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(54) **DEVICE FOR REDUCING NOX EMISSION IN A DIESEL ENGINE SYSTEM**

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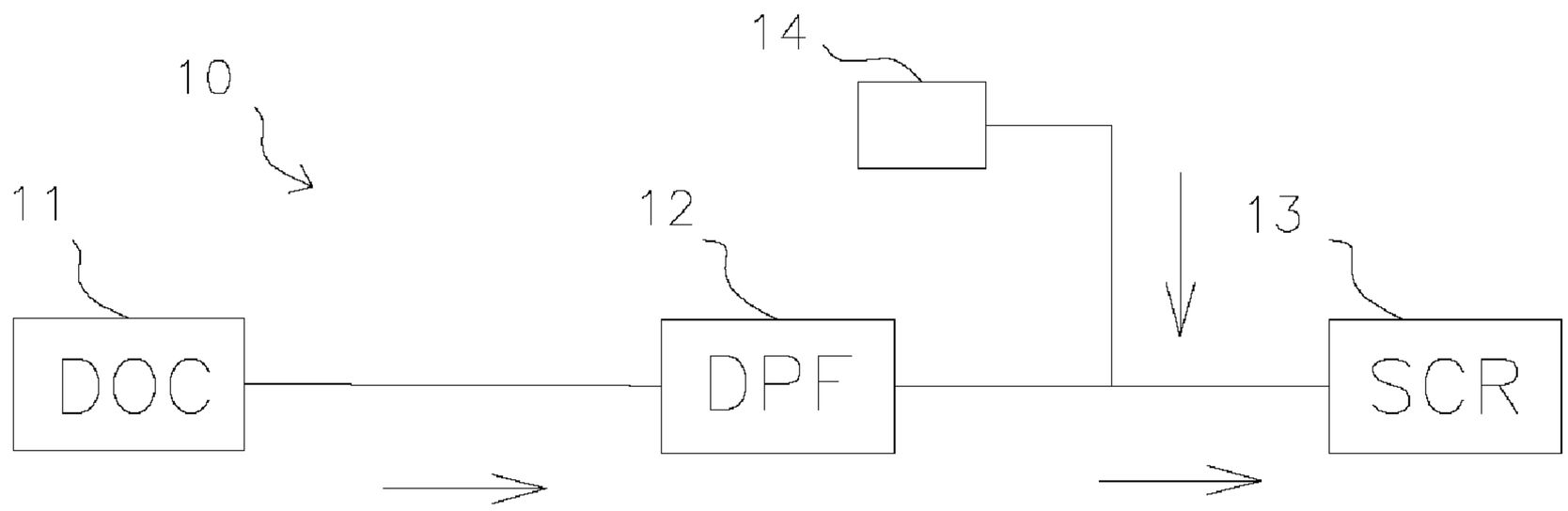
(57) **ABSTRACT**

A device is provided for reducing NOx emission in the engine exhaust stream for a Diesel engine system. The engine system including, but not limited to an exhaust line having at least a Diesel Oxidation Catalyst (DOC), a Diesel Particulate Filter (DPF) and a Selective Catalyst Reduction (SCR) system. Inside the Diesel Particulate Filter (DPF) a NOx absorber is provided and the NOx absorber being suitable to store the NOx at low temperature and subsequently release the NOx when a target temperature is reached.



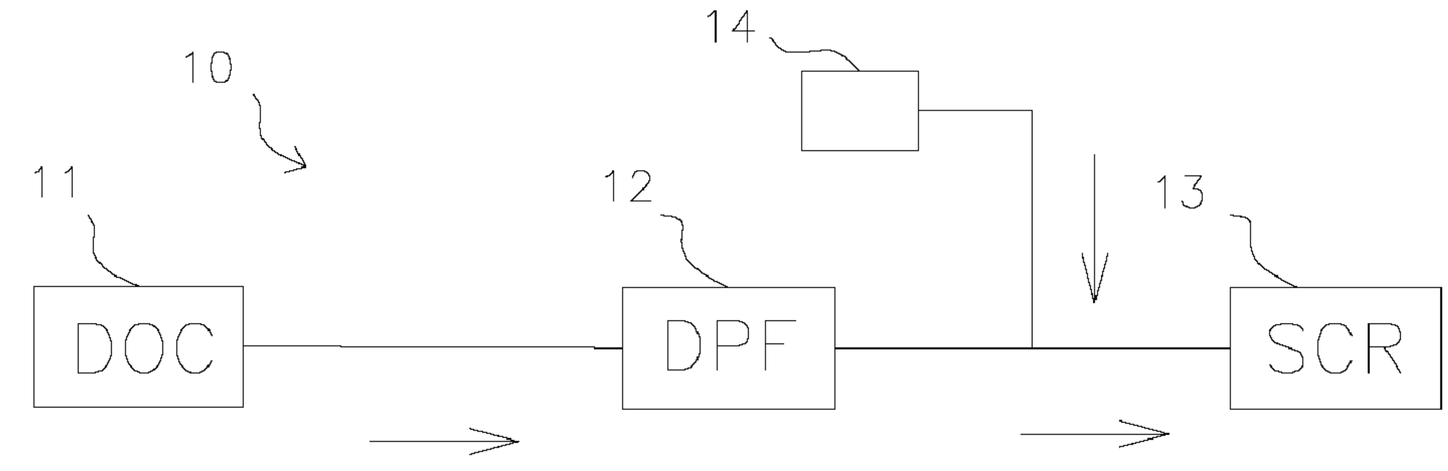


Fig. 1

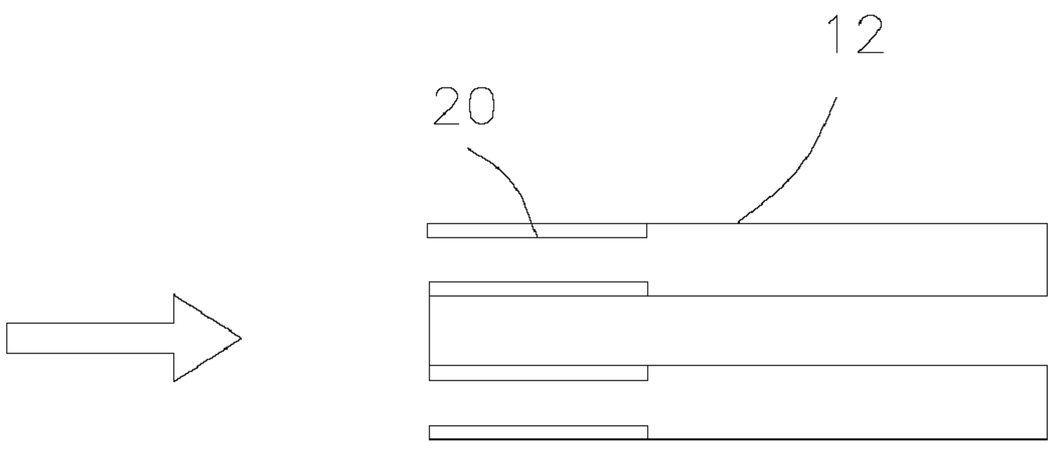


Fig. 2

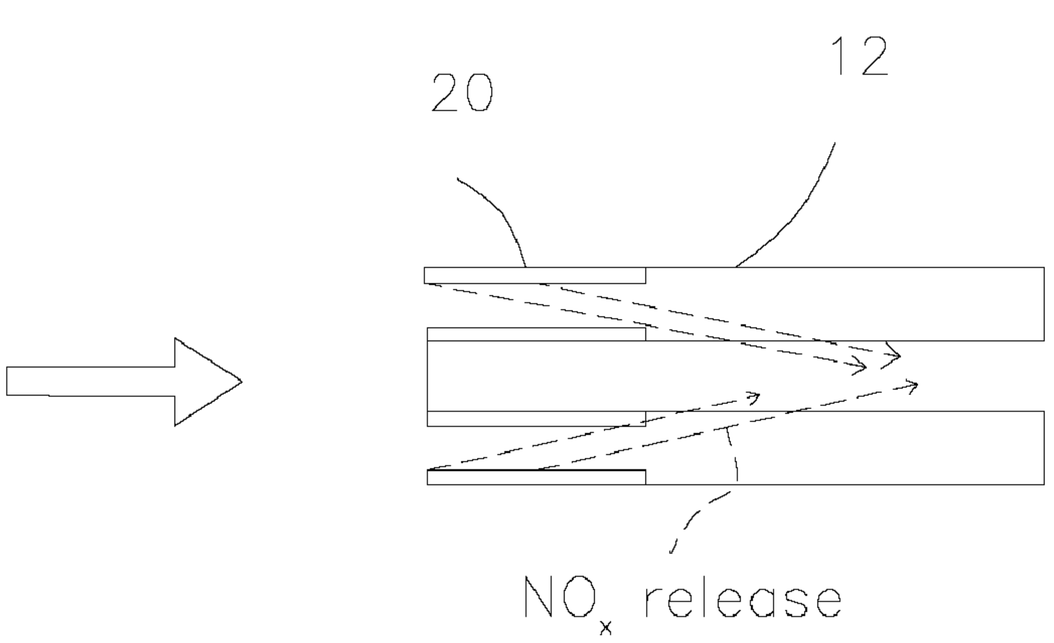


Fig. 3

DEVICE FOR REDUCING NOX EMISSION IN A DIESEL ENGINE SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to British Patent Application No. 1003184.7, filed Feb. 25, 2010, which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] The technical field relates to a device for reducing NOx emission in a diesel engine system.

BACKGROUND

[0003] Diesel emission legislation requires the use of a Diesel Particulate Filter (DPF) to reduce the particles emitted and be compliant with Euro 5 emission requirements. Future Diesel emission legislation will also require more stringent NOx emission levels.

[0004] As it is known, lean NOx Trap (LNT) and Selective Catalyst Reduction (SCR) systems are two of the after treatment systems that can be used to reach NOx emission target as required by legislation. In particular, a Selective Catalytic Reduction system (SCR) is a catalytic device in which the nitrogen oxides (NOx) contained in the exhaust gas are reduced into diatomic nitrogen (N2) and water (H2O), with the aid of a gaseous reducing agent, typically ammonia (NH3) that can be obtained by urea (CH4N2O) thermo-hydrolysis and that is absorbed inside catalyst. Typically, urea is injected in the exhaust line and mixed with the exhaust gas upstream the SCR.

[0005] SCR systems are very effective in NOx reduction, but require periodic injection of urea. The injection of urea is possible only above a certain temperature to avoid NH3 slip and deposits. Such temperature is a function of the specific SCR system used, typically around 180° C. Additionally how fast such temperature is reached is function of different driving profiles, namely an urban driving profile or an extra urban profile give rise to different exhaust temperatures.

[0006] In driving profiles characterized by low exhaust temperature the SCR catalyst may have not reached the required activation temperature and thus cannot be efficient for NOx reduction. Before urea injection starts, the SCR inlet temperature must reach the activation temperature otherwise urea will not begin thermo-hydrolysis and, as a result, contribute to NH3 slip over catalyst. As additional consequence, deposit over injector and pipes may occur. As a consequence of this temperature dependence, there is a sensible risk of a low NOx conversion efficiency due to slip of NOx during the cold phase of a cycle while waiting to reach a higher temperature. In order to improve overall NOx reduction efficiency, some actual solutions consider the NOx absorber technology to be used in Diesel Oxidation Catalyst (DOC) system.

[0007] Accordingly, at least one object is to provide an after treatment device able to reach a good NOx conversion efficiency during all driving profiles, both at low and high exhaust gas temperatures. At least another object is to provide a particulate filter with added NOx absorber capability in combination with an under floor SCR. At least another object is to meet these goals by means of a simple, rational and inexpensive solution. In addition, other objects, desirable features and characteristics will become apparent from the subsequent summary and detailed description, and the appended claims, taken in conjunction with the accompanying drawings and this background.

SUMMARY

[0008] An embodiment provides for a device for reducing NOx emission in the engine exhaust stream of a Diesel engine system, the engine system comprising an exhaust line having at least a Diesel Oxidation Catalyst (DOC), a Diesel Particulate Filter (DPF) and a Selective Catalyst Reduction (SCR) system. Inside the Diesel Particulate Filter (DPF) a NOx absorber is provided, the NOx absorber being suitable to store said NOx and subsequently release the NOx when a target temperature is reached. This embodiment has the advantage of being designed as a NOx trap enhancing NOx storage capabilities at low temperature without adding further catalysts and consequently reduce NOx emission in the engine exhaust stream.

[0009] Another embodiment provides for a NOx absorber that is suitable to release the NOx when a target temperature is reached, said target temperature being correlated to the activation temperature of the Selective Catalyst Reduction (SCR) system. This embodiment has the advantage of synchronizing the activation of the Selective Catalyst Reduction (SCR) in correspondence of the release of the NOx by the NOx absorber in the DPF achieving a better management of urea.

[0010] In another embodiment said NOx absorber is distributed over the inlet channels of said Diesel Particulate Filter (DPF). This embodiment has the advantage of improving general NOx emission reduction, especially at low temperature, without the need of adding any other catalyst or device.

[0011] Another embodiment provides for the fact that the Selective Catalyst Reduction (SCR) system is an under floor SCR.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The present invention will hereinafter be described in conjunction with the following drawing figures, wherein like numerals denote like elements, and:

[0013] FIG. **1** is a schematic representation of an embodiment of the device in a positioning inside the engine exhaust system;

[0014] FIG. **2** is a schematic representation of an embodiment in a first operative state; and

[0015] FIG. **3** is a schematic representation of an embodiment of the device in a second operative state.

DETAILED DESCRIPTION

[0016] The following detailed description is merely exemplary in nature and is not intended to limit application and uses. Furthermore, there is no intention to be bound by any theory presented in the preceding background or summary or the following detailed description.

[0017] A preferred embodiment is now described with reference to the drawings. A Diesel engine exhaust line **10** is depicted in FIG. **1**, whereby the line **10** has a Diesel Oxidation Catalyst (DOC) **11**, a Diesel Particulate Filter (DPF) **12**, or equivalent device, and a Selective Catalyst Reduction (SCR) system **13**, this latter being provided with a tank **14** for a reducing agent such as for example urea. As shown in FIG. **2**, the Diesel Particulate Filter (DPF) **11** has an additional NOx

absorber **20**, providing a NOx absorber function for storing and releasing NOx emissions in the engine exhaust stream. Therefore in the embodiment described, to enhance the NOx reduction also during any cold cycle phase during use of the vehicle, the additional NOx absorber **20** is used before the SCR system **13**.

[0018] Such NOx absorber **20** is able to trap the NOx during cold phase and to release them by thermal desorption, as schematically shown in FIG. **3**, when the SCR is active and urea is injected. A target temperature may be then defined as a temperature, typical of the NOx absorber **20** technology, at which the NOx trapped in the absorber **20** are released without any external aid or action such as, for example, additional additives or engine management modifications. This temperature is normally about 180-200° C., depending of typology of the absorber technology.

[0019] NOx stored are function of the NOx storage capacity and of substrate temperature but, according to the embodiment described, they can be released by thermal desorption. It is emphasized that with this device there is no need of rich combustion to achieve NOx desorption at the target temperature.

[0020] A preferred embodiment of the NOx absorber in the Diesel Particulate Filter (DPF) **12** comprises a NOx absorber made of a washcoat element to enhance NOx storing capabilities. Also the NOx absorber washcoat element is designed in a way that when the thermal desorption occurs, the SCR is already active and urea can be injected. As results the overall NOx emission can be reduced thanks to a cut on NOx emission during cold system temperature phase In particular, the NOx absorber **20** in the DPF **12** can guarantee the storage of NOx during any low exhaust temperature phase. NOx stored are function of the NOx storage capacity and substrate temperature.

[0021] In a preferred embodiment, at said target temperature NOx are thermally released from NOx absorber in the DPF **12**. That specific temperature is correlated to the activation temperature of SCR technology and to the possibility to inject urea so that when the NOx are released by the DPF they can be effectively reduced by SCR system. In this way the overall NOx emission can be reduced thanks to a cut on NOx emission during cold system temperature phase. Therefore the NOx absorber as described has mainly the function to store the NOx derived from engine operation, for a temporary interval of time until a temperature correlated to the SCR activation temperature is reached; subsequently the NOx are released. In a particularly preferred embodiment the Selective Catalyst Reduction (SCR) system used in the exhaust line is an under floor SCR. Furthermore, the NOx absorber may be distributed in the inlet channels of the Diesel Particulate Filter (DPF).

[0022] By introducing NOx absorber functionalities within the inlet part of the DPF, in general NOx emission reduction is improved, especially at low temperature, without adding any other catalyst or device. Moreover, the coating technology needed to distribute the NOx absorber washcoat inside the DPF may follow the same procedure used for other catalyst coating.

[0023] The embodiments described have several important advantages and benefits. For example, NOx emissions in the engine exhaust stream are reduced due to added NOx storage at low temperature. Also, SCR system costs relative to current SCR systems may be reduced. Also, a better management of urea is obtained contributing to reduce urea consumption.

[0024] While at least one exemplary embodiment has been presented in the foregoing summary and detailed description, it should be appreciated that a vast number of variations exist. It should also be appreciated that the exemplary embodiment or exemplary embodiments are only examples, and are not intended to limit the scope, applicability, or configuration in any way. Rather, the foregoing summary and detailed description will provide those skilled in the art with a convenient road map for implementing at least one exemplary embodiment, it being understood that various changes may be made in the function and arrangement of elements described in an exemplary embodiment without departing from the scope as set forth in the appended claims and their legal equivalents.

What is claimed is:

1. A device for reducing NOx emission in an engine exhaust stream of a Diesel engine system, comprising:

an exhaust line comprising:

a Diesel Oxidation Catalyst (DOC);

a Diesel Particulate Filter (DPF); and

a Selective Catalyst Reduction (SCR) system; and

a NOx absorber inside the Diesel Particulate Filter (DPF), said NOx absorber configured to store NOx at a low exhaust temperature and subsequently release said NOx when a target temperature is reached.

2. A device according to claim **1**, wherein said target temperature is correlated to an activation temperature of said Selective Catalyst Reduction (SCR) system.

3. A device according to claim **1**, wherein said NOx absorber is distributed in a plurality of inlet channels of said Diesel Particulate Filter (DPF).

4. A device according to claim **1**, wherein said NOx absorber in the Diesel Particulate Filter (DPF) comprises a washcoat element.

5. A device according to claim **1**, wherein said Selective Catalyst Reduction (SCR) system is an under floor SCR.

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