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(54) **METHOD AND SYSTEM FOR CONTROLLING ELECTRONIC WATER PUMP OF ENGINE**

(57) The present invention provides a method for controlling an electronic water pump of an engine. The method includes: acquiring a target temperature of a water outlet of the engine and a basic pump speed of the electronic water pump; acquiring a PID control correction coefficient based on the target temperature of the water outlet of the engine and the measured temperature of the water outlet of the engine; acquiring an environment temperature correction coefficient, and acquiring a target revolving speed of the electronic water pump based on the basic pump speed of the electronic water pump, the PID control correction coefficient, and the environment

temperature correction coefficient; and controlling the electronic water pump of the engine by using the target revolving speed of the electronic water pump. The present invention also provides a system for controlling an electronic water pump of an engine. According to the present invention, the control of a target revolving speed of the electronic water pump is performed in two steps. Step 1, the target revolving speed of an electronic fan and a basic pump speed are output to realize the pre-control, thereby improving the system responsiveness. Step 2, the basic pump speed is corrected according to PID and an environment temperature together such that the

control precision is improved.

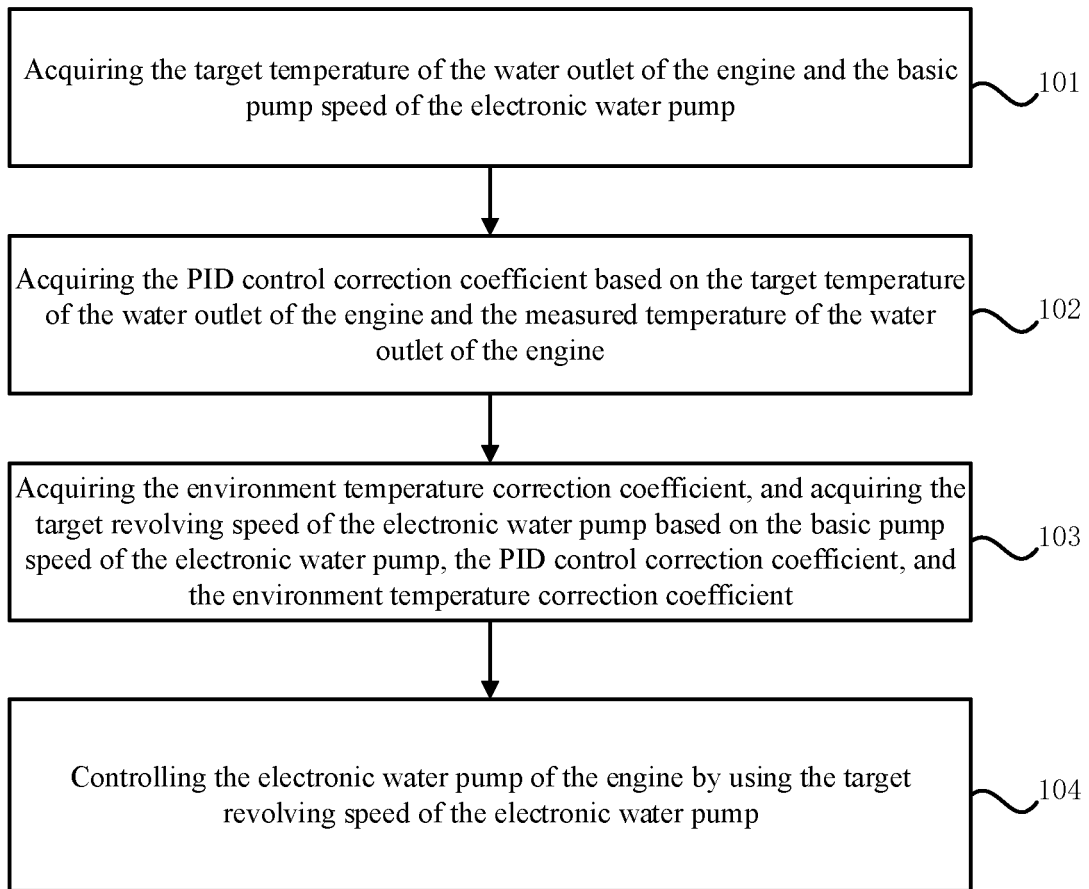


Figure 1

Description

Cross Reference

[0001] The application claims the priority to a Chinese Patent Application No. 201910069236.3, filed to the China National Intellectual Property Administration on January 24th, 2019, entitled "Method and system for controlling electronic water pump of engine", the entire content of which is incorporated herein by reference.

Technical Field

[0002] The present invention relates to the technical field of an engine cooling system, in particular to a method and a system for controlling an electronic water pump of an engine.

Background Art

[0003] An engine is a device for converting chemical energy into mechanical energy through combustion, generating a large amount of heat energy in the process. The engine itself must maintain a normal working temperature, so a suitable cooling system needs to be provided. At present, most vehicle engines adopt a mechanical water pump, and the pump speed of the mechanical water pump corresponds to the revolving speed of the engine at a certain ratio, namely the cooling water flow is only controlled by the revolving speed of the engine and cannot adapt to all working conditions, such as slowly climbing a slope, the revolving speed of the engine is low, and the cooling water flow is low. But the heat load is high such that the actual heat dissipation requirement of the engine cannot be met, the temperature of the engine is increased, and the operating efficiency is reduced.

[0004] The electronic water pump directly controls the revolving speed by an engine control unit, avoiding the influence of the revolving speed of the engine. The cooling water flow can be flexibly adjusted according to the actual heat dissipation requirement of the engine. Under the working condition of low flow requirement, if the output power of the electronic water pump is reduced, the oil consumption can be reduced. Under the condition of high flow requirement, the heat load can be reduced by increasing the output power of the electronic water pump such that the air inflow and the pre-ignition angle are further improved, and the torque output is improved. However, at present, some products of electronic water pumps are only used as additionally independent cooling systems and do not completely replace mechanical water pumps; the control of some products on the electronic water pump completely depends on PID adjustment, and the control stability is relatively poor; the target water temperature of the engine outlet under all working conditions of some products is the same value, leading to poor engine performance.

Summary of the Invention

[0005] On that account, the present invention is intended to propose a method for controlling an electronic water pump of an engine to solve the technical problems of the mechanical water pump and the electronic water pump.

[0006] In order to achieve the above object, the technical solutions of the present invention are realized as follows.

[0007] In one embodiment, the present invention provides a method for controlling an electronic water pump of an engine, the method comprising:

acquiring a target temperature of a water outlet of the engine and a basic pump speed of the electronic water pump;
acquiring PID control correction coefficient based on the target temperature of the water outlet of the engine and a measured temperature of the water outlet of the engine;
acquiring an environment temperature correction coefficient, and acquiring a target revolving speed of the electronic water pump based on the basic pump speed of the electronic water pump, the PID control correction coefficient, and the environment temperature correction coefficient;
controlling the electronic water pump of the engine by using the target revolving speed of the electronic water pump.

[0008] Further, acquiring a target temperature of a water outlet of the engine and a basic pump speed of the electronic water pump includes:

acquiring a heat load of a combustion system of the engine and the target temperature of the water outlet of the engine based on a revolving speed of the engine and a torque of the engine;
acquiring the basic pump speed of the electronic water pump based on the heat load of the combustion system of the engine and a measured temperature of a water outlet of a radiator.

[0009] Further, acquiring an environment temperature correction coefficient, and acquiring a target revolving speed of the electronic water pump based on the basic pump speed of the electronic water pump, the PID control correction coefficient, and the environment temperature correction coefficient include:

acquiring the environment temperature correction coefficient based on environment temperature;
acquiring the target revolving speed of the electronic water pump based on the basic pump speed of the electronic water pump, the PID control correction coefficient, and the environment temperature correction coefficient.

[0010] Further, acquiring the basic pump speed of the electronic water pump based on the heat load of the combustion system of the engine and a measured temperature of a water outlet of a radiator includes:

acquiring a target revolving speed of an electronic fan based on the heat load of the combustion system of the engine and the measured temperature of the water outlet of the radiator;
controlling the electronic water pump of the engine by using the target revolving speed of the electronic fan and the target revolving speed of the electronic water pump.

[0011] Further, the measured temperature of the water outlet of the engine is acquired by using the first temperature sensor mounted at the water outlet of the engine; and the measured temperature of the water outlet of the radiator is acquired by using a second temperature sensor mounted at the water outlet of the radiator.

[0012] Compared with the prior art, the method for controlling an electronic water pump of an engine according to the present invention has the following advantages.

[0013] According to the method of the present invention, the control of the target revolving speed of the electronic water pump is performed in two steps. Step 1, the target revolving speed of an electronic fan and a basic pump speed are output to realize the pre-control, thereby improving the system responsiveness. Step 2, the basic pump speed is corrected according to PID and the environment temperature together such that the control precision is improved.

[0014] Another object of the present invention is to propose a system for controlling an electronic water pump of an engine to solve the technical problems of the mechanical water pump and the electronic water pump.

[0015] In order to achieve the above object, the technical solutions of the present invention are realized as follows.

[0016] In one embodiment, the present invention provides a system for controlling an electronic water pump of an engine, the system comprising:

a first acquisition module for acquiring a target temperature of a water outlet of the engine and a basic pump speed of the electronic water pump;
a second acquisition module for acquiring PID control correction coefficient based on the target temperature of the water outlet of the engine and the measured temperature of the water outlet of the engine;
a third acquisition module for acquiring an environment temperature correction coefficient, and acquiring a target revolving speed of the electronic water pump based on the basic pump speed of the electronic water pump, the PID control correction coefficient, and the environment temperature correction coefficient;

a control module for controlling the electronic water pump of the engine by using the target revolving speed of the electronic water pump.

5 **[0017]** Further, the first acquisition module comprises:

a first acquisition submodule for acquiring a heat load of a combustion system of the engine and the target temperature of the water outlet of the engine based on a revolving speed of the engine and a torque of the engine;
a second acquisition submodule for acquiring the basic pump speed of the electronic water pump based on the heat load of the combustion system of the engine and a measured temperature of a water outlet of a radiator.

[0018] Further, the third acquisition module comprises:

a coefficient acquisition submodule for acquiring the environment temperature correction coefficient based on environment temperature;
a target revolving speed acquisition module for acquiring the target revolving speed of the electronic water pump based on the basic pump speed of the electronic water pump, the PID control correction coefficient, and the environment temperature correction coefficient.

30 **[0019]** Further, the control module comprises:

a third acquisition submodule for acquiring the target revolving speed of an electronic fan based on the heat load of the combustion system of the engine and the measured temperature of the water outlet of the radiator;
a control submodule for controlling the electronic water pump of the engine by using the target revolving speed of the electronic fan and the target revolving speed of the electronic water pump.

[0020] Further, the system further comprises:

a first temperature acquisition module for acquiring the measured temperature of the water outlet of the engine by using a first temperature sensor mounted at the water outlet of the engine;
a second temperature acquisition module for acquiring the measured temperature of the water outlet of the radiator by using a second temperature sensor mounted at the water outlet of the radiator.

[0021] In one embodiment, the present invention provides a computing processing equipment, comprising:

a memory storing computer readable code therein; one or more processors, wherein when the one or more processors execute the computer readable

code, the computing processing equipment executes the method for controlling an electronic water pump of an engine described above.

[0022] In one embodiment, the present invention provides a computer program, comprising the computer readable code which, when run on a computing processing equipment, causes the computing processing equipment to execute the method for controlling an electronic water pump of an engine described above.

[0023] In one embodiment, the present invention provides a computer readable medium storing therein the computer program described above.

[0024] Compared with the prior art, the system for controlling an electronic water pump of an engine according to the present invention has the following advantages.

[0025] According to the system of the present invention, the control of the target revolving speed of the electronic water pump is performed in two steps. Step 1, the target revolving speed of an electronic fan and a basic pump speed are output to realize the pre-control, thereby improving the system responsiveness. Step 2, the basic pump speed is corrected according to PID and the environment temperature together such that the control precision is improved.

[0026] The above description is merely an outline of the technical solutions of the present invention. In order that the technical means of the present invention may be more clearly understood, it may be implemented according to the content of the description. In order that the above and other objects, features, and advantages of the present invention may be more clearly understood, specific implementation modes of the present invention are hereinafter set forth.

Brief Description of the Drawings

[0027] In order to explain the embodiments of the present invention or the technical solution in the prior art more clearly, the following will briefly introduce the drawings that need to be used in the description of the embodiments or the prior art. Obviously, the drawings in the following description are some embodiments of the present invention. For those of ordinary skills in the art, other drawings can be obtained based on these drawings without creative efforts.

Fig. 1 is a flowchart illustrating steps of a method for controlling an electronic water pump of an engine according to an embodiment of the present invention;

Fig. 2 is a flowchart of a method for controlling an electronic water pump of an engine according to an embodiment of the present invention;

Fig. 3 is a block diagram of a structure of a system for controlling an electronic water pump of an engine according to an embodiment of the present invention;

Fig. 4 schematically shows a block diagram of a computing processing equipment for executing the method according to the present invention;

Fig. 5 schematically shows a storage unit for holding or carrying a program code implementing the method according to the present invention.

Detailed Embodiments

[0028] In order to make the objects, technical solutions, and advantages of the embodiments of the present invention clearer, the technical solutions of the embodiments of the present invention will be clearly and completely described with reference to the drawings in the embodiments of the present invention, and obviously, the described embodiments are part of the embodiments of the present invention, not all embodiments. Based on the embodiments of the present invention, all other embodiments obtained by a person of ordinary skills in the art without involving any inventive effort are within the scope of the present invention.

[0029] Referring to Figs. 1 and Figs. 2, an embodiment of the present invention provides a method for controlling an electronic water pump of an engine, the method including steps as follows.

[0030] Step 101, acquiring the target temperature of the water outlet of the engine and the basic pump speed of the electronic water pump.

[0031] In the embodiment, the heat load of the combustion system of the engine and the target temperature of the water outlet of the engine are acquired by using the revolving speed of the engine, the torque of the engine, and a preset first relationship, and the basic pump speed of the electronic water pump is acquired based on the heat load of the combustion system of the engine, the measured temperature of the water outlet of the radiator, and a preset second relationship. The preset first relationship is generated based on previous experimental data. The experimental data includes a preset temperature of the water outlet of the engine, revolving speed and torque of the engine required to reach the temperature obtained by using the preset temperature of the water outlet of the engine, and the heat load of the combustion system of the engine acquired by using the revolving speed and the torque of the engine. The preset second relationship is also generated based on previous experimental data including the previously obtained heat load of the combustion system of the engine, the measured temperature of the water outlet of the radiator measured in real time, and the obtained basic pump speed of the electronic water pump.

[0032] Step 102, acquiring a PID control correction coefficient based on the target temperature of the water outlet of the engine and the measured temperature of the water outlet of the engine.

[0033] In the embodiment, acquiring a PID control correction coefficient of a temperature sensor based on the target temperature of the water outlet of the engine and

the measured temperature of the water outlet of the engine includes: when the target temperature of the water outlet of the engine is higher than the measured temperature of the water outlet of the engine, setting the PID control correction coefficient of the temperature sensor to a number smaller than 1, and more specifically as follows: the larger the numerical value of the target temperature of the water outlet of the engine higher than the measured temperature of the water outlet of the engine is, the smaller the PID control correction coefficient of the temperature sensor is, and the smaller the numerical value of the target temperature of the water outlet of the engine higher than the measured temperature of the water outlet of the engine is, the larger the PID control correction coefficient of the temperature sensor is. For example, when the target temperature of the water outlet of the engine is 85°C, the measured temperature of the water outlet of the engine is 82°C, and the PID correction coefficient is 0.96; when the target temperature of the water outlet of the engine is 85°C, the measured temperature of the water outlet of the engine is 84°C, and the PID correction coefficient is 0.98.

[0034] When the target temperature of the water outlet of the engine is lower than the measured temperature of the water outlet of the engine, the PID control correction coefficient of the temperature sensor is set to be a number larger than 1, more specifically as follows, the larger the numerical value of the target temperature of the water outlet of the engine lower than the measured temperature of the water outlet of the engine is, the larger the PID control correction coefficient of the temperature sensor is, and the smaller the numerical value of the target temperature of the water outlet of the engine lower than the measured temperature of the water outlet of the engine is, the smaller the PID control correction coefficient of the temperature sensor is. For example, when the target temperature of the water outlet of the engine is 90°C, the measured temperature of the water outlet of the engine is 92°C, and the PID correction coefficient is 1.02; when the target temperature of the water outlet of the engine is 85°C, the measured temperature of the water outlet of the engine is 95°C, and the PID correction coefficient is 1.12.

[0035] Step 103, acquiring an environment temperature correction coefficient, and acquiring a target revolving speed of the electronic water pump based on the basic pump speed of the electronic water pump, the PID control correction coefficient, and the environment temperature correction coefficient.

[0036] In the embodiment, the target revolving speed of the electronic water pump is determined by the basic pump speed of the electronic water pump, the PID control correction coefficient, and the environment temperature correction coefficient together. When the PID control correction coefficient and the environment temperature correction coefficient are larger than 1, the target revolving speed of the electronic water pump is larger than the basic pump speed of the electronic water pump; when

the PID control correction coefficient and the environment temperature correction coefficient are smaller than 1, the target revolving speed of the electronic water pump is smaller than the basic pump speed of the electronic water pump; in a more specific embodiment, when the basic pump speed of the electronic water pump is 45000r/min, the PID control correction coefficient is 1.03, and the environment temperature correction coefficient is 1.02, the target revolving speed of the electronic water pump is 47277r/min; when the basic pump speed of the electronic water pump is 10000r/min, the PID control correction coefficient is 0.96, and the environment temperature correction coefficient is 0.98, the target revolving speed of the electronic water pump is 9408r/min.

[0037] Step 104, controlling the electronic water pump of the engine by using the target revolving speed of the electronic water pump.

[0038] In the embodiment, the control of the target revolving speed of the electronic water pump is performed in two steps. Step 1, the basic pump speed of the electronic water pump is directly output according to the heat load of the combustion system of the engine and the measured temperature of the water outlet of the radiator to realize the pre-control, thereby improving the system responsiveness. Step 2, the basic pump speed of the electronic water pump is corrected according to the PID and the environment temperature together such that the control precision is improved.

[0039] Further, acquiring the target temperature of the water outlet of the engine and the basic pump speed of the electronic water pump includes:

acquiring a heat load of the combustion system of the engine and the target temperature of the water outlet of the engine based on a revolving of the engine speed and a torque of the engine;
acquiring the basic pump speed of the electronic water pump based on the heat load of the combustion system of the engine and a measured temperature of a water outlet of a radiator.

[0040] In the embodiment, the relationship about the revolving speed of the engine, the torque of the engine, and the heat load of the combustion system of the engine is specifically as follows: the higher the revolving speed of the engine is, the higher the torque of the engine is, and the higher the heat load of the combustion system of the engine is. That is to say, there is a positive strong correlation about the heat load of the combustion system of the engine, the revolving speed of the engine and the torque of the engine. In particular, the higher the revolving speed is, the higher the torque is, and the higher the heat load is. For example: when the revolving speed of the engine is 4000r/min and the torque of the engine is 260Nm, the heat load of the combustion system of the engine is 0.65; when the revolving speed of the engine is 1400r/min and the torque of the engine is 40Nm, the heat load of the combustion system of the engine is 0.2.

In the embodiment, likewise, there is also a positive strong correlation about the revolving speed of the engine, the torque of the engine, and the target temperature of the water outlet of the engine. The higher the revolving speed is, the higher the torque is, and the higher the target temperature of the water outlet of the engine is. But when the torque and the revolving speed are increased to a certain area, the target temperature of the water outlet will reach the upper limit and will not be continuously increased. For example: when the revolving speed of the engine is 4000r/min and the torque of the engine is 260Nm, the target temperature of the water outlet of the radiator is 90°C; when the revolving speed of the engine is 1400r/min and the torque of the engine is 40Nm, the target temperature of the water outlet of the radiator is 83°C.

[0041] In the embodiment, there is a strong correlation about the basic pump speed of the electronic water pump, the heat load of the combustion system of the engine and the measured temperature of the water outlet of the radiator. For example: when the heat load of the combustion system of the engine is 0.65 and the measured temperature of the water outlet of the radiator is 95°C, the basic pump speed of the electronic water pump is 45000r/min. When the heat load of the combustion system of the engine is 0.2 and the measured temperature of the water outlet of the radiator is 80°C, the basic pump speed of the electronic water pump is 10000r/min. In the embodiment, when the heat load of the combustion system of the engine is large and the measured temperature of the water outlet of the radiator is high, the target revolving speed of the electronic fan is relatively adjusted to be high, and when the heat load of the combustion system of the engine is small and the measured temperature of the water outlet of the radiator is low, the electronic fan does not need to be turned on. For example: when the heat load of the combustion system of the engine is 0.65 and the measured temperature of the water outlet of the radiator is 95°C, the target revolving speed of the electronic fan is 4000r/min. When the heat load of the combustion system of the engine is 0.2 and the measured temperature of the water outlet of the radiator is 80°C, the target revolving speed of the electronic fan is 0r/min.

[0042] Further, acquiring an environment temperature correction coefficient, and acquiring a target revolving speed of the electronic water pump based on the basic pump speed of the electronic water pump, the PID control correction coefficient, and the environment temperature correction coefficient include:

acquiring the PID control correction coefficient based on the target temperature of the water outlet of the engine and the measured temperature of the water outlet of the engine;
acquiring an environment temperature correction coefficient based on the environment temperature;
and acquiring a target revolving speed of the elec-

tronic water pump based on the basic pump speed of the electronic water pump, the PID control correction coefficient, and the environment temperature correction coefficient.

[0043] In the embodiment, the environment temperature correction coefficient is a number close to 1. When the environment temperature is high, the environment temperature correction coefficient is correspondingly set to be a little large, and when the environment temperature is low, the environment temperature correction coefficient is correspondingly set to be a little small. In a more specific embodiment, the environment temperature correction coefficient is 1.02 when the environment temperature is 40°C, and 0.96 when the environment temperature is 0°C.

[0044] Further, acquiring the basic pump speed of the electronic water pump based on the heat load of the combustion system of the engine and a measured temperature of a water outlet of a radiator includes:

acquiring a target revolving speed of the electronic fan based on the heat load of the combustion system of the engine and the measured temperature of the water outlet of the radiator;
controlling the electronic water pump of the engine by using the target revolving speed of the electronic fan and the target revolving speed of the electronic water pump.

[0045] In the embodiment, the heat load of the combustion system of the engine and the target temperature of the water outlet of the engine are acquired by using the revolving speed of the engine, the torque of the engine, and the preset first relation, and the target revolving speed of the electronic fan is acquired based on the heat load of the combustion system of the engine, the measured temperature of the water outlet of the radiator, and the preset second relation. The preset first relationship is generated based on previous experimental data. The experimental data includes a preset temperature of the water outlet of the engine, revolving speed and torque of the engine required to reach the temperature obtained by using the preset temperature of the water outlet of the engine, and the heat load of the combustion system of the engine acquired by using the revolving speed and the torque of the engine. The preset second relationship is also generated based on previous experimental data including the previously obtained heat load of the combustion system of the engine, the measured temperature of the water outlet of the radiator measured in real time, and the obtained target revolving speed of the electronic fan.

[0046] In the embodiment, the control of the target revolving speed of the electronic water pump is performed in two steps. Step 1, the target revolving speed of the electronic fan and the basic pump speed are directly output according to the heat load of the combustion system

of the engine and the measured temperature of the water outlet of the radiator to realize the pre-control, thereby improving the system responsiveness. Step 2, the basic pump speed is corrected according to the PID and the environment temperature together such that the control precision is improved. In the embodiment, only the target revolving speed of the electronic water pump is corrected, and the target revolving speed of the electronic fan is not corrected. Because the electronic fan responds slower than the electronic water pump, the stability of the system for correcting the target revolving speed of the electronic fan is higher.

[0047] Further, the measured temperature of the water outlet of the engine is acquired by using the first temperature sensor mounted at the water outlet of the engine.

[0048] The measured temperature of the water outlet of the radiator is acquired by using the second temperature sensor mounted at the water outlet of the radiator.

[0049] In the embodiment, the first temperature sensor is used for measuring the measured temperature of the water outlet of the engine in real time such that the electronic water pump is accurately controlled.

[0050] The measured temperature of the water outlet of the radiator is measured in real time by using the second temperature sensor such that the electronic water pump is accurately controlled.

[0051] In the embodiment, the control of the target revolving speed of the electronic water pump is performed in two steps. Step 1, the target revolving speed of the electronic fan and the basic pump speed are directly output according to the heat load of the combustion system of the engine and the measured temperature of the water outlet of the radiator to realize the pre-control, thereby improving the system responsiveness. Step 2, the basic pump speed is corrected according to the PID and the environment temperature together such that the control precision is improved. The temperature is the manifestation of the heat load, the heat load transfers heat to the wall surface through the combustion chamber, and the heat is taken away by the cooling water so the temperature of the cooling water is increased. Then the cooling water at the wall surface flows to the temperature sensor which needs a certain period of time resulting in hysteresis. For example, the heat load is sharply increased in a sudden acceleration process, but at such time the temperature at the sensor hardly changes. If the electronic water pump is only controlled by the PID of the temperature sensor, the revolving speed of the electronic water pump does not change, that is, the heat dissipation amount of the combustion chamber does not change. However, a large heat dissipation amount is needed at the time such that it is ensured that local overheating of the combustion chamber does not occur to damage the engine. If a pre-control mode of directly outputting the target revolving speed of the electronic fan and the basic pump speed according to the heat load of the combustion system of the engine and the measured temperature of the water outlet of the radiator is adopted, the revolving

speed of the electronic water pump will immediately react such that the revolving speed is increased, the heat dissipation amount is increased, and the local overheating of the combustion chamber is prevented. Therefore, compared with the PID control only according to temperature, the pre-control improves the responsiveness and ensures the safety of the engine. Because of scattered errors in production, the electronic water pump may not reach the target temperature of the water outlet of the engine under the condition of the basic pump speed. So PID correction is carried out to improve the control precision. In addition, because the heat dissipation amount is strongly correlated with the environment temperature, the lower the environment temperature is, the more favorable it is to the heat dissipation of the cooling water, and the revolving speed of the electronic water pump can be reduced to achieve the same heat dissipation effect, and on the contrary, the revolving speed of the electronic water pump needs to be increased to reach the same heat dissipation effect such that the environment temperature correction coefficient is increased, and the control precision is further improved; according to the embodiment, the target revolving speed of the electronic fan is not corrected, and it is because the electronic fan responds slower than the electronic water pump such that the stability of the system for correcting the target revolving speed of the electronic fan is higher.

[0052] Referring to Fig. 3, the present invention also provides a system for controlling an electronic water pump of an engine, the system including:
a system for controlling an electronic water pump of an engine, the system including:

a first acquisition module 301 for acquiring a target temperature of a water outlet of the engine and a basic pump speed of an electronic water pump;
a second acquisition module 302 for acquiring a PID control correction coefficient based on the target temperature of the water outlet of the engine and the measured temperature of the water outlet of the engine;
a third acquisition module 303 for acquiring an environment temperature correction coefficient, and acquiring a target revolving speed of the electronic water pump based on the basic pump speed of the electronic water pump, the PID control correction coefficient, and the environment temperature correction coefficient;
a control module 304 for controlling the electronic water pump of the engine by using the target revolving speed of the electronic water pump.

[0053] Further, the first acquisition module 301 includes:

a first acquisition submodule for acquiring a heat load of a combustion system of the engine and the target temperature of the water outlet of the engine based

on a revolving speed of the engine and a torque of the engine;

a second acquisition submodule for acquiring the basic pump speed of the electronic water pump based on the heat load of the combustion system of the engine and a measured temperature of a water outlet of a radiator.

[0054] Further, the third acquisition module 303 includes:

a coefficient acquisition submodule for acquiring the environment temperature correction coefficient based on the environment temperature;

a target revolving speed acquisition module for acquiring a target revolving speed of the electronic water pump based on the basic pump speed of the electronic water pump, the PID control correction coefficient, and the environment temperature correction coefficient.

[0055] Further, the control module 304 includes:

a third acquisition submodule for acquiring the target revolving speed of an electronic fan based on the heat load of the combustion system of the engine and the measured temperature of the water outlet of the radiator;

a control submodule for controlling the electronic water pump of the engine by using the target revolving speed of the electronic fan and the target revolving speed of the electronic water pump.

[0056] Further, the system further includes:

a first temperature acquisition module for acquiring the measured temperature of the water outlet of the engine by using a first temperature sensor mounted at the water outlet of the engine;

a second temperature acquisition module for acquiring the measured temperature of the water outlet of the radiator by using a second temperature sensor mounted at the water outlet of the radiator. According to the system provided by the embodiment of the present invention, the control of the target revolving speed of the electronic water pump is performed in two steps. Step 1, the target revolving speed of the electronic fan and the basic pump speed are directly output according to the heat load of the combustion system of the engine and the measured temperature of the water outlet of the radiator to realize the pre-control, thereby improving the system responsiveness. Step 2, the basic pump speed is corrected according to the PID and the environment temperature together such that the control precision is improved.

[0057] For the system embodiment, since it is substantially similar to the method embodiment, the description

is relatively simple. For related details, please refer to the part of the description of the method embodiment.

[0058] Various component embodiments of the present invention may be implemented in hardware, in software modules running on one or more processors, or in a combination thereof. Those skilled in the art will appreciate that a microprocessor or digital signal processor (DSP) may be used in practice to implement some or all of the functions of some or all of the components in computing processing equipment according to embodiments of the present invention. The present invention may also be implemented as equipment or device program (e.g., a computer program and a computer program product) for executing part or all of the method described herein. Such a program implementing the present invention may be stored on a computer readable medium, or may take the form of one or more signals. Such signals may be downloaded from an Internet website, or provided on a carrier signal, or provided in any other form.

[0059] For example, Fig. 4 illustrates computing processing equipment that may implement the method according to the present invention. The computing processing equipment conventionally includes a processor 1010 and a computer program product or computer-readable medium in the form of a memory 1020. Memory 1020 may be electronic memory such as flash memory, EEPROM (Electrically Erasable Programmable Read Only Memory), EPROM, hard disk, or ROM. The memory 1020 has a storage space 1030 for a program code 1031 for executing any of the method steps of the method. For example, the storage space 1030 for program code may include respective program code 1031 for implementing the various steps in the above method, respectively. These program codes may be read from or written to one or more computer program products. These computer program products include program code carriers such as hard disks, compact disks (CDs), memory cards, or floppy disks. Such a computer program product is typically a portable or fixed storage unit as described with reference to Fig. 5. The storage unit may have storage segments, storage space, etc. arranged similarly to the memory 1020 in the computing processing equipment of Fig. 4. The program code may be compressed, for example, in a suitable form. Typically, the storage unit includes the computer readable code 1031', i.e. the code readable by a processor, such as, for example 1010, which, when run by computing processing equipment, causes the computing processing equipment to execute each step of the method described above.

[0060] Reference herein to "one embodiment", "an embodiment", or "one or more embodiments" means that a particular feature, structure, or characteristic described in connection with the embodiments is included in at least one embodiment of the present invention. In addition, it is noted that the exemplary word "in one embodiment" is used herein to mean not necessarily all of the same embodiment.

[0061] In the description provided herein, numerous

specific details are set forth. It will be understood, however, that embodiments of the present invention may be practiced without these specific details. In some instances, well-known methods, structures, and techniques have not been shown in detail in order not to obscure an understanding of the description.

[0062] In the claims, any reference marks placed between parentheses shall not be construed as limiting the claim. The word "comprise" does not exclude the presence of elements or steps not listed in the claim. The word "a" or "one" preceding an element does not exclude the presence of a plurality of such elements. The present invention may be implemented by means of the hardware including several different elements, and by means of a suitably programmed computer. In the unit claims enumerating several devices, several of these devices can be specifically embodied by the same hardware item. The use of the words first, second, third, etc. does not indicate any order. These words can be interpreted as names.

[0063] Finally, it should be noted that: the above embodiments are merely illustrative of the technical solutions of the present invention, not limiting thereof; although the present invention has been described in detail with reference to the foregoing embodiments, those of ordinary skills in the art should understand that: the technical solutions recited in the above-mentioned embodiments can still be modified, or some of the technical features can be equivalently replaced; these modifications or substitutions do not cause the essence of the corresponding technical solution to deviate from the spirit and scope of the technical solution of the embodiments of the present invention.

Claims

1. A method for controlling an electronic water pump of an engine, **characterized by** comprising:

acquiring a target temperature of a water outlet of the engine and a basic pump speed of the electronic water pump;
acquiring a PID control correction coefficient based on the target temperature of the water outlet of the engine and a measured temperature of the water outlet of the engine;
acquiring an environment temperature correction coefficient, and acquiring a target revolving speed of the electronic water pump based on the basic pump speed of the electronic water pump, the PID control correction coefficient, and the environment temperature correction coefficient;
controlling the electronic water pump of the engine by using the target revolving speed of the electronic water pump.

2. The method according to claim 1, **characterized in that** the acquiring a target temperature of a water outlet of the engine and a basic pump speed of the electronic water pump comprises:

acquiring a heat load of a combustion system of the engine and the target temperature of the water outlet of the engine based on a revolving speed of the engine and a torque of the engine;
acquiring the basic pump speed of the electronic water pump based on the heat load of the combustion system of the engine and a measured temperature of a water outlet of a radiator.

3. The method according to claim 1, **characterized in that** the acquiring an environment temperature correction coefficient, and acquiring a target revolving speed of the electronic water pump based on the basic pump speed of the electronic water pump, the PID control correction coefficient, and the environment temperature correction coefficient comprises:

acquiring the environment temperature correction coefficient based on environment temperature;
acquiring the target revolving speed of the electronic water pump based on the basic pump speed of the electronic water pump, the PID control correction coefficient, and the environment temperature correction coefficient.

4. The method according to claim 2, **characterized in that** the acquiring the basic pump speed of the electronic water pump based on the heat load of the combustion system of the engine and a measured temperature of a water outlet of a radiator comprises:

acquiring a target revolving speed of an electronic fan based on the heat load of the combustion system of the engine and the measured temperature of the water outlet of the radiator;
controlling the electronic water pump of the engine by using the target revolving speed of the electronic fan and the target revolving speed of the electronic water pump.

5. The method according to claim 2, **characterized in that** the measured temperature of the water outlet of the engine is acquired using a first temperature sensor mounted at the water outlet of the engine; the measured temperature of the water outlet of the radiator is acquired by using a second temperature sensor mounted at the water outlet of the radiator.

6. A system for controlling an electronic water pump of an engine, **characterized in that** the system comprises:

- a first acquisition module for acquiring a target temperature of a water outlet of the engine and a basic pump speed of the electronic water pump;
- a second acquisition module for acquiring a PID control correction coefficient based on the target temperature of the water outlet of the engine and the measured temperature of the water outlet of the engine;
- a third acquisition module for acquiring an environment temperature correction coefficient, and acquiring a target revolving speed of the electronic water pump based on the basic pump speed of the electronic water pump, the PID control correction coefficient, and the environment temperature correction coefficient;
- a control module for controlling the electronic water pump of the engine by using the target revolving speed of the electronic water pump.
7. The system according to claim 6, **characterized in that** the first acquisition module comprises:
- a first acquisition submodule for acquiring a heat load of a combustion system of the engine and the target temperature of the water outlet of the engine based on a revolving speed of the engine and a torque of the engine;
- a second acquisition submodule for acquiring the basic pump speed of the electronic water pump based on the heat load of the combustion system of the engine and a measured temperature of a water outlet of a radiator.
8. The system according to claim 6, **characterized in that** the third acquisition module comprises:
- a coefficient acquisition submodule for acquiring the environment temperature correction coefficient based on environment temperature;
- a target revolving speed acquisition module for acquiring the target revolving speed of the electronic water pump based on the basic pump speed of the electronic water pump, the PID control correction coefficient, and the environment temperature correction coefficient.
9. The system according to claim 7, **characterized in that** the control module comprises:
- a third acquisition submodule for acquiring the target revolving speed of an electronic fan based on the heat load of the combustion system of the engine and the measured temperature of the water outlet of the radiator;
- a control submodule for controlling the electronic water pump of the engine by using the target revolving speed of the electronic fan and the tar-
- get revolving speed of the electronic water pump.
10. The system according to claim 7, **characterized in that** the system further comprises:
- a first temperature acquisition module for acquiring the measured temperature of the water outlet of the engine by using a first temperature sensor mounted at the water outlet of the engine;
- a second temperature acquisition module for acquiring the measured temperature of the water outlet of the radiator by using a second temperature sensor mounted at the water outlet of the radiator.
11. A computing processing equipment, **characterized by** comprising:
- a memory storing computer readable code therein;
- one or more processors, wherein when the one or more processors execute the computer readable code, the computing processing equipment executes the method for controlling an electronic water pump of an engine according to any one of claims 1-5.
12. A computer program, comprising computer readable code which, when run on a computing processing equipment, causes the computing processing equipment to execute the method for controlling an electronic water pump of an engine according to any one of claims 1-5.
13. A computer readable medium storing therein the computer program according to claim 12.

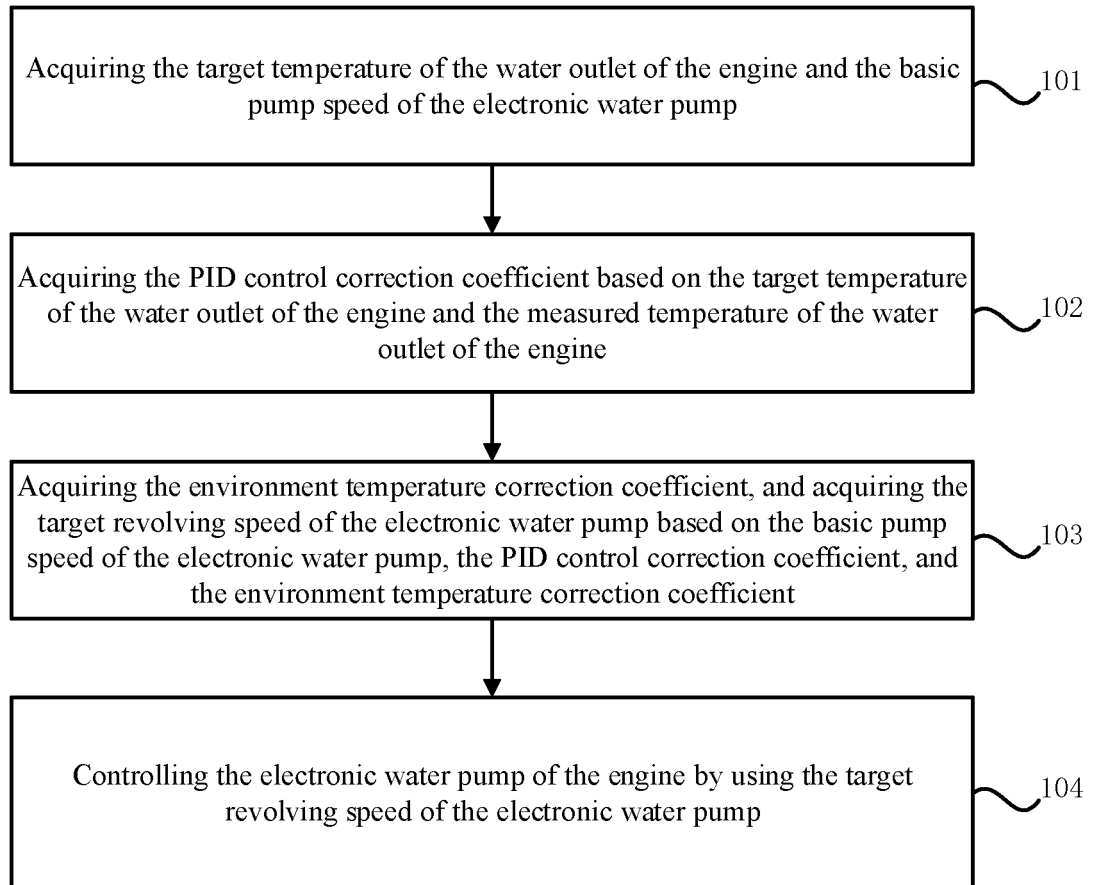


Figure 1

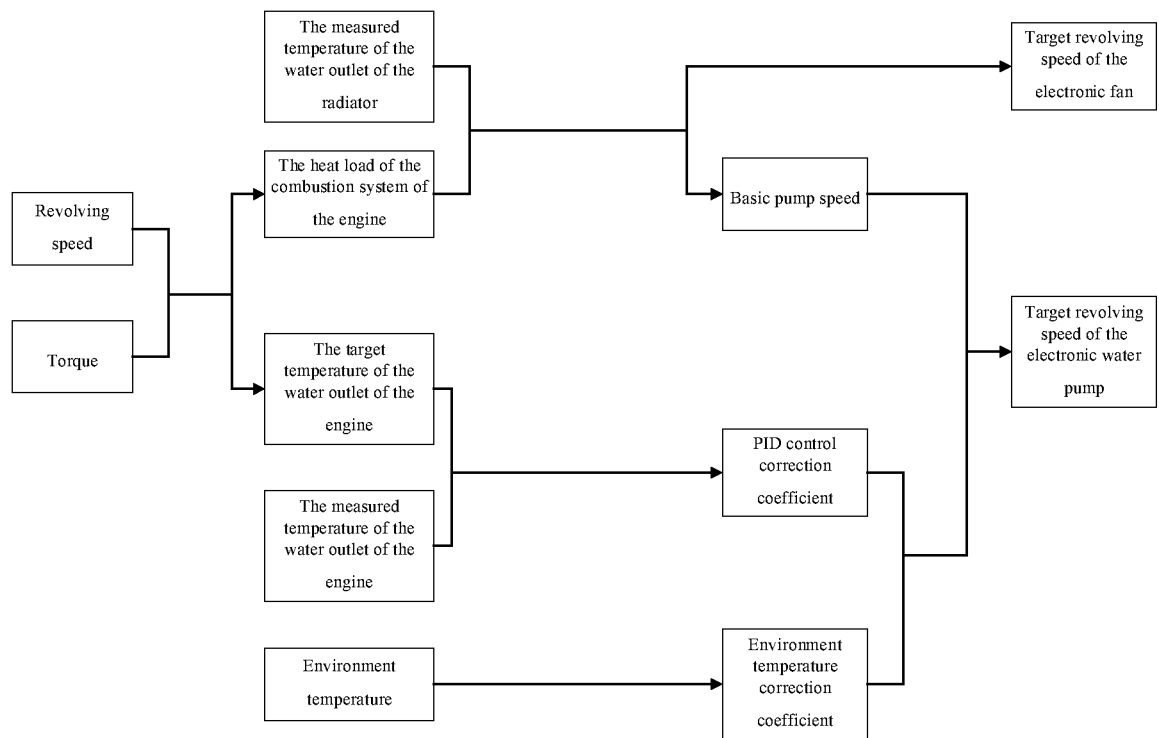


Figure 2

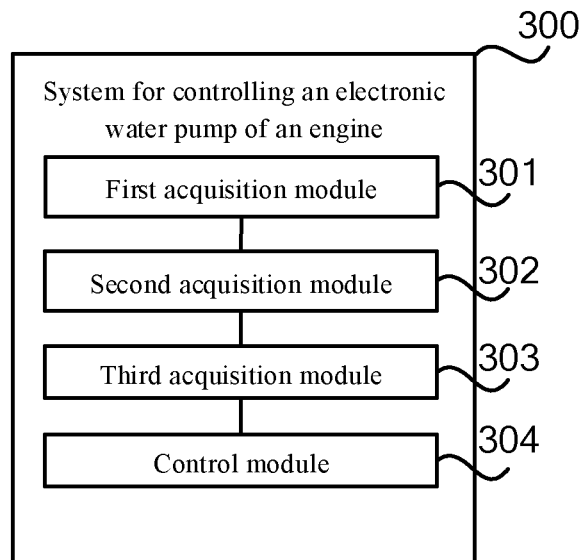


Figure 3

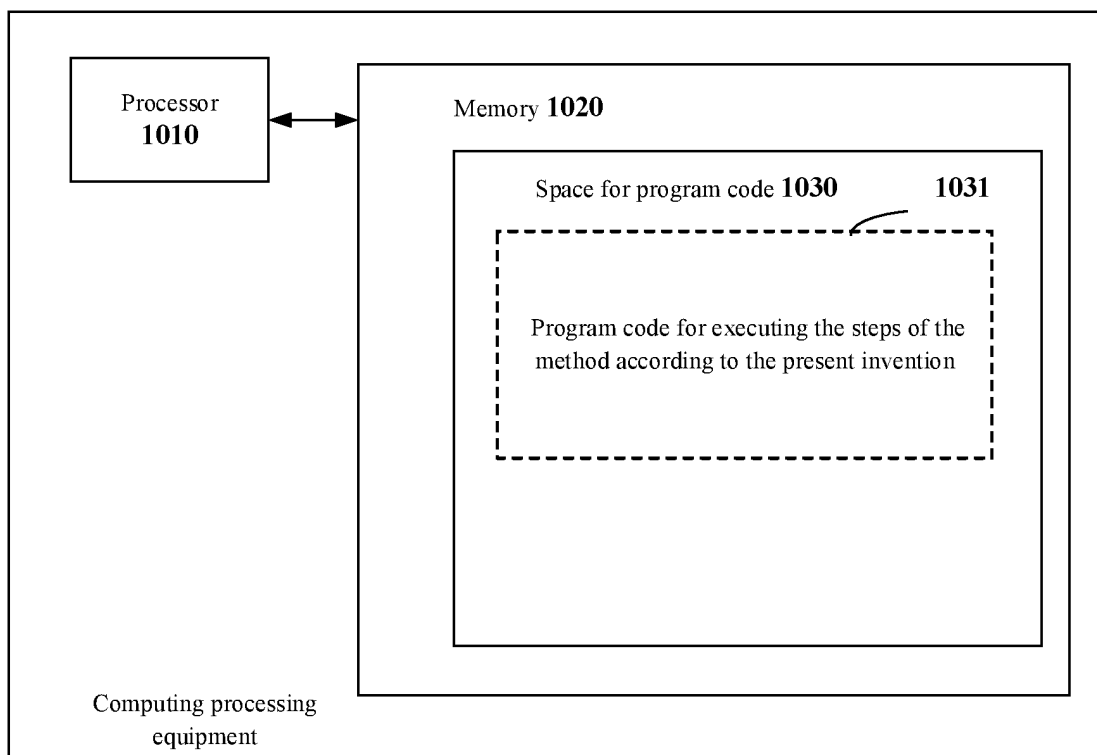


Figure 4

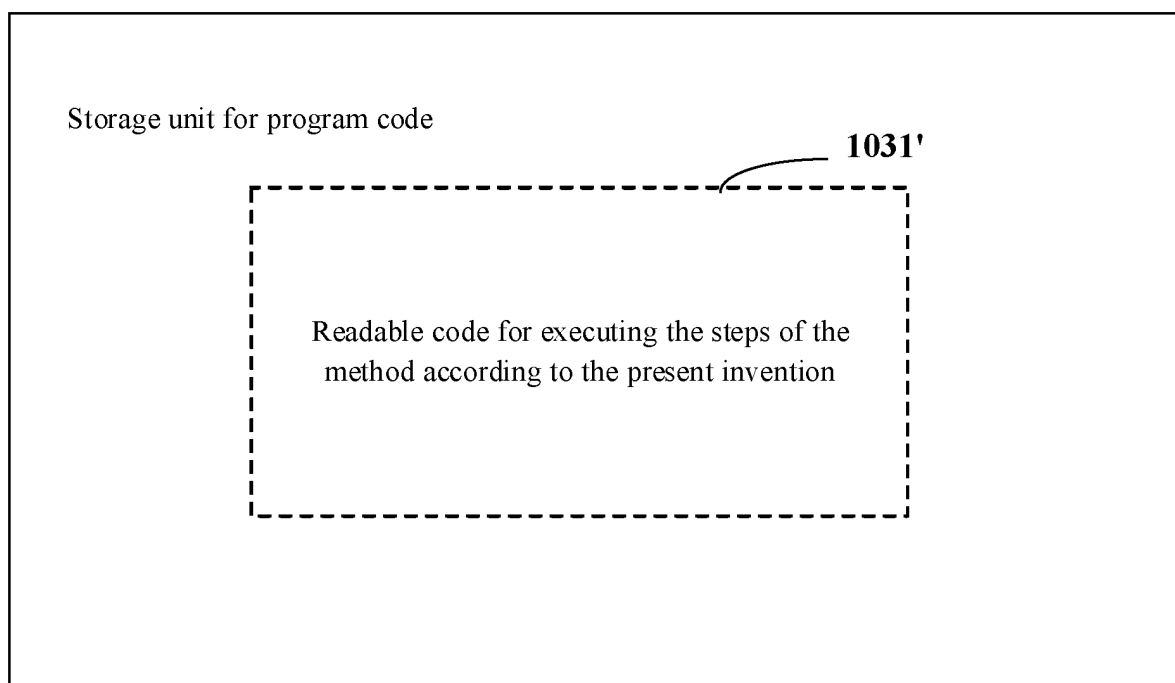


Figure 5

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2020/072190

A. CLASSIFICATION OF SUBJECT MATTER F01P 7/16(2006.01)i 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) F01P	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 practicable, search terms used) CNABS: 电子水泵, 温度, 泵速, 转速, 修正; VEN: pump, temperature, speed, correct+, modif+, regulat+	C. DOCUMENTS CONSIDERED TO BE RELEVANT																					
<table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>CN 104481667 A (ANHUI JIANGHUAI AUTOMOBILE CORP., LTD.) 01 April 2015 (2015-04-01) description, paragraphs [0003]-[0046]</td> <td>1-13</td> </tr> <tr> <td>A</td> <td>US 2011135508 A1 (HYUNDAI MOTOR CO., LTD. et al.) 09 June 2011 (2011-06-09) abstract, and drawings</td> <td>1-13</td> </tr> <tr> <td>A</td> <td>JP 2013044295 A (DAIMLER AG) 04 March 2013 (2013-03-04) abstract, and drawings</td> <td>1-13</td> </tr> <tr> <td>A</td> <td>JP 62288309 A (KAWASAKI HEAVY INDUSTRIES, LTD.) 15 December 1987 (1987-12-15) description, particular embodiments, and figures</td> <td>1-13</td> </tr> <tr> <td>A</td> <td>CN 103711566 A (HITACHI AUTOMOTIVE PRODUCTS (SUZHOU) LTD.) 09 April 2014 (2014-04-09) description, paragraphs [0005]-[0010]</td> <td>1-13</td> </tr> <tr> <td>A</td> <td>CN 1884804 A (BYD COMPANY LIMITED) 27 December 2006 (2006-12-27) description, particular embodiments, and figures</td> <td>1-13</td> </tr> </tbody> </table>	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	A	CN 104481667 A (ANHUI JIANGHUAI AUTOMOBILE CORP., LTD.) 01 April 2015 (2015-04-01) description, paragraphs [0003]-[0046]	1-13	A	US 2011135508 A1 (HYUNDAI MOTOR CO., LTD. et al.) 09 June 2011 (2011-06-09) abstract, and drawings	1-13	A	JP 2013044295 A (DAIMLER AG) 04 March 2013 (2013-03-04) abstract, and drawings	1-13	A	JP 62288309 A (KAWASAKI HEAVY INDUSTRIES, LTD.) 15 December 1987 (1987-12-15) description, particular embodiments, and figures	1-13	A	CN 103711566 A (HITACHI AUTOMOTIVE PRODUCTS (SUZHOU) LTD.) 09 April 2014 (2014-04-09) description, paragraphs [0005]-[0010]	1-13	A	CN 1884804 A (BYD COMPANY LIMITED) 27 December 2006 (2006-12-27) description, particular embodiments, and figures	1-13	☐ Further documents are listed in the continuation of Box C. ☒ 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
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Date of the actual completion of the international search 25 February 2020	Date of mailing of the international search report 12 March 2020																					
Name and mailing address of the ISA/CN China National Intellectual Property Administration No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088 China Facsimile No. (86-10)62019451	Authorized officer Telephone No.																					

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2020/072190

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CN	1884804	A	27 December 2006	None			

REFERENCES CITED IN THE DESCRIPTION

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