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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
20 September 2012 (20.09.2012)

WIPO | PCT

(10) International Publication Number
WO 2012/125154 A1

(51) International Patent Classification:
F02M 25/07 (2006.01)

(21) International Application Number:
PCT/US2011/028428

(22) International Filing Date:
15 March 2011 (15.03.2011)

(25) Filing Language: English

(26) Publication Language: English

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

Declarations under Rule 4.17:

— *as to the identity of the inventor (Rule 4.17(i))*

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

[Continued on next page]

(54) **Title**: COOLING SYSTEM

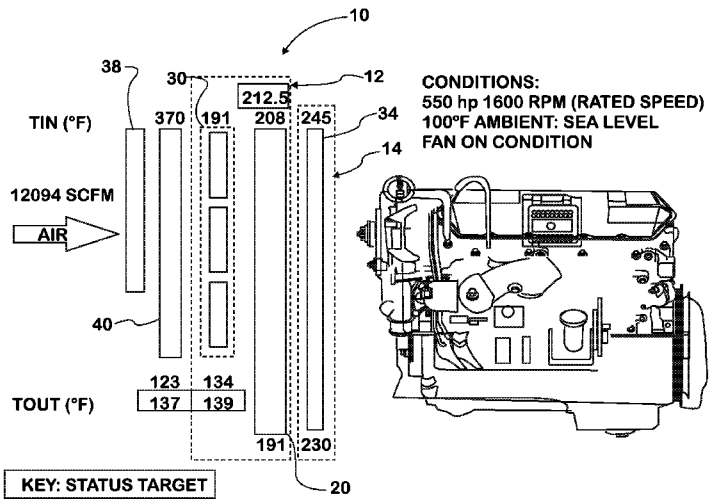


FIG. 2

(57) **Abstract**: A cooling system and method for use in an internal combustion engine having an exhaust gas recirculation system to reduce the engine thermal load, the cooling system having a first radiator and a second radiator, wherein the second radiator is adapted for high temperature heat absorption. The first radiator is positioned within a primary cooling circuit, which includes a pump for circulating a first coolant through the cooling circuit. The second radiator is positioned within a secondary cooling circuit separate from the first cooling circuit, wherein the secondary cooling circuit includes a pump for circulating a second coolant through the secondary cooling circuit resulting in effect dissipation of engine thermal load.

WO 2012/125154 A1

Published:

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

COOLING SYSTEM

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates to a cooling system for use in internal combustion engines. Particularly, the present invention relates to a dual cooling system for reducing and managing engine thermal load for an advanced EGR engine.

BACKGROUND OF THE INVENTION

[0002] Internal combustions engines convert chemical energy from a fuel into mechanical energy. The fuel may be petroleum-based (gasoline or diesel), natural gas, a combination thereof, or the like. Some internal combustion engines, such as gasoline engines, inject an air-fuel mixture into one or more cylinders for ignition by a spark from a spark plug or the like. Other internal combustion engines, such as diesel engines, compress air in the cylinder and then inject fuel into the cylinder for the compressed air to ignite. An internal combustion engine may use a camshaft system, a hydraulically activated electronically controlled unit injection (HEUI) system, or the like to control the fuel injection into the cylinders. In each cylinder, the ignited fuel generates rapidly expanding gases that actuate a piston in the cylinder. The piston usually is connected to a crankshaft or similar device for converting the reciprocating motion of the piston into rotational motion. The rotational motion from the crankshaft may be used to propel a vehicle, operate a pump or an electrical generator, or perform other work. The vehicle may be a truck, an automobile, a boat, or the like.

[0003] Most internal combustion engines have a cooling system to circulate coolant through the engine. The coolant removes heat from the engine during operation. The coolant may be water, an antifreeze fluid such as ethylene glycol, a combination thereof, or the like. The cooling system usually is connected to a radiator or other heat exchanger that removes heat from the coolant. The cooling system typically has a water or coolant pump that moves

coolant through the engine crankcase, around each cylinder, and into the cylinder head. The coolant may flow from the crankcase, through other components in the engine such as an oil cooler, and into the cylinder head. The coolant flows from the cylinder head, through the radiator, and returns to the coolant pump for continued circulation through the engine. The cooling system may have a thermostat to prevent coolant flow through the radiator when the engine is cold such as during engine startup.

[0004] Many internal combustion engines use an exhaust gas recirculation (EGR) system to reduce the production of nitrogen oxides (NO_x) during the combustion process in the cylinders. EGR systems typically divert a portion of the exhaust gases exiting the cylinders for mixing with intake air. The exhaust gas generally lowers the combustion temperature of the fuel below the temperature where nitrogen combines with oxygen to form nitrogen oxides (NO_x). Many EGR systems have an EGR cooler or heat exchanger that reduces the temperature of the exhaust gases. Generally, more exhaust gas can be mixed with the intake air when the exhaust gas temperature is lower. Additional exhaust gases in the intake air may further reduce the amount of NO_x produced by the engine.

[0005] Many EGR coolers use coolant from the engine's cooling system to reduce the temperature of the exhaust gases. Typically, the EGR cooler is connected to another engine component in series so that the same coolant flows through the other component and then the EGR cooler in sequence. In some internal combustion engines, the coolant flows sequentially from the coolant pump through the crankcase, through an oil cooler prior, and then through the EGR cooler. The coolant usually flows from the EGR cooler into the cylinder head, where it combines with coolant from the crankcase for return to the coolant pump.

[0006] Coolant circulating in the engine cooling loop has already absorbed combustion heat from the engine when it arrives at the EGR cooler. In the EGR cooler, additional heat is transferred to the coolant from the exhaust gas. The hot coolant then flows through the

radiator where heat is rejected to the ambient air. Because the coolant carries more heat from the EGR cooler than it would otherwise carry if it were only cooling the engine, more heat must be rejected in the radiator. In addition, just by their nature, diesel engine operate under extreme temperatures. Bigger radiators to dissipate this large amount of heat, however, are not an option, given the aerodynamic design of today's trucks. However, better management of the airflow to and through the radiator and cooling system overall may offer the desired heat dissipation in a diesel engine. Therefore, it would be advantageous to provide a system and method for reducing the thermal load on a diesel engine equipped with an EGR system, while meeting the high demands of emission standards, fuel efficiency, performance and compact design.

[0007] The system and method of the present invention provide the foregoing and other advantages.

SUMMARY OF THE INVENTION

[0008] There is disclosed herein and improved system and method for reducing and managing engine thermal load for an advanced EGR engine.

[0009] Generally speaking, the cooling system of an internal combustion engine having an advanced EGR system comprises a first radiator and a second radiator, wherein the second radiator is positioned downstream in an air flow path from the first radiator, the second radiator adapted for high temperature heat absorption and transfer.

[0010] In one aspect of the invention, the first radiator is included within a primary cooling circuit, wherein the primary cooling circuit includes a majority of the engine cooling system and further comprises a first pump, an auxiliary cooling circuit with a low temperature radiator and an interstage cooler.

[0011] In another aspect of the invention, the second radiator is included within a separate secondary cooling circuit, which further includes a second pump. The second pump

circulates a second coolant having a high heat transfer efficiency through the secondary cooling circuit and second radiator.

[0012] In another aspect of the invention, the cooling system comprises a primary cooling circuit having at least a first radiator and a pump for circulating a first fluid through the primary cooling circuit; and, a separate secondary cooling circuit having a second radiator and a second pump for circulating a second fluid through the secondary cooling circuit, wherein the secondary cooling circuit and second radiator are positioned behind the primary cooling circuit and first radiator.

[0013] In the method for dissipating the heat load generated by an internal combustion engine having an EGR system, the method comprises the steps of, providing a diesel engine having an exhaust gas recirculation system, the engine having a cooling system, providing a primary cooling circuit as part of the engine cooling system, the primary cooling circuit having a first high temperature radiator and a pump for circulating a fluid through the first radiator. The method further includes providing a separate secondary cooling circuit downstream in an air flow path from the primary cooling circuit, the secondary cooling circuit having a second high temperature radiator and a second pump for circulating a second fluid having a high heat efficiency, wherein the second radiator is capable of high heat transfer. The method also includes the step of creating an ambient air flow and utilizing a temperature change between the first radiator and the second radiator to absorb and dissipate the heat load generated by the engine.

[0014] These and other aspects of the invention may be understood more readily from the following description and the appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] For the purpose of facilitating an understanding of the subject matter sought to be protected, there are illustrated in the accompanying drawings embodiments thereof, from an

inspection of which, when considered in connection with the following description, the subject matter sought to be protected, its construction and operation, and many of its advantages should be readily understood and appreciated.

[0016] FIG. 1 is a block diagram of a cooling system for use in an internal combustion engine having an EGR system.

[0017] FIG. 2 is a schematic diagram of the cooling system components and method of heat dissipation for use in an internal combustion engine having an EGR system.

DETAILED DESCRIPTION OF THE INVENTION

[0018] While this invention is susceptible of embodiments in many different forms, there is shown in the drawings and will herein be described in detail a preferred embodiment of the invention with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the broad aspect of the invention to embodiments illustrated.

[0019] Referring to FIG. 1, there is illustrated a block diagram of a typical cooling system 10 for use in an internal combustion engine having an EGR system, and in particular, a diesel engine incorporating an EGR system. As known, the cooling system 10 circulates coolant through the components of engine to remove heat from the engine. This action is facilitated through the use of a fan drawing air through the front grill of the vehicle and over the engine and other hot components. The cooling system 10 of a diesel engine generally includes the following components: water jackets surrounding each cylinder, water passages within the engine block and head(s), water pump, radiator, engine fan and external electrical fan(s), thermostats, hoses, heat and temperature sensors and a change air cooler, located between the turbocharger and the intake manifold to lower the temperature of the intake air. Many of these components and their associated functions are well-known, and therefore, will not be described in detail unless where necessary for understanding the aspects of the present

cooling system. In addition, while a particular configuration may be shown and described, the present cooling system may have other arrangements or components depending on vehicle specifications and requirements.

[0020] The present cooling system 10 also incorporates various components relating to A/C and heating systems of the vehicle, which are also understood and will not be described in detail herein. Engines having EGR systems typically divert a portion of the exhaust gases exiting the cylinders for mixing with intake air. As is understood, many EGR systems have an EGR cooler or heat exchanger that reduces the temperature of the exhaust gases.

[0021] The cooling system 10 of the present application includes at least two separate cooling circuits or modules, a primary cooling circuit 12, and a secondary high temperature cooling circuit 14. The primary cooling circuit 12 is a closed loop system, forming the majority of the engine cooling system to transfer heat out of the engine block 16 and other components. The primary cooling circuit 12 includes at least the following components: a first coolant pump 18, a first radiator, radiator core or heat exchanger 20, at least one thermostat 22, an oil cooler 24, and an EGR cooler 26 .

[0022] As shown by the direction of the arrows in FIG. 1, under typical operating conditions, coolant or fluid is pumped from a reservoir 18a by the coolant pump 18 through hoses (not shown) to cool the engine block 16. The thermostat 22 regulates the coolant flow to the radiator 20 positioned at the front of the vehicle (not shown) and/or through a radiator by-pass 20a. When the coolant temperature is above the threshold level, the thermostat directs the coolant through the radiator 20, where it rejects the absorbed heat. When the coolant temperature is at or near the threshold temperature, the thermostat 22 may direct the coolant through both the radiator 20 and the radiator by-pass 20a. The first coolant pump 18, which may be the engine-driven coolant pump or an auxiliary pump, serves to circulate the first coolant through the primary cooling circuit. The first coolant of the primary cooling

circuit 12 may be water, an antifreeze compound like ethylene glycol, a combination thereof, or the like.

[0023] The primary cooling circuit 12 may also include a separate auxiliary cooling circuit 28, which includes a low temperature radiator 30, an intercooler 32 and a thermostat 34. The auxiliary cooling circuit 28 is part of the cold start loop, and may also include a low temperature radiator by-pass 28a. Circulation of coolant may be carried out intermittently between the cooling circuit 12 including the first radiator 20 and the auxiliary cooling circuit 28, depending on the operating temperature of the engine. Alternatively, coolant may by-pass the low temperature radiator 30, once the engine has reached the threshold operating temperature, and coolant is passing through the primary radiator 20.

[0024] As discussed, the primary cooling circuit 12 dissipates heat from the engine block 16 and surrounding components. In operation, the primary cooling circuit 12 is located behind the front grill of the vehicle (not shown), and utilizes ambient air drawn through the front of the vehicle by the engine fan (not shown) to dissipate the heat absorbed by the coolant within the radiator 20. However, it has been found that addition of a separate secondary cooling circuit 14 having a second high temperature radiator or heat exchanger 34, downstream in the air flow or behind the primary cooling circuit 12 and the primary radiator 20, further utilizes the engine fan power and temperature change between the radiators or heat exchangers, i.e., the temperature change in the coolant within the radiators, to effectively dissipate the heat generated operation of the engine.

[0025] The secondary cooling circuit 14 includes a second, high temperature radiator or heat exchanger 34 and at least a second pump 36 for pumping a coolant or fluid from a second reservoir 36a through the circuit. As shown in FIG. 2, the secondary cooling circuit 14 is also closed loop system, but completely separate from the primary cooling circuit 12. The secondary cooling circuit 14 may be located behind the primary cooling circuit 12.

Positioning the secondary cooling circuit 14 and the second radiator 34 behind or downstream from the primary cooling circuit 12 and the first radiator 20 provides an additional heat exchange core further down the air flow path to further utilize the fan power and temperature change between the radiators or cores. The increase temperature absorption capacity of the second radiator 34 increases the capability and efficiency of the cooling system 10 and allows for the addition of another heat exchanger that might otherwise not be utilized. Arrangement of the primary cooling circuit 12 and its associated components to the secondary cooling circuit 14 may vary depending on the configuration and requirements of the particular vehicle the cooling system is being used in.

[0026] The second radiator 34, or EGR radiator, is capable of running a coolant having a high boiling point, such as propylene glycol, which absorbs large amounts of heat without detriment. In this manner, a significant amount of heat can be transferred and absorbed by the second coolant, providing for more effective dissipation of heat from the engine. In turn, because the second radiator is capable of absorbing large amounts of heat, less burden is on the primary radiator 20 and the thermal capacity of the primary radiator 20 is likewise increased.

[0027] FIG. 2 shows a method for dissipating the heat load generated by an internal combustion engine having an EGR system. The method incorporates the primary cooling circuit 12 and the secondary cooling circuit 14, and respective radiators or heat exchangers 20 and 34, as previously discussed. Additional components include a condenser 38 for the A/C system and a charge air cooler 40 for cooling intake air. The charge air cooler 40, while not typically considered part of the cooling system, lowers the temperature of the intake air between the turbocharger (not shown) and the intake manifold (not shown). In a typical cooling system, a fan (not shown) draws ambient air through the front of the vehicle, reaching the first cooling circuit 12 and its components. Ambient air subsequently reaches

the secondary cooling circuit 14, and the EGR radiator 34, which is positioned downstream from the intake air flow through the front of the vehicle. As discussed, the increase heat load capacity of the second radiator 34 in combination with the first radiator 20 increases the overall thermal load dissipation of the engine. It should be understood that the location and configuration of the primary circuit and radiator and secondary circuit and radiator, as well as the other components of the cooling system, may vary depending on the specific requirements of the vehicle they are being used in.

[0028] FIG. 2 shows one embodiment of the method of dissipating the heat load for an engine using the present cooling system 10. The temperature of the coolant at the entry to the first radiator 20 is about 212.5°F while the temperature of the coolant exiting the first radiator is about 191°F. The coolant entry temperature at the second radiator 34 is about 245°F, while the coolant exiting the second radiator is about 230°F. Because the second radiator 34 operates at a much higher temperature capacity than the first radiator 20, it can absorb and reject a large amount of heat, contributing to an improvement in overall heat dissipation and better management of the engine thermal load. In turn, the thermal capacity of the first radiator 20 also increases, making it more efficient. The separation of cooling circuits or modules and their respective radiators or heat exchange components takes advantage of the thermal differences between the components, and fully utilizes the ambient air the engine fan draws through the cooling modules to further dissipate the heat load, which was not previously contemplated. In this manner, the use of auxiliary or remote mounted heat exchangers, which are expensive, difficult to package, and have a finite life span can be avoided.

[0029] The matter set forth in the foregoing description and accompanying drawings is offered by way of illustration only and not as a limitation. While particular embodiments have been shown and described, it will be apparent to those skilled in the art that changes and

modifications may be made without departing from the broader aspects of applicants' contribution. The actual scope of the protection sought is intended to be defined in the following claims when viewed in their proper perspective based on the prior art.

CLAIMS

What is claimed is:

1. A cooling system for use in an internal combustion engine having an exhaust gas recirculation system, the cooling system comprising;

a first radiator; and

a second radiator, wherein the second radiator is positioned downstream from the first radiator, the second radiator adapted for high temperature heat absorption and transfer.

2. The cooling system of claim 1, wherein the first radiator is included within a primary cooling circuit.

3. The cooling system of claim 2, wherein the primary cooling circuit further comprises a first pump and an auxiliary cooling circuit having a low temperature radiator and an interstage cooler.

4. The cooling system of claim 3, wherein the first pump circulates a first coolant through the primary cooling circuit and the first radiator.

5. The cooling system of claim 4, wherein the second radiator is included within a separate secondary cooling circuit.

6. The cooling system of claim 5, wherein the second radiator is an EGR radiator.

7. The cooling system of claim 5, wherein the secondary cooling circuit includes a second pump.

8. The cooling system of claim 7, wherein the second pump circulates a second coolant having a high heat transfer efficiency through the secondary cooling circuit and the second radiator.

9. A cooling system for use in an internal combustion engine having an exhaust gas recirculation system to reduce the engine thermal load, the cooling system comprising;

a first radiator positioned within a primary cooling circuit; and

a second radiator positioned within a separate secondary cooling circuit located downstream in an air flow path from the first radiator and the primary cooling circuit, the second radiator adapted for high temperature heat absorption.

10. The cooling system of claim 9, wherein the primary cooling circuit further comprises a first pump for circulating a first fluid through the primary cooling circuit and the first radiator, and an auxiliary cooling circuit including a low temperature radiator and an interstage cooler.

11. The cooling system of claim 9, wherein the second radiator is an EGR radiator.

12. The cooling system of claim 9, wherein the secondary cooling circuit includes a second pump for circulating a second fluid through the secondary cooling circuit and the second radiator.

13. The cooling system of claim 12, wherein the second fluid has a high heat transfer efficiency.

14. A cooling system for use in a diesel engine having an exhaust gas recirculation system, the cooling system comprising;

a primary cooling circuit having a first radiator and a pump for circulating a first fluid through the primary cooling circuit and the first radiator; and,

a secondary cooling circuit having a second radiator and a second pump for circulating a second fluid through the secondary cooling circuit and the second radiator, wherein the secondary cooling circuit and second radiator are positioned behind and separate from the primary cooling circuit and first radiator.

15. The cooling system of claim 14, wherein the primary cooling circuit further comprises an auxiliary cooling circuit including a low temperature radiator and an interstage cooler.

16. The cooling system of claim 14, wherein the second radiator is an EGR radiator.

17. The cooling system of claim 14, wherein the second fluid has a higher heat transfer efficiency than the first fluid.

18. A method for dissipating the heat load generated by an internal combustion engine having an exhaust gas recirculation system, the method comprising the steps of:

providing a primary cooling circuit having a first high temperature radiator; and

providing a separate secondary cooling circuit having a second high temperature radiator, wherein the secondary cooling circuit is located downstream in an ambient air flow path from primary cooling circuit.

19. The method of claim 18, wherein the primary cooling circuit further comprises an auxiliary cooling circuit including a low temperature radiator and an interstage cooler.

20. The method of claim 18, wherein the method further comprises the step of providing a pump for circulating a first fluid through the primary cooling circuit and the first radiator.

21. The method of claim 18, wherein the method further comprises the step of providing a second pump for circulating a second fluid having a higher heat transfer efficiency than the first fluid through the secondary cooling circuit.

22. The method of claim 18, wherein the method further comprises the step of creating an ambient air flow between the first radiator and the second radiator to absorb the heat load generated by the engine.

23. The method of claim 22, wherein the ambient air flow promotes a temperature change between the first radiator and the second radiator, wherein the second radiator is adapted for running at an elevated temperature to effectively adsorb the heat load generated by the engine.

24. The method of claim 23, wherein the second fluid within the second radiator absorbs and dissipates the heat load generated by the engine.

25. A method for dissipating a heat load generated by an internal combustion engine, the method comprising the steps of:

providing a diesel engine having an exhaust gas recirculation system, the engine having a cooling system;

providing a primary cooling circuit as part of the engine cooling system, the primary cooling circuit having a first high temperature radiator and a pump for circulating a fluid through the first radiator; and

providing a separate secondary cooling circuit downstream from the primary cooling circuit, the secondary cooling circuit having a second radiator and a second pump for circulating a second fluid having a high heat efficiency, wherein the second radiator is capable of high heat transfer; and,

creating an ambient air flow and providing a temperature change between the first radiator and the second radiator to adsorb and dissipate the heat load generated by the engine.

26. The method of claim 25, wherein the method further includes the step of providing an auxiliary cooling circuit including a low temperature radiator and an interstage cooler.

27. A method for dissipating a heat load generated by a diesel engine having an exhaust gas recirculation system, the method comprising the steps of:

providing a primary cooling circuit as part of a main engine cooling system including an auxiliary cooling circuit having a low temperature radiator and an interchange cooler, the primary cooling circuit further including a first high temperature radiator and a pump for circulating a cooling fluid through the first radiator; and

providing a separate secondary cooling circuit behind the primary cooling circuit, the secondary cooling circuit having a second high temperature radiator and a second pump for circulating a second cooling fluid having a high heat efficiency, wherein the second radiator is capable of high heat transfer; and,

creating an ambient air flow between the primary cooling circuit and the first radiator and the secondary cooling circuit and the second radiator; and,

utilizing a temperature change between the first radiator and the second radiator to effectively adsorb and dissipate the heat load generated by the engine.

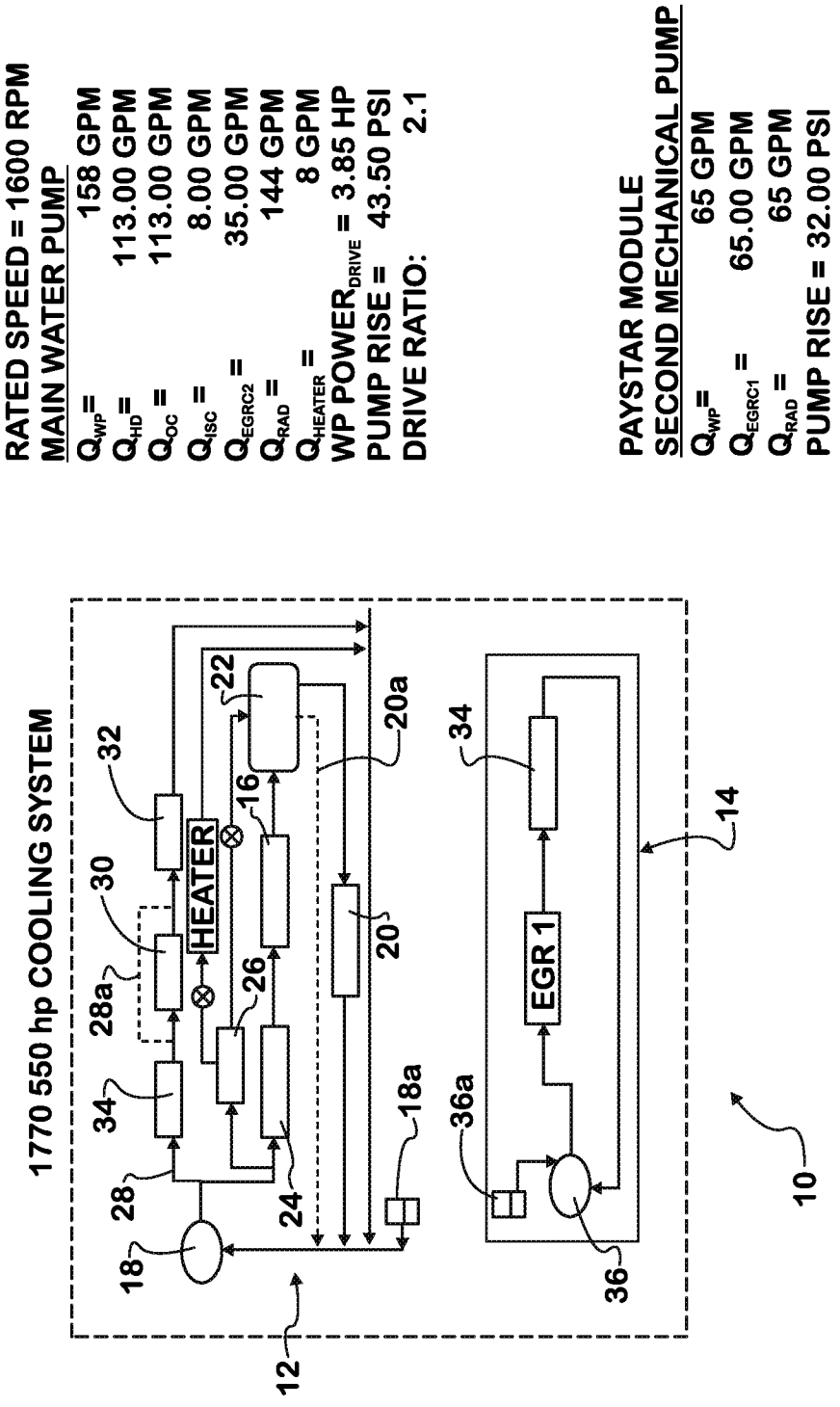

RATED SPEED = 1600 RPM
MAIN WATER PUMP
Q_{WP}= 158 GPM
Q_{HD}= 113.00 GPM
Q_{OC} = 113.00 GPM
Q_{ISC} = 8.00 GPM
Q_{EGRC2} = 35.00 GPM
Q_{RAD} = 144 GPM
Q_{HEATER} = 8 GPM
WP POWER$_{DRIVE}$ = 3.85 HP
PUMP RISE = 43.50 PSI
DRIVE RATIO: 2.1
PAYSTAR MODULE
SECOND MECHANICAL PUMP
Q_{WP}= 65 GPM
Q_{EGRC1} = 65.00 GPM
Q_{RAD} = 65 GPM
PUMP RISE = 32.00 PSI
1770 550 hp COOLING SYSTEM
HEATER
EGR 1
10
12
14
16
18
18a
20
20a
22
24
26
28
28a
30
32
34
34
36
36a

FIG. 1

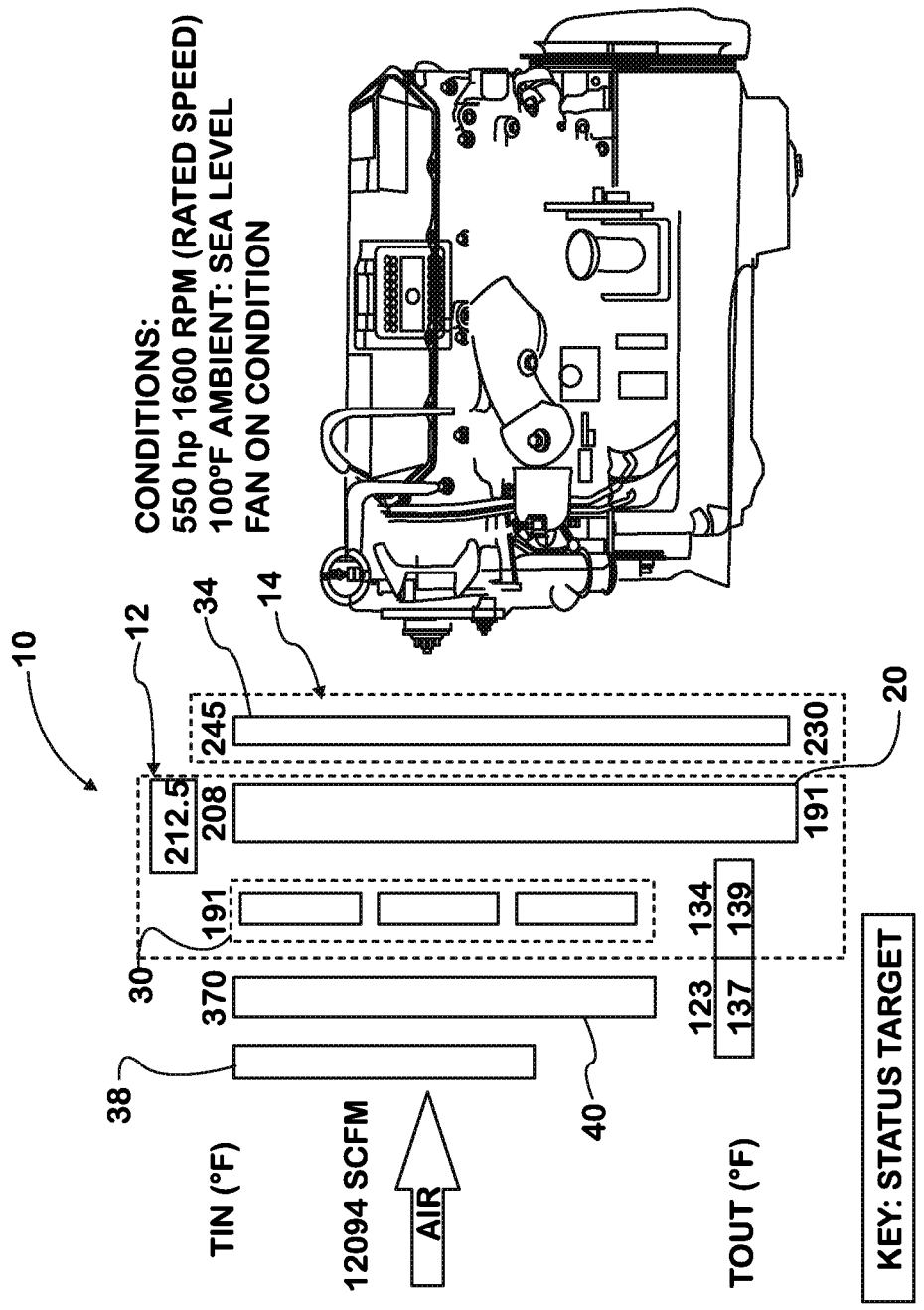

CONDITIONS:
550 hp 1600 RPM (RATED SPEED)
100°F AMBIENT: SEA LEVEL
FAN ON CONDITION
10
12
34
14
20
245
230
212.5
208
191
191
134
139
30
370
123
137
38
40
TIN (°F)
12094 SCFM
AIR
TOUT (°F)
KEY: STATUS TARGET

FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 11/28428

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - F02M 25/07 (2011.01)
USPC - 123/568.12
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(8) - F02M 25/07 (2011.01)
USPC - 123/568.12

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC - 60/274, 278, 599, 605.2; 123/41.01, 41.28, 41.29, 41.31, 41.42, 41.44, 41.48, 41.51, 41.55, 540, 568.11, FOR126; 165/41, 51, 52 (text search - see terms below)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PubWEST(USPT,PGPB,EPAB,JPAB); Google Scholar; Google Patents
Search Terms: second, auxiliary, radiator, cool, engine, downstream, behind, first, main, primary, EGR, circuit, pump, cooler, interstage, coolant, fluid, etc...

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 2006/0277906 A1 (Burk et al.) 14 December 2006 (14.12.2006), fig 1, para [0010]-[0015]	1-2 ------- 3-27
Y	US 2004/0216701 A1 (Hutchins) 04 November 2004 (04.11.2004), para [0027]	3-8, 10, 15, 19 and 26-27
Y	US 2006/0130888 A1 (Yamaguchi et al.) 22 June 2006 (22.06.2006), fig 1, para [0025]	5-27

☐ Further documents are listed in the continuation of Box C. ☐

* 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
02 May 2011 (02.05.2011)	19 MAY 2011
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774