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(54) **SYSTEM AND METHOD FOR REDUCTION OF NITROGEN OXIDES FROM EXHAUST GASES GENERATED BY A LEAN-BURN INTERNAL COMBUSTION ENGINE**

SYSTEM UND VERFAHREN ZUR VERRINGERUNG VON STICKOXIDEN AUS DURCH VERBRENNUNGSMOTOREN MIT MAGERER VERBRENNUNG ERZEUGTEN ABGASEN

SYSTEME ET PROCEDE DE REDUCTION DES OXYDES D'AZOTE DES GAZ D'ECHAPPEMENT GENERES PAR UN MOTEUR A COMBUSTION INTERNE A MELANGE PAUVRE

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Description

TECHNICAL FIELD

[0001] The invention relates to a system for reduction of nitrogen oxides from exhaust gases generated by a lean-burn internal combustion engine according to the preamble of claim 1 and furthermore to a method for reduction of nitrogen oxides from exhaust gases generated by a lean-burn internal combustion engine according to claim 12. In particular the invention relates to a system and method for reduction of nitrogen oxides from exhaust gases generated by a lean-burn internal combustion engine where a reduction agent is injected to a lean NOx catalyst. A lean NOx catalyst is a catalyst which can reduce NOx under lean burn conditions. Examples of lean NOx catalysts that may be used in connection with this invention is provided in EP 830201, US 4946659, US 2003/0069125 and JP 2002-327618.

BACKGROUND ART

[0002] There is a general demand for low emissions of harmful substances in the exhaust gases from vehicles, which are operated by combustion engines. These substances are primarily considered to be pollutants and often take the form of nitrogen oxide compounds (NOx), hydrocarbon compounds (HC), and carbon monoxide (CO). The role of NOx in the urban city is a major problem and in Europe, North America and Japan this concern is reflected in stricter emission legislation. In 1997, leaders from more than 150 countries signed the Kyoto agreement, which involved a solution on how to reduce green house gases such as carbon dioxide (CO2). The CO2 emission from a vehicle is related to the fuel consumption and with the potential of lower fuel consumption from diesel or lean-burn engines, emission of CO2 can be decreased. By replacing diesel as a fuel in heavy-duty trucks with DME, it is possible to considerably reduce emissions such as NOx and particles, from heavy-duty trucks. However it is not possible to achieve the future emission standards in Europe and America by alone changing the fuel, more drastic and innovative methods are required. The conventional three-way catalyst is ineffective of reducing NO_x from lean-burn engines and for several years various types of $DeNO_x$ catalyst have been studied such as the Lean NOx catalysts (HC-SCR). Known Lean NOX catalyst systems are continuously reducing NO_x from the exhaust by using hydrocarbons such as diesel fuel as reducing agent.

[0003] A catalytic reactor in an exhaust duct is normally arranged as one of several monolithic bodies of a matrix material providing a plurality of flow channels where the exhaust is exposed to a large surface area carrying a catalytic material. In order for the catalyst to operate properly the flow of the exhaust through the monolithic bodies should have a flow profile which to the largest extent is uniform over the whole cross section of the monolithic bodies. The expression flow profile refers in this context to the distribution of massflow per area unit over a cross section of a monolithic body.

[0004] In lean NOX catalysts a reduction agent is injected in order to perform reduction of NOx over the catalyst. Since the amount of reduction agent is proportional to the amount of NOX to be reduced, the mass flow of the reduction agent should preferably have the same flow profile as the mass flow of exhausts.

[0005] In known state of the art systems it has shown to be problematic to inject fuel so as to obtain a flow profile having a sufficient even distribution of mass flow over the cross section of the monolithic body. Therefore, prior art system have suggested the use of mixers positioned in front of the catalytic body, in between the injector and the catalytic body, in order to more evenly distribute the reduction agent over the cross section of the catalytic body. However, introduction of mixers increases the pressure drop over the catalytic device, which thereby reduces the efficiency of the engine and adds to fuel consumption. Furthermore, even after mixers have been installed it has shown to be problematic to control the distribution of the reduction agent and known systems in operation have shown to generate areas with locally increased concentration of reduction agent.

[0006] Further attempts have been made to reduce the local variation of the concentration of reduction agent. By increasing the injection pressure it is possible to more evenly distribute the reduction agent over the cross section of the flow channel. However, in order to obtain a sufficiently even distribution of reduction agent, injectors operating with high injection pressures comparable to injection system known for injecting fuel into the combustion chambers of a conventional internal combustion engine must be used.

[0007] Injection at high injection pressure reduces the efficiency of the engine and adds to fuel consumption in an unacceptable way.

DISCLOSURE OF INVENTION

[0008] The object of the invention is to provide a system for reduction of nitrogen oxides from exhaust gases generated by a lean-burn internal combustion engine where the uniformity of the mass flow over the cross section of the monolithic body is increased in comparison to conventional systems, and which inventive system reduces the need for use of energy consuming accessories such high pressure injection systems and mixers.

[0009] The object is achieved by a system for reduction of nitrogen oxides from exhaust gases generated by a lean-burn internal combustion engine according to the characterising portion of claim 1. With the inventive arrangement of the injection ports an even distribution of the reduction agent is accomplished.

[0010] Additionally, di-methyl ether is used as a reduction agent as suggested in the Japanese Patent application JP2002-327618. The use of di-methyl ether as reduction agent increases the uniformity of the mass flow profile in comparison to use of other conventional reduction agents, such as diesel fuel, since the di-methyl ether is supplied in gaseous form or will quickly turn into gaseous form shortly after injection. The need to use of mixers in between the injector and the catalytic body will therefore be reduced. Furthermore, since di-methyl ether is stored in a pressure tank, the injection of the di-methyl ether can be propelled be the pressure difference between the pressure tank and the exhaust conduit. The possibility of using the pressure generated by the di-methyl ether stored in the pressure tank obviates the need for inclusion of a pump in the injection system. The control of the injection may be performed by a valve opening and closing the connection between the pressure tank and the injector.

[0011] Further preferred embodiments will be defined in the dependent claims.

[0012] The objects of the invention are also achieved by a method for reduction of nitrogen oxides from exhaust gases generated by a lean-burn internal combustion engine as claimed in claim 12.

BRIEF DESCRIPTION OF DRAWINGS

[0013] An embodiment of the invention will be described in detail below, with references to appended drawings, wherein

- Fig. 1 show a system for reduction of nitrogen oxides generated by a lean burn combustion engine,
- Fig. 2 show an injector, which according to the invention is adapted for injection of di-methyl ether into an exhaust conduit, and
- Fig. 3 show a flow chart of a method for reduction of nitrogen oxides from exhaust gases generated by a lean-burn internal combustion engine according to the invention.

EMBODIMENT(S) OF THE INVENTION

[0014] Figure 1 show a combustion engine 10 to which a system 20 for reduction of nitrogen oxides generated by the combustion engine is attached. The combustion engine is of lean burn type, that is the combustion is performed at an excess amount of air in relation to the amount of fuel present in the combustion. Typically for gasoline powered engines the air/fuel ratio would be over 18, for diesel powered engines the air fuel ratio would be from 22 to 40 and for di-methyl ether powered engines the air fuel ratio would be around 20 - 40. Preferably the engine is run on di-methyl ether. The engine is preferably of a multi cylinder type and includes an cylinder block 11, a cylinder head 12 in which a plurality of pistons are arranged in a plurality of cylinders are mounted for reciprocating movement, which linear movement is transferred into a rotational movement of a crank shaft arranged in the engine. A fuel injection system 13 is arranged to supply fuel into the engine. The fuel supply system is preferably arranged for supplying di-methyl ether to the cylinders of the engine. The fuel supply system Includes a pressure tank 14, a high pressure pump 15 and injection means 16 which may be of common rail, port injection or direct injection type. The fuel injection is controlled by a control unit 17, which is conventionally arranged to control the engine.

[0015] The combustion engine 10 furthermore includes an exhaust manifold 18, to which said system 20 for reduction of nitrogen oxides are arranged. The system 20 for reduction of nitrogen oxides includes a lean NOx catalyst 21 arranged in an exhaust duct 22 connected to the exhaust manifold 18. The lean NOx catalysts may be of the type as described in EP 830201, US 4946659; and US 2003/0069125. Preferable the catalytic material of the lean NOx catalyst is composed of a silver-alumina coating, cupper zeolite or silver mordenite.

[0016] An injector 23 is arranged in the exhausts duct 22 upstream of the lean NOx catalysts 21 for injecting a reduction agent for being used in the reduction of the nitrogen oxides contained in the exhausts. The injector is connected to a pressure tank 14 in which di-methyl-ether is stored under pressure in liquid state. In the event the engine is run on di-methyl ether, a common storage unit in the form of a pressure tank 14 may be used for the fuel needed in the combustions propelling the engine and for the di-methyl ether used as a reduction agent. Injection of the di-methyl ether through the injector 23 is controlled by a valve 24 opening and closing a passage between the pressure tank 14 and the injector 23. Since di-methyl ether is stored under pressure as a liquid, the injection may be propelled by the pressure difference between the pressure tank 14 and the pressure in the exhaust channel solely. Preferably the injector is arranged to inject the di-methyl ether in gaseous form into the exhaust conduit.. The phase transition between liquid and gaseous phase, which occur at 6 bar at room temperature, should therefore occur before the di-methyl ether passes through the injection ports of the injector 23. Since the pressure tank 14 will contain di-methyl ether both in gaseous and liquid state, it is possible to make sure that only di-methyl ether in gaseous phase enters the duct 25 leading to the control valve 23.

[0017] Since di-methyl ether is injected in gaseous state, there will be no need for arranging mixers in between the injector 23 and the lean NOx catalyst 21. The distance between the injector 23 and the lean NOx catalyst 21 can also be reduced to be smaller than 30 cm, preferably smaller than 20 cm when installed in a system connected to an internal combustion engine having a cylinder volume between 10 -15 litres.

[0018] In figure 2 is shown an injector 23, which according to the invention is adapted for injection of di-methyl ether into an exhaust conduit 22. The injector 23 comprises a spiral portion 26 including a set of injection ports 27 distributed along the length of the spiral 26. The spiral portion 26 is connected to an inlet duct 28 which extents through the wall defining the exhaust duct 22.

[0019] The set of injection ports are preferably arranged in a matrix wherein the distance (d), in a radial direction of a cross section taken along an length axis of an exhaust conduit at a position where the injector is positioned, between the injection ports in said set of injection ports which are positioned most distant from each other, and an equivalent radius (R) of the lean NOx catalyst fulfil the following relationship: d/R > 0,5. By distributing the injector ports in a matrix fulfilling the above relationship, an even distribution of the mass flow of di-methyl ether is accomplished without need of providing mixers in the exhaust duct. Preferably more than 6 injector ports should be used. By equivalent radius is meant the radius of a circle having the same area of an cross section as the area the cross section of the actual catalyst, which may have a different shape.

[0020] In figure 3 a flow chart of a method for reduction of nitrogen oxides from exhaust gases generated by a lean-burn internal combustion engine according to the invention is shown. In a first method step S10 exhaust gases generated by a lean-burn internal combustion engine are exposed to a lean NOx catalyst connected to an exhaust conduit of the lean-burn internal combustion engine. While exposing the lean NOx catalyst to exhausts di-methyl-ether is supplied as a reduction agent from a pressure tank to an injector and injecting di-methyl-ether upstream of said lean NOx catalyst in order to reduce the nitrogen oxides in a second method step S20.

[0021] The step of injection of the di-methyl ether the injection of di-mehtyl ether is preferably propelled by pressure generated by di-methyl-ether stored as a liquid in a pressure tank.

[0022] In a preferred embodiment a valve is arranged in a conduit connecting the injector with the pressure tank. The valve controls the injection of di-methyl ether, by opening and closing a fluid passage whereby, when the valve is in open state, the pressure in the pressure tank propels the injection of the di-methyl ether into the exhaust conduit.

[0023] Preferably the di-methyl ether is injected into the exhaust conduit in a gaseous state.

Claims

1. System (20) for reduction of nitrogen oxides from exhaust gases generated by a lean-burn internal combustion engine (10), **characterised in that** the system comprising a lean NOx catalyst (21) arranged to be connected to an exhaust conduit (22) of the lean-burn internal combustion engine (10), an injector (23) arranged for injecting a reduction agent to be used by the lean NOx catalyst (21) in a reduction process, and a fuel tank (14) containing the reduction agent, wherein said fuel tank (14) is a pressure tank adapted to contain di-methyl-ether as a reduction agent and said injector (23) is adapted to inject di-methyl-ether upstream of said lean NOx catalyst (21), whereby
the injector (23) is formed as a spirally shaped conduit having a plurality of openings provided along its length thereby providing a matrix of injection ports (27), wherein a distance (d), in a radial direction of a cross section taken along a length axis of an exhaust conduit at a position where the injector is positioned, between the injection ports positioned most distant from each other in said set of injection ports, and an equivalent radius (R) of the lean NOx catalyst fulfil the following relationship: d/R> 0,5.

2. A system according to claim 1, **characterised in that** the matrix of injection ports (27) includes at least 6 ports.

3. A system according to any of the preceding claims, **characterised in that** the pressure tank (14) is adapted to store the di-methyl-ether as a liquid whereby injection is propelled by the pressure generated by the di-methyl-ether stored in the pressure tank (14).

4. A system according to any of the preceding claims, **characterised in that** a valve (24) is arranged in a conduit connecting the injector (23) with the pressure tank (14), and that said valve (24) is arranged to control the injection of di-methyl ether.

5. A system according to any of the preceding claims, **characterised in that** said injector (23) is positioned directly upstream of said lean NOx catalyst (21) without presence of a mixer in between said injector (23) and said lean NOx catalyst (21).

6. A system according to any of the preceding claims, **characterised in that** the injector (23) is arranged to inject di-methyl ether at a pressure lower than 6 bar absolute.

7. A system according to any of the claims 1- 6, **characterised in that** the catalytic material of the lean NOx catalyst (21) is composed of a silver-alumina coating.

8. A system according to any of the claims 1- 6, **characterised in that** the catalytic material of the lean NOx catalyst (21) is composed of cupper zeolite.

9. A system according to any of claims 1- 6, **characterised in that** the catalytic material of the lean NOx catalyst (21) is composed of silver mordenite.

10. A system according to any of the preceding claims, **characterised in that** the system is arranged to sup-

port a phase transition of the di-methyl ether from liquid to gas before injection into the exhaust conduit.

11. A method for reduction of nitrogen oxides from exhaust gases generated by a lean-burn internal combustion engine (10), comprising the steps of exposing (S10) exhaust gases generated by a lean-burn internal combustion engine (10) to a lean NOx catalyst (21) connected to an exhaust conduit (22) of the lean-burn internal combustion engine (10),
supplying di-methyl-ether (S20) as a reduction agent from a pressure tank (14) to an injector (23) formed as a spirally shaped conduit having a plurality of openings provided along its length thereby providing a matrix of injection ports (27), wherein a distance (d), in a radial direction of a cross section taken along a length axis of an exhaust conduit at a position where the injector is positioned, between the injection ports positioned most distant from each other in said set of injection ports, and an equivalent radius (R) of the lean NOx catalyst fulfil the following relationship: $d/R > 0,5$, and
injecting di-methyl-ether upstream of said lean NOx catalyst (21) in order to reduce the nitrogen oxides.

12. A method according to claim 11, **characterised in that** the injection of di-mehtyl ether is propelled by pressure generated by di-methyl-ether stored as a liquid in a pressure tank.

13. A method according to claim 12, **characterised in that** a valve (24) is arranged in a conduit connecting the injector with the pressure tank (14), and that said valve (24) controls the injection of di-methyl ether, by opening and closing a fluid passage whereby, when the valve is in open state, the pressure in the pressure tank propels the injection of the di-methyl ether into the exhaust conduit.

14. A method according to any of claims 11 -13, **characterised in that** the injector (23) injects di-methyl ether at a pressure lower than 6 bar absolute.

15. A method according to any of claims 11 -14, **characterised in that** the method supports a phase transition of the di-methyl ether from liquid to gas before injection into the exhaust conduit.

Patentansprüche

1. System (20) zum Reduzieren von Stickstoffoxiden von Abgasen, die von einem Verbrennungsmotor (10) mit magerer Verbrennung erzeugt werden, **dadurch gekennzeichnet, dass** das System einen Mager-NOx-Katalysator (21), der verbunden mit einer Abgasleitung (22) des Verbrennungsmotors (10) angeordnet ist, eine Einspritzvorrichtung (23), die dazu ausgelegt ist, ein Reduktionsmittel, das von dem Mager-NOx-Katalysator in einem Reduktionsvorgang verwendbar ist, einzuspritzen, und einen das Reduktionsmittel enthaltenden Treibstofftank (14) aufweist, wobei der Treibstofftank (14) ein Drucktank ist, der dazu ausgelegt ist, Dimethylether als Abbaumittel zu enthalten, und die Einspritzvorrichtung (23) dazu ausgelegt ist, Dimethylether stromauf des Mager-NOx-Katalysators einzuspritzen, wobei die Einspritzvorrichtung als spiralförmig geformte Leitung ausgebildet ist, die mehrere entlang ihrer Länge vorgesehene Öffnungen aufweist, wodurch eine Matrix aus Einspritzauslässen (27) bereitgestellt wird, und ein Abstand (d) zwischen den in der Einspritzauslassmatrix am weitesten voneinander angeordneten Einspritzauslässen, wobei der Abstand in Radialrichtung eines Querschnitts entlang einer Längsachse der Abgasleitung an einem Ort gemessen wird, an dem die Einspritzvorrichtung positioniert ist, und ein äquivalenter Radius (R) des Mager-NOx-Katalysators folgendes Verhältnis erfüllen: $d/R > 0,5$.

2. System nach Anspruch 1, wobei die Matrix aus Einspritzauslässen (27) mindestens 6 Auslässe umfasst.

3. System nach einem der vorhergehenden Ansprüche, wobei der Drucktank (14) dazu ausgelegt ist, Dimethylether in flüssiger Form zu speichern, wodurch das Einspritzen über den Druck, der durch den in dem Drucktank (14) gespeicherten Dimethylether entsteht, antreibbar ist.

4. System nach einem der vorhergehenden Ansprüche, wobei ein Ventil (24) in einer Leitung, die die Einspritzvorrichtung (23) und den Drucktank (14) verbindet angeordnet ist, und das Ventil (24) dazu aufgelegt ist, das Einspritzen von Dimethylether zu steuern.

5. System nach einem der vorhergehenden Ansprüche, wobei die Einspritzvorrichtung (23) direkt stromauf des Mager-NOx-Katalysators (21) angeordnet ist, ohne dass eine Mischvorrichtung zwischen Einspritzvorrichtung (23) und Mager-NOx-Katalysator (21) vorhanden ist.

6. System nach einem der vorhergehenden Ansprüche, wobei die Einspritzvorrichtung (23) dazu ausgelegt ist, Dimethylether mit einem Druck von weniger als 6 bar absolut einzuspritzen.

7. System nach einem der Ansprüche 1 bis 6, wobei das katalytische Material des Mager-NOx-Katalysators (21) aus einer Silber-Aluminium-Beschichtung gebildet ist.

8. System nach einem der Ansprüche 1 bis 6, wobei das katalytische Material des Mager-NOx-Katalysators (21) aus Kupferzeolith gebildet ist.

9. System nach einem der Ansprüche 1 bis 6, wobei das katalytische Material des Mager-NOx-Kataiysators (21) aus Silber-Mordenit gebildet ist.

10. System nach einem der vorhergehenden Ansprüche, wobei das System dazu ausgelegt ist, vor dem Einspritzen in die Abgasleitung einen Phasenübergang des Dimethylether von flüssig zu gasförmig zu unterstützen.

11. Verfahren zur Reduktion von Stickstoffoxiden aus Abgasen, die von einem Verbrennungsmotor (10) mit magerer Verbrennung erzeugt werden, folgende Schritte umfassend:

In Kontakt bringen (S10) der Abgase, die von einem Verbrennungsmotor (10) mit magerer Verbrennung erzeugt werden, mit einem Mager-NOx-Katalysator (21), der mit einer Abgasleitung (22) des Verbrennungsmotors (10) mit magere Verbrennung verbunden ist;
Bereitstellen von Dimethylether (S20) als ein Reduktionsmittel aus einem Drucktank (14) an einer Einspritzvorrichtung (23), die als spiralförmig geformte Leitung mit mehreren entlang ihrer Länge vorgesehenen Öffnungen ausgebildet ist, wodurch eine Matrix aus Einspritzauslässen (27) bereitgestellt wird, und ein Abstand (d) zwischen den in der Einspritzauslassmatrix am weitesten voneinander angeordneten Einspritzauslässen, wobei der Abstand in Radialrichtung eines Querschnitts entlang einer Längsachse der Abgasleitung an einem Ort gemessen wird, an dem die Einspritzvorrichtung positioniert ist, und ein äquivalenter Radius (R) des Mager-NOx-Katalysators folgendes Verhältnis erfüllen: $d/R > 0{,}5$; und
Einspritzen des Dimethylethers stromauf des Mager-NOx-Katalysators, um die Stickoxide zu reduzieren.

12. Verfahren nach Anspruch 11, wobei das Einspritzen des Dimethylethers über Druck, der durch den in dem Drucktank gespeicherten Dimethylether entsteht, angetrieben wird.

13. Verfahren nach Anspruch 12, wobei ein Ventil (24) in einer Leitung, die die Einspritzvorrichtung mit dem Drucktank (14) verbindet, angeordnet ist, und das Ventil (24) das Einspritzen von Dimethylether steuert, indem ein Fluiddurchflussweg geöffnet bzw. geschlossen wird, wodurch, wenn das Ventil in dem geöffneten Zustand ist, der Druck des Drucktanks das Einspritzen des Dimethylethers in die Abgasleitung antreibt.

14. Verfahren nach einem der Ansprüche 11 bis 13, wobei die Einspritzvorrichtung (23) Dimethylether mit einem Druck von weniger als 6 bar absolut einspritzt.

15. Verfahren nach einem der Ansprüche 11 bis 14, wobei das Verfahren vor dem Einspritzen in die Abgasleitung einen Phasenübergang des Dimethylether von flüssig zu gasförmig unterstützt.

Revendications

1. Système (20) de réduction des oxydes d'azote des gaz d'échappement générés par un moteur à combustion interne à mélange pauvre (10), **caractérisé en ce que** le système comporte un catalyseur de NOx pauvre (21) agencé de manière à être raccordé à un conduit d'échappement (22) du moteur à combustion interne à mélange pauvre (10), un injecteur (23) agencé pour injecter un agent de réduction devant être utilisé par le catalyseur de NOx pauvre (21) dans un processus de réduction, et un réservoir de carburant (14) contenant l'agent de réduction, dans lequel ledit réservoir de carburant (14) est un réservoir pressurisé adapté pour contenir un éther diméthylique en tant qu'agent de réduction et ledit injecteur (23) est adapté pour injecter l'éther diméthylique en amont dudit catalyseur de NOx pauvre (21), dans lequel
l'injecteur (23) est formé comme un conduit de forme spiralée ayant une pluralité d'ouvertures agencées le long de sa longueur fournissant ainsi une matrice d'orifices d'injection (27), de sorte qu'une distance (d), dans la direction radiale d'une section transversale prise le long d'un axe longitudinal d'un conduit d'échappement dans une position dans laquelle l'injecteur est positionné, entre les orifices d'injection positionnés les plus à distance l'un de l'autre dans ledit ensemble d'orifices d'injection, et un rayon équivalent (R) du catalyseur de NOx pauvre satisfont à la relation suivante : $d/R > 0{,}5$.

2. Système selon la revendication 1, **caractérisé en ce que** la matrice d'orifices d'injection (27) inclut au moins 6 orifices.

3. Système selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le réservoir pressurisé (14) est adapté pour stocker de l'éther diméthylique sous forme liquide de sorte que l'injection est propulsée par la pression générée par l'éther diméthylique stocké dans le réservoir pressurisé (14).

4. Système selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**une vanne (24) est agencée dans un conduit raccordant l'injecteur (23) au réservoir pressurisé (14), et **en ce que** ladite vanne (24) est agencée de manière à commander l'injection d'éther diméthylique.

5. Système selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ledit injecteur (23) est positionné directement en amont dudit catalyseur de NOx pauvre (21) sans présence d'un mélangeur entre ledit injecteur (23) et ledit catalyseur de NOx pauvre (21).

6. Système selon l'une quelconque des revendications précédentes, **caractérisé en ce que** l'injecteur (23) est agencé de manière à injecter de l'éther diméthylique à une pression inférieure à 6 x 10^5 Pa absolus (6 bars absolus).

7. Système selon l'une quelconque des revendications 1 à 6, **caractérisé en ce que** le matériau catalytique du catalyseur de NOx pauvre (21) est composé d'un revêtement d'argent-alumine.

8. Système selon l'une quelconque des revendications 1 à 6, **caractérisé en ce que** le matériau catalytique du catalyseur de NOx pauvre (21) est composé de zéolite de cuivre.

9. Système selon l'une quelconque des revendications 1 à 6, **caractérisé en ce que** le matériau catalytique du catalyseur de NOx pauvre (21) est composé de mordénite d'argent.

10. Système selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le système est agencé pour supporter une transition de phase de l'éther diméthylique de l'état liquide à l'état gazeux avant injection dans le conduit d'échappement.

11. Procédé de réduction d'oxydes d'azote des gaz d'échappement générés par un moteur à combustion interne à mélange pauvre (10), comportant les étapes consistant à :

exposer (S10) des gaz d'échappement générés par un moteur à combustion interne à mélange pauvre (10) à un catalyseur de NOx pauvre (21) raccordé à un conduit d'échappement (22) du moteur à combustion interne à mélange pauvre (10),

alimenter de l'éther diméthylique (S20) en tant qu'agent de réduction depuis un réservoir pressurisé (14) jusqu'à un injecteur (23) formé comme un conduit de forme spiralée ayant une pluralité d'ouvertures agencées le long de sa longueur en fournissant ainsi une matrice d'orifices d'injection (27), une distance (d) dans une direction radiale d'une section transversale prise le long d'un axe longitudinal d'un conduit d'échappement dans une position où l'injecteur est positionné, entre les orifices d'injection positionnés les plus à distance l'un de l'autre dans ledit ensemble d'orifices d'injection, et un rayon équivalent (R) du catalyseur de NOx pauvre satisfaisant à la relation suivante : $d/R > 0,5$, et

injecter de l'éther diméthylique en amont dudit catalyseur de NOx pauvre (21) afin de réduire les oxydes d'azote.

12. Procédé selon la revendication 11, **caractérisé en ce que** l'injection d'éther diméthylique est propulsée par une pression générée par de l'éther diméthylique stocké sous forme liquide dans un réservoir pressurisé.

13. Procédé selon la revendication 12, **caractérisé en ce qu'**une vanne (24) est agencée dans un conduit raccordant l'injecteur au réservoir pressurisé (14), et que ladite vanne (24) commande l'injection d'éther diméthylique, en ouvrant et en fermant un passage de fluide de sorte que lorsque la vanne est à l'état ouvert, la pression dans le réservoir pressurisé propulse l'injection de l'éther diméthylique dans le conduit d'échappement.

14. Procédé selon l'une quelconque des revendications 11 à 13, **caractérisé en ce que** l'injecteur (23) injecte de l'éther diméthylique à une pression inférieure à 6 x 10^5 Pa absolus (6 bars absolus).

15. Procédé selon l'une quelconque des revendications 11 à 14, **caractérisé en ce que** le procédé supporte une transition de phase de l'éther diméthylique d'un état liquide à un état gazeux avant injection dans le conduit d'échappement.

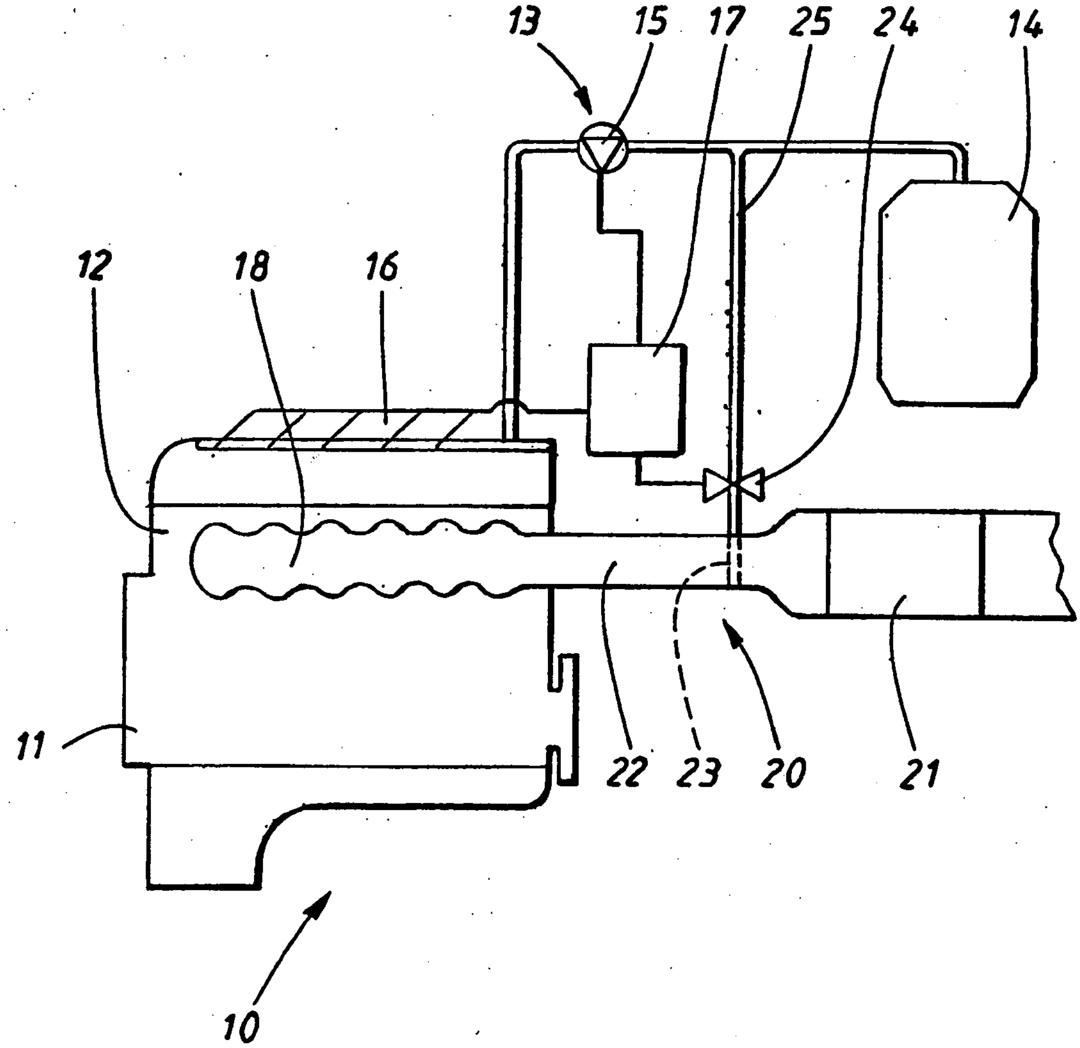

FIG.1

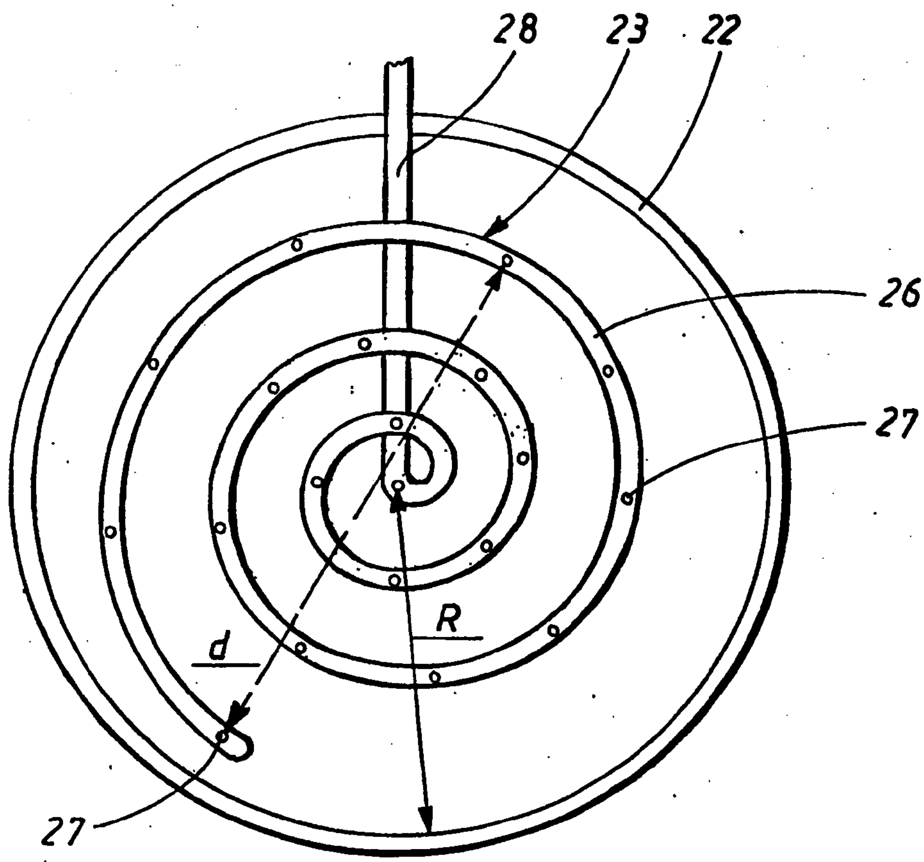

FIG.2

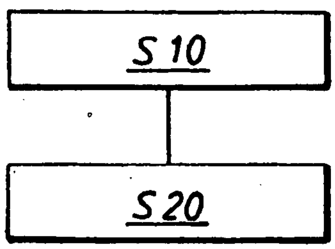

FIG.3

REFERENCES CITED IN THE DESCRIPTION

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