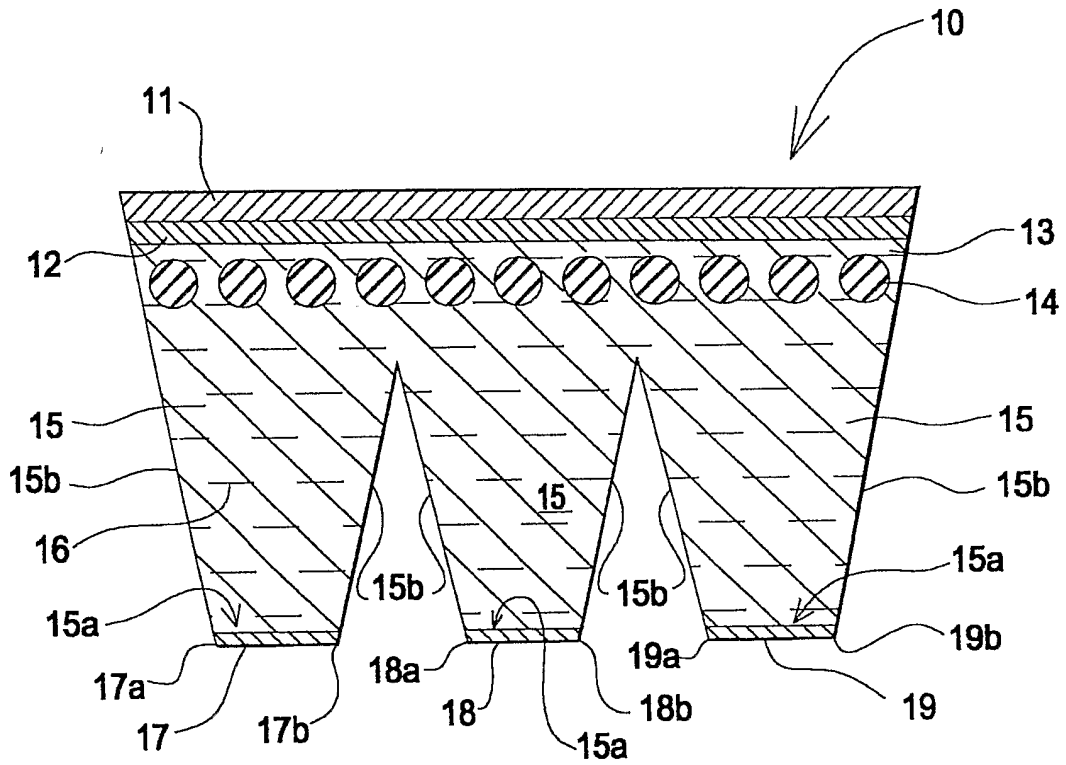


FIG. 1

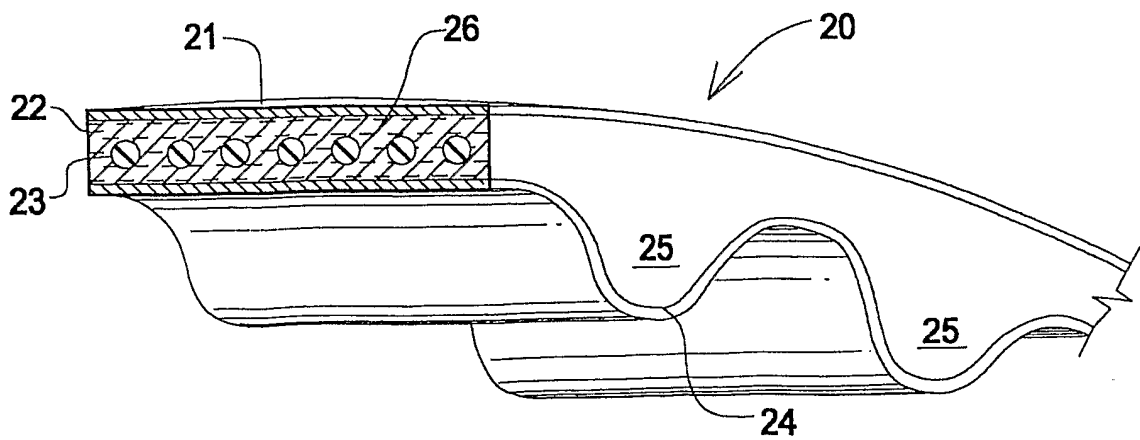


FIG. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/US 03/21986

A. CLASSIFICATION OF SUBJECT MATTER IPC 7 F16G5/20 F16G1/28		
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 F16G B29D		
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, EPO-Internal, PAJ		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 154 171 A (GOODYEAR TIRE & RUBBER) 14 November 2001 (2001-11-14) column 1, line 51 -column 4, line 8; figure 1	1, 7, 12
A	----	3-6, 9, 10, 14
X	EP 1 180 615 A (GOODYEAR TIRE & RUBBER) 20 February 2002 (2002-02-20) column 2, line 41 -column 3, line 46	1-10, 12-14
X	EP 1 063 448 A (NORDDEUTSCHE SEEKABELWERK GMBH) 27 December 2000 (2000-12-27) column 5, line 11 -column 6, line 14 column 7, line 46 - line 52; figure 1	1-10
-/--		
<input checked="" type="checkbox"/> Further documents are listed in the continuation of box C. <input checked="" type="checkbox"/> Patent family members are listed in 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	
9 December 2003	16/12/2003	
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, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Baron, C	

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 03/21986

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 0 695 627 A (DAYCO PTI SPA) 7 February 1996 (1996-02-07) page 2, line 10 - line 42 page 3, line 15 - line 39; figure 4	1
A	----	3,5, 9-11,14
X	US 4 265 627 A (IMAMURA JUNJI) 5 May 1981 (1981-05-05) column 4, line 1 - line 9; figure 2	7
A	----	10
X	PATENT ABSTRACTS OF JAPAN vol. 1995, no. 05, 30 June 1995 (1995-06-30) & JP 07 035201 A (MITSUBOSHI BELTING LTD), 7 February 1995 (1995-02-07) abstract	7
A	----	8,10,11
X	US 4 011 766 A (WAUGH DALE L) 15 March 1977 (1977-03-15) cited in the application column 4, line 6 - line 10; figure 1	7
A	----	10
X	FR 2 210 251 A (UNIROYAL INC) 5 July 1974 (1974-07-05) page 3, line 10 -page 4, line 27; figure 1	12,13
A	----	14
X	US 3 964 328 A (REDMOND JR JOHN D) 22 June 1976 (1976-06-22) column 2, line 47 -column 4, line 30; figure 1	12,13
A	----	2,3,8,9, 14
X	PATENT ABSTRACTS OF JAPAN vol. 1995, no. 04, 31 May 1995 (1995-05-31) & JP 07 027178 A (BANDO CHEM IND LTD), 27 January 1995 (1995-01-27) abstract	12,13
X,P	US 2002/187869 A1 (DUNLAP PAUL N ET AL) 12 December 2002 (2002-12-12) cited in the application the whole document	12,13
A	----	14
A	GB 1 249 527 A (GOODYEAR) 13 October 1971 (1971-10-13) the whole document	2,3,8,9, 13,14

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 03/21986

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1154171	A	14-11-2001	US 6409621 B1 25-06-2002
			BR 0101660 A 18-12-2001
			EP 1154171 A1 14-11-2001
			JP 2002005238 A 09-01-2002
EP 1180615	A	20-02-2002	US 6443866 B1 03-09-2002
			BR 0106685 A 21-05-2002
			EP 1180615 A2 20-02-2002
			JP 2002122187 A 26-04-2002
EP 1063448	A	27-12-2000	BR 0002771 A 30-01-2001
			CA 2312084 A1 22-12-2000
			DE 10028831 A1 04-01-2001
			EP 1063448 A2 27-12-2000
			US 6561344 B1 13-05-2003
EP 0695627	A	07-02-1996	IT 1274698 B 24-07-1997
			DE 69522396 D1 04-10-2001
			DE 69522396 T2 03-01-2002
			EP 0695627 A1 07-02-1996
			ES 2161823 T3 16-12-2001
			US 5851635 A 22-12-1998
US 4265627	A	05-05-1981	JP 1164786 C 26-08-1983
			JP 55135244 A 21-10-1980
			JP 57056619 B 30-11-1982
JP 07035201	A	07-02-1995	JP 3207976 B2 10-09-2001
US 4011766	A	15-03-1977	NONE
FR 2210251	A	05-07-1974	AR 199811 A1 30-09-1974
			AT 1011273 A 15-01-1975
			AU 6278673 A 22-05-1975
			BE 808192 A1 04-06-1974
			DE 2359575 A1 12-06-1974
			ES 421273 A1 16-04-1976
			FR 2210251 A5 05-07-1974
			IT 999945 B 10-03-1976
			JP 50047372 A 26-04-1975
			NL 7316617 A 11-06-1974
			ZA 7308857 A 30-10-1974
			US 3964328
BE 819567 A1 31-12-1974			
CA 1000524 A1 30-11-1976			
DE 2442335 A1 17-04-1975			
DE 2462458 A1 07-04-1977			
FR 2243065 A1 04-04-1975			
GB 1443634 A 21-07-1976			
JP 1035222 B 24-07-1989			
JP 1598405 C 28-01-1991			
JP 61223352 A 03-10-1986			
JP 1140028 C 24-03-1983			
JP 54042553 A 04-04-1979			
JP 57028813 B 18-06-1982			
JP 1339570 C 29-09-1986			
JP 50054755 A 14-05-1975			

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 03/21986

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3964328 A		JP 60014223 B	12-04-1985
JP 07027178 A	27-01-1995	JP 2500290 B2	29-05-1996
US 2002187869 A1	12-12-2002	WO 02084144 A1	24-10-2002
GB 1249527 A	13-10-1971	BE 734853 A	01-12-1969
		CA 926654 A1	22-05-1973
		DE 1926964 A1	02-01-1970
		FR 2011543 A5	06-03-1970
		NL 6909657 A	30-12-1969