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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
2 February 2012 (02.02.2012)

PCT

(10) International Publication Number
WO 2012/014006 A1

(51) International Patent Classification:
E02F 9/22 (2006.01) *F15B 13/02* (2006.01)
B62D 5/06 (2006.01) *F16L 1/024* (2006.01)

(21) International Application Number:
PCT/IB2010/002222

(22) International Filing Date:
26 July 2010 (26.07.2010)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant *(for all designated States except US)*: **HART, David, V.** [—/CA]; 3579 Anzio Drive, Vancouver, British Columbia V5M 4E2 (CA).

(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, 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, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

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

WO 2012/014006 A1

(54) Title: SYSTEM AND METHOD FOR MANAGING LOAD FLOW REQUIREMENTS FOR A TRACTOR SINGLE PUMP HYDRAULIC SYSTEM

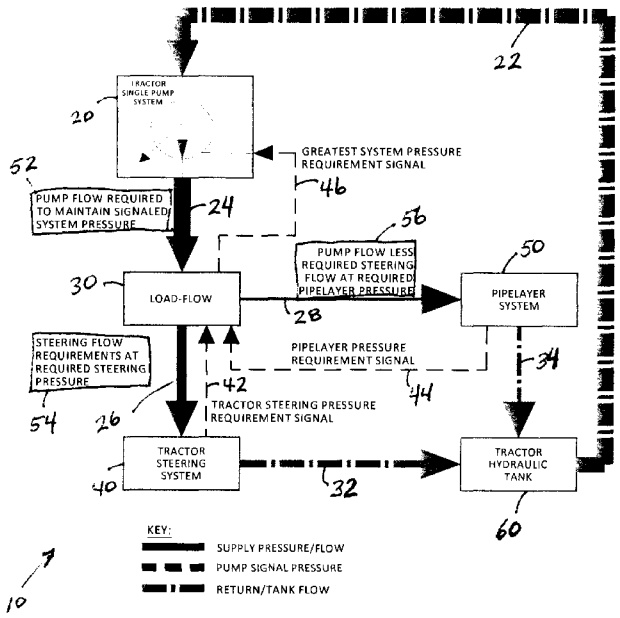

FIG. 1

(57) Abstract: A system and method for managing hydraulic fluid load flow requirements for a tractor having a single pump hydraulic system. The system connects a hydraulic implement in parallel and gives precedence to the tractor's essential operations, such as a hydraulic steering system, to be controlled independently of the hydraulic pressure requirements of the implement system. The method includes determining the essential operation fluid pressure requirement; determining the implement fluid pressure requirement; and maintaining the essential operation fluid pressure requirement by providing hydraulic fluid flow to the essential operation regardless of the implement fluid pressure requirement.

SYSTEM AND METHOD FOR MANAGING LOAD FLOW REQUIREMENTS FOR A TRACTOR SINGLE PUMP HYDRAULIC SYSTEM

CROSS REFERENCE TO RELATED APPLICATION

This application claims the priority of U.S. Provisional Patent Application No. 61/228,498 entitled "SYSTEM AND METHOD FOR MANAGING LOAD FLOW REQUIREMENTS FOR A TRACTOR SINGLE PUMP HYDRAULIC SYSTEM," filed July 24, 2009, the contents of which are hereby incorporated by reference.

FIELD OF THE INVENTION

The present invention relates to land vehicle hydraulic systems generally and more specifically to pipelayer hydraulic assemblies mounted to track-type tractors.

BACKGROUND OF THE INVENTION

Hydraulic track-type pipelayers consist of a track-type crawler tractor with a pipelayer structure mounted to it, along with the associated hydraulic hook and boom winches, the winch hydraulic-controls, and all the necessary rigging. The track-type crawler tractor provides the power to drive the hydraulic winches, and any other hydraulic system fitted or used to control the crawler tractor.

The pipelayer hydraulic system can be driven either directly with a dedicated implement pump supplying only the pipelayer system, or connected in parallel with the tractor hydraulic implement system. The tractor implement system is also arranged in parallel. A parallel system means that when hydraulic functions are actuated simultaneously, hydraulic fluid flow is divided to each function. It is known however, that there will be a greater flow to the path with the least resistance. Due to this fact, the pipelayer is connected to the tractor implement system in parallel, either the tractor implement system or the pipelayer system could be impaired when used

simultaneously. This is because the fluid directed to the path of least resistance could leave the other system with insufficient hydraulic pressure to adequately operate that system. This is typically not an issue with the pipelayer system, since all other existing implements–bulldozer cylinders, rippers, tow winches, etc.–are typically either removed or disconnected, or are not used during critical pipelaying operations. The same is not true, however, for essential hydraulic operations such as the tractor steering system.

Crawler tractors have two methods for steering control: mechanical steering clutches, or hydraulic differential steering. Mechanical steering clutches are completely separate from the hydraulic implement system, and are unaffected by it. Hydraulic differential steering systems use a hydraulic steering motor to facilitate a change of direction. The hydraulic steering motor can be powered either by its own dedicated pump, separate from the implement system (a two-pump system), or by the tractor implement pump (a single-pump system).

In a single pump system, the steering function could be severely compromised unless it is given precedence over the other tractor implement functions. With a pipelayer connected directly to a single-pump system which also services the steering function, the steering of the tractor could be drastically impaired if a load placed by the pipelayer implement consumes hydraulic flow, leaving insufficient flow for the steering function. For example, if the tractor was making a turn while quickly raising an empty hook, the hook winch would have a very low pressure requirement (least resistance) while having a high flow requirement. In this example, the majority of hydraulic fluid would flow through the pipelayer's hook circuit, leaving significantly less, and potentially insufficient, flow for the steering function. This is an extremely undesirable situation. For this type of reason, single pump differential steering systems have not

been successfully implemented on tractors including implements such as pipelayers, and therefore pipelayers have been primarily used on crawler tractors with mechanical steering clutches. A need, therefore, exists for a single pump differential steering system and method for a tractor including hydraulic implement, such as a pipelayer connected in parallel thereto, wherein the tractor steering system, or any other essential hydraulic system, is not affected by the hydraulic flow requirements of the implement (pipelayer).

SUMMARY OF THE INVENTION

The system of the present disclosure connects an implement hydraulic system to a single-pump, differential steer, crawler tractor's implement valve in parallel. The present load-flow system and process gives precedence to the tractor's essential operation which is in hydraulic fluid communication with an implement system (such as a pipelayer), by allowing the hydraulic power (pressure and flow) to be controlled in the essential operation independently of the hydraulic pressure requirements of the implement system. As a result, full control of the essential hydraulic operation is maintained regardless of the implement system demands. A secondary function and sub-process also allow either the tractor's essential operation, or the implement system, to dictate the implement pump's supply-pressure output. As used herein, the term essential operation shall include any system of the tractor which relates to its essential operation and function, such as, but not limited to, the steering system.

In its general form, the present disclosure includes a process for managing fluid flow for an essential operation and an implement connected in parallel to a single hydraulic pump. The process includes the steps of determining the essential operation fluid pressure requirement; determining the implement fluid pressure requirement; and maintaining said essential operation fluid pressure requirement by providing fluid flow to the essential operation regardless of the implement fluid pressure requirement.

In a preferred embodiment, the present disclosure includes a process for managing fluid flow requirements for a steering system and a pipelayer system connection in parallel to a single pump hydraulic system. The process includes the steps of:

(1) obtaining a steering system fluid pressure requirement from the essential operation system;

(2) obtaining a pipelayer fluid pressure requirement from the pipelayer system;

(3) determining a greatest system pressure requirement;

(4) transmitting the greatest system pressure requirement signal to the single pump hydraulic system;

(5) obtaining fluid flow from the single pump hydraulic system to maintain the greatest system pressure requirement; and

(6) maintaining fluid flow to satisfy the steering system fluid pressure requirement independent of the pipelayer system fluid pressure requirement.

Further aspects, features, and advantages of the present invention will be apparent to those of ordinary skill in the art upon examining the accompanying drawings and upon reading the following detailed description of the preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 depicts a schematic diagram of a single pump parallel hydraulic system including the apparatus and process of the present disclosure.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The system of the present disclosure in a preferred embodiment connects a pipelayer hydraulic system to a single-pump, differential steer, crawler tractor's implement valve in parallel. It gives precedence to the tractor's steering and implement system by allowing the hydraulic power (pressure and flow) to be controlled in the steering system independently of the hydraulic pressure requirements of the pipelayer system. In this way, full steering control is maintained regardless of the pipelayer system demands. A secondary function also allows either the tractor steering and implement system or the pipelayer system to dictate the implement pump's supply-pressure output. Without the system of the present disclosure installed, steering control of single-pump, differential steer, crawler tractors would be unreliable with a hydraulic pipelayer system installed.

With reference to FIG. 1, a tractor hydraulic steering system connected to a pipelayer hydraulic system in parallel **10** is disclosed. System **10** includes a tractor single-pump system **20**, the load flow hydraulic fluid flow apparatus of the present disclosure **30**, tractor steering system **40**, pipelayer system **50**, and tractor hydraulic tank **60**. In system **10**, load-flow apparatus **30** and pipelayer system **50** are preferably connected to the implement valve of a crawler tractor in parallel such that the tractor single pump **20** is in fluid communication with load-flow **30**, which is, in turn, in fluid communication with both the tractor steering system **40** and pipelayer system **50**. Tractor single pump **20**, tractor steering system **40**, and pipelayer system **50** are in fluid communication with tractor hydraulic tank **60**.

Hydraulic fluid is pumped by tractor single pump **20** from hydraulic tank **60**, shown by flow diagram **22**. Hydraulic fluid is pumped by the tractor single pump **20** into load flow apparatus **30**, as shown at **24**. Load flow apparatus **30** obtains the fluid

flow pressure requirements of the tractor steering system and provides hydraulic fluid flow to steering to tractor steering system **40**, as shown at **26**. Load flow apparatus **30** also obtains the fluid flow pressure requirements of pipelayer system **50** and provides fluid flow to pipelayer system **50** at **28**. Load flow apparatus **30** satisfies the fluid flow pressure requirements of tractor steering system **40** regardless and independent of the fluid flow pressure demands of pipelayer system **50**. Fluid is returned by tractor steering system **40** to hydraulic tank **60**, as shown at **32**. Fluid is returned by pipelayer system **50** to hydraulic tank **60**, as shown at **34**.

In operation, tractor steering system **40** provides a signal **42** to load flow apparatus **30** regarding the fluid flow pressure required for proper tractor steering system function. Pipelayer system **50** provides a signal **44** to load flow apparatus **30** regarding the fluid pressure requirement necessary for operation of the pipelayer system. From tractor steering pressure requirement signal **42** and pipelayer pressure requirement signal **44**, load flow apparatus **30** determines the greatest system pressure requirement necessary for the proper function of tractor steering system **40** and/or pipelayer system **50**. This is done by comparing the tractor steering system pressure requirement signal **42** with pipelayer pressure requirement signal **44**. Load flow apparatus **30** provides a signal **46** to tractor single pump **20** regarding this greatest system pressure requirement **46**. Load flow apparatus **30** may include a microprocessor for receiving signals **42** and **44** and for determining the greatest system pressure requirement, the microprocessor may also include as an output for providing the greatest system pressure requirement signal **46** to single pump system **20**.

In response to the greatest system pressure requirement signal **46**, the tractor single pump system **20** provides the fluid flow required to maintain the signaled greatest system pressure at **52**. Load flow apparatus **30** receives the flow required to

maintain the greatest signal system pressure **52** from tractor pump system **20**. Load flow apparatus **30** distributes the fluid flow required by tractor steering system **40** at the required pressure **54**. Load flow apparatus **30** also provides fluid flow to pipelayer system **50**. The fluid flow to pipelayer system **50** from load flow apparatus **30** is the pump flow required to maintain the greatest system signaled pressure **52** less the fluid flow requirements at the required steering pressure **54** required by steering system **40**. In this way, load flow apparatus **30** maintains at all times the required fluid flow to tractor steering system **40** at the required steering fluid pressure, regardless and independent of the pipelayer system **50**. In the event that the pipelayer system pressure requirement (per signal **44**) of pipelayer system **50** is less than the tractor steering system requirement (per signal **42**) of tractor steering system **40**, load flow apparatus **30** will provide the necessary fluid flow to tractor steering system **40** required to maintain the tractor steering pressure requirement without a pressure drop due to fluid flow taking the path of least resistance caused by the lower pressure request of pipelayer system **50**.

Load flow apparatus **30** may also provide the necessary fluid flow to maintain the required system pressure in either tractor steering system **40** or pipelayer system **50**, depending on which produces the greatest system pressure requirement, which then becomes the greatest system pressure requirement signal **46**. In this way, either the tractor steering system **40** or the pipelayer system **50** may dictate the pump flow **52** required to maintain the greatest system pressure (per signal 46).

* * * *

Thus, the present invention is well adapted to carry out the objects and attain the ends and advantages mentioned above as well as those inherent therein. While presently preferred embodiments have been described for purposes of this disclosure, numerous

changes and modifications will be apparent to those skilled in the art. Such changes and modifications are encompassed within the spirit of this invention as defined by the appended claims.

CLAIMS

What is claimed is:

1. A process for managing fluid flow requirements for a tractor steering system and a pipelayer system connected in parallel to a single pump hydraulic system, comprising::

determining the tractor steering system fluid pressure requirement;

obtaining fluid flow from the single pump hydraulic system;

providing fluid flow to satisfy the tractor steering system fluid pressure requirement; and

providing fluid flow to the pipelayer system independent of the fluid flow provided to satisfy the tractor steering system fluid pressure requirement.

2. The process of claim 1 further including determining the pipelayer system fluid pressure requirement.

3. The process of claim 2 wherein fluid flow is provided to the pipelayer system necessary to satisfy the pipelayer system fluid pressure requirement.

4. The process of claim 2 further including comparing the tractor steering system fluid pressure requirement and the pipelayer system fluid pressure requirement to determine a greatest system fluid pressure requirement.

5. The process of claim 4 including obtaining fluid flow from the single pump hydraulic system to satisfy the greatest system fluid pressure requirement.

6. A process for managing fluid flow for an essential operation and an implement connected in parallel to a single hydraulic pump, comprising:

determining the essential operation fluid pressure requirement;

determining the implement fluid pressure requirement; and

maintaining said essential operation fluid pressure requirement by providing fluid flow to the essential operation regardless of the implement fluid pressure requirement.

7. The process of claim 6 wherein fluid flow is provided to the implement necessary to satisfy the implement fluid pressure requirement.

8. The process of claim 6 further including comparing the essential operation fluid pressure requirement and the implement fluid pressure requirement to obtain a greatest system fluid pressure requirement.

9. The process of claim 6 further including obtaining fluid flow from said single hydraulic pump necessary to maintain said greatest system fluid pressure requirement.

10. The process of claim 9 including providing fluid flow to said implement at said implement fluid pressure requirement while maintaining said essential operation fluid pressure requirement.

11. A process for managing fluid flow requirements for an essential operation system and an implement system connected in parallel to a single pump hydraulic system, comprising:

obtaining an essential operation fluid pressure requirement from the essential operation system;

obtaining an implement fluid pressure requirement from the implement system;

determining a greatest system pressure requirement;

transmitting said greatest system pressure requirement signal the single pump hydraulic system;

obtaining fluid flow from said single pump hydraulic system to maintain said greatest system pressure requirement; and

maintaining an essential operation fluid flow to satisfy said essential operation fluid pressure requirement independent of said implement fluid pressure requirement.

12. The process of claim 11 including providing fluid flow to the implement system necessary to satisfy the implement fluid pressure requirement.

13. The process of claim 11 wherein the essential operation system is a tractor steering control system and the implement system is a pipelayer system.

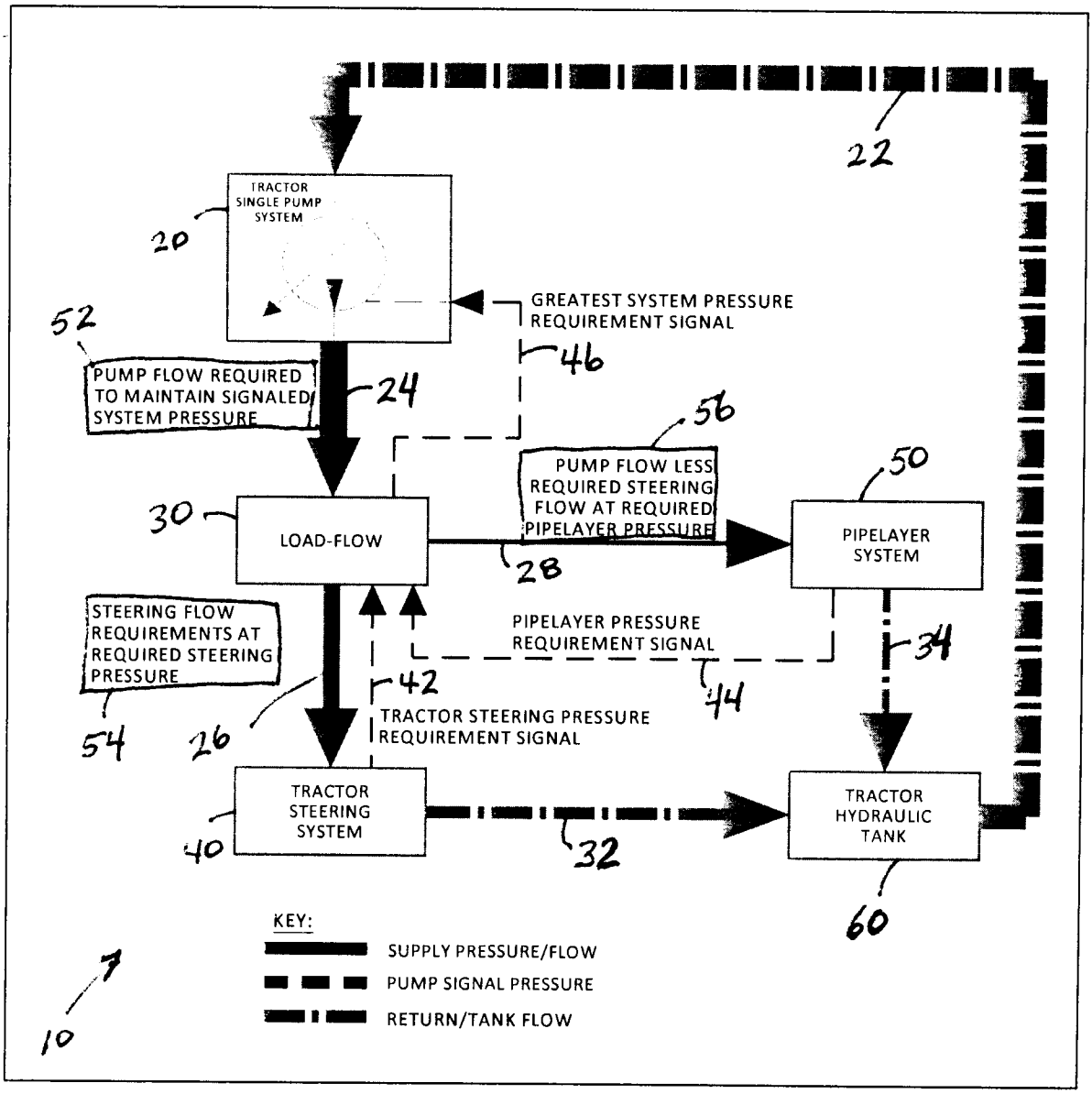
22
TRACTOR SINGLE PUMP SYSTEM
20
GREATEST SYSTEM PRESSURE REQUIREMENT SIGNAL
46
52
PUMP FLOW REQUIRED TO MAINTAIN SIGNALED SYSTEM PRESSURE
24
56
PUMP FLOW LESS REQUIRED STEERING FLOW AT REQUIRED PIPELAYER PRESSURE
50
30
LOAD-FLOW
28
PIPELAYER SYSTEM
STEERING FLOW REQUIREMENTS AT REQUIRED STEERING PRESSURE
54
PIPELAYER PRESSURE REQUIREMENT SIGNAL
34
44
42
26
TRACTOR STEERING PRESSURE REQUIREMENT SIGNAL
TRACTOR STEERING SYSTEM
40
32
TRACTOR HYDRAULIC TANK
60
KEY:
SUPPLY PRESSURE/FLOW
PUMP SIGNAL PRESSURE
RETURN/TANK FLOW
10

FIG. 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2010/002222

A. CLASSIFICATION OF SUBJECT MATTER

IPC: ***E02F 9/22*** (2006.01) , ***B62D 5/06*** (2006.01) , ***F15B 13/02*** (2006.01) , *F16L 1/024* (2006.01)

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 (2011.1): E02F 9/22, B62D 5/06, F15B 13/02, F16L 1/024

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)

EPOQUE(EPODOC), Canadian Patent Database

keywords: steer, parallel, hydraulic, fluid flow, pressure, single, pump

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 6889634 B1 (Roth, D. B.) 10 May 2005 (10-05-2005) *abstract, figure 2*	6-12 1-5, 13
Y	US 4637482 (Ohashi et al.) 20 January 1987 (20-01-1987) *column 1, lines 5-34*	1-5, 13
A	US 4343151 (Lorimor, L. W.) 10 August 1982 (10-08-1982) *abstract*	1-13
A	US 3952509 (Coleman, M. W.) 27 April 1976 (27-04-1976) *abstract*	1-13
A	US 2008/0078285 A1 (Cheong, H. K.) 03 April 2008 (03-04-2008) *abstract*	1-13

[ ] 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 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	Date of mailing of the international search report
15 March 2011 (15-03-2011)	6 April 2011 (06-04-2011)

Name and mailing address of the ISA/CA	Authorized officer
Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 001-819-953-2476	Alison Canteenwalla 934-8534

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IB2010/002222

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
US6889634B1	10-05-2005	CN1690373A	02-11-2005
		DE602005000063D1	21-09-2006
		DE602005000063T2	08-03-2007
		EP1586750A1	19-10-2005
		EP1586750B1	09-08-2006
		JP2005307976A	04-11-2005
		KR20060045751A	17-05-2006
		US2005232787A1	20-10-2005
		US7322800B2	29-01-2008
US4637482A	20-01-1987	JP61162603U	08-10-1986
		JP3033745Y2	17-07-1991
US4343151A	10-08-1982	CA1140835A1	08-02-1983
		DE3071511D1	24-04-1986
		EP0051603A1	19-05-1982
		EP0051603A4	06-04-1983
		EP0051603B1	19-03-1986
		JP57500601T	08-04-1982
		WO8103364A1	26-11-1981
US3952509A	27-04-1976	CA1045510A1	02-01-1979
US2008078285A1	03-04-2008	CN101153619A	02-04-2008
		EP1906030A2	02-04-2008
		JP2008082549A	10-04-2008
		KR100780897B1	30-11-2007