Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).
Cooperative Patent Classification (CPC): (Cont.)
F01N 2560/14; F01N 2610/03; F01N 2900/1404;
F01N 2900/1614; Y02T 10/12; Y02T 10/40
The present invention relates to an exhaust gas aftertreatment catalyst which utilizes an NOx occlusion reduction catalyst and more particularly to an NOx reduction control method for an exhaust gas aftertreatment device in which hydrocarbons (HC) are adsorbed to an oxidation catalyst or the like of the exhaust gas aftertreatment device for use for NOx reduction.

Background Art

An NOx occlusion reduction catalyst is such that a noble metal catalyst such as Pt, Pd or the like and an occlusion material having an NOx occlusion function such as an alkali metal including Na, K, Cs and the like, an alkali earth metal including Ca, Ba and the like or a rare earth including Y, La, Ce and the like, and the like are carried on a catalyst carrier such as an alumina (Al₂O₃) and exhibits occlusion material having an NOx occlusion function as nitrates (Ba(NO₃)₂) to purify NOx.

Summary of the Invention

At this time, with regard to released NOx, in case the amounts of HC and CO which are necessary for the required reaction are not enough, part of NOx is not reduced, and the untreated NOx is released as it is.

Problem that the Invention is to solve

At higher speeds so as to more easily contribute to the reduction of NOx, whereby the NOx slip is reduced during the rich state.

The switching between the lean and rich operations is performed as follows. An NOx adsorption amount is estimated based on a detection value of an NOx sensor provided at the inlet and exit of the LNT catalyst. Alternatively, an NOx adsorption amount is estimated by obtaining an NOx amount based on a map from an NOx concentration which is based on an operating state of the engine, that is, the injection amount of fuel and an exhaust gas flow rate, and integrating the ob-

Description

Technical Field

Prior Art Literature

Patent Literature

[0006] In this way, in the purification system using the LNT catalyst, the three-way catalyst function works in which NOx is adsorbed or occluded when the air-fuel ratio is in a lean state (under the high oxygen concentration condition), and the NOx adsorbed or occluded are desorbed or released from Ce or Ba during the rich state, so that HC, CO and NOx in the exhaust gases become harmless by the three-way catalyst function.

[0007] EP 2559872 discloses an exhaust gas purification device for improving a low temperature characteristic of an exhaust gas post-processing device. It includes an exhaust injection valve 22, a first catalyst 35, a second catalyst 36 for thermally decomposing fuel injected by the exhaust injection valve 22, an exhaust temperature estimation unit 41 for estimating an exhaust temperature, an engine injection control unit 42 for controlling fuel injection in the engine 10, and regeneration control units 43, 44 for controlling regeneration of the exhaust gas post-processing device 30.

[0008] EP 2559872 discloses an exhaust gas purification device for improving a low temperature characteristic of an exhaust gas post-processing device. It includes an exhaust injection valve 22, a first catalyst 35, a second catalyst 36 for thermally decomposing fuel injected by the exhaust injection valve 22, an exhaust temperature estimation unit 41 for estimating an exhaust temperature, an engine injection control unit 42 for controlling fuel injection in the engine 10, and regeneration control units 43, 44 for controlling regeneration of the exhaust gas post-processing device 30.

[0009] EP 2559872 discloses an exhaust gas purification device for improving a low temperature characteristic of an exhaust gas post-processing device. It includes an exhaust injection valve 22, a first catalyst 35, a second catalyst 36 for thermally decomposing fuel injected by the exhaust injection valve 22, an exhaust temperature estimation unit 41 for estimating an exhaust temperature, an engine injection control unit 42 for controlling fuel injection in the engine 10, and regeneration control units 43, 44 for controlling regeneration of the exhaust gas post-processing device 30.

[0010] Normally, HC are dosed to exhaust gases as a result of performing a post-injection in the cylinders or dosing HC into the exhaust pipe and are dissociated by temperatures or a catalyst reaction in the DOC to be supplied to the catalyst.

[0011] However, when the temperatures of the exhaust gas and the catalyst are low (equal to or lower than 200°C), since it takes some time until supplied unburnt fuel is dissociated into HC, the NOx reduction efficiency is reduced during the rich state and NOx tends to slip easily.

[0012] When the temperature becomes high to some extent (for example, 250°C or higher), HC are dissociated at higher speeds so as to more easily contribute to the reduction of NOx, whereby the NOx slip is reduced during the rich state.

[0013] The switching between the lean and rich operations is performed as follows. An NOx adsorption amount is estimated based on a detection value of an NOx sensor provided at the inlet and exit of the LNT catalyst. Alternatively, an NOx adsorption amount is estimated by obtaining an NOx amount based on a map from an NOx concentration which is based on an operating state of the engine, that is, the injection amount of fuel and an exhaust gas flow rate, and integrating the ob-

[0014] When the occlusion of NOx continues, however, since nitrates are saturated to lose the occlusion function as the occlusion material, the operating condition is changed to form a rich state by performing an EGR (Exhaust Gas Recirculation), a post-injection of fuel or an exhaust pipe injection of fuel under a low oxygen concentration condition (a rich air-fuel ratio), so that fuel is reduced on the noble metal catalyst to thereby produce CO, HC, H₂ in the exhaust gases so as to release NOx for purification.

[0015] When the switching between the lean and rich operations is performed as follows. An NOx adsorption amount is estimated based on a detection value of an NOx sensor provided at the inlet and exit of the LNT catalyst. Alternatively, an NOx adsorption amount is estimated by obtaining an NOx amount based on a map from an NOx concentration which is based on an operating state of the engine, that is, the injection amount of fuel and an exhaust gas flow rate, and integrating the ob-

[0016] When the occlusion of NOx continues, however, since nitrates are saturated to lose the occlusion function as the occlusion material, the operating condition is changed to form a rich state by performing an EGR (Exhaust Gas Recirculation), a post-injection of fuel or an exhaust pipe injection of fuel under a low oxygen concentration condition (a rich air-fuel ratio), so that fuel is reduced on the noble metal catalyst to thereby produce CO, HC, H₂ in the exhaust gases so as to release NOx for purification.

[0017] When the switching between the lean and rich operations is performed as follows. An NOx adsorption amount is estimated based on a detection value of an NOx sensor provided at the inlet and exit of the LNT catalyst. Alternatively, an NOx adsorption amount is estimated by obtaining an NOx amount based on a map from an NOx concentration which is based on an operating state of the engine, that is, the injection amount of fuel and an exhaust gas flow rate, and integrating the ob-

[0018] When the switching between the lean and rich operations is performed as follows. An NOx adsorption amount is estimated based on a detection value of an NOx sensor provided at the inlet and exit of the LNT catalyst. Alternatively, an NOx adsorption amount is estimated by obtaining an NOx amount based on a map from an NOx concentration which is based on an operating state of the engine, that is, the injection amount of fuel and an exhaust gas flow rate, and integrating the ob-

Patent Literature


tained NOx amount according to the operating state. Then, when the NOx adsorption amount exceeds a set value, the operating state is switched from the lean operating state to the rich operating state, and when the NOx reduction amount becomes equal to or smaller than a threshold value, the operating state is switched from the rich operating state to the lean operating state.

[0014] However, as described above, when the temperature of the exhaust gas is equal to or lower than 200°C which is the catalyst activation temperature, there is caused a problem that even when the operating state is switched from the lean operating state to the rich operating state, the NOx reduction cannot be effected sufficiently.

[0015] Accordingly, an object of the present invention is to solve the problem described above and to provide an NOx reduction control method for an exhaust gas aftertreatment device which can execute an NOx reduction without any problem even when the temperature of the exhaust gas is low.

Means for solving the Problem

[0016] With a view to achieving the object, according to the present invention, there is provided an NOx reduction control method for an exhaust gas aftertreatment device having an oxidation catalyst and an LNT catalyst which are disposed in an exhaust pipe and repeating an adsorption or occlusion of NOx which is executed when an air-fuel ratio is in a lean state and a reduction of NOx which is executed when the air-fuel ratio is in a rich state, wherein the LNT catalyst is disposed downstream of the oxidation catalyst, and the oxidation catalyst absorbs HC when an exhaust gas temperature is lower than a catalyst activation temperature, and desorbs HC adsorbed when the exhaust gas temperature is equal to or greater than the catalyst activation temperature, the method comprising: executing a post-injection of fuel or an exhaust pipe injection of fuel and causing HC to be adsorbed in the oxidation catalyst when an exhaust gas temperature is lower than a catalyst activation temperature; estimating an HC adsorption amount adsorbed in the oxidation catalyst; stopping the post-injection or the exhaust pipe injection when the HC adsorption amount reaches a threshold value; and after HC is adsorbed in the oxidation catalyst, causing the HC which is adsorbed in the oxidation catalyst to be desorbed and reducing an adsorbed NOx in the LNT catalyst by raising the exhaust gas temperature when the exhaust gas temperature exceeds the catalyst activation temperature and it is instructed that the air-fuel ratio is caused to be in the rich state based on an amount of the adsorbed NOx.

Brief Description of Drawing

[0017] Fig. 1 is a schematic diagram showing a device for executing an NOx reduction control method for an exhaust gas aftertreatment device of the present invention.

Mode for Carrying out the Invention

[0018] Hereinafter, a preferred embodiment of the present invention will be described in detail based on the accompanying drawings.

[0019] Fig. 1 shows an exhaust gas aftertreatment device 10 which utilizes an LNT catalyst.

[0020] A turbocharger 11 and an EGR pipe 12 are connected to an intake and exhaust systems of an engine E, whereby air which is taken in from an air cleaner 13 is compressed by a compressor 14 of the turbocharger 11 and is then sent under pressure to an intake passage-way 15 so as to be supplied into the engine E from an intake manifold 16 of the engine E. An intake valve 17 which controls the amount of air supplied to the engine E is provided along the intake passageway 15.

[0021] Exhaust gas discharged from the engine E is discharged from an exhaust manifold 18 to a turbine 19 of the turbocharger 11 to drive the turbine 19 and is then discharged into an exhaust pipe 20.

[0022] The EGR pipe 12 is connected to the intake manifold 16 and the exhaust manifold 18, and both an EGR cooler 21 for cooling exhaust gases which flows from the exhaust manifold 18 to the intake manifold 16 and an EGR valve 22 for controlling an EGR amount are connected to the EGR pipe 12.

[0023] In the exhaust gas aftertreatment device 10, an exhaust pipe injector 23 is provided downstream of the turbine 19 on the exhaust pipe 20, and a DOC (Diesel Oxidation Catalyst) 25, an LNT catalyst 26 and a DPF 27 are canned sequentially in a canning container 24 which is formed downstream of the exhaust pipe injector 23 on the exhaust pipe 20.

[0024] A pre-DOC exhaust gas temperature sensor 28 is provided upstream of the DOC 25, and a post-DOC exhaust gas temperature sensor 29 and an NOx sensor 30 are provided on an entrance side and an exit side of the LNT catalyst 26, respectively.

[0025] An overall operation of the engine E is controlled by an ECU 32. The ECU 32 includes an NOx adsorption amount estimating means 33, an HC adsorption amount estimating means 34 and an NOx reduction amount estimating means 35.

[0026] The ECU 32 executes a lean cycle in which the LNT catalyst 26 is caused to occlude NOx with an air-fuel ratio staying in a lean state and a rich cycle in which, when an NOx occlusion rate is reduced, NOx are reduced for purification with the air-fuel ratio staying in a rich state by executing a post-injection in cylinders or injecting fuel HC in a pulsating fashion by using the exhaust pipe injector 23 shown.
In switching between the lean cycle and the rich cycle, the NOx adsorption amount estimating means 33 estimates an amount of NOx adsorbed by the LNT catalyst 26 during a lean combustion, and when the NOx adsorption amount reaches a set value, the lean combustion is switched to the rich combustion.

The NOx adsorption amount estimating means 33 obtains an amount of NOx which is released based on a map from an NOx concentration which is based on the operating state of the engine and an exhaust gas flow rate, and integrates the NOx amount so obtained to estimate an NOx adsorption amount at the LNT catalyst 26 or calculates an NOx adsorption amount based on a detection value of the NOx sensor 30.

The ECU 32 controls the combustion of the engine based on the lean cycle when the NOx adsorption amount is smaller than the set value and controls the combustion of the engine based on the rich cycle when the NOx adsorption amount is equal to or greater than the set value.

In the present invention, in the lean cycle, the ECU 32 executes the post-injection or activates the exhaust pipe injector 23 to inject fuel when an exhaust gas temperature detected by the pre-DOC exhaust gas temperature sensor 28 is lower than a catalyst activation temperature (approximately 200°C).

By doing so, unburnt fuel is adsorbed by the DOC 25, during which the unburnt fuel is so adsorbed while being dissociated to HC in the DOC 25. This HC adsorption amount is calculated by the HC adsorption amount estimating means 34 based on a post-injection amount or an amount of fuel injected by the exhaust pipe injector 23.

In the rich cycle, the NOx reduction amount estimating means 35 calculates an NOx reduction amount when NOx are reduced by HC, and when the NOx reduction amount so calculated becomes equal to or smaller than a threshold value, the rich cycle is switched to the lean cycle.

In the normal rich cycle, when the exhaust gas temperature is low, since it takes some time until being dissociated into HC, the NOx reduction efficiency at the catalyst is reduced, and the slip of NOx tends to take place easily.

In the present invention, when the exhaust temperature is low, fuel (HC) is supplied into the exhaust pipe 20 by means of a post-injection or an exhaust pipe injection to be adsorbed by the DOC 25. The HC which are adsorbed in advance by the DOC 25 are desorbed from the DOC 25 when the exhaust gas temperature exceeds 200°C to be used easily for NOx reduction, and the reduction of NOx progresses even at low exhaust gas temperatures during the rich state, whereby the NOx slip can be reduced.

In this way, the reduction of NOx when the exhaust gas temperature is low during the rich state can be executed by making use of the HC which are adsorbed in advance by the catalyst, and therefore, the engine is allowed to devotedly increase the exhaust gas temperature and produce a rich air-fuel ratio, whereby an improvement in reduction efficiency by increasing the temperature can be expected.

The DOC 25 and the LNT catalyst 26 act to adsorb NOx and HC when the exhaust gas temperature is so low as to be equal to or lower than 200°C. Accordingly, in a lean combustion, HC are supplied into exhaust gases when the exhaust gas temperature is low, and the HC so supplied are caused to be adsorbed mainly by the DOC 25, and part of the HC which is not adsorbed by the DOC 25 is caused to be adsorbed by the LNT catalyst 26.

In case the amount of adsorption of HC is too great, when the exhaust gas temperature is increased, there may be a case where the exhaust gas temperature is increased extraordinarily. Therefore, an HC adsorption amount is estimated by the HC adsorption amount estimating means 34, and a threshold value is provided for the HC adsorption amount. Then, when the HC adsorption amount reaches the threshold value, the post-injection or the exhaust pipe injection is stopped to prevent an excessive adsorption.

A rich reduction is executed when the exhaust gas temperature exceeds the activation temperatures (for example, 200°C) of the DOC 25 and the LNT catalyst 26. The rich reduction to be executed here is intended to increase the exhaust gas temperature by burning fuel supplied into the cylinders by means of a post-injection and to make the air-fuel ratio of exhaust gas rich. Namely, since the conventional supply of HC into the exhaust pipe is not intended, as to an injection timing, the post-injection is moved close to a main injection (for example, within 45° BTDC). A main injection amount and a post-injection amount are calibrated so as not to produce a sensation of physical disorder so that torque produced during the rich state matches torque produced when combustion is performed normally. As this occurs, a glow plug may be energized to assist the combustion.

When the exhaust gas whose temperature is increased reaches surfaces of the catalysts, the movement of molecules is activated, the HC adsorbed by the DOC 25 and the NOx adsorbed by the LNT catalyst 26 are desorbed therefrom, and the NOx are reduced under the rich air-fuel ratio.

When the rich combustion is performed several times, the temperatures of the catalysts are increased to a high temperature (250°C or higher), and all the HC adsorbed by the DOC 25 are desorbed to be used for NOx reduction. Thus, when the amount of desorption of HC is reduced to a low level based on the HC adsorption amount estimated by the HC adsorption amount estimating means 34, the rich combustion method is changed, and the post-injection is delayed (for example, the crank angle is 150° BTDC) so as to supply HC from the engine to the catalyst. Since the catalyst is heated to the high temperature, the dissociation of HC is promoted, whereby an NOx reduction can be executed even by HC sup-
plied from the engine during the rich state.

[0041] Next, the NOx reduction control method described heretofore will be explained based on a flowchart shown in Fig. 2.

[0042] When the control is started in step S10, in step S11, when the pre-DOC exhaust gas temperature T1 > the catalyst activation temperature (approximately of 200°C), HC are supplied into exhaust gases by means of a post-injection or dosing HC into the exhaust pipe.

[0043] Next, in step S12, it is determined whether or not the pre-DOC exhaust gas temperature T1 > the catalyst activation temperature (approximately of 200°C). If it is determined that the pre-DOC exhaust gas temperature T1 is lower than the catalyst activation temperature (the condition is not met; NO), the control process is returned to step S11, where HC is continued to be supplied into exhaust gases while integrating the HC so supplied, and an amount of HC adsorbed by the catalyst is estimated. In these steps S11, S12, if the HC adsorption amount reaches the threshold value (the set value), the supply of HC is stopped.

[0044] If it is determined in step S12 that the pre-DOC exhaust gas temperature T1 exceeds the catalyst activation temperature (approximately of 200°C) (the condition is met; YES), the control process proceeds to step S13, where a rich reduction is executed if a command to execute such a rich reduction is given based on the NOx adsorption amount. In the execution of the rich reduction, as to the timing of injection of fuel, since fuel is injected not to supply HC into the exhaust pipe but to raise the exhaust gas temperature, the post-injection is executed at a timing which is close to the timing of a main injection (for example, within 45° BTDC), whereby fuel is injected almost as in an after-injection. In this case, the exhaust gas temperature may be raised by assisting the combustion by energizing the glow plug.

[0045] Next, it is determined in step S14 whether or not a post-DOC exhaust gas temperature T2 > a fuel dissociation temperature (250°C or higher), and if the post-DOC exhaust gas temperature T2 does not exceed the fuel dissociation temperature or the HC adsorption amount does not exceed the threshold value (the condition is not met), the control process is returned to step S13, where the post-injection is caused to continue to raise the exhaust gas temperature whereby NOx are reduced by using the adsorbed HC in step S13. On the other hand, if it is determined in step S14 that the post-DOC exhaust gas temperature T2 exceeds the fuel dissociation temperature and that the HC adsorption amount is equal to smaller than the threshold value (the condition is met), in step S 15, the rich combustion method is changed, so that the post-injection is delayed (for example, the crank angle is 150° BTDC) to realize the normal post-injection so as to supply HC from the engine to the catalyst to thereby execute a rich reduction.

[0046] Next, it is determined in step S16 whether or not the NOx reduction amount becomes equal to or smaller than the threshold value, and if it is determined that the NOx reduction amount does not become equal to or smaller than the threshold value (the condition is not met), the control process is returned to step S15, where the rich reduction is caused to continue, whereas if it is determined that the NOx reduction amount becomes equal to or smaller than the threshold value (the condition is met), the control process ends in step S17 to return to the initial step.

[0047] In this way, according to the present invention, when the exhaust gas temperature is low, the post-injection or the exhaust pipe injection is executed so that the DOC 25 adsorbs unburnt fuel, whereby the adsorbed unburnt fuel is dissociated into HC in the catalyst even when the ambient temperature is low. Then, in executing the rich reduction, the exhaust gas temperature is raised to be 200°C or higher, whereby the adsorbed HC are desorbed so that NOx are reduced by the desorbed HC, thereby making it possible to prevent the slip of NOx in the rich reduction when the exhaust gas temperature is low.

Claims

1. An NOx reduction control method for an exhaust gas aftertreatment device having an oxidation catalyst and an LNT catalyst which are disposed in an exhaust pipe and repeating an adsorption or occlusion of NOx which is executed when an air-fuel ratio is in a lean state and a reduction of NOx which is executed when the air-fuel ratio is in a rich state,

wherein the LNT catalyst is disposed downstream of the oxidation catalyst, and the oxidation catalyst adsorbs HC when an exhaust gas temperature is lower than a catalyst activation temperature, and desorbs HC adsorbed when the exhaust gas temperature is equal to or greater than the catalyst activation temperature, the method comprising:

executing a post-injection of fuel or an exhaust pipe injection of fuel and causing HC to be adsorbed in the oxidation catalyst when an exhaust gas temperature is lower than a catalyst activation temperature; estimating an HC adsorption amount adsorbed in the oxidation catalyst; stopping the post-injection or the exhaust pipe injection when the HC adsorption amount reaches a threshold value; and after HC is adsorbed in the oxidation catalyst, causing the HC which is adsorbed in the oxidation catalyst to be desorbed and reducing an adsorbed NOx in the LNT catalyst by raising the exhaust gas temperature when the exhaust gas temperature ex-
ceeds the catalyst activation temperature and it is instructed that the air-fuel ratio is caused to be in the rich state based on an amount of the adsorbed NOx.

2. The NOx reduction control method for the exhaust gas aftertreatment device according to claim 1, wherein the post-injection or the exhaust pipe injection is executed when the exhaust gas temperature is 200°C or lower, and wherein the HC which is adsorbed in the oxidation catalyst is caused to be desorbed and the NOx is reduced by raising the exhaust gas temperature either by executing the post-injection continually after a main injection in which fuel is injected at a timing in proximity to a compression top dead center or by energizing a glow plug, when the exhaust gas temperature exceeds the catalyst activation temperature and the air-fuel ratio is caused to be in the rich state based on an NOx adsorption amount in the LNT catalyst.

3. The NOx reduction control method for the exhaust gas aftertreatment device according to claim 2, the method further comprising:
executing a normal reduction of NOx by supplying HC to the LNT catalyst either by causing the post-injection to be delayed or by executing the exhaust pipe injection, when an HC adsorption amount in the oxidation catalyst becomes equal to or smaller than a threshold value.

4. The NOx reduction control method for the exhaust gas aftertreatment device according to claim 3, the method further comprising:
causing the air-fuel ratio to be in the lean state and adsorbing or occluding NOx when an NOx reduction amount becomes equal to or smaller than a threshold value.

Patentansprüche

1. Steuerungsverfahren zur NOx-Reduktion für eine Abgasnachbehandlungsvorrichtung, die einen Oxidationskatalysator und einen LNT-Katalysator aufweist, die in einer Abgasleitung angeordnet sind und eine Adsorption oder Okklusion von NOx, welche ausgeführt wird, wenn ein Luft-Kraftstoff-Verhältnis in einem mageren Zustand ist, und eine Reduktion von NOx, die ausgeführt wird, wenn das Luft-Kraftstoff-Verhältnis in einem fetten Zustand ist, wiederholen,

wobei der LNT-Katalysator stromabwärts des Oxidationskatalysators angeordnet ist, und der Oxidationskatalysator KW adsorbiert, wenn eine Abgastemperatur niedriger als eine Katalysatoraktivierungstemperatur ist, und adsorbierte KW desorbiert, wenn die Abgastemperatur gleich oder höher als die Katalysatoraktivierungstemperatur ist;

2. Steuerungsverfahren zur NOx-Reduktion für die Abgasnachbehandlungsvorrichtung nach Anspruch 1, wobei die Nacheinspritzung oder die Abgasrohreinspritzung von Kraftstoff und Veranlassen, dass KW in dem Oxidationskatalysator adsorbiert werden, wenn eine Abgastemperatur niedriger als eine Katalysatoraktivierungstemperatur ist;

Schätzen einer KW-Adsorptionsmenge, die in dem Oxidationskatalysator adsorbiert ist;

Stoppen der Nacheinspritzung oder der Abgasroreinspritzung, wenn die KW-Adsorptionsmenge einen Schwellenwert erreicht; und nachdem KW in dem Oxidationskatalysator adsorbiert sind, Veranlassen, dass die KW, die in dem Oxidationskatalysator adsorbiert sind, desorbiert werden, und Reduzieren eines adsorbierten NOx in dem LNT-Katalysator durch Erhöhen der Abgastemperatur, wenn die Abgastemperatur die Katalysatoraktivierungstemperatur übersteigt und es wird angewiesen, dass veranlasst wird, dass das Luft-Kraftstoff-Verhältnis in den fetten Zustand gebracht wird, basierend auf einer Menge des adsorbierten NOx.

3. Steuerungsverfahren zur NOx-Reduktion für die Abgasnachbehandlungsvorrichtung nach Anspruch 2, wobei der Nacheinspritzung oder die Abgasrohreinspritzung ausgeführt wird, wenn die Abgastemperatur 200 °C oder weniger beträgt, und wobei die KW, die in dem Oxidationskatalysator adsorbiert sind, veranlasst werden, zu desorbiieren und das NOx reduziert wird, indem die Abgastemperatur entweder durch kontinuierliche Durchführung der Nacheinspritzung nach einer Haupteinspritzung, bei der Kraftstoff zu einem Zeitpunkt in der Nähe des oberen Totpunktes der Verdichtung eingespritzt wird, oder durch Aktivieren einer Glühkerze erhöht wird, wenn die Abgastemperatur die Katalysatoraktivierungstemperatur übersteigt und veranlasst wird, dass das Luft-Kraftstoff-Verhältnis auf der Grundlage einer NOx-Adsorptionsmenge in dem LNT-Katalysator in den fetten Zustand gebracht wird.
wobei das Verfahren ferner umfasst:

4. Steuerungsverfahren zur NOx-Reduktion für die Abgasnachbehandlungsvorrichtung nach Anspruch 3, wobei das Verfahren ferner umfasst:
Veranlassen, dass das Luft-Kraftstoff-Verhältnis in den mageren Zustand versetzt wird, und Adsorbieren oder Okkludieren von NOx, wenn eine NOx-Reduktionsmenge gleich oder kleiner als ein Schwellenwert wird.

Revendications
1. Procédé de commande de réduction de NOx pour dispositif de post-traitement de gaz d’échappement ayant un catalyseur d’oxydation et un catalyseur LNT qui sont disposés dans un tuyau d’échappement et répétant une adsorption ou une occlusion du NOx qui est exécutée quand un rapport air-combustible est dans un état pauvre et une réduction du NOx qui est exécutée quand le rapport air-combustible est dans un état riche,

le catalyseur LNT étant disposé en aval du catalyseur d’oxydation, et
le catalyseur d’oxydation absorbant le HC quand une température de gaz d’échappement est plus basse qu’une température d’activation de catalyseur, et désorbe le HC adsorbé quand la température de gaz d’échappement est supérieure ou égale à la température d’activation de catalyseur,
le procédé comprenant :

l’exécution d’une post-injection de carburant ou d’une injection de carburant par le tuyau d’échappement et entraînant le HC à être adsorbé dans le catalyseur d’oxydation quand une température de gaz d’échappement est plus basse qu’une température d’activation de catalyseur ;
l’estimation d’une quantité d’adsorption de HC adsorbé dans le catalyseur d’oxydation ;
l’interruption de la post-injection ou de l’injection par le tuyau d’échappement quand la quantité d’adsorption de HC atteint une valeur seuil ; et après que le HC est adsorbé au catalyseur d’oxydation, entraînant le HC qui est adsorbé dans le catalyseur d’oxyda-
tion à être désorbé et réduisant un NOx adsorbé dans le catalyseur LNT en augmentant la température de gaz d’échappement quand la température de gaz d’échappement dépasse la température d’activation de catalyseur et est instruite que le rapport air-combustible est entraîné à être dans l’état riche sur la base d’une quantité du NOx adsorbé.

2. Procédé de commande de réduction de NOx pour dispositif de post-traitement de gaz d’échappement selon la revendication 1,
dans lequel la post-injection ou l’injection par le tuyau d’échappement est exécutée quand la température du gaz d’échappement est de 200 °C ou moins, et
le HC qui est adsorbé dans le catalyseur d’oxydation étant entraîné à être désorbé et le NOx étant réduit en augmentant la température du gaz d’échappement soit en exécutant la post-injection en continu après une injection principale dans laquelle le carburant est injecté à un timing à proximité d’un point mort haut de compression soit en énergisant une bougie de préchauffage, quand la température de gaz d’échappement dépasse la température d’activation de catalyseur et que le rapport air-combustible est entraîné à être dans l’état riche sur la base d’une quantité d’adsorption du NOx dans le catalyseur LNT.

3. Procédé de commande de réduction de NOx pour dispositif de post-traitement de gaz d’échappement selon la revendication 2, le procédé comprenant en outre :
l’exécution d’une réduction normale de NOx en fournissant du HC au catalyseur LNT soit en entraînant la post-injection à être retardée soit en exécutant l’injection par le tuyau d’échappement, quand une quantité d’adsorption de HC dans le catalyseur d’oxydation devient inférieure ou égale à une valeur seuil.

4. Procédé de commande de réduction de NOx pour dispositif de post-traitement de gaz d’échappement selon la revendication 3, le procédé comprenant en outre :
l’entraînement du rapport air-combustible à être dans l’état pauvre et l’adsorption ou l’occlusion du NOx quand une quantité de réduction de NOx devient inférieure ou égale à une valeur seuil.
FIG. 2

START

PRE-DOC EXHAUST GAS TEMPERATURE $T_1 < $ CATALYST ACTIVATION TEMPERATURE (APPROXIMATELY 200°C) → HC ARE SUPPLIED INTO EXHAUST GASES BY EXECUTING POST-INJECTION OR DOSING HC. HC ADSORPTION AMOUNT IS ESTIMATED, AND HC ARE SUPPLIED TO REACH THRESHOLD VALUE

PRE-DOC EXHAUST GAS TEMPERATURE $T_1 > $ CATALYST ACTIVATION TEMPERATURE (APPROXIMATELY 200°C)

CONDITION IS MET

IF COMMAND TO EXECUTE RICH REDUCTION IS GIVEN BASED ON NOx ADSORPTION AMOUNT, RICH REDUCTION IS EXECUTED. AS TO INJECTION TIMING, POST-INJECTION IS EXECUTED AT TIMING CLOSE TO TIMING OF MAIN INJECTION (FOR EXAMPLE, WITHIN 45° BTDC). COMBUSTION ASSISTANCE BY ENERGIZING GLOW PLUG IS ALSO POSSIBLE

POST-DOC EXHAUST GAS TEMPERATURE $T_2 > $ FUEL DISSOCIATION TEMPERATURE (250°C OR HIGHER) AND HC ADSORPTION AMOUNT IS EQUAL TO OR SMALLER THAN THRESHOLD VALUE

CONDITION IS NOT MET

CONDITION IS MET

RICH COMBUSTION METHOD IS CHANGED, AND POST-INJECTION IS DELAYED (FOR EXAMPLE, 150° BTDC), WHEREBY HC ARE SUPPLIED FROM ENGINE TO CATALYST

NOx REDUCTION AMOUNT IS EQUAL TO OR SMALLER THAN THRESHOLD VALUE

CONDITION IS NOT MET

CONDITION IS MET

END, RETURN
REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 2559872 A [0008]