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(54) ENGINE CONTROL METHOD, APPARATUS, AND DEVICE AND COMPUTER READABLE STORAGE MEDIUM

(57) A method for controlling an engine, including: obtaining a concentration of nitrogen oxide in exhaust gas emitted by the engine at least once through a NOx sensor provided at an upstream of a three-way catalytic converter, and obtaining an engine torque corresponding to the concentration of the nitrogen oxide; determining a fuel quality factor from a preset ignition control diagram based on the concentration of the nitrogen oxide and the engine torque; and in response to that the fuel quality factor is within a first preset range, controlling an intake pressure of an engine based on the fuel quality factor. An apparatus, a device and a computer-readable storage medium are also disclosed.

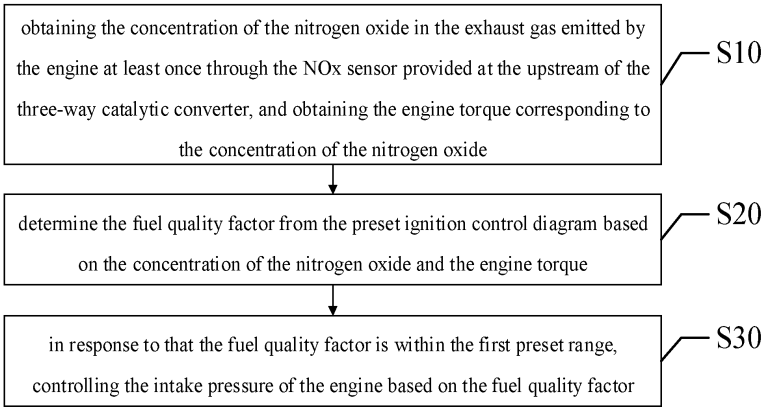

FIG. 2

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Description

[0001] The present application claims priority to Chinese patent application No. 202310780093.3, filed on June 28, 2023, the entire contents of which are incorporated by reference in the present application.

TECHNICAL FIELD

[0002] The present application relates to the technical field of automobile control, and in particular to a method, an apparatus and a device for controlling an engine, and a computer-readable storage medium.

BACKGROUND

[0003] During vehicle operation, the vehicle controls the intake pressure of the engine to control the intake volume of the engine fuel combustion process, thereby controlling the products of engine fuel combustion and minimizing the amount of pollutants in the engine exhaust gas. At present, it is mainly through measuring the concentration of oxygen in the exhaust gas and the injection pressure of the fuel, and controlling the intake pressure, so as to keep the intake volume within a reasonable range. If the concentration of oxygen in the engine exhaust gas is too high, it means that the engine intake volume is too large, and incomplete combustion of fuel will lead to an increase in pollutants. At this time, the engine intake volume should be reduced. Similarly, if the concentration of oxygen is too low, incomplete combustion of fuel will also occur, resulting in an increase in pollutants. At this time, the engine intake volume should be increased.

[0004] However, the products of fuel combustion are not only related to the intake volume, but also to the fuel quality. When the control is performed by the above control method, if the change in concentration of oxygen is caused by fuel quality, then the adjustment of fuel injection pressure and intake volume according to concentration of oxygen is inaccurate, and incomplete combustion of fuel may still occur, resulting in an increase of pollutants in exhaust gas.

SUMMARY

Technical Problem

[0005] The main purpose of the present application is to provide a method, an apparatus and a device for controlling an engine, and a computer-readable storage medium, aiming to provide a method for controlling an engine based on fuel quality, improve the control accuracy of controlling engine intake pressure, and reduce the pollution of engine exhaust gas.

Technical Solution

[0006] To achieve the above purpose, the present application provides a method for controlling an engine, including:

obtaining a concentration of nitrogen oxide in exhaust gas emitted by the engine at least once through a NOx sensor provided at an upstream of a three-way catalytic converter, and obtaining an engine torque corresponding to the concentration of the nitrogen oxide;
determining a fuel quality factor from a preset ignition control diagram based on the concentration of the nitrogen oxide and the engine torque; and
in response to that the fuel quality factor is within a first preset range, controlling an intake pressure of the engine based on the fuel quality factor.

[0007] In an embodiment, before the obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter, the method further includes:

detecting whether an operating working condition of the engine reaches a preset working condition, wherein the preset working condition is a working condition point where a difference between fuel quality factors of different quality fuels exceeds a preset value; and
in response to that the operating working condition reaches the preset working condition, obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter.

[0008] In an embodiment, in response to that the operating working condition reaches the preset working condition, the obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter includes:

in response to that the operating working condition reaches the preset working condition, detecting whether an operating duration of the engine under the operating working condition reaches a first preset duration; and
in response to that the operating duration reaches the first preset duration, obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter.

[0009] In an embodiment, before the detecting whether

the operating working condition of the engine reaches the preset working condition, the method further includes:

detecting whether a new fuel is injected into the engine; and
in response to that the new fuel is injected into the engine, obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter.

[0010] In an embodiment, the method for controlling the engine further includes:

monitoring a fuel liquid level in the engine;
wherein the detecting whether the new fuel is injected into the engine includes:
detecting whether the fuel liquid level satisfies a preset condition, wherein the preset condition is that a changing value of the fuel liquid level within a second preset duration exceeds a second preset range;
in response to that the fuel liquid level satisfies the preset condition, determining that the new fuel is injected into the engine; and
in response to that the fuel liquid level does not satisfy the preset condition, determining that the new fuel is not injected into the engine.

[0011] In an embodiment, in response to that the concentration of the nitrogen oxide is obtained at least twice, the determining the fuel quality factor from the preset ignition control diagram based on the concentration of the nitrogen oxide and the engine torque includes:

determining a plurality of control factors from the preset ignition control diagram based on the concentration of each nitrogen oxide and the corresponding engine torque; and
calculating the fuel quality factor based on the plurality of control factors.

[0012] In an embodiment, the controlling the intake pressure of the engine includes:

obtaining an actual injection duration through multiplying the fuel quality factor by an injection duration of the engine; and
controlling the intake pressure of the engine based on the actual injection duration, wherein the longer the actual injection duration is, the greater the intake pressure is.

[0013] In addition, in order to realize the above objective, the present application also provides an apparatus for controlling an engine, including:

an obtaining module configured to obtain a concentration of nitrogen oxide in exhaust gas emitted by the engine at least once through a NOx sensor provided at an upstream of a three-way catalytic converter, and obtaining an engine torque corresponding to the concentration of the nitrogen oxide;
a determination module configured to determine a fuel quality factor from a preset ignition control diagram based on the concentration of the nitrogen oxide and the engine torque; and
a control module configured to control an intake pressure of the engine based on a fuel quality factor in response to that the fuel quality factor is within a first preset range.

[0014] In addition, in order to realize the above objective, the present application also provides a device for controlling an engine, including: a memory, a processor, and a program for controlling an engine stored in the memory and executable on the processor, and the program for controlling the engine is configured to implement the method for controlling the engine.

[0015] In addition, in order to realize the above objective, the present application also provides a computer-readable storage medium, a program for controlling an engine is stored in the computer-readable storage medium, and when the program for controlling the engine is performed by a processor, the method for controlling the engine is implemented.

Advantageous Effect

[0016] In the present application, the concentration of the nitrogen oxide in the exhaust gas emitted by the engine is obtained at least once through the NOx sensor provided at the upstream of the three-way catalytic converter, and the engine torque corresponding to the concentration of the nitrogen oxide is obtained; based on the concentration of the nitrogen oxide and the engine torque, the fuel quality factor is determined from the preset ignition control diagram; if the fuel quality factor is within the first preset range, the fuel quality is determined to be normal, and the intake pressure of the engine is controlled. The present application realizes the detection of the fuel quality in the engine before the intake pressure of the engine is controlled, and the control of the intake pressure of the engine is performed based on the fuel quality when the fuel quality is normal, so that the interference of the fuel quality on the intake pressure is considered in the process of controlling the intake pressure, and the accuracy of controlling the engine intake pressure is improved, thereby reducing the pollution of the engine exhaust gas.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

FIG. 1 is a schematic structural diagram of a device

of a hardware operating environment involved in an embodiment of the present application.

FIG. 2 is a schematic flow chart of a method for controlling an engine according to a first embodiment of the present application.

FIG. 3 is a schematic flow chart of the method for controlling the engine involved in an embodiment of the present application.

FIG. 4 is a schematic flow chart of the method for controlling the engine involved in an embodiment of the present application.

[0018] The realization of the objective, functional characteristics, and advantages of the present application are further described with reference to embodiments and the accompanying drawings.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0019] It should be understood that the specific embodiments described herein are only intended to explain the present application and are not intended to limit the present application.

[0020] As shown in FIG. 1, FIG. 1 is a schematic structural diagram of a device of a hardware operating environment involved in an embodiment of the present application.

[0021] It should be noted that the device for controlling the engine in the embodiment of the present application can be a vehicle controller or a device that establishes a communication connection with the vehicle controller, such as a computer, a server, etc., which are not specifically limited here.

[0022] As shown in FIG. 1, the device for controlling the engine may include: a processor 1001, such as a CPU, a network interface 1004, a user interface 1003, a memory 1005, and a communication bus 1002. The communication bus 1002 is configured to realize the connection and communication between these components. The user interface 1003 may include a display screen, an input unit such as a keyboard, and the user interface 1003 may also include a standard wired interface and a wireless interface. The network interface 1004 may include a standard wired interface and a wireless interface (such as a WI-FI interface). The memory 1005 may be a high-speed RAM memory or a non-volatile memory, such as a disk memory. The memory 1005 may also be a storage apparatus independent of the processor 1001.

[0023] Those skilled in the art may understand that the device structure shown in FIG. 1 does not constitute a limitation on the device for controlling the engine, which may include more or less components than shown in the figure, or combine certain components, or with different configuration.

[0024] As shown in FIG. 1, the memory 1005, as a computer storage medium, may include an operating system, a network communication module, a user interface module, and a program for controlling an engine. The operating system is a program that manages and controls the hardware and software resources of the device, and supports the operation of the program for controlling the engine and other software or programs. In the device shown in FIG. 1, the user interface 1003 is mainly configured for data communication with the client; the network interface 1004 is mainly configured to establish a communication connection with the server; and the processor 1001 can be used to call the program for controlling the engine stored in the memory 1005 and perform the following operations:

obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter, and obtaining the engine torque corresponding to the concentration of the nitrogen oxide;

determining the fuel quality factor from the preset ignition control diagram based on the concentration of the nitrogen oxide and the engine torque; and

in response to that the fuel quality factor is within the first preset range, controlling the intake pressure of the engine based on the fuel quality factor.

[0025] In an embodiment, before the obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter, the method further includes:

detecting whether the operating working condition of the engine reaches the preset working condition, the preset working condition is the working condition point where the difference between the fuel quality factors of different quality fuels exceeds the preset value;

in response to that the operating working condition reaches the preset working condition, performing the obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter.

[0026] In an embodiment, in response to that the operating working condition reaches the preset working condition, the obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter includes:

in response to that the engine reaches the preset working condition, detecting whether the operating duration of the engine under the operating working condition reaches the first preset duration;

in response to that the operating duration reaches the first preset duration, performing the obtaining the concentration of the nitrogen oxide in the exhaust

gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter.

[0027] In an embodiment, before the detecting whether the operating working condition of the engine reaches the preset working condition, the method also includes:

detecting whether the new fuel is injected into the engine;
in response to that the new fuel is injected into the engine, performing the obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter.

[0028] In an embodiment, the method for controlling the engine further includes:

monitoring the fuel liquid level in the engine;
and the detecting whether the new fuel is injected into the engine includes:
detecting whether the fuel liquid level satisfies the preset condition, and the preset condition is that the changing value of the fuel liquid level within the second preset duration exceeds the second preset range;
in response to that the fuel liquid level satisfies the preset condition, determining that the new fuel is injected into the engine; and
in response to that the fuel liquid level does not satisfy the preset condition, determining that the new fuel is not injected into the engine.

[0029] In an embodiment, when the concentration of the nitrogen oxide is obtained at least twice, the determining the fuel quality factor from the preset ignition control diagram based on the concentration of the nitrogen oxide and the engine torque includes:

determining a plurality of control factors from the preset ignition control diagram respectively based on each of the concentration of the nitrogen oxides and the corresponding engine torque; and
calculating to obtain the fuel quality factor based on the plurality of control factors.

[0030] In an embodiment, the controlling the intake pressure of the engine includes:

obtaining the actual oil-injection duration through multiplying the fuel quality factor by the engine injection duration; and
controlling the intake pressure of the engine based on the actual injection duration, and the longer the actual injection duration is, the greater the intake pressure is.

[0031] Based on the above structure, various embodiments of the method for controlling the engine are provided.

[0032] Referring to FIG. 2, FIG. 2 is a schematic flow chart of a method for controlling an engine according to a first embodiment of the present application.

[0033] The present application provides an embodiment of a method for controlling an engine. It should be noted that, although the logical order is shown in the flowchart, in some cases, the steps shown or described can be performed in a different order from that shown here. In this embodiment, the method for controlling the engine can be applied to a vehicle controller, or a device that establishes a communication connection with the vehicle controller, such as a computer, a server, etc. In this embodiment, the method for controlling the engine includes:

[0034] Step S10, obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter, and obtaining the engine torque corresponding to the concentration of the nitrogen oxide.

[0035] The present self-adaption control process of the engine intake pressure is: measuring the concentration of oxygen of the exhaust gas through an oxygen sensor; determining the fuel oil injection pressure of the engine based on the concentration of oxygen, thereby determining the engine intake pressure; and controlling the engine intake based on the determined intake pressure.

[0036] If there is a problem with the fuel oil component in the engine, such as aging of the injector, the amount of fuel oil sprayed by the injector will decrease, and the concentration of oxygen in the exhaust gas will increase. At this time, based on the above control process, the fuel oil injection pressure and intake pressure of the engine will be increased so that the fuel oil can be completely combusted and the pollution of the exhaust gas can be reduced. However, if the problem is that the fuel quality changes, such as the fuel calorific value decreases, then even if the fuel pressure is normal, it will still cause incomplete combustion of the fuel, resulting in an increase in concentration of oxygen. At this time, based on the above control process, the engine fuel oil injection pressure will still be increased, but due to the problem of fuel quality, the intake air volume required for complete combustion of the fuel has changed, that is, the correlation between the injection pressure and the intake pressure has changed. If the engine fuel oil injection pressure is still controlled according to the previous fuel quality, the incomplete combustion of the fuel may still occur.

[0037] Therefore, this embodiment provides a method for controlling the engine intake pressure based on the fuel quality. By detecting the fuel quality before controlling the intake pressure, the accurate control of the engine intake pressure is achieved. Specifically, the fuel quality referred to in this embodiment may refer to the calorific value of the fuel, the content of impurities in the fuel, or

other indicators related to the fuel quality, which are not limited here.

[0038] In this embodiment, the exhaust gas emitted by the engine upstream of the three-way catalytic converter is referred as the exhaust gas emission of the engine. The incomplete combustion may be caused by engine parts problems (such as injector aging, injector consistency problems, etc.), and changes in fuel quality. In the two cases, the concentration of NOx in the exhaust gas emitted by the engine is different. The incomplete combustion caused by engine parts problems is caused by the mismatch between the fuel amount and the air amount. Under this problem, the concentration of NOx in the exhaust gas emission under the same working condition will not change; while the incomplete combustion caused by the fuel quality will cause the concentration of NOx in the exhaust gas emission to increase. Therefore, in this embodiment, the fuel quality factor is determined based on the NOx in the exhaust gas emission. The fuel quality factor can represent the quality of the fuel. For example, as for the fuel calorific value, the larger the fuel quality factor is, the higher the fuel calorific value is. Since the three-way catalytic converter is configured to convert harmful gases such as CO, HC and NOx in the exhaust gas emission into harmless carbon dioxide, water and nitrogen through oxidation and reduction. In this embodiment, obtaining the concentration of NOx in the exhaust gas emission of the engine provided at the upstream of the three-way catalytic converter can be obtaining by the NOx sensor provided at the upstream of the three-way catalytic converter. In the specific detection process, the concentration of NOx can be obtained for a plurality of times, and the fuel quality factor can be determined based on the plurality of concentrations of NOx to improve the accuracy of the fuel quality factor; or the concentration of NOx can be obtained once, and the fuel quality factor can be determined based on one concentration of NOx to reduce the detection step and improve the detection efficiency, which is not limited here.

[0039] In this embodiment, the engine torque corresponding to the concentration of the nitrogen oxide is also obtained, that is, the concentration of the nitrogen oxide and the engine torque are obtained at the same time. The specific method of obtaining torque is not limited here. For example, in one feasible implementation, it can be to determine the time of obtaining the concentration of the nitrogen oxide, and determine the engine torque at that time from the vehicle operation data according to the time; in another feasible implementation, it can also be to determine the vehicle working condition when the concentration of the nitrogen oxide is obtained, and determine the engine torque according to the working condition.

[0040] Step S20, determine the fuel quality factor from the preset ignition control diagram based on the concentration of the nitrogen oxide and the engine torque.

[0041] In this embodiment, a management absolute pressure (MAP) diagram with concentration of NOx and engine torque as independent variables and fuel quality factor as dependent variables is preset, which is referred as the ignition control diagram for convenience of description. The preset ignition control diagram can be obtained by testing on a bench using fuel of different qualities through a single variable experiment. The specific test process is not repeated here.

[0042] Based on the concentration of the nitrogen oxide and the engine torque, the fuel quality factor is determined from the preset ignition control diagram.

[0043] In an embodiment, when the fuel quality refers to the fuel calorific value, the preset ignition control diagram can also be with the fuel calorific value as dependent variables, that is, the fuel calorific value is determined from the preset ignition control diagram based on the concentration of the nitrogen oxide and the engine torque; and the quality factor is determined according to the mapping relationship between the fuel calorific value and the quality factor. The higher the fuel calorific value is, the higher the quality factor is.

[0044] step S30, in response to that the fuel quality factor is within the first preset range, controlling the intake pressure of the engine based on the fuel quality factor.

[0045] In this embodiment, after determining the fuel quality factor, detect whether the fuel quality factor is within a preset reasonable range (hereinafter referred as the first preset range for distinction). If the fuel quality factor is within the first preset range, it is determined that the fuel quality is within a reasonable range, and the fuel can be used for engine operation. At this time, considering the impact of fuel quality changes on the engine intake pressure, the engine intake pressure is controlled based on the fuel quality factor, so that the current intake pressure is determined based on the fuel quality of the current engine fuel, thereby improving the accuracy of the intake pressure control.

[0046] In an embodiment, if the fuel quality factor is within the first preset range, a fuel quality factor over-limit fault is reported, prompting the user to check the fuel quality.

[0047] In this embodiment, the concentration of the nitrogen oxide in the exhaust gas emitted by the engine is obtained at least once by the NOx sensor provided at the upstream of the provided three-way catalytic converter, and the engine torque corresponding to the concentration of the nitrogen oxide is obtained; the fuel quality factor is determined from the preset ignition control diagram based on the concentration of the nitrogen oxide and the engine torque; if the fuel quality factor is within the first preset range, the fuel quality is determined to be normal, and the intake pressure of the engine is controlled. This embodiment realizes the detection of the fuel quality in the engine before the intake pressure of the engine is controlled, and the control of the intake pressure of the engine is based on the fuel quality when the fuel quality is normal, so that the interference of the fuel quality on the intake pressure is considered in the process of controlling the intake pressure, and the accuracy

of controlling the engine intake pressure is improved, thereby reducing the pollution in the engine exhaust gas.

[0048] In an embodiment, based on the above first embodiment, a second embodiment of the method for controlling the engine of the present application is provided. In this embodiment, before step S 10, the method also includes:

step S40, detecting whether the operating working condition of the engine reaches the preset working condition, and the preset working condition is the working condition point where the difference between the fuel quality factors of different quality fuels exceeds the preset value.

[0049] **In** this embodiment, the operating working condition (hereinafter referred as preset working condition for distinction) for determining the fuel quality factor is preset. **In** a feasible implementation, the preset working condition can be determined according to the ignition control diagram, specifically, the working condition point corresponding to the torque where the difference between the fuel quality factors of different quality fuels exceeds the preset value can be selected as the preset working condition, or the preset working condition can be set according to actual needs, which is not limited here.

[0050] **In** an embodiment, detecting whether the operating working condition of the engine reaches the preset working condition can be determining whether the operating working condition reaches the preset working condition by comparing the torque result. When the operating torque of the engine is the same as the torque of the preset working condition, it is determined that the operating working condition reaches the preset working condition. In another feasible implementation, it can also be determined whether the operating working condition reaches the preset working condition according to the engine speed. The specific determination method is the same as that of the torque.

[0051] Step S50, in response to that the operating working condition reaches the preset working condition, performing the obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter.

[0052] In this embodiment, if the operating working condition reaches the preset working condition, it is determined that the engine is in a working condition with a significant difference in the fuel quality factor. At this time, a more accurate fuel quality factor can be obtained. Therefore, the obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter is performed.

[0053] In an embodiment, the step S50 includes:

step S501, in response to that the engine reaches the preset working condition, detecting whether the operating duration of the engine under the operating working condition reaches the first preset duration.

[0054] In an embodiment, if the engine reaches the preset working condition, detecting whether the operating duration of the engine under the operating working condition reaches the first preset duration, so as to determine whether the vehicle is running stably.

[0055] step S502, if the operating duration reaches the first preset duration, performing the obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter.

[0056] If the operating duration reaches the first preset duration, it is determined that the vehicle is running stably. At this time, the fuel quality factor can be determined to control the intake pressure, and the obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter can be performed.

[0057] In an embodiment, if the operation duration does not reach the first preset duration, the intake pressure can be adjusted according to the self-adaption factor corresponding to the concentration of oxygen to reduce the pollution in the engine exhaust gas.

[0058] In an embodiment, before the step S40, the method also includes:

step S60, detecting whether the new fuel is injected into the engine.

[0059] In an embodiment, before determining the fuel quality factor and adjusting the intake pressure according to the fuel quality factor, it can detect whether the new fuel is injected into the engine.

[0060] step S70, in response to that the new fuel is injected into the engine, performing the obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter.

[0061] If new fuel is injected into the engine, it is necessary to re-determine the fuel quality factor to improve the accuracy of controlling the intake pressure, and perform the obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter.

[0062] In an embodiment, if no new fuel is injected into the engine, the intake pressure can be adjusted according to the previous fuel quality factor; the intake pressure can also be adjusted according to the self-adaption factor corresponding to the concentration of oxygen.

[0063] In an embodiment, the method for controlling the engine further includes:

step S80, monitoring the fuel liquid level in the engine.

[0064] In an embodiment, monitoring the fuel liquid level in the engine to determine whether the new fuel is injected into the engine.

[0065] In an embodiment, the step S60 includes:

step S601, detecting whether the fuel liquid level satisfies the preset condition, and the preset condition is that the changing value of the fuel liquid level in the second preset

duration exceeds the second preset range.

[0066] In an embodiment, a preset condition representing the injection of new fuel is preset. The preset condition is that the changing value of the fuel liquid level in the second preset duration exceeds the second preset range, that is, the preset condition represents that the engine fuel has increased significantly in the second preset duration. In an embodiment, the preset condition can also limit the liquid level before the fuel liquid level changes (hereinafter referred as the baseline liquid level for distinction) to be lower than the preset liquid level. The preset liquid level can be set according to actual needs. In an embodiment, detecting whether the fuel liquid level satisfies the preset condition.

[0067] Step S602, in response to that the fuel liquid level satisfies the preset condition, determining that the new fuel is injected into the engine.

[0068] If the fuel liquid level satisfies the preset condition, it is determined that the engine fuel has increased significantly (i.e., the second preset range) within the second preset duration, and it is determined that the new fuel is injected into the engine.

[0069] Step S603, in response to that the fuel liquid level does not satisfy the preset condition, determining that no new fuel is injected into the engine.

[0070] If the fuel liquid level does not satisfy the preset condition, it is determined that the engine fuel has not increased significantly (i.e., the second preset range) within the second preset duration, which may be that the new fuel is injected into the engine for a plurality of times in small amounts, or that only a small amount of the new fuel is injected into the engine, or that no new fuel is injected. In an embodiment, the above possible situations are all regarded as no new fuel is injected into the engine.

[0071] In this embodiment, the operating working condition of the engine is detected to determine whether it reaches the preset working condition, and the preset working condition is the working condition point where the difference between the fuel quality factors of different quality fuels exceeds the preset value. If the operating working condition reaches the preset working condition, the obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter is performed. This implementation can obtain a more accurate fuel quality factor, thereby improving the accuracy of the intake pressure control and reducing the pollution in the exhaust gas.

[0072] Based on the first embodiment and/or the second embodiment described above, a third embodiment of the method for controlling the engine of the present application is provided. In this embodiment, when the concentration of the nitrogen oxide is obtained at least twice, the step S20 includes:

step S201, determining a plurality of control factors from the preset ignition control diagram respectively based on each of the concentration of the nitrogen oxides and the corresponding engine torque.

[0073] **In** this embodiment, the plurality of fuel quality factors (hereinafter referred as control factors for distinction) are determined from the preset ignition control diagram respectively based on each of the concentration of the nitrogen oxides and the corresponding engine torque.

[0074] step S202, obtaining the fuel quality factor based on a plurality of control factors.

[0075] The fuel quality factor is obtained based on a plurality of control factors.

[0076] **In** an embodiment, the average value of a plurality of control factors may be taken as the fuel quality factor, which is not limited here, and can be set according to actual needs.

[0077] **In** an embodiment, the step S30 includes:

step S301, obtaining the actual injection duration by multiplying the fuel quality factor by the injection duration of the engine.

[0078] The actual injection duration is obtained by multiplying the fuel quality factor by the injection duration of the engine (i.e., the duration of the injector injecting fuel oil), and the injection amount of the fuel oil can be controlled by controlling the injection duration.

[0079] step S302, controlling the intake pressure of the engine based on the actual injection duration. The longer the actual injection duration is, the greater the intake pressure is.

[0080] For the same engine, the injection pressure is maintained at a constant value (hereinafter referred to as the preset pressure constant value for distinction), that is, the injection pressure of the injector is constant per unit time. Therefore, the actual injection amount of fuel oil can be determined based on the actual injection duration.

[0081] The actual injection amount of fuel oil is determined based on the actual injection duration, and the required amount of air is determined according to the actual injection amount, so that the intake pressure of the engine is obtained and the intake pressure of the engine can be controlled. The longer the actual injection duration is, the more air is required and the greater the intake pressure is.

[0082] **In** an embodiment, the self-adaption factor of the fuel oil injection pressure can also be determined based on the concentration of oxygen; the adjustment factor can be obtained by multiplying the self-adaption factor by the fuel oil injection factor; and the actual injection duration is obtained by calculating the adjustment factor and the injection duration. That is, the influence of the engine zero component problem on the intake pressure is also considered, so as to further improve the accuracy of the intake pressure control and reduce the pollution in the exhaust gas.

[0083] In this embodiment, a plurality of control factors are determined from the preset ignition control diagram based on each concentration of nitrogen oxide and the corresponding engine torque; and the fuel quality factor is calculated based on the plurality of control factors. In this

embodiment, by obtaining concentration of NOx for a plurality of times and determining fuel quality factor based on the plurality of concentrations of NOx, the accuracy of the fuel quality factor can be improved, thereby improving the accuracy of the intake control.

[0084] In an embodiment, referring to FIG. 3, the control process for controlling the intake pressure can be: monitoring the fuel liquid level of the engine, and detecting whether the new fuel is injected into the engine based on fuel liquid level. In an embodiment, it can be detected that when the fuel liquid level increases from an empty position to a full position, it is considered that a new box of fuel is added.

[0085] In an embodiment, whether the fuel self-adaption calculation is completed for the newly added fuel is detected, and the self-adaption calculation refers to the entire process of adjusting the intake pressure based on the fuel quality factor. If the self-adaption calculation is completed, the self-adaption calculation for the fuel in the tank is stopped; and if the self-adaption calculation is not completed, the self-adaption function is activated to perform the self-adaption calculation for the fuel in the tank.

[0086] Entering the self-adaption calculation, detecting whether the engine operating working condition reaches the preset working condition, and whether the operating duration under the working condition reaches the preset duration. If the operating working condition reaches the preset working condition and the operating duration of the engine under the working condition reaches the preset duration, the concentration of the nitrogen oxide in the exhaust gas emitted by the engine is obtained for a plurality of times through the NOx sensor provided at the upstream of the three-way catalytic converter, and the engine torque corresponding to the concentration of the nitrogen oxide is obtained; a plurality of control factors are determined from the preset ignition control diagram based on the concentration of the nitrogen oxide and the engine torque; and the fuel quality factor is calculated based on each control factor. If the operating working condition does not reach the preset working condition or the operating duration of the engine under the working condition does not reach the preset duration, it is returned to detect whether the fuel self-adaption calculation is completed for the newly added fuel.

[0087] It is determined whether the fuel quality factor is within the preset range. If the fuel quality factor is within the preset range, the intake pressure of the engine is controlled based on the fuel quality factor. The specific correction process is to correct the injection amount of the engine according to the fuel quality factor, and correct the intake pressure, so as to ensure that the output torque after correction will not change due to the fuel quality. If the fuel quality factor exceeds the preset range, a self-adaption factor over-limit fault is reported to remind the user to check the fuel quality.

[0088] In addition, the present application also provides an apparatus for controlling an engine. Referring to FIG. 4, the apparatus for controlling the engine includes: an obtaining module 10, a determining module 20, and a control module 30.

[0089] The obtaining module 10 is configured to obtain the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter, and obtain the engine torque corresponding to the concentration of the nitrogen oxide.

[0090] The determining module 20 is configured to determine the fuel quality factor from the preset ignition control diagram based on the concentration of the nitrogen oxide and the engine torque.

[0091] The control module 30 is configured to control the intake pressure of the engine based on the fuel quality factor in response to that the fuel quality factor is within the first preset range.

[0092] In an embodiment, the apparatus for controlling the engine further includes a detecting module configured to:

detect whether the operating working condition of the engine reaches the preset working condition, and the preset working condition is the working condition point where the difference between the fuel quality factors of different quality fuels exceeds the preset value;

in response to that the operating working condition reaches the preset working condition, perform the obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter.

[0093] In an embodiment, the detecting module is also configured to:

in response to that the engine reaches the preset working condition, detect whether the operating duration of the engine under the operating working condition reaches the first preset duration; and

in response to that the operating duration reaches the first preset duration, perform the obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter.

[0094] In an embodiment, the detecting module is also configured to:

detect whether the new fuel is injected into the engine; and

in response to that the new fuel is injected into the engine, perform the obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic

converter.

[0095] In an embodiment, the apparatus for controlling the engine also includes a monitoring module configured to:

monitor the fuel liquid level in the engine.

[0096] The detecting module is also configured to:

detect whether the fuel liquid level satisfies a preset condition, and the preset condition is that the changing value of the fuel liquid level within the second preset duration exceeds the second preset range;

in response to that the fuel liquid level satisfies the preset condition, determine that the new fuel is injected into the engine;

in response to that the fuel liquid level does not satisfy the preset condition, determine that the new fuel is not injected into the engine.

[0097] In an embodiment, the determination module 20 is also configured to:

determine a plurality of control factors from the preset ignition control diagram based on each of the concentration of the nitrogen oxides and the corresponding engine torque; and

calculate to obtain a fuel quality factor based on the plurality of control factors.

[0098] In an embodiment, the adjustment module is also configured to:

obtain an actual injection duration by multiplying the fuel quality factor by the injection duration of the engine; and

control the intake pressure of the engine based on the actual injection duration. The longer the actual injection duration is, the greater the intake pressure is.

[0099] The various embodiments of the apparatus for controlling the engine of the present application may refer to the various embodiments of the method for controlling the engine of the present application, which will not be repeated here.

[0100] In addition, the embodiment of the present application also provides a computer-readable storage medium, on which a program for controlling an engine is stored, and when the program for controlling the engine is performed by a processor, the method for controlling the engine described above is implemented.

[0101] The various embodiments of the device for controlling the engine and computer-readable storage medium of the present application may refer to the various embodiments of the method for controlling the engine of the present application, which will not be repeated here.

[0102] It should be noted that, in the present application, the terms "include", "comprise" or any other variants thereof are intended to cover non-exclusive inclusion, so that a process, method, article or system including a series of elements includes not only those elements, but also other elements not explicitly listed, or also includes elements inherent to such process, method, article or system. In the absence of further restrictions, an element defined by the sentence "includes one.." does not exclude the existence of other identical elements in the process, method, article or system including the element.

[0103] The serial numbers of the embodiments of the present application are only for description and do not represent the advantages and disadvantages of the embodiments.

[0104] Through the description of the above implementation methods, those skilled in the art can clearly understand that the above embodiment method can be implemented by means of software plus the necessary general hardware platform, of course, it can also be implemented by hardware, but in many cases the former is a better implementation method. Based on this understanding, the technical solution of this application, or the part that contributes to the prior art, can be embodied in the form of a software product, which is stored in a computer-readable storage medium (such as ROM/RAM, disk, CD) as mentioned above, and includes several instructions for a device for controlling an engine (which can be a mobile phone, computer, server, or network device, etc.) to perform the methods described in each embodiment of the present application.

[0105] The above are only embodiments of the present application, and do not limit the scope of the present application. Any equivalent structure or equivalent process transformation made by using the contents of the specification and drawings of the present application, or directly or indirectly used in other related technical fields, are also included in the scope of the present application.

Claims

1. A method for controlling an engine, **characterized by** comprising:

obtaining a concentration of nitrogen oxide in exhaust gas emitted by the engine at least once through a NOx sensor provided at an upstream of a three-way catalytic converter, and obtaining an engine torque corresponding to the concentration of the nitrogen oxide;

determining a fuel quality factor from a preset ignition control diagram based on the concentration of the nitrogen oxide and the engine torque; and

in response to that the fuel quality factor is within a first preset range, controlling an intake pressure of the engine based on the fuel quality

factor.

2. The method for controlling the engine according to claim 1, **characterized in that** before the obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter, the method further comprises:

detecting whether an operating working condition of the engine reaches a preset working condition, wherein the preset working condition is a working condition point where a difference between fuel quality factors of different quality fuels exceeds a preset value; and
in response to that the operating working condition reaches the preset working condition, obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter.

3. The method for controlling the engine according to claim 2, **characterized in that** in response to that the operating working condition reaches the preset working condition, the obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter comprises:

in response to that the operating working condition reaches the preset working condition, detecting whether an operating duration of the engine under the operating working condition reaches a first preset duration; and
in response to that the operating duration reaches the first preset duration, obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter.

4. The method for controlling the engine according to claim 2, **characterized in that** before the detecting whether the operating working condition of the engine reaches the preset working condition, the method further comprises:

detecting whether a new fuel is injected into the engine; and
in response to that the new fuel is injected into the engine, obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter.

5. The method for controlling the engine according to claim 4, **characterized by** further comprising:

monitoring a fuel liquid level in the engine;
wherein the detecting whether the new fuel is injected into the engine comprises:

detecting whether the fuel liquid level satisfies a preset condition, wherein the preset condition is that a changing value of the fuel liquid level within a second preset duration exceeds a second preset range;
in response to that the fuel liquid level satisfies the preset condition, determining that the new fuel is injected into the engine; and
in response to that the fuel liquid level does not satisfy the preset condition, determining that the new fuel is not injected into the engine.

6. The method for controlling the engine according to any one of claims 1 to 5, **characterized in that** in response to that the concentration of the nitrogen oxide is obtained at least twice, the determining the fuel quality factor from the preset ignition control diagram based on the concentration of the nitrogen oxide and the engine torque comprises:

determining a plurality of control factors from the preset ignition control diagram based on the concentration of each nitrogen oxide and the corresponding engine torque; and
calculating the fuel quality factor based on the plurality of control factors.

7. The method for controlling the engine according to any one of claims 1 to 5, **characterized in that** the controlling the intake pressure of the engine comprises:

obtaining an actual injection duration through multiplying the fuel quality factor by an injection duration of the engine; and
controlling the intake pressure of the engine based on the actual injection duration, wherein the longer the actual injection duration is, the greater the intake pressure is.

8. An apparatus for controlling an engine, **characterized by** comprising:

an obtaining module configured to obtain a concentration of nitrogen oxide in exhaust gas emitted by the engine at least once through a NOx sensor provided at an upstream of a three-way catalytic converter, and obtain an engine torque corresponding to the concentration of the nitrogen oxide;

a determination module configured to determine a fuel quality factor from a preset ignition control diagram based on the concentration of the nitrogen oxide and the engine torque; and
a control module configured to control an intake pressure of the engine based on a fuel quality factor in response to that the fuel quality factor is within a first preset range.

9. A device for controlling an engine, **characterized by** comprising: a memory, a processor, and a program for controlling an engine stored in the memory and executable on the processor, wherein the program for controlling the engine is configured to implement the method for controlling the engine according to any one of claims 1 to 7.

10. A computer-readable storage medium, **characterized in that**, a program for controlling an engine is stored in the computer-readable storage medium, and when the program for controlling the engine is performed by a processor, the method for controlling the engine according to any one of claims 1 to 7 is implemented.

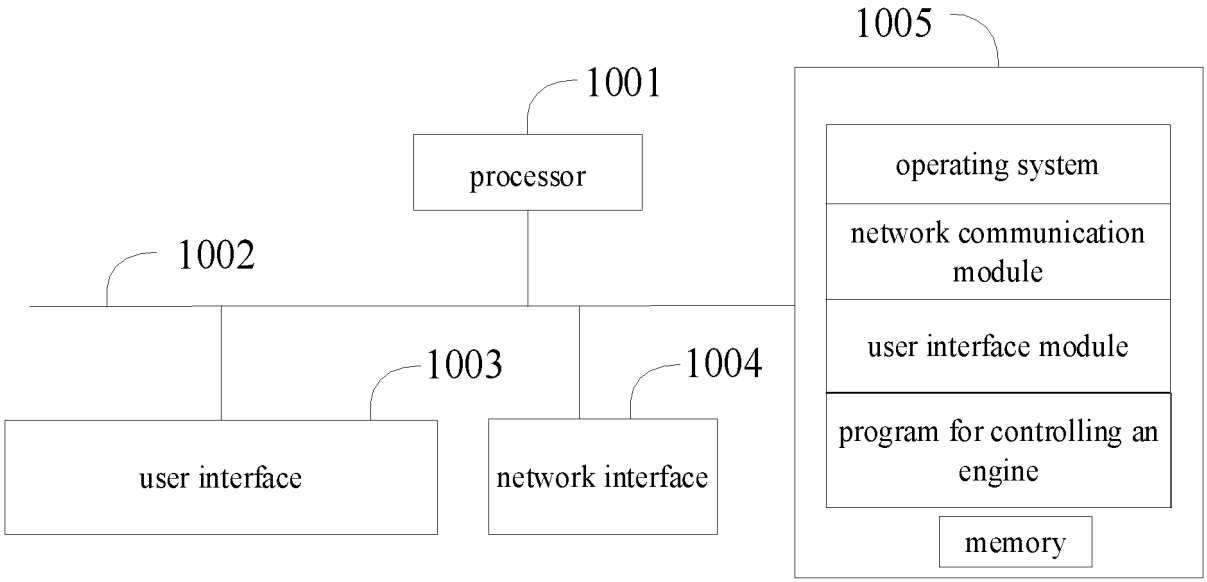

1005
1001
processor
operating system
network communication module
1002
user interface module
1003
1004
program for controlling an engine
user interface
network interface
memory

FIG. 1

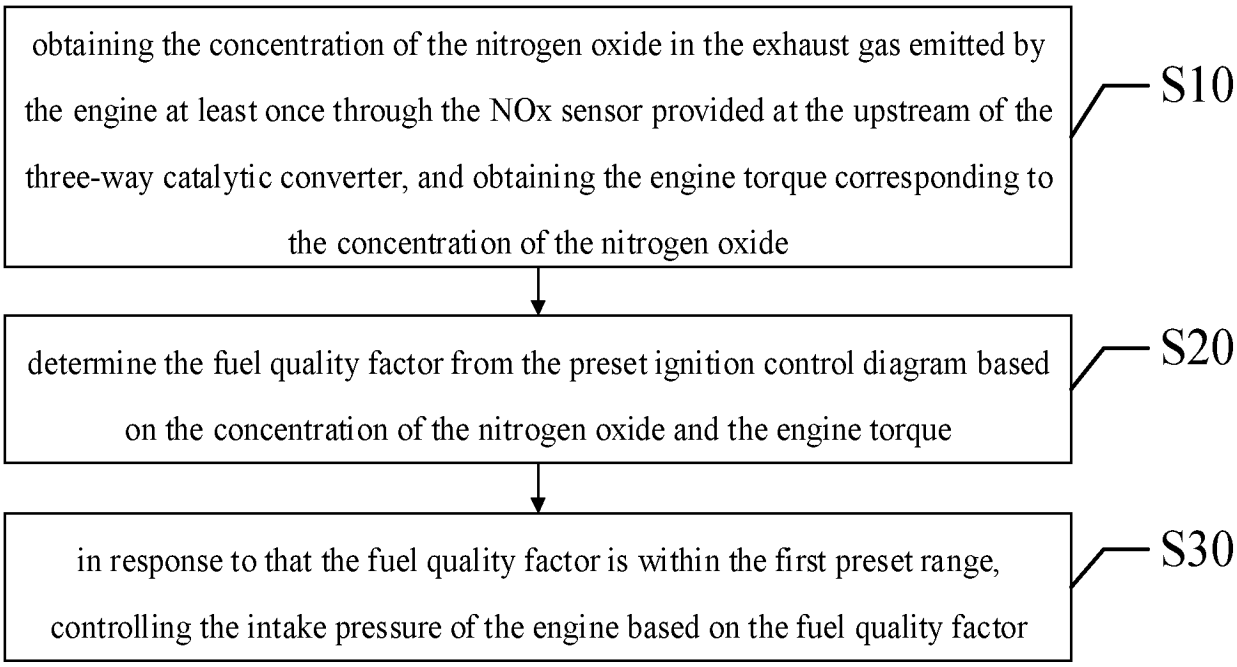
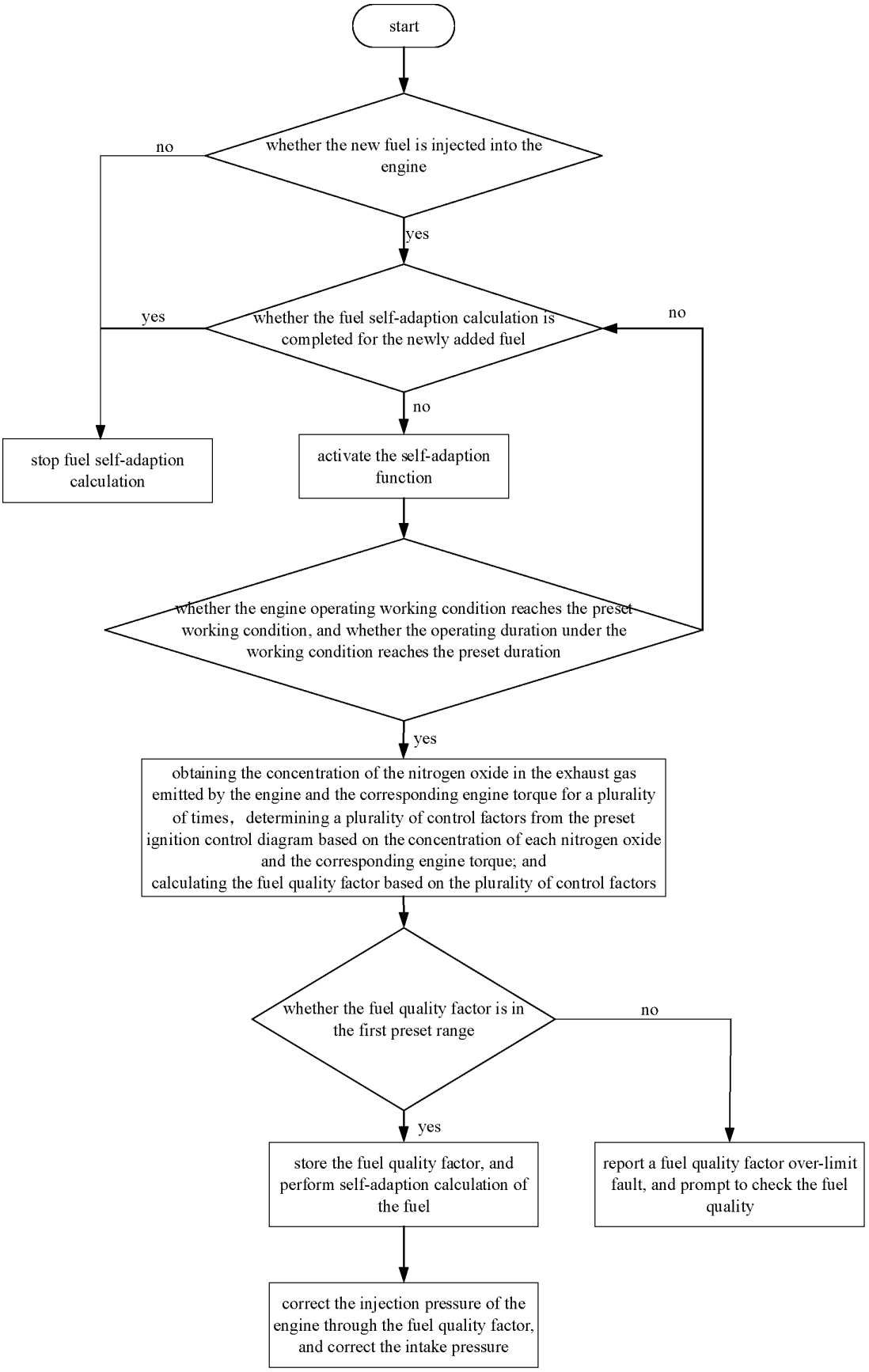

obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine at least once through the NOx sensor provided at the upstream of the three-way catalytic converter, and obtaining the engine torque corresponding to the concentration of the nitrogen oxide
S10
determine the fuel quality factor from the preset ignition control diagram based on the concentration of the nitrogen oxide and the engine torque
S20
in response to that the fuel quality factor is within the first preset range, controlling the intake pressure of the engine based on the fuel quality factor
S30

FIG. 2


start
whether the new fuel is injected into the engine
no
yes
whether the fuel self-adaption calculation is completed for the newly added fuel
yes
no
no
stop fuel self-adaption calculation
activate the self-adaption function
whether the engine operating working condition reaches the preset working condition, and whether the operating duration under the working condition reaches the preset duration
yes
obtaining the concentration of the nitrogen oxide in the exhaust gas emitted by the engine and the corresponding engine torque for a plurality of times, determining a plurality of control factors from the preset ignition control diagram based on the concentration of each nitrogen oxide and the corresponding engine torque; and
calculating the fuel quality factor based on the plurality of control factors
whether the fuel quality factor is in the first preset range
no
yes
store the fuel quality factor, and perform self-adaption calculation of the fuel
report a fuel quality factor over-limit fault, and prompt to check the fuel quality
correct the injection pressure of the engine through the fuel quality factor, and correct the intake pressure

25

FIG. 3

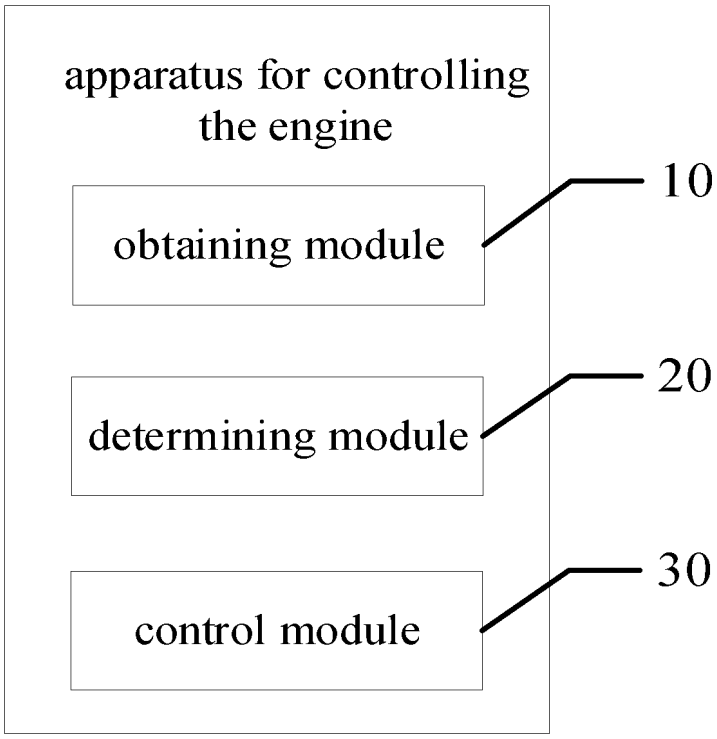

apparatus for controlling the engine
obtaining module
10
determining module
20
control module
30

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2024/102086

A. CLASSIFICATION OF SUBJECT MATTER

F02D41/00(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)

IPC:F02D41/-

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)

CNTXT; CNABS; ENTXTC; VEN; CNKI: 催化器, 催化剂, 氮氧化物, 浓度, 扭矩, 转矩, 燃料, 燃油, 品质, 系数, 热值, 进气压力, catalyst, nitrogen, oxide, NOx, concentration, torque, fuel, quality, coefficient, heating, value, intake, pressure

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 116591837 A (ZHEJIANG GEELY HOLDING GROUP CO., LTD. et al.) 15 August 2023 (2023-08-15) claims 1-10	1-10
A	CN 114856839 A (XI'AN JIAOTONG UNIVERSITY) 05 August 2022 (2022-08-05) description, paragraphs [0057]-[0077], and figures 1-3	1-10
A	CN 101153565 A (HONDA MOTOR CO., LTD.) 02 April 2008 (2008-04-02) entire document	1-10
A	CN 103982310 A (FORD GLOBAL TECHNOLOGIES, LLC) 13 August 2014 (2014-08-13) entire document	1-10
A	JP H08210171 A (KOMATSU MANUFACTURING CO., LTD.) 20 August 1996 (1996-08-20) entire document	1-10
A	US 2009248279 A1 (HONDA MOTOR CO., LTD.) 01 October 2009 (2009-10-01) entire document	1-10

☑ 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
"D" document cited by the applicant in the international application
"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
13 September 2024	**29 September 2024**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **China No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2024/102086

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2003056369 A (TOKYO GAS CO., LTD.) 26 February 2003 (2003-02-26) entire document	1-10

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2024/102086

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	116591837	A	15 August 2023	None			
CN	114856839	A	05 August 2022	None			
CN	101153565	A	02 April 2008	US	2008072878	A1	27 March 2008
				US	7475683	B2	13 January 2009
				BRPI	0703701	A	13 May 2008
				BRPI	0703701	B1	06 November 2018
				BRPI	0703701	B8	17 September 2019
				MX	2007011202	A	03 February 2009
				AR	062892	A1	10 December 2008
				PE	20081048	A1	08 September 2008
				CO	5960136	A1	30 September 2008
				DE	602007000770	D1	07 May 2009
				JP	2008082171	A	10 April 2008
				JP	5095973	B2	12 December 2012
				ES	2322822	T3	29 June 2009
				EP	1905990	A1	02 April 2008
				EP	1905990	B1	25 March 2009
				TH	93232	A	30 January 2009
				MX	286752	B	20 May 2011
				CN	101153565	B	29 June 2011
CN	103982310	A	13 August 2014	RU	145307	U1	20 September 2014
				US	2014222314	A1	07 August 2014
				US	9255542	B2	09 February 2016
				DE	102014201853	A1	07 August 2014
				CN	103982310	B	04 September 2018
JP	H08210171	A	20 August 1996	None			
US	2009248279	A1	01 October 2009	BRPI	0900512	A2	17 November 2009
				BRPI	0900512	B1	20 October 2020
				JP	2009243407	A	22 October 2009
				JP	5042105	B2	03 October 2012
				US	7778764	B2	17 August 2010
JP	2003056369	A	26 February 2003	None			

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 202310780093 **[0001]**