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(54) **Title**: FLAMELESS GLYCOL HEATER

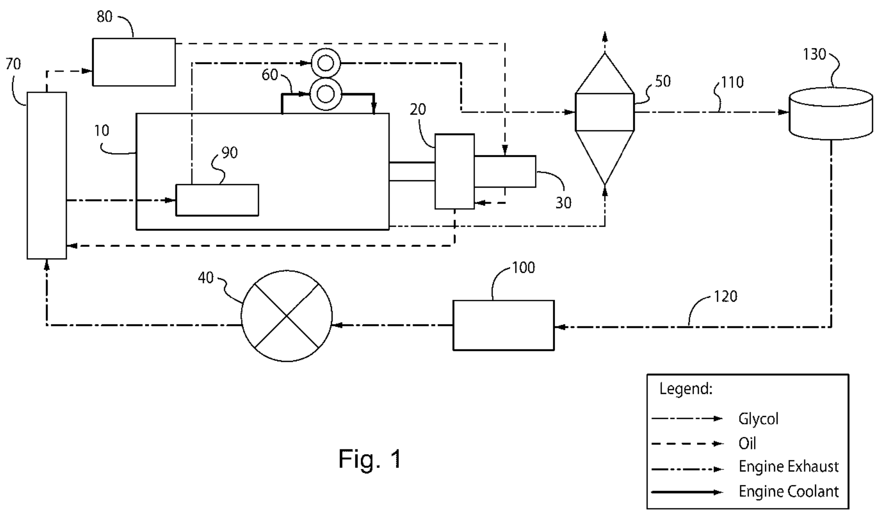

Fig. 1

(57) **Abstract**: A fluid heating process which does not utilize an open flame, heat is created by a rotating prime mover(s) driving a hydraulic heat generator. Heat is also collected from the prime mover cooling system, and any exhaust heat generated by the prime mover. The heat energy is collected from all these sources, and transmitted through heat exchangers to generate a hot fluid, which can be used to heat other fluids and used for any application where heat is required.

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FLAMELESS GLYCOL HEATER

BACKGROUND

This invention generally relates to processes used to heat and pump industrial fluids, where the heating process does not require an open flame.

Certain industrial applications require large volumes of heated fluid, such as water, glycol, hydrocarbons or caustic solutions. Although the present application is not limited to any one of these fluids, this application will refer to glycol as the heated fluid. Also, although many types of fluids, such as glycol and oil, may be used as a hydraulic heat generator fluid, this application will refer to oil as the heating fluid.

Specific environments may require that an open flame not be present. This commonly occurs in the energy industry. This fluid heating system and process described herein was created to heat fluids in these environments.

Common practice has been to truck water to several tanks located at an oil or gas well location. The water is heated by open flamed trucks which utilize diesel or propane fired burners. However, these burners are energy inefficient (*e.g.*, utilizing excessive amounts of fuel) and hazardous (*e.g.*, causing fires, severe burns, and fatalities).

A flameless heating system removes these hazards by supplying hot glycol (*e.g.*, temperature less than 100 degrees Celsius). There is no risk of explosion or burns due to open flames or high temperature steam. With the flameless heating system, once the tanks are filled, the heater is moved to the tank site, and heats the water, or any other fluid contained in the tanks, to a desired temperature. The heater generates hot glycol, which is pumped to the tanks. The tanks are equipped with a steam tube or similar heat exchanger that allows the hot glycol to transfer heat to the fluid in the tank. Multiple tanks can be heated, for example, by connecting them in series with hoses and quick connect couplers or with the use of a manifold and connected in parallel. The heating process is efficient and safe, making the best use of fuel in a flameless environment.

SUMMARY

One aspect of the present invention consists of a number of components connected in such a way that the process provides efficient and flameless heat. The components are generally trailer mounted, but may also be truck or skid mounted.

The largest component is a prime mover. The prime mover is most often a diesel engine; however, gasoline or natural gas engines, or an electric drive may also be used depending on the environmental considerations. Connected directly to a drive shaft of the prime mover is a hydraulic heat generator. This component utilizes a majority of power available from the prime mover, and converts this energy into heat. The hydraulic heat generator can either be built as one or more components. It consists of a hydraulic pump to provide pressure and flow for the heat generator.

The heat generator can be attached to the hydraulic pump or standalone and connected via a hydraulic hose. The heat generator provides heat, for example, by shearing oil. One way this is accomplished is by pumping the oil at high pressure and volume and forcing it through different sizes of orifices. This heat is transferred to the glycol through a liquid to liquid heat exchanger.

Also driven by the prime mover is the main pump to move the glycol through the system. This pump, for example, is typically a centrifugal pump, and allows movement of glycol through the heating unit, out to wherever it is needed by using hoses and is returned back to the heating unit. This is a closed loop system, so there is no contamination or loss of the glycol.

The remaining major components to the system are heat exchangers.

A first heat exchanger, for example, is a liquid-to-liquid heat exchanger, mentioned above, that transfers heat from the oil, generated by the hydraulic heat generator, to the glycol.

A second heat exchanger, for example, is also a liquid-to-liquid heat exchanger, which transfers heat generated in the engine coolant to the glycol. This fluid is pumped by the main pump, as mentioned above.

A third heat exchanger, for example, is an air-to-liquid heat exchanger, (*e.g.*, an intercooler) which transfers heat generated in the turbocharger compressor of the prime mover to the glycol.

A fourth heat exchanger, for example, is also an air-to-liquid heat exchanger, which transfers the heat generated in the engine exhaust to the glycol.

Other system components include, for example, a fuel tank to operate the engine, glycol and oil reservoirs, a trailer to house the components, and a control system to maintain operation of the system and alarm in the event of a mechanical failure.

The closed loop glycol heating process of the present invention has a capability of approximately 1.2M Btu.

BRIEF DESCRIPTION OF THE DRAWING

The following drawing illustrates an example of various components of the invention disclosed herein, and is for illustrative purposes only.

Fig. 1 is a schematic of one embodiment of a flameless glycol heater.

DETAILED DESCRIPTION

While the present invention may be embodied in many different forms, a number of illustrative embodiments are described herein with the understanding that the present disclosure is to be considered as providing examples of the principles of the invention and such examples are not intended to limit the invention to preferred embodiments described herein and/or illustrated herein.

Reference will now be made to Figure 1, a more detailed description of the flameless heat generation process. Each component will be described in detail, followed by an overview of the heat generation process.

The largest component of the flameless process, for example, is prime mover 10. The prime mover 10 can be any type of engine, fueled by a variety of fuels such as diesel, propane or natural gas. It can be electrical in certain applications. The fuel driven engines, for example, are typically set up like a marine engine, which will have a liquid cooled intercooler to cool and increase the density of the air travelling from the compressor side of the turbocharger to the engine intake. It will also have a liquid/engine coolant heat exchanger to keep the engine running within its ideal temperature range. For the purpose of this application the liquid used is glycol.

Attached to the prime mover 10 are heat generator 20 and hydraulic pump 30. Oil is pumped by the hydraulic pump 30 through the heat generator 20. In the heat generator 20 the oil is sheared under high pressure and volume by pumping it through orifices of different sizes. As stated previously, this hydraulic heat generator can be a combined unit or separate components. Between the engine 10 and hydraulic heat generator, for example, is a torsional vibration dampener (not shown), which is used to smooth out vibrations created by the prime mover 10. The use of the torsional vibration dampener, for example, extends the life of the output shaft and the hydraulic heat generator.

Centrifugal pump 40 (*e.g.*, glycol pump) is configured to pump glycol to the various components within the flameless heater and to wherever the hot glycol is needed. This is a closed loop system, where the glycol is continually circulated within the system.

Exhaust heat exchanger 50, in communication with the prime mover 10, is constructed, for example, of stainless steel or similar non corrosive material. In this example, the exhaust of the prime mover 10 enters the bottom of the heat exchanger 50, where it is directed upward to heat tube bundles containing glycol. Typically the exhaust gases enter the exhaust heat exchanger 50 at temperatures of up to 700 F (400 C) and exit the exhaust heat exchanger 50 at 70 F (25 C).

In this example, glycol is pumped through engine coolant/glycol heat exchanger 60 in order to keep the engine coolant within the appropriate operating range of the engine. This heat exchanger 60 is constructed, for example, of marine grade material.

In this example, heat exchanger 70 is configured to transfer heat from the oil to the glycol. Heat exchanger 70 is constructed, for example, of marine grade material.

In this example, reservoir tank 80 (e.g., oil reservoir) is configured to hold the oil. Reservoir tank 80 is typically 50 gallons (200 litres) in size and has an attached filter for filtering the oil. However, one of ordinary skill in the art would utilize varying sizes that are appropriate.

In this example, reservoir tank 100 (*e.g.*, glycol reservoir) is configured to hold the glycol. Reservoir tank 100 is typically 50 gallons (200 Litres) in size and has an attached filter for filtering the glycol. However, one of ordinary skill in the art would utilize varying sizes that are appropriate.

In this example, hose 110 and hose 120 are configured to transfer the glycol. Each of hoses 110 and 120 can be of various lengths and may be connected to other hoses with, for example, quick connect couplers.

In one example, the heating process consists of collecting heat from four different components and transferring it to the glycol. For example, the four heat source components are the hydraulic heat generator 20, engine coolant heat exchanger 60, engine intercooler 90 and the exhaust heat exchanger 50. The sequence of glycol flow can be in any order, for example, mostly depending on ease of piping within the flameless heater.

In this example, the heating process begins by starting the prime mover 10. Once the prime mover 10 has warmed up, the prime mover 10 is throttled up to maximum power and rpm. At this time the hydraulic heat generator begins to generate heat and the heat is transferred to the oil, which is pumped from the reservoir 80, through the hydraulic pump 30, through the heat generator 20, and through the heat exchanger 70. It is at the heat exchanger 70, for example, that heat is transferred from the oil to the glycol.

Once the fluid has passed through the heat exchanger 70, it is returned to the reservoir 80, where it is stored and filtered until it is pumped back through the cycle. The oil is in a closed system that continually follows this route. This is one source of heat.

From the outlet of the centrifugal pump 40, the glycol is pumped to the oil/glycol heat exchanger 70. In this example, the glycol is then pumped to intercooler 90. The purpose of the intercooler 90, for example, is to cool the air coming from the compressor side of the turbocharger. As the air is compressed by the turbocharger it is heated. By passing through the intercooler 90, this air is cooled by the glycol. This results in the air being cooled as well as the glycol being heated at the same time. This is the second source of heat.

The glycol continues from the intercooler 90 to the engine coolant heat exchanger 60. The heat exchanger 60 allows the heat from the hot coolant to be transferred to the glycol. Sufficient volume of glycol is pumped to keep the engine operating within its specified temperature range. This is the third source of heat.

After exiting the engine heat exchanger 60, the glycol is pumped to the exhaust heat exchanger 50. In this exchanger 50, the hot exhaust from the engine which can be at 700 F (400 C) is allowed to flow across a series of pipes that the glycol flows through. This exchanger 60 is sized so that the exhaust output temperature is at approximately 70 F (20-25 C). From the outlet of this heat exchanger 60 the glycol is pumped to the water tank 130 where the heat from the hot glycol is transferred to the water. From there it is returned to the glycol reservoir 100 until it is pumped through the system 1 again.

Although an embodiment of the instant invention has been described above and illustrated in the accompanying drawing in order to be more clearly understood, the above description is made by way of example and not as a limitation to the scope of the instant invention. It is contemplated that various modifications apparent to one of ordinary skill in the art could be made without departing from the scope of the invention which is to be determined by the following claims.

CLAIMS

We claim:

1. A flameless heater, comprising:

a first circulation path configured to circulate a heating fluid in said heater;

a second circulation path configured to circulate a heated fluid in said heater;

a prime mover arranged in the second circulation path, said prime mover including circulating engine coolant and engine exhaust;

a heat generator arranged in the first circulation path and configured to heat the heating fluid received from an oil reservoir;

a first heat exchanger arranged in both the first circulation path and the second circulation path, said first heat exchanger configured to transfer heat from the heating fluid received from the heat generator to the heated fluid received from the second circulation path;

a second heat exchanger arranged in the second circulation path downstream of the first heat exchanger, said second heat exchanger configured to transfer heat from the circulating engine coolant to the heated fluid received from the first heat exchanger; and

a third heat exchanger arranged in the second circulation path downstream of the second heat exchanger, said third heat exchanger configured to transfer heat from the engine exhaust received by the third heat exchanger from the prime mover to the heated fluid received by the third heat exchanger from the second heat exchanger.

2. The flameless heater of claim 1, further comprising:

a fourth heat exchanger arranged in the second circulation path at a position downstream of the first heat exchanger and upstream of the second heat exchanger, said fourth heat exchanger configured to transfer heat generated by compressed air to the heated fluid received from the first heat exchanger, wherein

the compressed air is generated by a compressor of the prime mover.

3. The flameless of claim 1, wherein said second circulation path is configured as a closed loop such that there is no contamination or loss of the heated fluid.

4. The flameless of claim 1, wherein the heating fluid is a hydraulic heat generator fluid.

5. The flameless heater of claim 1, wherein the heated fluid is glycol.

6. The flameless heater of claim 1, wherein the heat generator is connected to a drive shaft of the prime mover.

7. The flameless heater of claim 1, wherein the heat generator is a liquid-to-liquid heat exchanger configured to generate heat by pumping the heating fluid at a high pressure and volume through a plurality of orifices of varying sizes.

8. The flameless heater of claim 1, wherein the third heat exchanger is an air-to-liquid heat exchanger, transferring the heat generated in the exhaust gas to the heated fluid.

9. The flameless heater of claim 2, wherein the fourth heat exchanger is an air-to-liquid heat exchanger, transferring the heat generated in the compressor to the heated fluid.

10. The flameless heater of claim 1, wherein the third heat exchanger is configured such that the exhaust gas of the prime mover enters a bottom of the third heat exchanger and is directed upward to heat tubes containing the heated fluid.

11. A method for flamelessly heating a liquid, said method comprising:

moving a heating fluid through a first circulation path of a heater system;

moving a heated fluid through a second circulation path of the heater system;

powering a prime mover of the heater system;

heating the heating fluid with a heat generator arranged in the first circulating path;

conveying the heating fluid in the first circulation path from the heat generator to a first heat exchanger, said first heat exchanger arranged in both the first circulation path and the second circulation path;

transferring the heat from the heating fluid received from the heat generator to the heated fluid received from the second circulation path at the first heat exchanger;

conveying the heated fluid in the second circulation path from the first heat exchanger to a second heat exchanger, said second heat exchanger arranged downstream of the first heat exchanger;

transferring heat from a circulating engine coolant of the prime mover to the heated fluid received from the first heat exchanger at the second heat exchanger;

conveying the heated fluid in the second circulation path from the second heat exchanger to a third heat exchanger, said third heat exchanger arranged downstream of the second heat exchanger; and transferring heat generated from engine exhaust received by the third heat exchanger from the prime mover to the heated fluid received by the third heat exchanger from the second heat exchanger.

12. The method of claim 11, further comprising:

conveying the heated fluid in the second circulation path from the first heat exchanger to a fourth heat exchanger arranged in the second circulation path at a position downstream of the first heat exchanger and upstream of the second heat exchanger; and

transferring heat generated by compressed air to the heated fluid received from the first heat exchanger, wherein

the compressed air is generated by a compressor of the prime mover.

13. The method of claim 11, wherein said second circulation path is configured as a closed loop such that there is no contamination or loss of the heated fluid.

14. The method of claim 11, wherein the heating fluid is a hydraulic heat generator fluid.

15. The method of claim 11, wherein the heated fluid is glycol.

16. The method of claim 11, wherein the heat generator is connected to a drive shaft of the prime mover.

17. The method of claim 11, wherein the heat generator is a liquid-to-liquid heat exchanger configured to generate heat by pumping the heating fluid at a high pressure and volume through a plurality of orifices of varying sizes.

18. The method of claim 11, wherein the third heat exchanger is an air-to-liquid heat exchanger, transferring the heat generated in the exhaust gas to the heated fluid.

19. The method of claim 12, wherein the fourth heat exchanger is an air-to-liquid heat exchanger, transferring the heat generated in the compressor to the heated fluid.

20. The method of claim 11, wherein the third heat exchanger is configured such that the exhaust gas of the prime mover enters a bottom of the third heat exchanger and is directed upward to heat tubes containing the heated fluid.

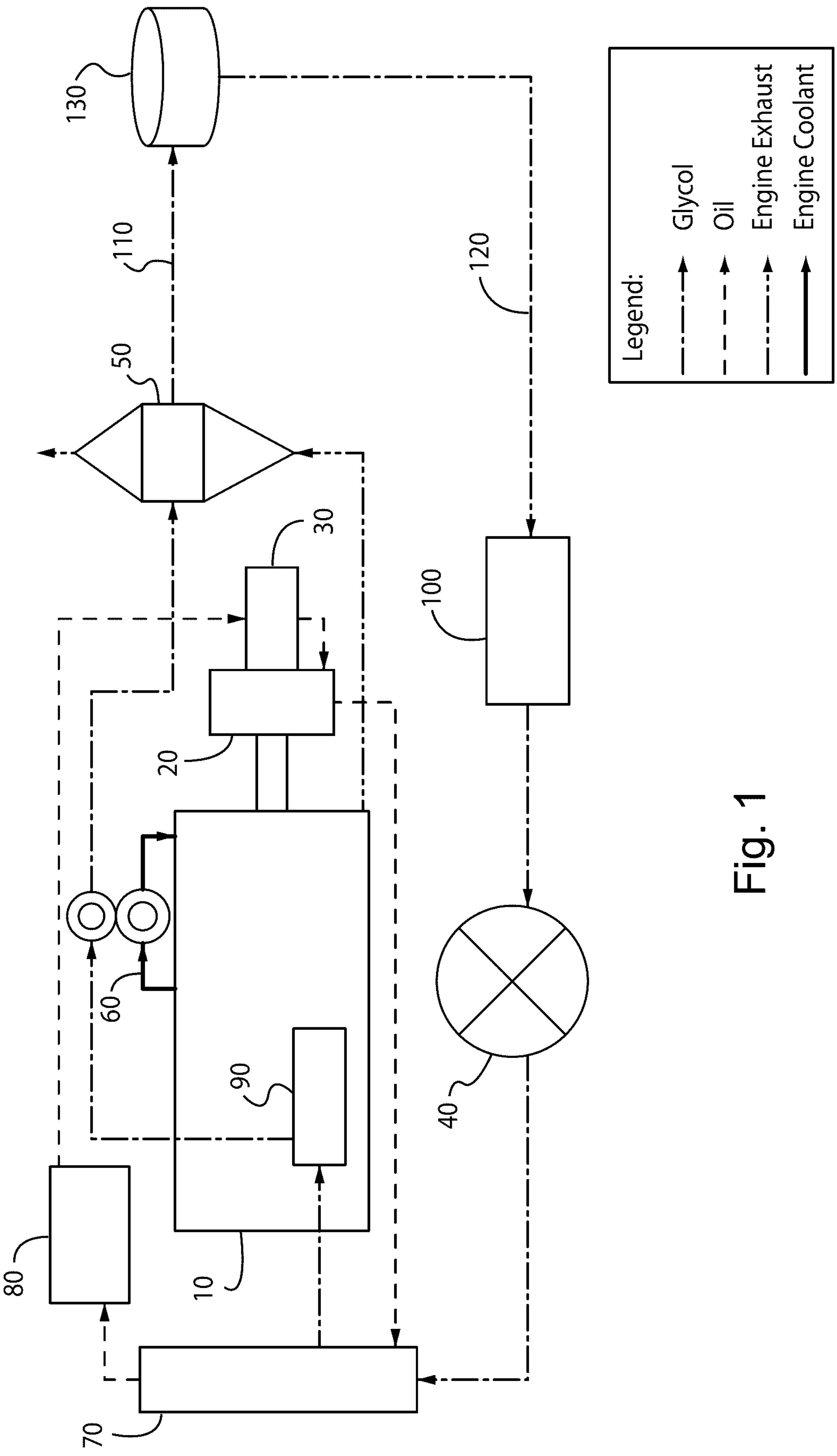
130
110
120
50
30
100
20
60
90
40
80
10
70
Legend:
Glycol
Oil
Engine Exhaust
Engine Coolant

Fig. 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2014/050919

A. CLASSIFICATION OF SUBJECT MATTER
IPC: ***F24H 1/22*** (2006.01) , ***E21B 41/00*** (2006.01) , ***F24H 1/38*** (2006.01) , ***F24H 9/14*** (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 (2006.01): F24H 1/22, 1/38, 9/14; E21B 41/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
None

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
Canadian Patent Database; Questel-Orbit (FamPat) (keywords: flameless, heater, pump, exhaust, internal combustion, prime mover, diesel, gasoline, fluid heater, water heater, glycol heater, and similar expressions).

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US2011005757A1 (HEBERT, J.) 13 January 2011 (13-01-2011) * Figures 1-3; paragraphs 0024-0032 *	1, 3-8, 10, 11, 13-18, and 20 2, 9, 12, and 19
Y	US2012048717A1 (FRICK, F.) 01 March 2012 (01-03-2012) * Figures 1-3; paragraphs 0043-0060 *	2, 9, 12, and 19
A	US2011297353A1 (STEGEMAN, J.) 08 December 2011 (08-12-2011) * Figures 1-5; paragraphs 0033-0042 *	
A	US7614367B1 (FRICK, F.) 10 November 2009 (10-11-2009) * Figures 1, 2; column 4, line 66-column 7, line 14 *	
X, P	US2014174691A1 (KAMPS, D. et al.) 26 June 2014 (26-06-2014) * The entire document *	1-20

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

*	Special categories of cited documents:	"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
"A"	document defining the general state of the art which is not considered to be of particular relevance	"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
"E"	earlier application or patent but published on or after the international filing date	"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
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"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		

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CA2014/050919

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
US2011005757A1 13	January 2011 (13-01-2011)	None	
US2012048717A1 01	March 2012 (01-03-2012)	US2012048717A1	01 March 2012 (01-03-2012)
		US7614367B1	10 November 2009 (10-11-2009)
		US2010154395A1	24 June 2010 (24-06-2010)
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		US2014021033A1	23 January 2014 (23-01-2014)
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US7614367B1	10 November 2009 (10-11-2009)	US7614367B1	10 November 2009 (10-11-2009)
		US2010154395A1	24 June 2010 (24-06-2010)
		US8371251B2	12 February 2013 (12-02-2013)
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		US2013075245A1	28 March 2013 (28-03-2013)
		US2013125842A1	23 May 2013 (23-05-2013)
		US2014021032A1	23 January 2014 (23-01-2014)
		US2014021033A1	23 January 2014 (23-01-2014)
US2014174691A1 26	June 2014 (26-06-2014)	None	