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(71) Applicant (for all designated States except US): **VOLVO LASTVAGNAR AB** [SE/SE]; SE-405 08 Göteborg (SE).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **ERIXON, Martin** [SE/SE]; Mogatan 4, S-444 42 Stenungsund (SE).
LINDH, Mikael [SE/SE]; Skogsbovägen 35, S-428 34 Kallered (SE).(74) Agent: **FRÖHLING, Werner**; Volvo Technology Corporation, Corporate Patents, 06820, M1.7, S-405 08 Göteborg (SE).

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(54) Title: METHOD FOR OPERATING AN EXHAUST AFTERTREATMENT SYSTEM AND EXHAUST AFTERTREATMENT SYSTEM

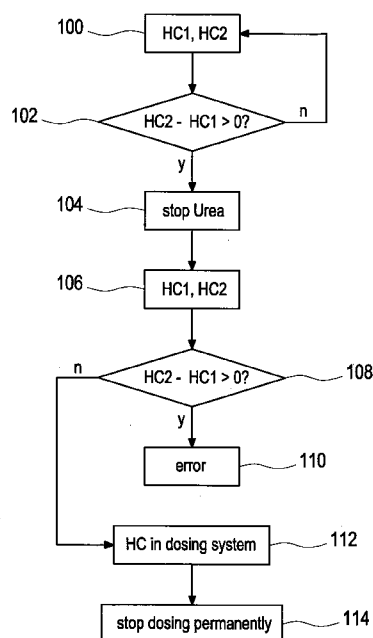


Fig. 2

(57) Abstract: The invention relates to a method for operating an exhaust aftertreatment system (20) comprising a reductant dosing system (40) for supplying a reductant into an exhaust gas of an engine (10). By performing the steps of determining a first hydrocarbon amount (HC1) in the exhaust gas upstream of the reductant dosing device (42); determining a second hydrocarbon amount (HC2) in the exhaust gas downstream of a nitrogen-oxide-removing catalytic converter (22) arranged downstream of a reductant dosing device (42); comparing the first and the second hydrocarbon amounts (HC1, HC2); if the second hydrocarbon amount (HC2) is higher than the first hydrocarbon amount (HC1), extracting a hydrocarbon amount (HC2-HC1) presumably introduced by the reductant dosing system (40) from the difference between the first and the second hydrocarbon amount (HC1, HC2); comparing the extracted hydrocarbon amount (ΔHC) to a reductant amount supplied by the reactant dosing system (40) to the exhaust gas upstream of the catalytic converter (22); deciding whether the extracted hydrocarbon amount (ΔHC) is originating from the reactant dosing system (40) or not, a contamination with hydrocarbons originating from the dosing system can be detected reliably.

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DESCRIPTION

Method for Operating an Exhaust Aftertreatment System and Exhaust Aftertreatment System

5

TECHNICAL FIELD

The invention relates to a method for operating an exhaust aftertreatment system and an exhaust aftertreatment system.

10

BACKGROUND OF THE INVENTION

It is known in the art that ammonia is used for reducing nitrogen oxide in the exhaust gas of combustion engines to nitrogen and water. In vehicles urea is used instead of pure ammonia, which can be stored and handled more easily than ammonia. Urea is injected into the hot exhaust gas and subsequently decomposes into ammonia immediately before chemically reducing nitrogen oxide to nitrogen and water. However, urea dosing systems are very sensitive to hydrocarbons such as diesel. After a short time of contact with diesel, for instance, plastic parts of the urea dosing systems, e.g. in the dosing pump, start to break. Further, the catalytic converter in the aftertreatment system is also sensitive to hydrocarbons in the exhaust gas and might need to be replaced when exposed to high concentrations of hydrocarbons.

Developments are made to design urea dosing systems which are more stable against hydrocarbon impurities. However, if fuel is erroneously filled in the urea tank instead of urea, hydrocarbons might erroneously be injected into the hot exhaust gas instead of urea.

30 SUMMARY OF THE INVENTION

It is an object of the invention to provide a method for operating an exhaust aftertreatment system which allows to detect hydrocarbons in the exhaust gas introduced via the urea supply path. Another object of the invention is to provide

an exhaust aftertreatment system which is failsafe against an erroneous addition of hydrocarbons in the urea dosing system.

The objects are achieved by the features of the independent claims. The other
5 claims and the description disclose advantageous embodiments of the invention.

A method is proposed for operating an exhaust aftertreatment system comprising a reductant dosing system for supplying a reductant into an exhaust gas of an engine, comprising the steps of (a) determining a first hydrocarbon amount in the
10 exhaust gas upstream of a reductant dosing device; (b) determining a second hydrocarbon amount in the exhaust gas downstream of a nitrogen-oxide-removing catalytic converter arranged downstream of the reductant dosing device; (c) comparing the first and the second hydrocarbon amounts; (d) extracting a hydrocarbon amount presumably introduced by the reductant dosing system from
15 the difference between the first and the second hydrocarbon amounts; (e) comparing the extracted hydrocarbon amount to an amount of reductant supplied by the reactant dosing system to the exhaust gas upstream of the catalytic converter; and (f) deciding whether the extracted hydrocarbon amount is originating from the reactant dosing system or not.

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Favourably, existing hardware in the aftertreatment system can be used for reliably determine a poisoning of the reductant dosing system with hydrocarbons. For instance, a NOx sensor can be used to derive the hydrocarbon amount downstream of the catalytic converter. The reductant can comprise or consist of
25 ammonia or can be ammonia-developing reducing agent such urea which is used for reducing nitrogen oxide to nitrogen and water.

According to a favourable method step the dosing of reductant can be stopped at least temporarily when the extracted hydrocarbon amount is indicating a
30 hydrocarbon amount probably originating from the reductant dosing system. By stopping the dosing a signal behaviour related to the presumed injection of hydrocarbon via the dosing system can be traced and can provide information about the source of a hydrocarbon contamination.

According to a favourable method step a plausibility check can be performed to confirm whether the extracted hydrocarbon amount is really originating from the reductant dosing system or has other reasons. Particularly, the dosing of the reactant can temporarily be interrupted and the difference between the first and the second hydrocarbon amounts can be determined anew without dosing of the reactant. Thus, it can be determined if the hydrocarbon amount detected downstream of the catalytic converter is correlated with the dosing of the reductant or not. The result is a hint to a reason for the occurrence of a hydrocarbon amount downstream of the catalytic converter which is higher than at the outlet of the engine, for instance if there is a hydrocarbon contamination or if the hydrocarbon amount downstream of the catalytic converter is an artefact. Unnecessary stops for maintenance, e.g. for cleaning or replacing the dosing system and/or the catalytic converter, can be avoided.

15. According to a favourable method step a controlled dosing of hydrocarbons can be performed, and the difference between the first and the second hydrocarbon amounts can be determined. The occurrence of the hydrocarbon amount downstream of the catalytic converter resulting from the dosing system can be confirmed or identified as artefact.

20

According to a favourable method step the dosing can be permanently stopped if the reductant dosing system is confirmed as source of the hydrocarbon amount downstream of the catalytic converter. The contamination can be safely removed from the dosing system or components can be replaced if necessary.

25. Unnecessary operation interruptions and expensive maintenance can be reduced and an exposure of hydrocarbon sensitive materials to hydrocarbons in the dosing system can be minimized.

30. According to a favourable method step the first hydrocarbon amount can be derived from a fuel injection rate into the engine based on a lambda sensor signal. Such a signal can be easily assessed as being usually available in standard after engine control systems. For deriving the fuel injection rate from the lambda value, the air mass flow into the engine combustion is needed. This can be derived from

an air mass flow sensor or from a calculated air mass flow, e.g. from intake manifold pressure and volumetric efficiency.

Alternatively or additionally the first hydrocarbon amount can be derived from a
5 fuel injection rate based on a fuel injection demand for the engine. Such a signal can be easily assessed as being usually available in standard after engine control systems. When used additionally, error sources in the analysis can be minimized.

According to a further aspect of the invention an aftertreatment system for
10 cleaning of an exhaust gas of a vehicle is proposed which performs a method comprising the steps of (a) determining a first hydrocarbon amount in the exhaust gas upstream of a reductant dosing device; (b) determining a second hydrocarbon amount in the exhaust gas downstream of a nitrogen-oxide-removing catalytic converter arranged downstream of the reductant dosing device; (c) comparing the
15 first and the second hydrocarbon amounts; (d) extracting a hydrocarbon amount introduced by the reductant dosing system from the difference between the first and the second hydrocarbon amount; (e) comparing the extracted hydrocarbon amount to an amount of reductant supplied by the reactant dosing system to the exhaust gas upstream of the catalytic converter; and (f) deciding whether the
20 extracted hydrocarbon amount is originating from the reactant dosing system or not. The first hydrocarbon amount can derivable from a fuel injection rate based on a fuel injection demand for the engine or be calculated from a lambda value of the exhaust gas. Favourably, a unit for performing the method is provided on which a computer program can be run for determining the hydrocarbon amounts and
25 initiating plausibility steps for confirming or disproving the origin of an increased hydrocarbon amount downstream of the nitrogen-removing catalytic converter. Particularly, the unit can be coupled to or comprised in a control unit of the vehicle, for instance in an engine control unit or an aftertreatment system control unit.

30 According to still another aspect of the invention a vehicle is proposed comprising an exhaust aftertreatment system comprising a reductant dosing system for supplying a reductant into an exhaust gas of an engine, which aftertreatment system is designed to perform a method for operating the exhaust aftertreatment system comprising the steps of (a) determining a first hydrocarbon amount in the

- exhaust gas upstream of a reductant dosing device; (b) determining a second hydrocarbon amount in the exhaust gas downstream of a nitrogen-oxide-removing catalytic converter arranged downstream of a reductant dosing device; (c) comparing the first and the second hydrocarbon amounts; (d) extracting a hydrocarbon amount presumably introduced by the reductant dosing system from the difference between the first and the second hydrocarbon amounts; (e) comparing the extracted hydrocarbon amount to an amount of reductant supplied by the reactant dosing system to the exhaust gas upstream of the catalytic converter; and (f) deciding whether the extracted hydrocarbon amount is originating from the reactant dosing system or not.

BRIEF DESCRIPTION OF THE DRAWINGS

- The present invention together with the above-mentioned and other objects and advantages may best be understood from the following detailed description of the embodiments, but not restricted to the embodiments, wherein is shown schematically:
- Fig. 1 an embodiment of an arrangement of an aftertreatment system according to the invention;
- Fig. 2 a flow chart of an embodiment of a method according to the invention; and
- Fig. 3 an embodiment of a vehicle comprising an aftertreatment system according to the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

In the drawings, equal or similar elements are referred to by equal reference numerals. The drawings are merely schematic representations, not intended to portray specific parameters of the invention. Moreover, the drawings are intended

to depict only typical embodiments of the invention and therefore should not be considered as limiting the scope of the invention.

Fig. 1 depicts schematically an embodiment of an arrangement for operating an aftertreatment system 20 according to the invention. The aftertreatment system 20 comprises a reductant dosing system 40 for supplying a reductant into an exhaust gas of an engine 10 via a dosing device 42, e.g. an injector. The reductant may be a reducing agent like urea or ammonia.

In an exhaust pipe 12 of the aftertreatment system 20 between the engine 10 and a catalytic converter 22 a unit 30 is arranged upstream of the dosing device 42. The unit 30 may be a lambda sensor which determines a lambda value of the exhaust gas evacuated from the engine 10 but can also be a virtual sensor, i.e. the lambda value at the location of unit 30 can be calculated from the operating parameters of the engine 10 which is generally known in the art. A fuel injection rate can be derived from the lambda value. In this calculation an air mass flow into the engine combustion is needed. The air mass flow is indicated by an arrow pointing to the engine 10. The air mass flow can be derived from an air mass flow sensor or from a calculated air mass flow, e.g. from intake manifold pressure and volumetric efficiency.

The catalytic converter 22 is a selective catalytic reduction (SCR) catalytic converter which is employed to remove nitrogen oxides from the exhaust gas. Downstream of the catalytic converter 22 a sensor 32 is arranged in an outlet pipe 14 of the catalytic converter 22. The sensor 32 may be a nitrogen-oxides sensor (NOx sensor) or a lambda sensor. NOx sensors are commonly used in context with SCR catalytic converters for emission monitoring in on-board-diagnosis systems. Furthermore, NOx sensors usually enclose a lambda sensor. Favourably, by using a NOx sensor as sensor 32, no additional hardware is needed. Moreover, as a great number of vehicles with SCR catalytic converters are equipped with such NOx sensors, the invention can be applied in already existing vehicles without hardware changes. Of course, a separate lambda sensor can be used.

The sensor 32 downstream of the catalytic converter 22 is used to detect hydrocarbon which may originate from the dosing device 42. By performing one or more plausibility tests, it can be decided if the dosing system 40 is the source of the hydrocarbon in the exhaust gas or not.

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Fig. 2 illustrates an embodiment of the method according to the invention by a flow chart of the process which can be performed in the system of Fig. 1.

In step 100, a first hydrocarbon amount HC1 in the exhaust gas upstream of the catalytic converter 22 is determined. This can be done either by calculating a fuel injection rate from the signal of the real or virtual sensor 30 or derived from the fuel injection rate demanded by an engine controller (not shown). Also, a second hydrocarbon amount HC1 in the exhaust gas downstream of the catalytic converter 22 is determined.

15

In step 102 the second hydrocarbon amount HC2 in the exhaust gas downstream of the catalytic converter 22 is compared to the first hydrocarbon amount HC1 in the exhaust gas upstream of the catalytic converter 22. If the second hydrocarbon amount HC2 downstream the catalytic converter 22 is less than or equal to the hydrocarbon amount HC2 upstream of the catalytic converter 22, i.e. $\Delta HC = HC2 - HC1 \leq 0$ ("n" in step 102), the routine jumps back to step 100. If the second hydrocarbon amount HC2 downstream of the catalytic converter 22 is higher than the hydrocarbon amount HC1 upstream of the catalytic converter 22 which originates from the engine 10, i.e. $\Delta HC = > 0$ ("y" in step 102), the amount of hydrocarbon in the exhaust gas has either increased between the outlet of the engine 10 and the outlet of the catalytic converter 22 or an erroneous signal has been read.

25

The positive difference $\Delta HC = HC2 - HC1 > 0$ can be determined as hydrocarbon introduced by the dosing device 42 and compared to a hydrocarbon signal when dosing of the reactant is demanded for plausibility reasons. In step 104 the dosing of the reactant is temporarily stopped if the difference ΔHC is positive, i.e. a surplus hydrocarbon amount has been detected in the exhaust gas downstream of the catalytic converter 22.

30

In step 106 again the first hydrocarbon amount HC1 in the exhaust gas upstream of the catalytic converter 22 is determined as well as the second hydrocarbon amount HC2 in the exhaust gas downstream of the catalytic converter 22.

5

In step 108 the second hydrocarbon amount HC2 in the exhaust gas downstream of the catalytic converter 22 is compared to the first hydrocarbon amount HC1 in the exhaust gas upstream of the catalytic converter 22. If the hydrocarbon amount HC2 downstream the catalytic converter 22 is less than or equal to the

10 hydrocarbon amount HC1 upstream of the catalytic converter 22 ("n" in step 108), less hydrocarbon is contained in the exhaust gas downstream when the dosing device 42 with the dosing stopped compared with dosing on. If this is the case, then, without dosing, the source of hydrocarbons has vanished. It is decided that hydrocarbons from the dosing system are confirmed and the routine jumps to step
15 112.

In subsequent step 114 the dosing is stopped permanently for permitting maintenance and removing the hydrocarbons from the dosing system 40.

20 If the second hydrocarbon amount HC2 downstream of the catalytic converter 22 is higher than the first hydrocarbon amount HC1 upstream of the catalytic converter 22 ("y" in step 108), i.e. $\Delta HC > 0$, the amount of hydrocarbons in the exhaust gas seems to have increased between the outlet of the engine 10 and the outlet of the catalytic converter 22 although the dosing system 40 as possible
25 source of hydrocarbons in the exhaust gas is closed. Thus the signal $\Delta HC > 0$ is determined as an error in step 110. An intrusive test can be performed for such an inconclusive result to validate the result. For instance, a control dosing of the reactant with defined operation conditions can be performed and the response evaluated. If it is determined that the hydrocarbons are originating from the dosing
30 system 40, the dosing is permanently stopped.

Fig. 4 shows an embodiment of a vehicle 100 comprising an exhaust aftertreatment system 20 shown in Fig. 1 with a reductant dosing system 40 for supplying a reductant into an exhaust gas of an engine 10, which aftertreatment

system 20 is designed to perform a method for operating the exhaust aftertreatment system 20 as described in Fig. 2.

5 Damage to the engine can be prevented even when hydrocarbon is erroneously filled into the dosing system 40. As hydrocarbon can be detected early during operation of the dosing system 40, damage to the dosing system 40 can be avoided.

10 The invention can be employed in vehicles with an SCR catalytic converter, favourably for commercial vehicles such as trucks, trailer and semitrailer of the light, medium and heavy duty type.

C L A I M S

1. A method for operating an exhaust aftertreatment system (20) comprising a
5 reductant dosing system (40) for supplying a reductant into an exhaust gas
of an engine (10), comprising the steps of
- determining a first hydrocarbon amount (HC1) in the exhaust gas
upstream of the reductant dosing device (42);
 - determining a second hydrocarbon amount (HC2) in the exhaust gas
10 downstream of a nitrogen-oxide-removing catalytic converter (22)
arranged downstream of a reductant dosing device (42);
 - comparing the first and the second hydrocarbon amounts (HC1,
HC2);
 - if the second hydrocarbon amount (HC2) is higher than the first
15 hydrocarbon amount (HC1), extracting a hydrocarbon amount (HC2-
HC1) presumably introduced by the reductant dosing system (40)
from the difference between the first and the second hydrocarbon
amount (HC1, HC2);
 - comparing the extracted hydrocarbon amount (Δ HC) to a reductant
20 amount supplied by the reactant dosing system (40) to the exhaust
gas upstream of the catalytic converter (22);
 - deciding whether the extracted hydrocarbon amount (Δ HC) is
originating from the reactant dosing system (40) or not.
- 25 2. The method according to claim 1, further comprising the step of stopping
the dosing of reductant when a hydrocarbon amount is detected originating
from the reductant dosing system (40).
3. The method according to claim 1 or 2, further comprising the step of
30 performing a plausibility test to confirm whether the extracted hydrocarbon
amount (Δ HC) is originating from the reductant dosing system (40).
4. The method according to claim 3, further comprising the step of interrupting
the dosing of the reactant and determining the difference between the first

and the second hydrocarbon amounts (HC1, HC2) after interruption the dosing of the reactant.

5. The method according to claim 3 or 4, further comprising the step of performing a controlled dosing of hydrocarbons and the difference between the first and the second hydrocarbon amounts (HC1, HC2) is determined.
6. The method according to any preceding claim, further comprising the step of permanently stopping the dosing if the reductant dosing system (40) is confirmed as source of the extracted hydrocarbon amount (Δ HC).
7. The method according to any preceding claim, further comprising the step of deriving the first hydrocarbon amount (HC1) from a fuel injection rate into the engine (10) based on a lambda sensor signal.
8. The method according to any preceding claim, further comprising the step of deriving the first hydrocarbon amount (HC1) from a fuel injection rate based on a fuel injection demand for the engine (10).
9. An aftertreatment system (20) for cleaning of an exhaust gas of a vehicle (100) being capable of performing a method comprising the steps of
 - determining a first hydrocarbon amount (HC1) in the exhaust gas upstream of the reductant dosing device (42);
 - determining a second hydrocarbon amount (HC2) in the exhaust gas downstream of a nitrogen-oxide-removing catalytic converter (22) arranged downstream of a reductant dosing device (42);
 - comparing the first and the second hydrocarbon amounts (HC1, HC2);
 - if the second hydrocarbon amount (HC2) is higher than the first hydrocarbon amount (HC1), extracting a hydrocarbon amount (HC2-HC1) presumably introduced by the reductant dosing system (40) from the difference between the first and the second hydrocarbon amount (HC1, HC2);

- comparing the extracted hydrocarbon amount (ΔHC) to a reductant amount supplied by the reactant dosing system (40) to the exhaust gas upstream of the catalytic converter (22);
 - deciding whether the extracted hydrocarbon amount (ΔHC) is originating from the reactant dosing system (40) or not.
- 5
10. A vehicle (100) comprising an exhaust aftertreatment system (20) which comprises a reductant dosing system (40) for supplying a reductant into an exhaust gas of an engine (10), which aftertreatment system (20) is designed to perform a method for operating the exhaust aftertreatment system (20) according to anyone of the claims 1 to 8.
- 10
11. Computer program comprising a computer program code adapted to perform a method or for use in a method according to anyone of the claims 1 to 8 when said program is run on a programmable microcomputer.
- 15
12. Computer program according to claim 10 adapted to be downloaded to a control unit or one of its components when run on a computer which is connected to the internet.
- 20
13. Computer program product stored on a computer readable medium, comprising a program code for use in a method according to anyone of claims 1 to 8 on a computer.
- 25
14. A method for operating an exhaust aftertreatment system comprising a reductant dosing system (40) for supplying a reductant into an exhaust gas of an engine, comprising the steps of
- determining a first hydrocarbon amount in the exhaust gas upstream of the reductant dosing device;
 - determining a second hydrocarbon amount in the exhaust gas downstream of a nitrogen-oxide-removing catalytic converter arranged downstream of a reductant dosing device;
 - comparing the first and the second hydrocarbon amounts;
- 30

- if the second hydrocarbon amount is higher than the first hydrocarbon amount, extracting a hydrocarbon amount presumably introduced by the reductant dosing system from the difference between the first and the second hydrocarbon amount;
- 5 - comparing the extracted hydrocarbon amount to a reductant amount supplied by the reactant dosing system to the exhaust gas upstream of the catalytic converter;
- deciding whether the extracted hydrocarbon amount is originating from the reactant dosing system or not.

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15. The method according to claim 14, further comprising the step of stopping the dosing of reductant when a hydrocarbon amount is detected originating from the reductant dosing system.

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16. The method according to claim 14, further comprising the step of performing a plausibility test to confirm whether the extracted hydrocarbon amount is originating from the reductant dosing system.

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17. The method according to claim 16, further comprising the step of interrupting the dosing of the reactant and determining the difference between the first and the second hydrocarbon amounts after interruption the dosing of the reactant.

25

18. The method according to claim 16 or 17, further comprising the step of performing a controlled dosing of hydrocarbons and the difference between the first and the second hydrocarbon amounts is determined.

30

19. The method according to claim 14, further comprising the step of permanently stopping the dosing if the reductant dosing system is confirmed as source of the extracted hydrocarbon amount.

20. The method according to claim 14, further comprising the step of deriving the first hydrocarbon amount from a fuel injection rate into the engine based on a lambda sensor signal.

21. The method according to claim 14, further comprising the step of deriving the first hydrocarbon amount from a fuel injection rate based on a fuel injection demand for the engine.

5

22. An aftertreatment system for cleaning of an exhaust gas of a vehicle being capable of performing a method comprising the steps of

10

- determining a first hydrocarbon amount in the exhaust gas upstream of the reductant dosing device;

- determining a second hydrocarbon amount in the exhaust gas downstream of a nitrogen-oxide-removing catalytic converter arranged downstream of a reductant dosing device;

- comparing the first and the second hydrocarbon amounts;

15

- if the second hydrocarbon amount is higher than the first hydrocarbon amount, extracting a hydrocarbon amount presumably introduced by the reductant dosing system from the difference between the first and the second hydrocarbon amount;

20

- comparing the extracted hydrocarbon amount to a reductant amount supplied by the reactant dosing system to the exhaust gas upstream of the catalytic converter;

- deciding whether the extracted hydrocarbon amount is originating from the reactant dosing system or not.

25

23. A vehicle comprising an exhaust aftertreatment system which comprises a reductant dosing system for supplying a reductant into an exhaust gas of an engine, which aftertreatment system is designed to perform a method for operating the exhaust aftertreatment system according to claim 22.

30

24. Computer program comprising a computer program code adapted to perform a method or for use in a method according to claim 14 when said program is run on a programmable microcomputer.

25. Computer program according to claim 24 adapted to be downloadable to a control unit or one of its components when run on a computer which is connected to the internet.
- 5 26. Computer program product stored on a computer readable medium, comprising a program code for use in a method according to claim 14 on a computer.

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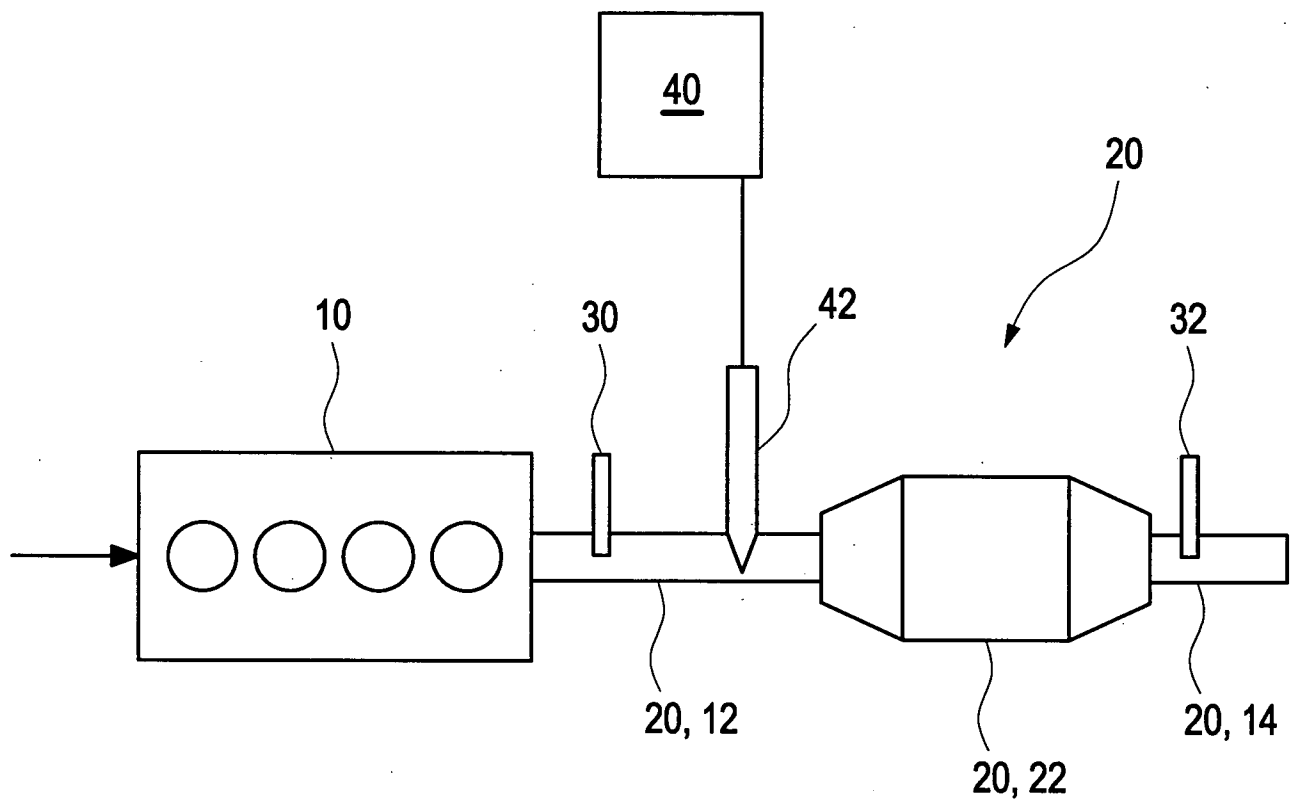


Fig. 1

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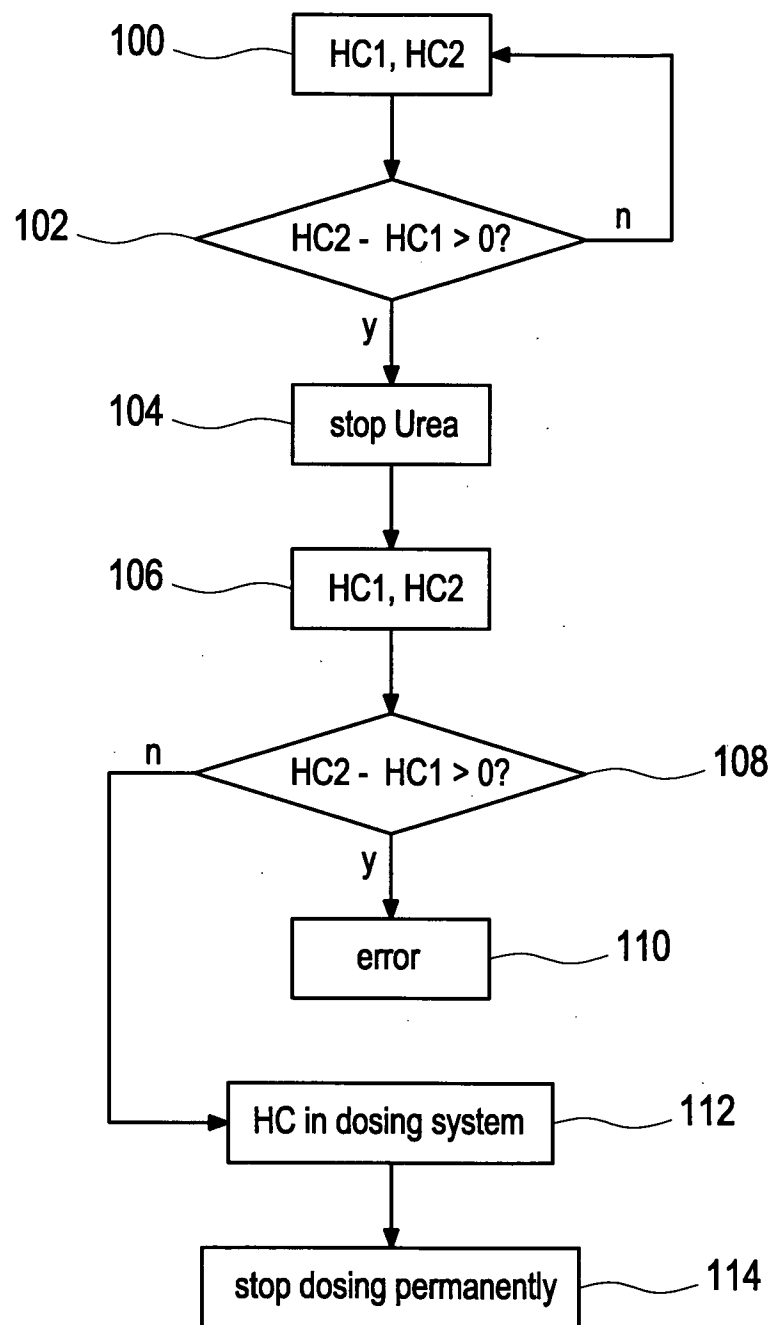


Fig. 2

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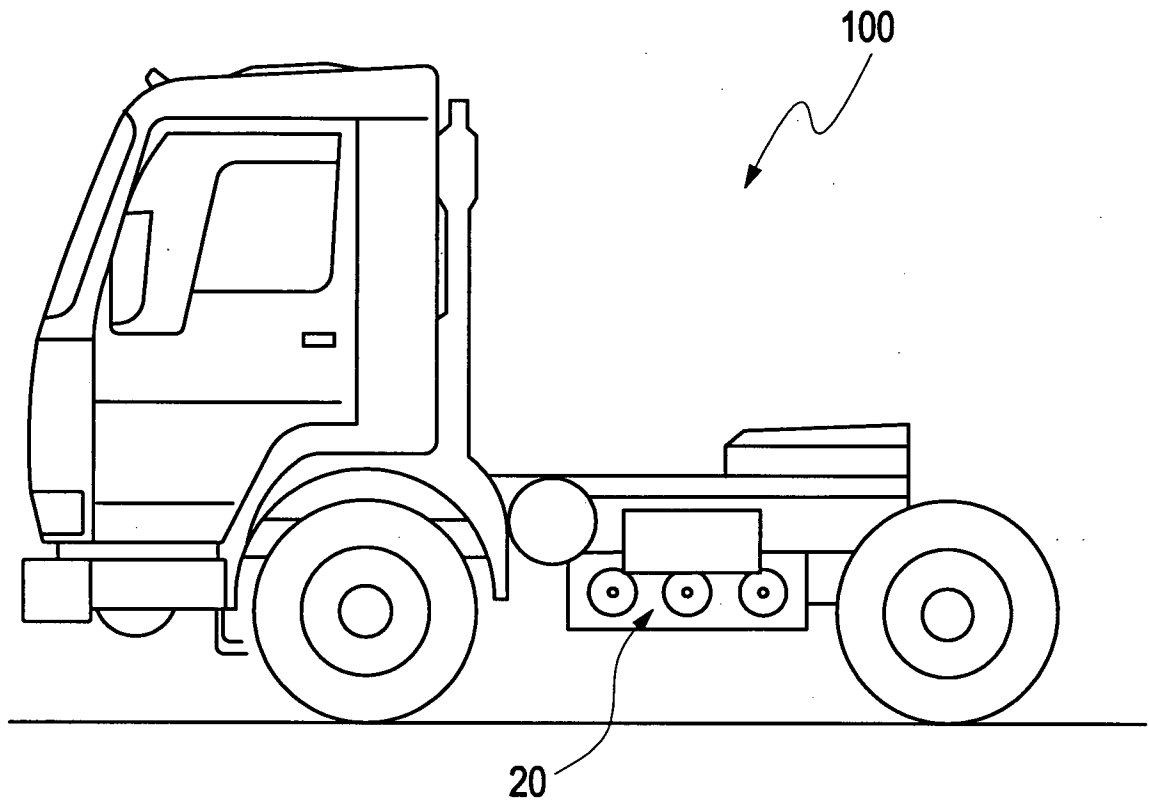


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE2009/000082

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, WPI DATA, PAJ, COMPDX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 20080103684 A1 (I. ALLMER ET AL), 1 May 2008 (01.05.2008), figure 2, paragraphs (0055)-(0059) --	1-8,10-21, 23-26
X	US 6079203 A (K. WAKAMOTO), 27 June 2000 (27.06.2000), column 7, line 20 - column 8, line 23, figure 3, abstract	9,22
Y	--	1-8,10-21, 23-26

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

* Special categories of cited documents:

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"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

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"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

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Date of the actual completion of the international search

16 October 2009

Date of mailing of the international search report

19-10-2009

Name and mailing address of the ISA/

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Facsimile No. +46 8 666 02 86

Authorized officer

Ulf Wallin / MRo

Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE2009/000082

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5927068 A (R. SCHENK), 27 July 1999 (27.07.1999), column 2, line 62 - column 4, line 22, figure 1, abstract	9,22
Y	--	1-8,10-21, 23-26
A	DE 102006055235 A1 (ROBER BOSCH GMBH), 29 May 2008 (29.05.2008), figures 1,2, claim 1, abstract, paragraphs (0004)-(0005)	1-26
A	WO 2008138682 A1 (ROBERT BOSCH GMBH), 20 November 2008 (20.11.2008), figure 1, abstract	1-26
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International patent classification (IPC)**F01N 11/00** (2006.01)**F01N 3/20** (2006.01)**Download your patent documents at www.prv.se**

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Cited literature, if any, will be enclosed in paper form.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/SE2009/000082

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