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(71) Applicant: **SCANIA CV AB** [SE/SE]; S-151 87 Södertälje (SE).

(72) Inventors: **NILSSON, Magnus**; Dellensvägen 28, S-120 58 Årsta (SE). **BIRGERSSON, Henrik**; Sannadalsvägen 28, 2 tr, S-117 65 Stockholm (SE).

(74) Agent: **GARDEMARK, Niklas**; Scania CV AB, S-151 87 Södertälje (SE).

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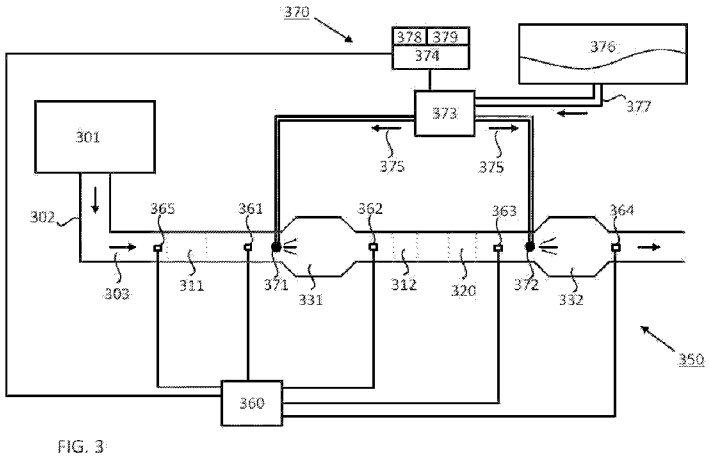


FIG. 3

(57) Abstract: According to the present invention a method and an exhaust treatment system (350) are provided for treatment of an exhaust stream (303), which results from a combustion in a combustion engine (301) and comprises nitrogen oxides NO_x. The method comprises a first supply (210) of a first additive into the exhaust stream (303), which is used at a first impact (220) on a first amount of nitrogen oxides NO_{x_1} reaching a first device (331), arranged to impact the first amount of nitrogen oxides NO_{x_1}. The method also comprises a second supply (230) of a second additive in the exhaust stream (303), which is used at a second impact (240) on a second amount of nitrogen oxides NO_{x_2} reaching a second device (332), arranged to impact the second amount of nitrogen oxides NO_{x_2}. According to the present invention, at least one of the first supply (210) and the second supply (230) is controlled, based on a total ability for the first device (331) to provide the first impact (220), and for the second device (332) to provide the second impact (240), so that a required total impact on the nitrogen oxides NO_x in the exhaust stream (303) is provided by the exhaust treatment system (350).

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METHOD AND SYSTEM FOR CONTROLLING NITROGEN OXIDE EMISSIONS FROM A COMBUSTION ENGINE

Technical field

The present invention relates to a method for treatment of an exhaust stream according to the preamble of claim 1. The present invention also relates to an exhaust treatment system arranged for the treatment of an exhaust stream according to the preamble to claim 26, and to a computer program and a computer program product, which implement the method according to the invention.

Background

The following background description constitutes a description of the background to the present invention, and thus need not necessarily constitute prior art.

In connection with increased government interests concerning pollution and air quality, primarily in urban areas, emission standards and regulations regarding emissions from combustion engines have been drafted in many jurisdictions.

Such emission standards often consist of requirements defining acceptable limits of exhaust emissions from combustion engines in, for example, vehicles. For example, emission levels of nitrogen oxides NO_x, hydrocarbons C_xH_y, carbon monoxide CO and particles PM are often regulated by such standards for most types of vehicles. Vehicles equipped with combustion engines typically give rise to such emissions in varying degrees. In this document, the invention will be described mainly for its application in vehicles. However, the invention may be used in substantially all applications where combustion engines are used, for example in vessels such as ships or

aeroplanes/helicopters, wherein regulations and standards for such applications limit emissions from the combustion engines.

In an effort to comply with these emission standards, the exhausts caused by the combustion of the combustion engine are treated (purified).

A common way of treating exhausts from a combustion engine consists of a so-called catalytic purification process, which is why vehicles equipped with a combustion engine usually comprise at least one catalyst. There are different types of catalysts, where the different respective types may be suitable depending on for example the combustion concept, combustion strategies and/or fuel types which are used in the vehicles, and/or the types of compounds in the exhaust stream to be purified. In relation to at least nitrous gases (nitrogen monoxide, nitrogen dioxide), referred to below as nitrogen oxides NO_x, vehicles often comprise a catalyst, wherein an additive is supplied to the exhaust stream resulting from the combustion in the combustion engine, in order to reduce nitrogen oxides NO_x, primarily to nitrogen gas and aqueous vapour. This is described in more detail below.

SCR (Selective Catalytic Reduction) catalysts are a commonly used type of catalyst for this type of reduction, primarily for heavy goods vehicles. SCR catalysts usually use ammonia NH_3, or a composition from which ammonia may be generated/formed, as an additive to reduce the amount of nitrogen oxides NO_x in the exhausts. The additive is injected into the exhaust stream resulting from the combustion engine upstream of the catalyst. The additive added to the catalyst is adsorbed (stored) in the catalyst, in the form of ammonia NH_3, so that a redox-reaction may occur between nitrogen oxides NO_x in the exhausts and ammonia NH_3 available via the additive.

A modern combustion engine is a system where there is cooperation and mutual impact between the engine and the exhaust treatment. Specifically, there is a correlation between the exhaust treatment system's ability to reduce nitrogen oxides NO_x and the fuel efficiency of the combustion engine. For the combustion engine, there is a correlation between the engine's fuel efficiency/total efficiency and the nitrogen oxides NO_x produced by it. This correlation specifies that for a given system there is a positive correlation between nitrogen oxides NO_x produced and fuel efficiency, in other words an engine that is permitted to emit more nitrogen oxides NO_x may be induced to consume less fuel by way of, for example, a more optimal selection of the injection timing, which may yield a higher combustion efficiency. Similarly, there is often a negative correlation between a produced particle mass PM and the fuel efficiency, meaning that an increased emission of particle mass PM from the engine is connected with an increased fuel consumption. This correlation is the background to the widespread use of exhaust treatment systems comprising an SCR-catalyst, where the intention is the optimisation of the engine regarding fuel consumption and emission of particles, towards a relatively larger amount of nitrogen oxides NO_x produced. A reduction of these nitrogen oxides NO_x is then carried out in the exhaust treatment system, which thus may also comprise an SCR catalyst. Through an integrated approach in the design of the engine and exhaust treatment system, where the engine and exhaust treatment complement each other, a high fuel efficiency may therefore be achieved jointly with low emissions of both particles PM as well as nitrogen oxides NO_x.

Brief description of the invention

To some extent, the performance of the exhaust treatment system may be enhanced by increasing the substrate volumes comprised in the exhaust treatment system, which in particular reduces losses due to uneven distribution of the exhaust flow through the substrate. At the same time, a larger substrate volume provides a greater back pressure, which may counteract gains in fuel efficiency due to the higher conversion degree. Larger substrate volumes also entail an increased cost. It is thus important to be able to use the exhaust treatment system optimally, for example by avoiding over-sizing and/or by limiting the exhaust treatment system's spread in terms of size and/or manufacturing cost.

The function and efficiency for catalysts in general, and for reduction catalysts specifically, is for example strongly dependent on the temperature over the reduction catalyst. The term "temperature over the reduction catalyst" as used herein, means the temperature in/at/for the exhaust stream through the reduction catalyst. The substrate will assume this temperature due to its heat exchanging ability. At a low temperature over the reduction catalyst, the reduction of nitrogen oxides NO_x is typically ineffective. The NO_2/NO_x-fraction in the exhausts provides a certain potential for increasing the catalytic activity, also at lower exhaust temperatures. The temperature over the reduction catalyst and the NO_2/NO_x-fraction are, however, generally difficult to control, since they to a great extent depend on a number of factors, such as how the driver drives the vehicle. For example, the temperature over the reduction catalyst depends on the torque requested by a driver and/or by a cruise control, on the appearance of the road section in which the vehicle is located, and/or the driving style of the driver.

Prior art exhaust treatment systems, such as systems that many manufacturers have used to meet the Euro VI emission standard, often comprise a first oxidation catalyst, a diesel particulate filter and a reduction catalyst. These prior art systems have problems related to the large thermal mass/inertia of the catalysts/filter and the large thermal mass/inertia of the rest of the exhaust treatment system, comprising for example exhaust pipes, silencers and various connections. At for example cold starts, where both the engine and the exhaust treatment system are cold, and at throttle from low exhaust temperatures, where more torque than previously is requested, for example when easy city driving turns into highway driving, or after idling and power take-off, it is primarily the diesel particulate filter's large thermal mass/inertia that causes the temperature of the reduction catalyst to increase only slowly in such prior art exhaust treatment systems. Thus, at for example cold starts and at vehicle operation with temperature- and/or flow transient elements, the function of the reduction catalyst deteriorates, and accordingly the reduction of nitrogen oxides NO_x also deteriorates. This deterioration may result in a poor exhaust purification, risking unnecessary pollution of the environment. Additionally, because of the deterioration of the reduction catalyst's function, the risk of not achieving the regulatory requirements relating to exhaust purification increases. Fuel consumption may also be adversely impacted by the deteriorating function, since fuel energy may then need to be used to increase the temperature and efficiency of the reduction catalyst, via different temperature increasing measures.

There is accordingly a need for an optimisation of the function in today's exhaust treatment systems.

Therefore, one objective of the present invention is to provide a method and a system which may provide a high performance, and a good function, under varying conditions.

This objective is achieved through the above-mentioned method in accordance with the characterising portion of claim 1. This objective is also achieved through the above-mentioned exhaust treatment system in accordance with the characterising portion of claim 26, and the above-mentioned computer program and computer program product.

According to the present invention a method and an exhaust treatment system are provided for treatment of an exhaust stream, which results from a combustion in a combustion engine and comprises nitrogen oxides NO_x.

A first supply of a first additive into the exhaust stream is carried out through the use of a first dosage device, arranged in the exhaust treatment system.

The first additive is used for a first impact on a first amount of nitrogen oxides NO_{x_1}, which reaches a first device arranged downstream of the first dosage device, in order to impact the first amount of nitrogen oxides NO_{1_x}.

A second supply of a second additive into the exhaust stream is carried out through the use of a second dosage device, arranged downstream of the first device.

The first and/or second additive are used for a second impact on a second amount of nitrogen oxides NO_{x_2}, reaching a second device, arranged downstream of the second dosage device, in order to impact the second amount of nitrogen oxides NO_{x_2}.

According to the present invention, at least one of the first supply and the second supply is controlled based on a total ability for the first device to provide the first impact, and for the second device to provide the second impact, so that a required total impact on the nitrogen oxides NO_x in the exhaust stream is provided by the exhaust treatment system.

Through the use of the present invention, a first and a second device are thus used, which impact, for example by way of reduction, the amount of nitrogen oxides NO_x in the exhaust stream. In addition, the supply of additive is controlled, which also controls the impact on nitrogen oxides NO_x regarding the first and second device, respectively, based on a total impact on nitrogen oxides NO_x in the system, which means that a cooperation/symbiosis between the impact provided by the first and second device may be optimised.

The first impact on nitrogen oxides NO_x in the first device may here thus be controlled in such a way that the activity of the first device constitutes a complement to the function of the second device. Similarly, the second impact on nitrogen oxides NO_x of the second device may be controlled in such a way that the activity of the second device constitutes a complement to the function of the first device.

These possibilities of optimising the first device, and/or the second device, result in an overall efficient exhaust purification, which better reflects the conditions and/or characteristics of the complete exhaust treatment system.

This means that the present invention may provide the required impact, such as for example the required reduction, of nitrogen oxides NO_x in the exhaust stream under a large number of different conditions. Accordingly, legal requirements and/or standards for emissions of nitrogen oxides NO_x from the

exhaust treatment system may be fulfilled in many more conditions and/or driving modes, than when prior art systems are used.

If, for example, a particulate filter is arranged between the first and second device, this means that the first and second device are exposed to different temperature functions/temperature processes, since the particulate filter has a significant thermal inertia/mass. The present invention may optimise the function for both the first and the second device, by taking into account the respective device's ability to impact nitrogen oxides NO_x in the exhaust stream, so that an overall required ability is provided.

Through the use of the present invention a better fuel optimisation may be obtained for the vehicle, since there is thus potential to control the engine in a more fuel efficient manner, so that a higher efficiency for the engine is obtained. Thus, a performance gain and/or a reduced emission of carbon dioxide CO_2 may be obtained, when the present invention is used.

Through the use of the present invention, the fraction of nitrogen oxides NO_x consisting of nitrogen dioxide NO_2 may be actively controlled, which is facilitated by an active control of the amount of nitrogen oxides NO_x upstream of at least one substrate with oxidising coating, for example comprising precious metals, in the exhaust treatment system. This control of the ratio NO_2/NO_x may, apart from advantages in catalytic performance, such as higher NO_x-conversion, also provide for a possibility of reducing emissions, specifically of nitrogen dioxide NO_2, which result in a very poisonous and strong smelling emission. This may result in advantages at a potential future introduction of a separate legal requirement

relating to nitrogen dioxide NO_2, through a possibility of reducing emissions of nitrogen dioxide NO_2. This may be compared with for example the Euro VI-system, in which the fraction of nitrogen dioxide NO_2 provided at exhaust purification may not be directly impacted in the exhaust treatment system itself, since the fraction of nitrogen dioxide NO_2 in the Euro VI-system is due to usage/operation, and may not be controlled in any other way.

The present invention also has an advantage in that two cooperating dosage devices are used in combination for the dosage of a reductant, for example urea, upstream of the first and second devices, which relieves and facilitates mixture and potential vaporisation of the reductant, since the injection of the reductant is divided between two physically separate positions. This reduces the risk of the reductant cooling down the exhaust treatment system locally, which may potentially form deposits at the positions where the reductant is injected, or downstream of such positions.

Brief list of figures

The invention will be illustrated in more detail below, along with the enclosed drawings, where similar references are used for similar parts, and where:

Figure 1 shows an example vehicle which may comprise the present invention,

Figure 2 shows a flow chart for the method for exhaust treatment according to the invention,

Figure 3 shows an example of an exhaust treatment system according to the present invention,

Figure 4 shows a control device, in which a method according to the present invention may be implemented.

Description of preferred embodiments

Figure 1 schematically shows an example vehicle 100 comprising an exhaust treatment system 150, which may be an exhaust treatment system 150 according to one embodiment of the present invention. The power-train comprises a combustion engine 101, which in a customary manner, via an output shaft 102 on the combustion engine 101, usually via a flywheel, is connected to a gearbox 103 via a clutch 106.

The combustion engine 101 is controlled by the engine's control system via a control device 115. Likewise, the clutch 106 and the gearbox 103 may be controlled by the vehicle's control system, with the help of one or more applicable control devices (not shown). Naturally, the vehicle's power-train may also be of another type, such as a type with a conventional automatic gearbox, of a type with a hybrid power-train, etc.

An output shaft 107 from the gearbox 103 drives the wheels 113, 114 via a final drive 108, such as e.g. a customary differential, and the drive shafts 104, 105 connected to the said final drive 108.

The vehicle 100 also comprises an exhaust treatment system/exhaust purification system 150 for treatment/purification of exhaust emissions resulting from combustion in the combustion chamber of the combustion engine 101, which may consist of cylinders. The exhaust treatment system 150 may be controlled by the vehicle's control system via a control device 160.

According to the present invention, a method is provided for the treatment of an exhaust stream, which results from a combustion in a combustion engine and comprises nitrogen oxides NO_x. This method may be illustrated with the flow chart in Figure 2.

In a first step 210 of the method, a first supply of a first additive into the exhaust stream is implemented, through the use of a first dosage device arranged in the exhaust treatment system. This first supply may, according to the present invention, be controlled based on an overall ability for a first device, described below, to provide the first impact, and for a second device, described below, to provide the second impact, so that a required total impact on the nitrogen oxides NO_x in the exhaust stream is provided by the exhaust treatment system.

In a second step of the method 220, the first additive is used for a first impact on a first amount of nitrogen oxides NO_{x_1}, reaching a first device arranged downstream of the first dosage device, to impact the first amount of nitrogen oxides NO_{x_1}. Here, the impact on the first amount of nitrogen oxides NO_{x_1} thus takes place in the first device.

In a third step 230 of the method, a second supply of a second additive into the exhaust stream is implemented, through the use of a second dosage device, arranged downstream of the first device. The second supply may, according to the present invention, be controlled based on an overall ability for the first device to provide the first impact, and for the second device, described below, to provide the second impact, so that a required total impact of nitrogen oxides NO_x in the exhaust stream is provided by the exhaust treatment system.

In a fourth step 240 of the method, the first and/or second additive is used for a second impact on a second amount of nitrogen oxides NO_{x_2}, reaching a second device, arranged downstream of the second dosage device, to impact the second amount of nitrogen oxides NO_{x_2}. Here, the impact of the first amount of nitrogen oxides NO_{x_1} thus takes place in the second device.

Thus, according to the present invention, at least one of the first supply and the second supply is controlled, and therefore also at least one of the corresponding first impact 220 and second impact 240 on the nitrogen oxides NO_x, based on an overall ability for the first device to provide the first impact 220, and for the second device to provide the second impact 240, so that a required total impact on the nitrogen oxides NO_x in the exhaust stream is provided by the exhaust treatment system.

Through the use of the present invention, a cooperation/symbiosis between the impact provided by the first and second device may be used, in order to provide an optimised exhaust treatment with respect to nitrogen oxides NO_x.

The first 220 and second 240, respectively, impact on nitrogen oxides NO_x may here thus be controlled, so that the activity of the first device constitutes a complement to the function of the second device, and/or so that the activity of the second device constitutes a complement to the function of the first device. These possibilities of optimising the first device, and/or the second device, result in an overall efficient exhaust purification, which better reflects the conditions and/or characteristics of the complete exhaust treatment system.

According to one embodiment, an oxidation catalyst DOC and a particulate filter DPF, following downstream, are arranged between the first device and the second dosage device, in order to oxidise nitrogen and/or hydrocarbon compounds 250, and to filter and oxidise soot 260, respectively. According to one embodiment, both the oxidation of nitrogen and/or hydrocarbon compounds 250, and the filtering and oxidation of soot 260, may be carried out by an at least partly coated particulate filter cDPF.

If a particulate filter is arranged between the first and second device, this means that the first and second device are exposed to different temperature functions/temperature processes, since the particulate filter has a significant thermal inertia/mass. The present invention may optimise the function for both the first and the second device, by taking into account the respective device's ability to impact nitrogen oxides NO_x in the exhaust stream, so that an overall required ability is provided.

The required total impact on nitrogen oxides NO_x in the exhaust stream, which the present invention ensures will be obtained, may be determined based on currently measured, modelled and/or predicted operating conditions for the combustion engine, and/or based on at least one threshold value for emission of nitrogen oxides NO_x. This threshold value may consist of, or correspond to, a threshold value corresponding to a legal requirement for emission of nitrogen oxides NO_x, a threshold value determined by authorities, representing a permitted emission of nitrogen oxides NO_x, and/or a threshold value or a standard, corresponding to a maximum desired emission of nitrogen oxides NO_x.

Thus, the present invention may ensure that legal requirements or similar for emissions are fulfilled under a large number of different operating conditions.

According to one embodiment of the present invention, the control of the first supply 210 of the first additive is carried out in such a way that a reduction of the first supply 210 of the first additive is provided.

This reduction of the first supply 210 may, according to one embodiment, correspond to an interruption of the first supply 210 of the first additive. Such an interruption is, according to the embodiment, acceptable if the second device, through its second impact 240, may itself provide a required total impact on the nitrogen oxides NO_x in the exhaust stream. In other words, the first supply 210 may be controlled to be interrupted, if it may be concluded that the second impact 240 is sufficient to cope with, for example, legal requirements applicable to emissions of nitrogen oxides NO_x.

Such an interruption of the first supply 210 of the first additive means that the first impact 220 on the first amount of nitrogen oxides NO_{x_1} decreases considerably, so that the first amount of nitrogen oxides NO_{x_1} may, relatively unaffected, pass through the first device and reach the subsequent components in the exhaust treatment system, for example a subsequent particulate filter DPF, which may for example be an at least partly coated particulate filter cDPF. The particulate filter DPF/cDPF may use this greater availability of nitrogen oxides NO_{x_1} to increase the efficiency of soot oxidation in the filter.

According to one embodiment of the present invention, the first device may be regenerated during and/or after the reduction of the first supply 210, where the reduction may for

example constitute an interruption, such as the one described above. During the regeneration residues of the first additive, which have accumulated in the first device, may be eliminated.

According to one embodiment, the reduction and/or interruption of the first supply 210 of the additive may continue for a period T_{stop_1}, which has a length corresponding to the time it takes to eliminate the residues of the first additive in the first device, and/or the time during which the second device may be able to provide a required impact on nitrogen oxides NO_x.

The first device's ability to provide the first impact 220 may be contingent on a number of parameters. The catalytic characteristics of the first device constitute such a parameter, and may for example be contingent on the catalyst type of the first device, a temperature interval within which the first device is active, a coverage degree of additive for the first device, and/or a temperature at the first device.

According to one embodiment of the present invention, the control of the second supply 230 of the second additive provides for a reduction of the second supply 230 of the second additive.

The reduction of the second supply 230 may, according to one embodiment, correspond to an interruption of the second supply 230. A control which results in such an interruption of the second supply 230 is, according to the embodiment, acceptable if the first device may, alone, provide a required total impact on the nitrogen oxides NO_x in the exhaust stream through the first impact 220.

The second device may be regenerated during and/or after the reduction, and/or the interruption of the second supply 230 of the second additive, so that residues of the second additive, which have remained accumulated in the second device 332, may be eliminated.

According to one embodiment, the reduction and/or interruption of the second supply 230 of the additive may continue for a period T_{stop_2}, which has a length corresponding to the time it takes to eliminate the residues of the second additive in the second device, and/or the time during which the first device may, alone, provide a required impact on nitrogen oxides NO_x.

The ability of the second device to provide the second impact 240 may be contingent on a number of parameters related to the catalytic characteristics for the second device, which may for example comprise a catalyst type for the second device, a temperature interval within which the second device is active, a coverage degree of additive for the second device, and/or a temperature at the second device.

According to one embodiment, the control of the first supply 210 of the first additive, and/or the control of the second supply 230 of the second additive, results in a respective increase of the first supply 210, and/or of the second supply 230.

According to one embodiment of the present invention, the first impact 220 on the first amount of nitrogen oxides NO_{x_1} comprises a first reduction of the first amount of nitrogen oxides NO_{x_1}, through a first selective catalytic reduction catalyst SCR_1, followed by a reduction of nitrogen oxides NO_x, and/or oxidation of potential additive in the exhaust stream, through a first slip-catalyst SC_1. Here, a first selective catalytic reduction catalyst SCR_1 is thus arranged downstream

of the first dosage device, and a slip-catalyst SC_1 is arranged downstream of the first selective catalytic reduction catalyst SCR_1.

The control of the first supply 210 may then be carried out in such a way that the first supply 210 of the first additive is increased, until a slip of additive out from the first selective catalytic reduction catalyst SCR_1 arises. The slip of additive may here be due to the filling/coverage degree for the additive in the first selective catalytic reduction catalyst SCR_1, which is obtained at the increase of the first supply 210, exceeding the value for the maximum filling degree of additive in the first selective catalytic reduction catalyst SCR_1. In other words, the first selective catalytic reduction catalyst SCR_1 is here filled up to a maximum with additive, which results in a very efficient reduction of nitrogen oxides NO_x in the first device.

The increase of the first supply 210 of the first additive may here be carried out in such a way that the slip of additive passing out from the first selective catalytic reduction catalyst SCR_1, and reaching the first slip-catalyst SC_1, may substantially be stored and/or oxidised in the first slip-catalyst SC_1. Thus, substantially no additive is allowed to follow the exhaust stream to, and negatively impact the function of, components placed downstream, such as for example an oxidation catalyst DOC, and/or a particulate filter DPF/cDPF.

The first amount of nitrogen oxides NO_{x_1} may, according to one embodiment, be represented by a first ratio NO_{2_1}/NO_{x_1}, between a first amount of nitrogen dioxide NO_{2_1} and a first amount of nitrogen oxides NO_{x_1} reaching the first device. A value $(NO_{2_1}/NO_{x_1})_{det}$ may be determined for this first ratio

NO_{2_1}/NO_{x_1}, for example as a measured, modelled and/or predicted value. For this embodiment, at least one oxidising component, such as for example an oxidation catalyst DOC, may be arranged upstream of the first device.

The first supply 210 of the first additive may, according to one embodiment, be based on this determined value $(NO_{2_1}/NO_{x_1})_{det}$, and accordingly be controlled in such a way that a fast reduction, also called "fast SCR", may be used in the first device. Thus, the first supply 210 may be controlled in such a way that the reduction in the first device occurs, to as great an extent as possible, via reaction paths over both nitrogen oxides NO, and nitrogen dioxide NO_2. Accordingly, the volume requirements relating to the catalyst may also be reduced. In fast reduction, the reaction uses equal parts of nitrogen monoxide NO and nitrogen dioxide NO_2, which means that an optimal value for the molar ratio NO_2/NO_x is nearly 50%.

A corresponding ratio NO_{2_2}/NO_{x_2} between a second amount of nitrogen dioxide NO_{2_2} and a second amount of nitrogen oxides NO_{x_2} reaching the second device may be determined, and used to control the second supply 230 of the second additive. Thus, the second supply 230 is then controlled, based on a determined value $(NO_{2_2}/NO_{x_2})_{det}$ for the second ratio, in such a way that fast reduction may be used in the second device. For this embodiment, at least one oxidising component, such as for example an oxidation catalyst DOC, may be arranged upstream of the second device.

A person skilled in the art will realise that a method for treatment of an exhaust stream according to the present invention may also be implemented in a computer program, which when executed in a computer will cause the computer to execute the method. The computer program usually consists of a part of

a computer program product 403, where the computer program product comprises a suitable non-volatile/permanent/persistent/durable digital storage medium on which the computer program is stored. Said non-volatile/permanent/persistent/durable computer readable medium consists of a suitable memory, e.g.: ROM (Read-Only Memory), PROM (Programmable Read-Only Memory), EPROM (Erasable PROM), Flash, EEPROM (Electrically Erasable PROM), a hard disk device, etc.

Figure 4 schematically shows a control device 400. The control device 400 comprises a calculation device 401, which may consist of essentially a suitable type of processor or microcomputer, e.g. a circuit for digital signal processing (Digital Signal Processor, DSP), or a circuit with a predetermined specific function (Application Specific Integrated Circuit, ASIC). The calculation device 401 is connected to a memory unit 402 installed in the control device 400, providing the calculation device 401 with e.g. the stored program code, and/or the stored data which the calculation device 401 needs in order to be able to carry out calculations. The calculation device 401 is also set up to store interim or final results of calculations in the memory device 402.

Further, the control device 400 is equipped with devices 411, 412, 413, 414 for receiving and sending of input and output signals. These input and output signals may contain wave shapes, pulses or other attributes, which may be detected as information by the devices 411, 413 for the receipt of input signals, and may be converted into signals that may be processed by the calculation device 401. These signals are then provided to the calculation device 401. The devices 412, 414 for sending output signals are arranged to convert the

calculation result from the calculation unit 401 into output signals for transfer to other parts of the vehicle's control system, and/or the component(s) for which the signals are intended, for example the first and/or second dosage devices.

Each one of the connections to the devices for receiving and sending of input and output signals may consist of one or several of a cable; a data bus, such as a CAN (Controller Area Network) bus, a MOST (Media Oriented Systems Transport) bus, or any other bus configuration; or of a wireless connection.

A person skilled in the art will realise that the above-mentioned computer may consist of the calculation device 401, and that the above-mentioned memory may consist of the memory device 402.

Generally, control systems in modern vehicles consist of a communications bus system, consisting of one or several communications buses to connect a number of electronic control devices (ECUs), or controllers, and different components localised on the vehicle. Such a control system may comprise a large number of control devices, and the responsibility for a specific function may be distributed among more than one control device. Vehicles of the type shown thus often comprise significantly more control devices than what is shown in Figure 4, which is well known to a person skilled in the art within the technology area.

The present invention, in the embodiment shown, is implemented in the control device 400. The invention may, however, also be implemented wholly or partly in one or several other control devices already existing in the vehicle, or in a control device dedicated to the present invention.

Here, and in this document, devices are often described as being arranged to carry out steps in the method according to

the invention. This also comprises that the devices are adapted and/or set up to carry out these method steps.

Figure 3 schematically shows an exhaust treatment system 350, which is connected via an exhaust pipe 302 to a combustion engine 301. Exhausts generated at combustion in the engine 301, that is to say the exhaust stream 303 (indicated with arrows), are led past a first dosage device 371, arranged in the exhaust treatment system 350 to provide a first supply 210 of a first additive into the exhaust stream 303.

The exhaust treatment system 350 comprises a first device 331, arranged downstream of the first dosage device 371, and arranged to provide a first impact 220 on a first amount of nitrogen oxides NO_{x_1} reaching the first device 331. At this first impact, which occurs in the first device 331, the first additive is used, which was supplied to the exhaust stream 303 during the first supply 210.

The exhaust treatment system 350 also comprises a second dosage device 372, arranged downstream of the first device 331, to provide a second supply 230 of a second additive to the exhaust stream 303.

Downstream of the second dosage device 372, a second device 332 is arranged, to provide a second impact 240 on a second amount of nitrogen oxides NO_{x_2} reaching the second device 332. At this second impact 240 the second additive is used, which was supplied to the exhaust stream by the second dosage device 372.

The exhaust treatment system 350 also comprises at least one dosage control device 374, arranged to control at least one of the first supply 210 and the second supply 230, based on an overall ability for the first device 331 to provide the first

impact 220, and for the second device 332 to provide the second impact 240, so that a required total impact on nitrogen oxides NO_x in the exhaust stream 303 is provided by the exhaust treatment system 350.

In other words, the dosage control device 374 controls one or several of the first dosage device 371 and the second dosage device 372, and/or pumps or similar devices which supply these dosage devices 371, 372 with additive, so that a sufficient total amount of additive it supplied to the exhaust stream, through the first dosage device 371 and the second dosage device 372, in order to ensure a required total impact on the nitrogen oxides in the exhaust stream NO_x.

The exhaust treatment system according to the present invention has similar advantages as specified above for the method according to the present invention, for example that the activities of the first device may be controlled in order to complete the activities of the second device, and reversely, so that an overall efficient exhaust purification is provided, which takes into consideration the complete exhaust treatment system's conditions and/or characteristics.

According to one embodiment of the present invention, the exhaust treatment system may comprise a first oxidation catalyst DOC_1 311, arranged upstream of the first dosage device 371, and/or the second oxidation catalyst DOC_2 312, arranged downstream of the first device 331. The first oxidation catalyst DOC_1 311, and/or the second oxidation catalyst DOC_2 312, are in that case arranged to oxidise nitrogen compounds, carbon compounds and/or hydrocarbon compounds in the exhaust stream 303 in the exhaust treatment system 350. During the oxidation in the first oxidation catalyst DOC_1 311,

a part of the nitrogen monoxides NO in the exhaust stream 303 is oxidised into nitrogen dioxide NO_2.

According to one embodiment of the invention, a first hydrolysis catalyst, which may consist of substantially any suitable hydrolysis coating, and/or a first mixer, may be arranged in connection with the first dosage device 371. The first hydrolysis catalyst, and/or the first mixer, are in this case used to increase the speed of the decomposition of urea into ammonia, and/or to mix the additive with the emissions, and/or to vaporise the additive.

According to one embodiment of the present invention, the exhaust system 350 comprises a particulate filter 320, downstream of the first device, or downstream of the second oxidation catalyst DOC_2 312, if this is comprised in the system. The particulate filter 320 is arranged to catch and oxidise soot particles. The exhaust stream 303 is here led through the filter structure of the particulate filter, where soot particles are caught in the filter structure from the exhaust stream 303 passing through, and are accumulated and oxidised in the particulate filter.

The first oxidation catalyst DOC_1 311, and/or the second oxidation catalyst DOC_2 312, are at least partly coated with a catalytically oxidising coating, where such oxidising coating may comprise at least one precious metal, for example platinum.

According to one embodiment of the present invention, the particulate filter 320 consists of a diesel particulate filter (DPF). This filter is thus used to catch, store and oxidise soot particles from the exhaust stream 303.

According to another embodiment of the present invention, the particulate filter 320 consists of a particulate filter cDPF, which is at least partly coated with a catalytically oxidising coating, where such oxidising coating may comprise at least one precious metal. That is to say, the particulate filter 320 may at least partly be coated with one or several precious metals, for example platinum. The particulate filter cDPF, which comprises the oxidising coating, may provide more stable conditions for the nitrogen dioxide level NO_2 at the second device 332. Additionally, the use of the particulate filter cDPF, comprising the oxidising coating, means that the value for the ratio NO_2/NO_x, that is to say the level of NO_2, may be controlled. Since the particulate filter cDPF with the oxidising coating is used, according to one embodiment, the second oxidation catalyst DOC_2 312 is not needed in the system.

According to one embodiment of the present invention, the first, and/or the second additive, comprises ammonia NH_3 or urea, from which ammonia may be generated/formed/released. This additive may for example consist of AdBlue. The first and the second additive may be of the same type, or may be of different types.

According to one embodiment of the present invention, the exhaust treatment system 350 comprises a system 370 for supply of additive, which comprises at least one pump 373, arranged to supply the first 371 and the second 372 dosage devices with additive, that is to say for example ammonia or urea.

One example of such a system 370 for supply of additive is schematically shown in Figure 3, where the system comprises the first dosage device 371 and the second dosage device 372, which are arranged upstream of the first device 331, and upstream of the second device 332, respectively. The first and

second dosage devices 371, 372, often consisting of dosage nozzles which administer additive to, and mix such additive with, the exhaust stream 303, are supplied with additive by the at least one pump 373, via conduits 375 for additive. The at least one pump 373 obtains additive from one or several tanks 376 for additive, via one or several conduits 377 between the tank/tanks 376, and the at least one pump 373. It should be realised that the additive may be in liquid form and/or gaseous form. Where the additive is in liquid form, the pump 373 is a liquid pump, and the one or several tanks 376 are liquid tanks. Where the additive is in gaseous form, the pump 373 is a gas pump, and the one or several tanks 376 are gas tanks. If both gaseous and liquid additives are used, several tanks and pumps are arranged, wherein at least one tank and one pump are set up to supply liquid additive, and at least one tank and one pump are set up to supply gaseous additive.

According to one embodiment of the invention, the at least one pump 373 comprises a joint pump, which feeds both the first 371 and the second 372 dosage device with the first and the second additive, respectively. According to another embodiment of the invention, the at least one pump comprises a first and a second pump, which feed the first 371 and the second 372 dosage device, respectively, with the first and the second additive, respectively. The specific function of the additive system 370 is well described in prior art technology, and the exact method for the injection of additive is therefore not described in any further detail herein. Generally, however, the temperature at the point of injection/SCR-catalyst should be above a lower threshold temperature to avoid precipitates and formation of unwanted by-products, such as ammonium nitrate NH_4NO_3. An example of a value for such a lower

threshold temperature may be approximately 200 °C. According to one embodiment of the invention, the system 370 for supply of additive comprises a dosage control device 374, arranged to control the at least one pump 373, so that the additive is supplied to the exhaust stream. The dosage control device 374 comprises, according to one embodiment, a first pump control device 378 arranged to control the at least one pump 373, in such a manner that a first dosage of the first additive is supplied to the exhaust stream 303, via the first dosage device 371. The dosage control device 374 also comprises a second pump control device 379, arranged to control the at least one pump 373, so that a second dosage of the second additive is supplied to the exhaust stream 303, via the second dosage device 372.

The first and second additives usually consist of the same type of additive, for example urea. However, according to one embodiment of the present invention, the first additive and the second additive may be of different types, for example urea and ammonia, which means that the dosage to each one of the first 331 and second 332 devices, and accordingly also the function for each of the first 331 and second 332 devices, may be optimised also with respect to the type of additive. If different types of additive are used, the tank 376 comprises several sub-tanks, which contain the different respective types of additive. One or several pumps 373 may be used to supply the different types of additive to the first dosage device 371 and the second dosage device 372. As mentioned above, the one or several tanks, and the one or several pumps, are adapted according to the state of the additive, that is to say according to whether the additive is gaseous or liquid.

The one or several pumps 373 are thus controlled by a dosage control device 374, which generates control signals for

control of supply of additive, so that a desired amount is injected in the exhaust stream 303 with the help of the first 371 and the second 372 dosage device, respectively, upstream of the first 331 and the second 332 device, respectively. In more detail, the first pump control device 378 is arranged to control either a joint pump, or a pump dedicated to the first dosage device 371, so that the first dosage is controlled to be supplied to the exhaust stream 303 via the first dosage device 371. The second pump control device 379 is arranged to control either a joint pump, or a pump dedicated to the second dosage device 372, so that the second dosage is controlled to be supplied to the exhaust stream 303 via the second dosage device 372.

The exhaust treatment system 350 may also equipped with one or several sensors, such as one or several NO_x, NO_2, and/or temperature sensors 361, 362, 363, 364, 365. arranged at the inlet to the oxidation catalyst 311, at the inlet to the first device 331, at the outlet from the first device 331, at the inlet to the oxidation catalyst 312, at the inlet to the second device 332, and/or at the outlet from the second device 332, for determination of nitrogen oxides, nitrogen dioxide and/or the temperature in the exhaust treatment system.

The control device 360 is arranged to provide control signals, and/or signals representing the measurement carried out by the one or several NO_x, NO_2 and/or the temperature sensors 361, 362, 363, 364, 365, to at least one dosage device 374. The at least one dosage control device 374 thereafter bases the control of supplying substances on such control signals, and/or measurement signals.

According to one embodiment of the present invention, the at least one dosage control device 374 is arranged to control the

first supply 210 of the first additive, in such a way that the first supply 210 decreases. If the second device 332, through the second impact 240, is capable of providing a required total impact on the nitrogen oxides NO_x on its own then at least one dosage control device 374 may even control the first supply 210 in such a way that an interruption of the first supply 210 is achieved. As mentioned above, such an interruption of the first supply 210 may increase the efficiency during soot oxidation in a subsequent filter, and/or may be used to regenerate the first device 331.

Similarly, the at least one dosage control device 374 is, according to one embodiment, arranged to control the second supply 230 of the second additive in such a way that the second supply 230 decreases. If the first device 331, through the first impact 220, is capable of providing a required total impact on the nitrogen oxides NO_x on its own, the at least one dosage control device 374 may control the second supply 230 in such a way that an interruption of the second supply 230 is achieved as a result of the control. As mentioned above, such an interruption of the second supply 230 may be used to regenerate the second device 332.

The at least one control device 374 is drawn in the figure comprising separately marked units 378, 379. These units 378, 379 may also be logically separate, but physically implemented in the same unit, or may be both logically and physically jointly arranged/implemented. For example, these units 378, 379 may correspond to different groups of instructions, for example in the form of program code, which is fed into, and used by a processor, when the respective unit is active/used to implement the respective method steps.

The method according to the present invention may be implemented in substantially all exhaust treatment systems comprising the above described first dosage device 371, and the above described first device 331, the above described second dosage device 372, and the above described second device 332. Each of the first device 331 and the second device 332 may be arranged in a number of different ways, and have a number of different characteristics/functions, as described in the examples below.

According to different embodiments of the present invention, the first device 331 may comprise one from among the group of:
- a first selective catalytic reduction catalyst SCR_1;

- a first selective catalytic reduction catalyst SCR_1, followed downstream by a first slip-catalyst SC_1, wherein the first slip-catalyst SC_1 is arranged to oxidise a residue of additive, and/or to assist the first selective catalytic reduction catalyst SCR_1 with an additional reduction of nitrogen oxides NO_x in the exhaust stream 303;

- a first slip-catalyst SC_1, which is arranged primarily for reduction of nitrogen oxides NO_x, and secondarily for oxidation of additive in the exhaust stream 303;

- a first slip-catalyst SC_1, followed downstream by a first selective catalytic reduction catalyst SCR_1, wherein the first slip-catalyst SC_1 is arranged to oxidise additive, and/or to assist the first selective catalytic reduction catalyst SCR_1 with a reduction of nitrogen oxides NO_x in the exhaust stream 303;

- a first slip-catalyst SC_1, followed downstream by a first selective catalytic reduction catalyst SCR_1, followed downstream by an additional first slip-catalyst SC_{1b}, wherein

the first slip-catalyst SC_1, and/or the additional first slip-catalyst SC_{1b}, is arranged to oxidise additive, and/or to assist the first selective catalytic reduction catalyst SCR_1 with a reduction of nitrogen oxides NO_x in the exhaust stream 303; and

- a first selective catalytic reduction catalyst SCR_1, combined with a purely oxidising coating in its outlet part; and

- a first slip-catalyst SC_1, followed downstream by a first selective catalytic reduction catalyst SCR_1, combined with a purely oxidising coating in its outlet part, wherein the first slip-catalyst SC_1 is arranged primarily for reduction of nitrogen oxides NO_x, and secondarily for oxidation of additive in the exhaust stream.

According to different embodiments of the present invention, the second device 332 comprises one from among the group of:
- a second selective catalytic reduction catalyst SCR_2; and
-a second selective catalytic reduction catalyst SCR_2, followed downstream by a second slip-catalyst SC_2, wherein the second slip-catalyst SC_2 is arranged to oxidise a residue of additive, and/or to assist the second selective catalytic reduction catalyst SCR_2 with an additional reduction of nitrogen oxides NO_x in the exhaust stream 303.

In this document, a selective catalytic reduction catalyst SCR means a traditional SCR-catalyst (Selective Catalytic Reduction). SCR catalysts usually use an additive, often ammonia NH_3, or a composition from which ammonia may be generated/formed, which is used for the reduction of nitrogen oxides NO_x in the exhausts. The additive is injected into the exhaust stream resulting from the combustion engine, upstream of the catalyst as described above. The additive added to the catalyst is adsorbed (stored) in the catalyst, in the form of

ammonia NH_3, so that a redox-reaction may occur between nitrogen oxides NO_x in the exhausts, and ammonia NH_3 available via the additive.

Slip-catalyst SC, as used in this document, means a catalyst which is arranged to oxidise additive, and/or to assist a selective catalytic reduction catalyst SCR with a reduction of nitrogen oxides NO_x in said exhaust stream 303. The use of a first slip-catalyst SC_1 in the first device 331 facilitates a greater load, and therefore a better use of the first selective catalytic reduction catalyst SCR_1, and it also facilitates a reduction of the starting temperature (the "light off"- temperature) for the NO_x-reduction. The slip-catalyst SC may also oxidise nitrogen monoxide NO and/or hydrocarbons HC in the exhaust stream, so that heat/an exothermal reaction is created.

To provide a slip-catalyst SC_1 and/or the additional first slip-catalyst SC_{1b}, in the first device 331, which slip catalysts are multifunctional, and accordingly reduce nitrogen oxides NO_x through the use of the additive, and which also oxidise the additive, entails a number of advantages for the exhaust treatment system. The first slip-catalyst SC_1, and/or the additional first slip-catalyst SC_{1b}, may here be used in symbiosis with the first reduction catalyst SCR_1, so that the activity of the first slip-catalyst SC_1, and/or the additional first slip-catalyst SC_{1b}, with respect to the reduction of nitrogen oxides NO_x, and oxidation of residues of additive, as well as the slip-catalysts' SC_1, SC_{1b} deposit characteristics for additive, constitute a complement to the function of the first reduction catalyst SCR_1. The combination of these characteristics for the first device 331, comprising the first reduction catalyst SCR_1, the first slip-catalyst SC_1, and/or the additional first slip-catalyst SC_{1b}, mean that a higher

conversion level may be obtained over the first device 331. Additionally, the use of the first slip-catalyst SC_1, and/or of the additional first slip-catalyst SC_{1b}, in the first device 331 result results in conditions making it possible to avoid a non-selective oxidation of reductant occurring in components placed downstream of the first device 331 in the exhaust treatment system, which may potentially comprise platinum metals.

Furthermore, tests have shown that the reduction of nitrogen oxides NO_x with the first multifunctional slip-catalyst SC_1, and/or the additional first slip-catalyst SC_{1b}, in the first device 331 becomes surprisingly efficient. This is a result of sufficient amounts of nitrogen oxides NO_x being present in the exhaust stream 303 at the first slip-catalyst SC_1, and/or at the additional first slip-catalyst SC_{1b}, in the first device 331, in order for an efficient reduction of nitrogen oxides NO_x to be obtained. In other words, the relatively good availability of nitrogen oxides NO_x at the first slip-catalyst SC_1, and/or at the additional first slip-catalyst SC_{1b}, may be used to achieve a very good performance, and/or a very good utilisation, when a multifunctional slip-catalyst SC_1, and/or a multifunctional additional first slip-catalyst SC_{1b}, is used in the first catalyst device 331.

The first selective catalytic reduction catalyst SCR_1, the first slip-catalyst SC_1, and/or the additional first slip-catalyst SC_{1b}, may be used with the objective of generating heat, for example by oxidation of hydrocarbons HC in the exhaust stream, which facilitates regeneration of sulphur contaminated components, such as the catalyst and/or components arranged downstream of the latter. At the regeneration of the sulphur contaminated components, the amount of sulphur intercalated in the components is reduced.

The system according to the present invention may be arranged to carry out all of the method embodiments described above and in the claims, wherein the system for the respective embodiment achieves the above described advantages for the respective embodiment.

A person skilled in the art will also realise that the above system may be modified according to the different embodiments of the method according to the invention. In addition, the invention relates to a motor vehicle 100, for example a truck or a bus, comprising at least one system for treatment of an exhaust stream.

The present invention is not limited to the embodiments of the invention described above, but pertains to and comprises all embodiments within the scope of the enclosed independent claims.

Claims

1. Method in an exhaust treatment system (350) for treatment of an exhaust stream (303), which results from a combustion in a combustion engine (301), and comprises nitrogen oxides NO_x, **characterised by**
- a first supply (210) of a first additive into said exhaust stream (303), through the use of a first dosage device (371), arranged in said exhaust treatment system (350);
- a first impact (220) on a first amount of nitrogen oxides NO_{x_1} reaching a first device (331), arranged downstream of said first dosage device (371), in order to impact said first amount of nitrogen oxides NO_{x_1} through the use of said first additive;
- a second supply (230) of a second additive into said exhaust stream (303), through the use of a second dosage device (372), arranged downstream of said first device (331); and
-a second impact (240) on a second amount of nitrogen oxides NO_{x_2} reaching a second device (332), arranged downstream of said second dosage device (372), in order to impact said second amount of nitrogen oxides NO_{x_2} through the use of said first and/or second additive; wherein
- at least one of said first supply (210) and said second supply (230) is controlled, based on an overall ability for said first device (331) to provide said first impact (220), and for said second device (332) to provide said second impact (240), so that a required total impact on said nitrogen oxides NO_x in said exhaust stream (303) is provided by said exhaust treatment system (350).

2. Method according to claim 1, wherein said control of said first supply (210) results in a reducing of said first supply (210).

3. Method according to claim 2, wherein said reducing of said first supply (210) corresponds to an interruption of said first supply (210) of said first additive, if said second device (332), through said second impact (240) is capable of providing said required total impact on said nitrogen oxides NO_x on its own in said exhaust stream (303).

4. Method according to claim 3, wherein said interruption of said first supply (210) of said first additive results in said first amount of nitrogen oxides NO_{x_1} passing relatively unaffected, through said first device (331), to subsequent components in said exhaust treatment system (350).

5. Method according to claim 4, wherein said subsequent components comprise at least one particulate filter (320), wherein said particulate filter (320) may use said relatively unaffected first amount of nitrogen oxides NO_{x_1} during soot oxidation.

6. Method according to any of claims 2-5, wherein said first device (331) is regenerated during, and/or after, said reducing of said first supply (210).

7. Method according to claim 6, wherein residues of said first additive, which are present in said first device (331), are eliminated at said regeneration.

8. Method according to claim 1, wherein said control of said second supply (230) results in a reducing of said second supply (230).

9. Method according to claim 8, wherein said reducing of said second supply (230) corresponds to an interruption of said second supply (230) of said second additive, if said first device (331), through said first impact (220) is capable

of providing said required total impact on said nitrogen oxides NO_x on its own in said exhaust stream (303).

10. Method according to any of claims 8-9, wherein said second device (332) is regenerated during, and/or after, said reducing of said second supply (230).

11. Method according to claim 10, wherein residues of said second additive, which are present in said second device (332), are eliminated at said regeneration.

12. Method according to claim 1, wherein said control of said first supply (210) of said first additive results in an increase of said first supply (210) of said first additive.

13. Method according to claim 12, wherein
- said first impact (220) comprises a first reduction of said first amount of nitrogen oxides NO_{x_1}, through a first selective catalytic reduction catalyst (SCR_1), followed by a reduction of nitrogen oxides NO_x, and/or oxidation of potential additive in said exhaust stream (303), through a first slip-catalyst (SC_1); and
- said increase of said first additive (210) of said first additive is carried out in such a way that a slip of additive arises from said first selective catalytic reduction catalyst (SCR_1).

14. Method according to claim 13, wherein said increase of said first supply (210) of said first additive is carried out in such a way that said slip of additive out from said first selective catalytic reduction catalyst (SCR_1) may substantially be stored, and/or oxidised, in said first slip-catalyst (SC_1).

15. Method according to any of claims 13-14, wherein said slip of additive depends on a coverage degree for additive in said first selective catalytic reduction catalyst (SCR_1), at said increase of said first supply (210), when said first additive exceeds a value for maximum coverage degree for additive in said first selective catalytic reduction catalyst (SCR_1).

16. Method according to claim 1, wherein said control of said second supply (230) of said second additive results in an increase of said second supply (230) of said second additive.

17. Method according to any of claims 1-16, wherein said required total impact on said nitrogen oxides NO_x in said exhaust stream (303) is determined, based on currently measured, modelled and/or predicted operating conditions for said combustion engine (301).

18. Method according to any of claims 1-16, wherein said required total impact on said nitrogen oxides NO_x in said exhaust stream (303) is determined, based on at least one threshold value for emission of nitrogen oxides NO_x.

19. Method according to claim 18, wherein said at least one threshold value consists of one or several of:
- a threshold value corresponding to a legal requirement for emissions of nitrogen oxides NO_x;
- a threshold value determined by authorities, representing a permitted emission of nitrogen oxides NO_x; and
- a threshold value representing a maximum desired emission of nitrogen oxides NO_x.

20. Method according to any of claims 1-19, wherein said ability for said first device (331) to provide said first impact (220) depends on one or several of:

- catalytic characteristics for said first device (331);
- a catalyst type for said first device (331);
- a temperature interval within which said first device (331) is active;
- a coverage degree of additive for said first device (331); and
- a temperature at said first device (331).

21. Method according to any of claims 1-20, wherein said ability for said second device (332) to provide said second impact (240) depends on one or several of:
- catalytic characteristics for said second device (332);
- a catalyst type for said second device (332);
- a temperature interval within which said second device (332) is active;
- a coverage degree of additive for said second device (332); and
- a temperature at said second device (332).

22. Method according to any of claims 1-21, wherein said first amount of nitrogen oxides NO_{x_1} corresponds to a first ratio NO_{2_1}/NO_{x_1}, between a first amount of nitrogen dioxide NO_{2_1} and a first amount of nitrogen oxides NO_{x_1}, reaching said first device (331); wherein said first supply (210) of said first additive is based on a determined value $(NO_{2_1}/NO_{x_1})_{det}$ for said first ratio, so that a fast reduction may be used in said first device (331).

23. Method according to claim 22, wherein said determined value for said first (NO_{2_1}/NO_{x_1}) consists of one from among the group:
- a measured value;

- a modelled value;
- a predicted value.

24. Computer program comprising a program code which, when said program code is executed in a computer, achieves that said computer executes the method according to any of claims 1-23.

25. Computer program product including a computer readable medium and a computer program according to patent claim 24, wherein said computer program is included in said computer readable medium.

26. Exhaust treatment system (350), arranged for treatment of an exhaust stream (303), which results from a combustion in a combustion engine (301) and comprises nitrogen oxides NO_x, **characterised by**
- a first dosage device (371), arranged in said exhaust treatment system (350) to provide a first supply (210) of a first additive into said exhaust stream (303);
- a first device (331), arranged downstream of said first dosage device (371) to provide a first impact (220) on a first amount of nitrogen oxides NO_{x_1} reaching said first device (331) through the use of said first additive;
- a second dosage device (372), arranged downstream of said first device (331), to provide a second supply (230) of a second additive into said exhaust stream (303);
- a second device (332), arranged downstream of said second dosage device (372), to provide a second impact (240) on a second amount of nitrogen oxides NO_{x_2} reaching said second device (332) through the use of said first and/or second additive; and

- at least one dosage control device (374), arranged to control at least one of said first supply (210) and said second supply (230), based on a total ability for said first device (331) to provide said first impact (220), and for said second device (332) to provide said second impact (240), so that a required total impact on said nitrogen oxides NO_x in said exhaust stream (303) is provided by said exhaust treatment system (350).

27. Exhaust treatment system (350) according to claim 26, wherein said at least one dosage control device (374) is arranged to control said first supply (210) of said first additive in such a way that said first supply (210) of said first additive is reduced.

28. Exhaust treatment system (350) according to claim 27, wherein said at least one dosage control device (374) is arranged to control said first supply (210) of said first additive in such a way that the reducing of said first supply (210) corresponds to an interruption of said first supply (210) of said first additive, if said second device (332), through said second impact (240) is capable of providing said required total impact on said nitrogen oxides NO_x on its own in said exhaust stream (303).

29. Exhaust treatment system (350) according to claim 26, wherein said at least one dosage control device (374) is arranged to control said second supply (230) of said second additive in such a way that said second supply (230) of said second additive is reduced.

30. Exhaust treatment system (350) according to claim 29, wherein said at least one dosage control device (374) is arranged to control said second supply (230) in such a way

that the reducing of said second supply (230) corresponds to an interruption of said second supply (230) of said second additive, if said first device (331), through said first impact (220) is capable of providing said required total impact on said nitrogen oxides NO_x on its own in said exhaust stream (303).

31. Exhaust treatment system (350) according to any of claims 26-30, wherein said first catalyst device (331) comprises one from among the group of:

- a first selective catalytic reduction catalyst SCR_1;
- a first selective catalytic reduction catalyst SCR_1, followed downstream by a first slip-catalyst SC_1, wherein said first slip-catalyst SC_1 is arranged to oxidise a residue of additive, and/or to assist the first selective catalytic reduction catalyst SCR_1 with an additional reduction of nitrogen oxides NO_x in said exhaust stream 303;
- a first slip-catalyst SC_1, which is arranged primarily for reduction of nitrogen oxides NO_x, and secondarily for oxidation of additive in said exhaust stream (303);
- a first slip-catalyst SC_1, followed downstream by a first selective catalytic reduction catalyst SCR_1, wherein said first slip-catalyst SC_1 is arranged to oxidise additive, and/or to assist the first selective catalytic reduction catalyst SCR_1 with a reduction of nitrogen oxides NO_x in said exhaust stream (303);
- a first slip-catalyst SC_1, followed downstream by a first selective catalytic reduction catalyst SCR_1, followed downstream by an additional first slip-catalyst SC_{1b}, wherein said first slip-catalyst SC_1, and/or said additional first slip-catalyst SC_{1b}, are arranged to oxidise additive, and/or to assist said first selective catalytic reduction catalyst SCR_1

with a reduction of nitrogen oxides NO_x in said exhaust stream (303);

- a first selective catalytic reduction catalyst SCR_1, combined with a purely oxidising coating in its outlet part; and
- a first slip-catalyst SC_1, followed downstream by a first selective catalytic reduction catalyst SCR_1, combined with a purely oxidising coating in its outlet part, wherein said first slip-catalyst SC_1 is arranged primarily for reduction of nitrogen oxides NO_x, and secondarily for oxidation of additive in said exhaust stream (303).

32. Exhaust treatment system (350) according to any of claims 26-31, wherein said second device (332) comprises one from among the group of:

- a second selective catalytic reduction catalyst (SCR_2); and
- a second selective catalytic reduction catalyst (SCR_2), followed downstream by a second slip-catalyst (SC_2), wherein said second slip-catalyst (SC_2) is arranged to oxidise a residue of additive, and/or to assist said second selective catalytic reduction catalyst (SCR_2) with an additional reduction of nitrogen oxides NO_x in said exhaust stream (303).

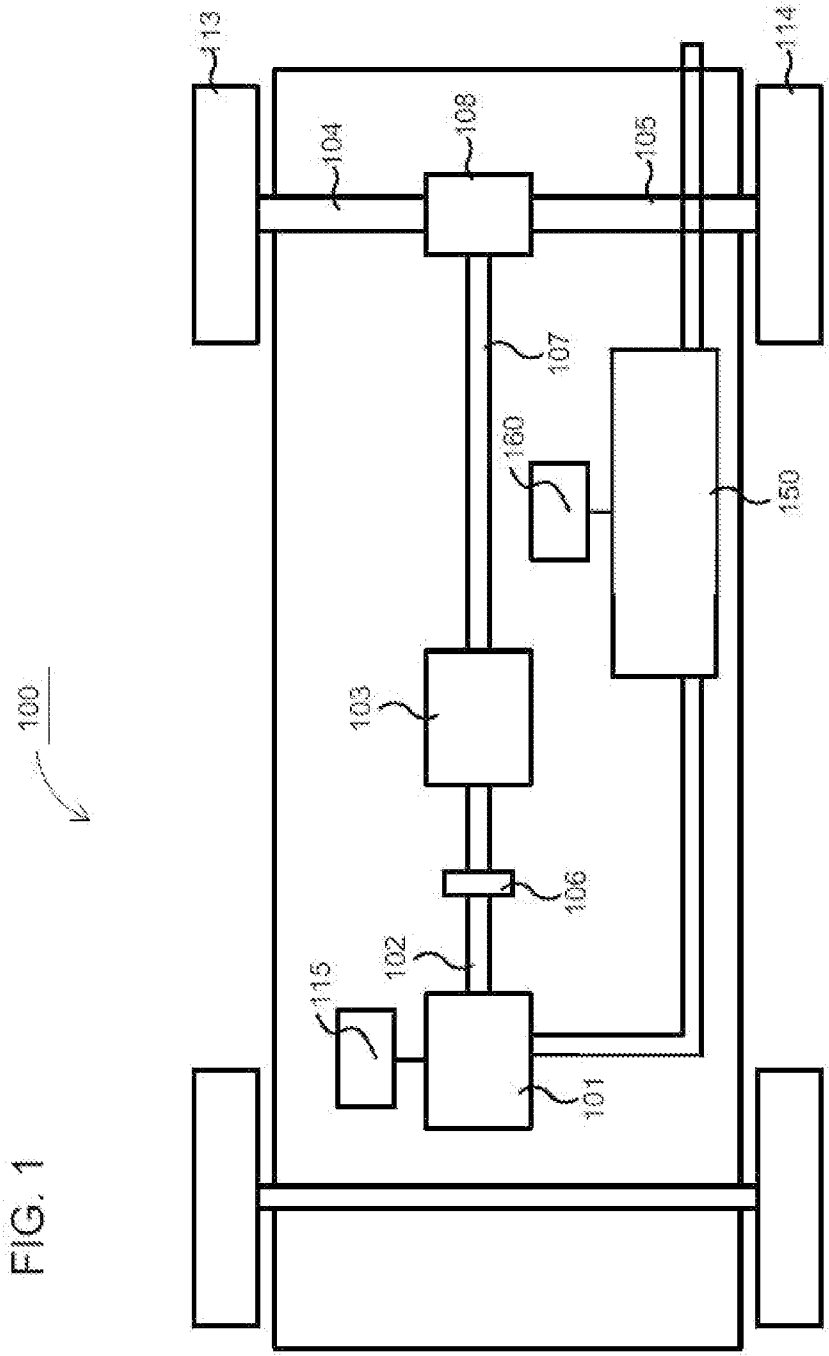


FIG. 1

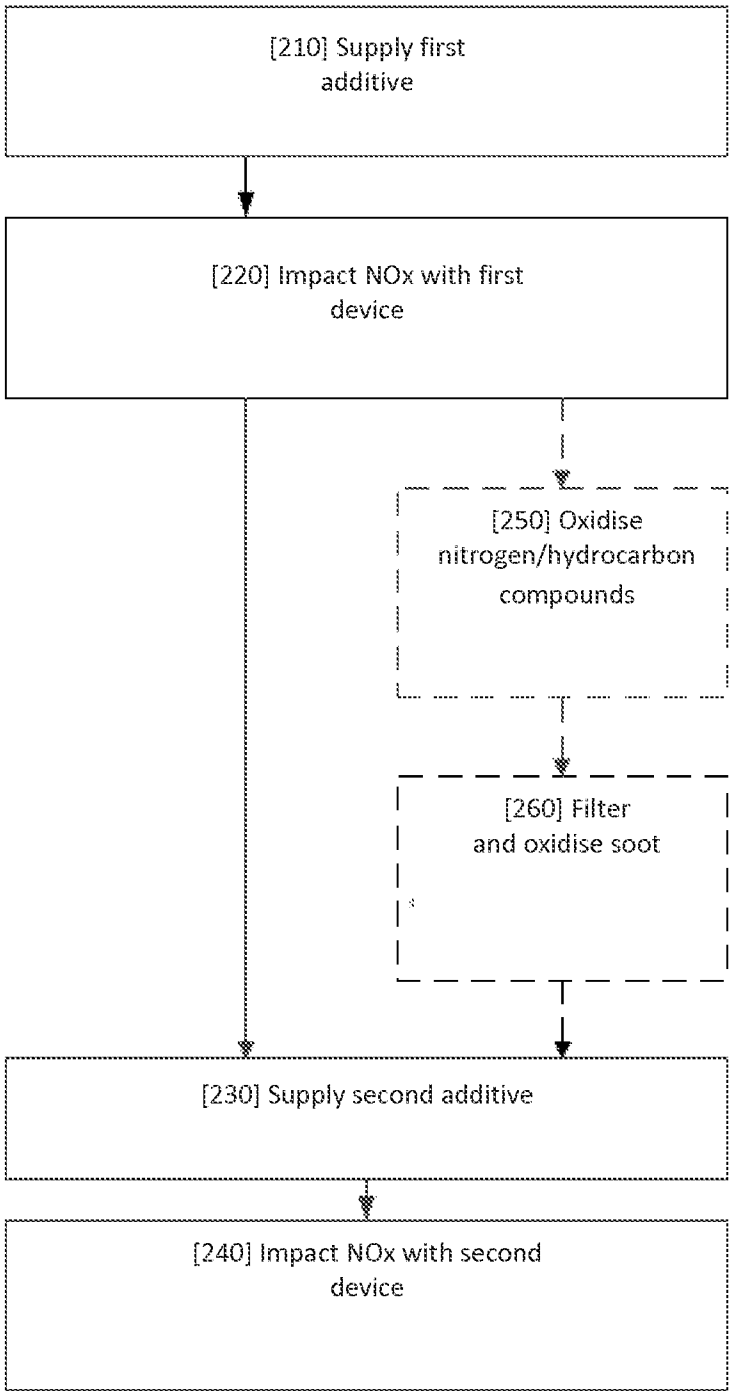

[210] Supply first additive
[220] Impact NOx with first device
[250] Oxidise nitrogen/hydrocarbon compounds
[260] Filter and oxidise soot
[230] Supply second additive
[240] Impact NOx with second device

Fig. 2

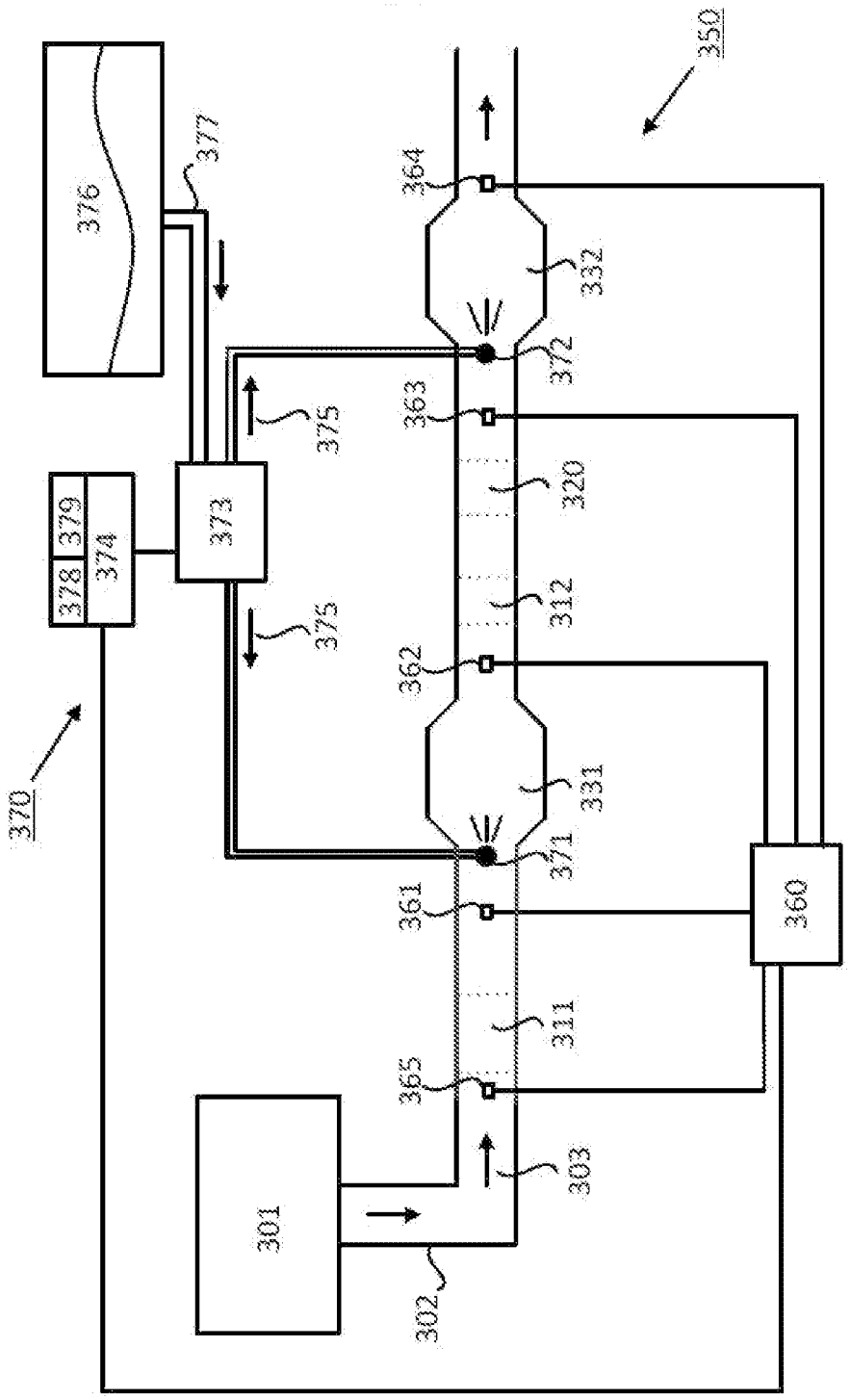

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FIG. 3

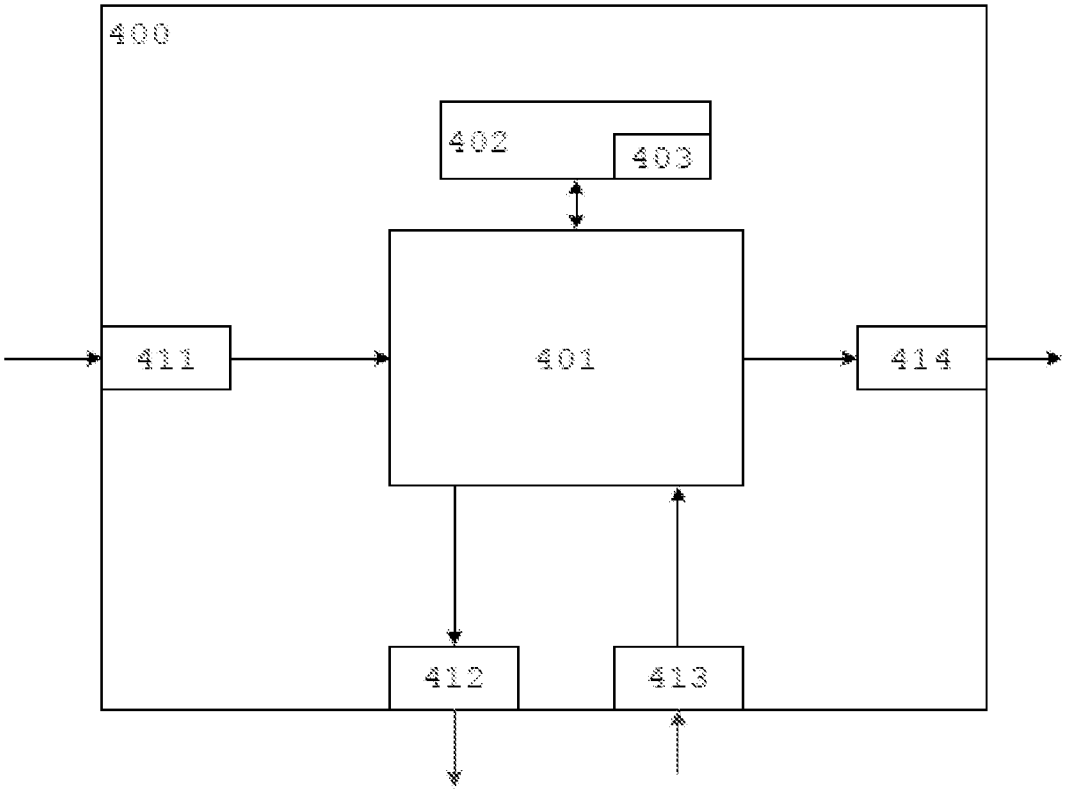


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2015/050229

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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: F01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2009017639 A1 (CATERPILLAR INC ET AL), 5 February 2009 (2009-02-05); page 1, line 15 - line 18; page 7, line 27 - page 8, line 23; page 14, line 25 - line 28; page 23, line 12 - page 24, line 14; figure 6 --	1-32
X	WO 2013095214 A1 (VOLVO LASTVAGNAR AB ET AL), 27 June 2013 (2013-06-27); abstract; page 18, line 25 - page 20, line 22; figures 1,2 --	1-32
X	WO 2012037342 A1 (JOHNSON MATTHEY INC ET AL), 22 March 2012 (2012-03-22); paragraphs [0006], [0009], [0011]-[0014], [0026]-[0034]; figure 3; claim 15 --	1-32

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12-06-2015	15-06-2015

Name and mailing address of the ISA/SE	Authorized officer
Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. + 46 8 666 02 86	Niels Rasmussen Telephone No. + 46 8 782 28 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2015/050229

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 20100024393 A1 (CHI JOHN N ET AL), 4 February 2010 (2010-02-04); paragraphs [0070], [0071], [0076], [0108]; figures 2,5 -- --------	22, 23

International application No.
PCT/SE2015/050229

Continuation of: second sheet

International Patent Classification (IPC)

F01N 3/20 (2006.01)
F01N 13/00 (2010.01)

WO	2009017639	A1	05/02/2009	US	20090035194	A1	05/02/2009
WO	2013095214	A1	27/06/2013	CN	104053871	A	17/09/2014
				EP	2795076	A1	29/10/2014
				JP	2015507118	A	05/03/2015
				US	20140363358	A1	11/12/2014
WO	2012037342	A1	22/03/2012	CN	103118780	A	22/05/2013
				EP	2616175	A1	24/07/2013
				JP	2013542847	A	28/11/2013
				KR	20130103502	A	23/09/2013
				US	20130078173	A1	28/03/2013
				US	20120107204	A1	03/05/2012
				US	8329127	B2	11/12/2012
US	20100024393	A1	04/02/2010	US	8201394	B2	19/06/2012