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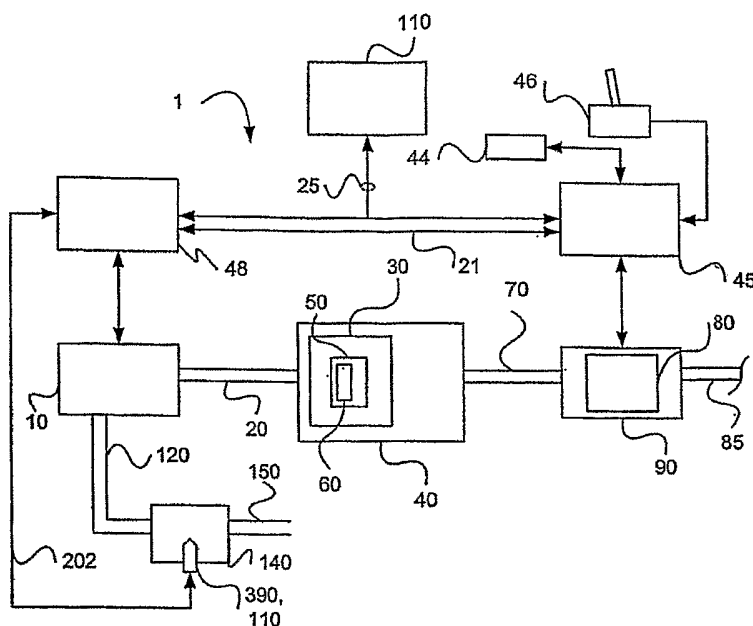
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(54) Title: MOTOR DRIVEN VEHICLE WITH EXHAUST CLEANING



(57) Abstract: The invention relates to a method for achieving lower emissions when operating a vehicle comprising a combustion engine (10) that emits exhaust gases to an exhaust system (140; 120), a catalyzer (320) located in the exhaust system, and a transmission (90) that is driven by the engine. Simulations are carried out continually with the object of predicting when cleaning of the catalyzer (320) should be carried out in the future. A gear in the vehicle's transmission is selected in response to at least information from the simulations, so that the temperature (T) in the exhaust system (140; 120) is regulated by the selected gear in a predetermined way, and so that cleaning of the catalyzer (320) is carried out in response to said temperature regulation.



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*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

## Motor driven vehicle with exhaust cleaning.

### 5      **Technical field**

The present invention relates to a method for achieving lower emissions when operating a vehicle comprising a combustion engine that emits exhaust gases to an exhaust system, a catalyzer located in the exhaust system, and a transmission that is driven by the engine.

The present invention also relates to a computer program for causing a computer to carry out such a method.

The present invention also relates to an engine driven vehicle comprising a combustion engine that, when operating, emits exhaust gases to an exhaust system comprising a catalyzer, and a transmission that is driven by the engine and control devices that are arranged to introduce a reducing agent into the exhaust system by means of a device.

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### **Background art**

Various types of catalyzer for exhaust cleaning are currently used in engine driven vehicles in order to obtain lower emissions. These catalyzers are used to reduce to some extent the emission of, for example, nitrogen compounds ( $\text{NO}_x$ ). Due to various circumstances, the catalyzers may work less well, resulting in a smaller quantity of the exhaust gases being converted into, for example, nitrogen or water, which results in unnecessarily large exhaust emissions when operating said vehicles. US 6467255 B1 describes a system for engine control in a vehicle where cleaning of a  $\text{NO}_x$ -trap (catalyzer) can be carried out. The cleaning is carried

out when the engine is operated in the homogeneous mode (homogeneous operation). However, most of the NO<sub>x</sub> is created during the stratified mode (stratified operation). A change of mode from homogeneous to stratified mode is carried out during a gear change in order to mask the critical vibrations that arise in association with a change of mode.

#### **Disclosure of invention**

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An object of the invention is to provide a method for achieving lower emissions in an engine driven vehicle in a cost-effective way.

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This object is achieved by a method of the type described in the introduction, by simulations being carried out continually in order to predict when cleaning of the catalyzer should be carried out in the future, and then selecting a gear in the vehicle's transmission in response to at least information from said simulations, so that the temperature in the exhaust system is regulated by the selected gear in a predetermined way, and so that cleaning of the catalyzer is carried out in response to said temperature regulation.

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An advantage that is achieved by this solution is obtained by utilization of the synergy between the transmission and the combustion engine that emits exhaust gases to the exhaust system during operation. This advantage can be obtained by selecting the speed of the engine and the gear of the transmission during the operation of the vehicle, for example so that the speed of rotation of the outgoing shaft from the transmission is essentially retained, while the speed of the engine is changed, so that the exhaust temperature changes value. This temperature regulation produces, in turn, the lower quantity of harmful

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emissions. This solution is very cost-effective, as the vehicle does not need to be provided with additional components according to the invention.

5 The method according to the invention means that the catalyzer can be used for a longer period of time, as it is not subjected to such large stresses as was previously the case, in particular in relation to too high temperatures. By means of the method, exhaust  
10 cleaning in engine vehicles can work better in practice.

Another advantage of the invention is that the gear can be changed in order to regulate the temperature in the  
15 vehicle's exhaust system in such a way that temperature-sensitive components in the exhaust system, or in its immediate vicinity, are not adversely affected to the same extent as was previously the case.

20 As the catalyzer is given a longer life, this has the advantage that it does not need to be removed from the vehicle in order to be repaired or replaced as often as was previously the case, which means that the invention saves both time and money, as the vehicle does not need  
25 to be brought into a workshop to the same extent as was previously the case.

According to an embodiment of the invention, lower emissions are achieved by means of a catalyzer in a  
30 vehicle's exhaust system. The catalyzer can be of the LNT type (Lean Nox Trap). By actively changing the gear in the vehicle's driveline while retaining the engine output, an optimal temperature for an LNT-catalyzer can be obtained, even at low engine speeds. This optimal  
35 temperature can be in a range around 300°C. With a suitable temperature in the exhaust system and the introduction of a suitable quantity of reducing agent, a catalysis with essentially optimal conversion ratio

for NO<sub>x</sub> and the introduced reducing agent can take place in the catalyzer. The residual products from the reaction can then be discharged out of the exhaust system. The method can be used for keeping the collected quantity of NO<sub>x</sub> in the catalyzer low during the time that the vehicle is in use. The method involves a combined control of the engine and transmission.

By means of temperature sensors and a lambda sensor, a system according to the invention can determine when it is time to clean the catalyzer with regard to, for example, NO<sub>x</sub> compounds. In the event of an indication, or after calculations, the system can temporarily deviate from stored gear selection strategies and possibly also optimal fuel consumption in order to adjust the temperature in the vehicle's exhaust system, whereby an improved catalysis can be achieved in the catalyzer. For example, when the engine has high output, the system can actively change to a temperature-reducing strategy. In concrete terms, this can mean a changing down in the transmission. With constant engine output, the temperature drops in the exhaust system as the engine speed increases. When the exhaust temperature in the exhaust system has reached the desired temperature, the ordinary gear selection strategy can be applied. The system is also designed to consider whether it is more advantageous to adjust the temperature at a later time than when a first indication is received. The method involving deviating from stored gear selection strategies, according to the invention, can extend to 10 seconds or more.

#### **Brief description of the drawings**

Figure 1 shows a schematic illustration of a vehicle and a control system for the same.

Figure 2 shows a databus with examples of detected or calculated data, which is used according to the invention.

5 Figure 3a shows a schematic illustration of an exhaust system for a vehicle. Figure 3b shows a diagram with a conversion ratio for NO<sub>x</sub> and hydrocarbon HC in a catalyzer. Figure 3c shows a diagram for how different  
10 constant engine outputs vary with regard to temperature and engine speed. Figure 3d shows a combustion chamber in a vehicle. Figure 3e shows schematically an injection method for fuel in a combustion chamber, according to the present invention. Figure 3f shows schematically how NO<sub>x</sub> collection/release derivatives in  
15 a catalyzer are dependent upon  $\lambda$  for different temperatures.

Figure 4a shows a flowchart illustrating a method according to an embodiment of the invention. Figure 4b  
20 shows a flowchart illustrating a more detailed method according to an embodiment of the invention.

Figure 5 shows an apparatus, which is used according to at least one embodiment of the invention.

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### Detailed description of the drawings

Figure 1 shows a schematic illustration of a vehicle and a control system for the same according to an  
30 embodiment of the present invention, in which 10 represents a six-cylinder combustion engine, for example a diesel engine, the crankshaft 20 of which is connected to a single-plate dry plate clutch represented in general by 30, which is enclosed in a  
35 clutch case 40. Instead of a single-plate clutch, a two-plate clutch can be used. The crankshaft 20 is connected to the clutch housing 50 of the clutch 30 in such a way that it cannot rotate, while its clutch

plate 60 is connected in such a way that it cannot rotate to an incoming shaft 70, which is mounted in such a way that it can rotate in the housing 80 of a gear box represented in general by 90. A main shaft and an intermediate shaft are mounted in the housing 80 in such a way that they can rotate. An outgoing shaft 85 from the gearbox 90 is arranged to drive the vehicle's wheels.

10 A first pipe 120 is arranged to conduct exhaust gases from the engine's combustion chamber to a catalyzer manifold 140, which manifold 140 is arranged for exhaust cleaning. A second pipe 150 is arranged to conduct cleaned exhaust gases, and the residues of the  
15 uncleaned exhaust gases, from the manifold 140 and out of the vehicle.

In addition, a first control unit 48 for controlling the engine 10 and a second control unit 45 for  
20 controlling the transmission are illustrated. The first and the second control units are arranged to communicate with each other via a databus 21. In the following, it is described how various processes and steps are carried out in the first control unit 48, but  
25 it should be made clear that the invention is not limited to this, but that the second control unit 45 can equally well be used, or a combination of the first and second control units.

30 Sensors, detectors and transducers have the common designation detectors 110. The detectors 110 are arranged to communicate with both the first and the second control units via a databus 25. The detectors 110 can, for example, comprise a temperature sensor 390  
35 for exhaust gases, which can be placed in association with the manifold 140. In addition, the detectors 110 can comprise a lambda sensor 310, which can be located

downstream of the engine's combustion chamber, for example in a branch pipe.

5 In an embodiment, the detectors 110 can be at least a fuel injector arranged to introduce fuel into the engine's combustion chamber.

10 In an embodiment, the detectors 110 can be at least a fuel injector, also called an injector, arranged to introduce fuel directly into the vehicle's exhaust system, in which at least one catalyzer is located.

15 The first control unit is arranged to receive journey data, such as, for example, the amount of fuel used and the engine's momentary load, from the detectors 110, and to process the journey data in order to calculate, for example, the vehicle's exhaust emissions in real time. The first control unit is arranged in particular to receive information indicating the temperature in  
20 the exhaust system and the momentary lambda value.

The temperature in the exhaust system can be a qualitative average value from a plurality of temperature sensors placed inside and in association  
25 with the vehicle's exhaust system.

The vehicle 1 comprises a throttle control 44 and a manual gear selector 46, which are arranged to communicate with the second control unit 45. The gear  
30 selector 46 can have one position for manual gear selection and one for automatic gear selection for the vehicle.

35 Figure 2 shows a databus 25 and examples of journey data recorded or calculated by the detectors 110. Examples of detected or calculated momentary parameters are engine torque 201, exhaust temperature 202, engine output 203, vehicle acceleration 204, exhaust back

pressure 205, fuel consumption 206 and lambda value 210. Other parameters can be injection timing, EGR-valve position, NOP (Needle Opening Pressure). Using the above said parameters, the first control unit can  
5 calculate, for example, exhaust emissions. The calculations are preferably carried out in real time.

The above said parameters can be measured directly using measuring devices for measuring the respective  
10 parameters. Alternatively, the respective parameters can be calculated indirectly by observing other parameters than the respective said parameters, for example by model-based estimation.

15 Figure 3a shows a schematic illustration of an exhaust system according to an embodiment of the invention. The first pipe 120 is arranged to take exhaust particles from the vehicle's combustion chamber to the catalyzer manifold 140, in which the exhaust gases are completely  
20 or partially cleaned. In addition, the second pipe 150 is arranged to take the cleaned exhaust gases from the manifold 140 out of the vehicle 1. The manifold 140 can be made of stainless steel. The first control unit is arranged to control the introduction of fuel into the  
25 manifold 140 from the vehicle's combustion chamber or via a direct injection of fuel into either the first pipe 120 or into the manifold 140 via an injector 311 and 310 respectively. The manifold 140 comprises, in addition, a catalyzer 320, which, according to an  
30 embodiment of the invention, can be an LNT-catalyzer. Typically, hydrocarbon compounds and NO<sub>x</sub> can react with each other in the catalyzer under the influence of temperature. In this text, the hydrocarbon compounds are referred to as HC compounds. NO<sub>x</sub> compounds can, for  
35 example, be nitrogen trioxide (NO<sub>3</sub>). The catalyzer 320 can consist of a ceramic material and have a catalytic coating.

HC compounds can react chemically with NO<sub>x</sub> compounds in the catalyzer 320 in certain temperature conditions in the exhaust system. Such a reaction can be started up by causing the temperature in the manifold 140 to  
5 attain a suitable value. The result of such a reaction can be carbon dioxide CO<sub>2</sub>, water and nitrogen N<sub>2</sub>. The water can be in gaseous form. The second pipe 150 is arranged to take the residual products from the manifold 140 and out of the vehicle 1 after the  
10 catalysis.

Figure 3b illustrates how the conversion ratio for NO<sub>x</sub> compounds and HC compounds in the catalyzer 320 is dependent upon the exhaust temperature. The conversion  
15 ratio is also dependent upon the catalyzer temperature and the introduction and/or direct injection of fuel into the exhaust system. It can be seen in the figure that the highest conversion ratio, according to this example 0.7, is obtained at a temperature of  
20 approximately 300°C. In addition, it can be seen that the conversion ratio is relatively high within a temperature range T1-T2. This temperature range can be between 250 and 500°C. The temperature range can be different for different types of fuel.

25 Figure 3c illustrates how various constant engine outputs are dependent upon the exhaust temperature T[°C] in the vehicle's exhaust system and the engine speed [rpm]. Figure 3c shows that the exhaust  
30 temperature increases if the engine speed is reduced with a constant engine output. In addition, the figure shows that higher exhaust temperatures can be obtained with a higher constant engine output when the engine speed is reduced.

35 Figure 3d illustrates an internal combustion chamber in a engine in the vehicle. A cylinder head 380 surrounds a combustion chamber 381, in which combustion chamber a

piston 382 is arranged to move. The piston 382 can be connected to a crankshaft (not shown in the figure) by means of a connecting rod 383 for propelling the vehicle.

5

In addition, the position of the piston in the combustion chamber 381 is illustrated in Figure 3d. At Top Dead Center, (TDC), the position of the piston is given by a whole-number multiple of  $2\pi$  radians. The whole-number multiple  $N$  is defined as a positive whole number, including 0, that is  $N=0,1,2,3\dots$ .

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At Bottom Dead Center, (BDC), the position of the piston is given by a whole-number multiple  $N$  plus 1 of  $\pi$  radians  $((N+1)\cdot\pi)$ . A four-stroke engine has a cycle of  $4\pi$  radians.

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Figure 3e shows the position of the piston in the combustion chamber 381 and an exemplary embodiment of fuel injection into the combustion chamber, according to the invention. The momentary position of the piston shown in Figure 3d is represented by an angle  $\alpha_5$  in Figure 3e.

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Normal injection of fuel into the engine's combustion chamber is indicated by an area  $A$ . The area  $A$  is delimited by an angle  $\alpha_1$  and an angle  $\alpha_2$ . In the same way, a second injection (Post injection) is indicated by an area  $B$ . The area  $B$  is delimited by an angle  $\alpha_3$  and an angle  $\alpha_4$ .

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The control unit 48 is arranged to control the introduction of fuel into the vehicle's combustion chamber. In particular, the control unit 48 is arranged, according to the invention, to control the introduction of fuel in such a way that optimizing of the conversion ratio for  $\text{NO}_x$  and HC compounds in the catalyzer 320 is achieved.

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Figure 3f shows schematically for various temperatures how NO<sub>x</sub> collection/release derivatives in a catalyzer depend on  $\lambda$ . In the figure, temperatures T5, T6 and T7 are illustrated.

The NO<sub>x</sub> accumulator derivate (with regard to the time) describes how many NO<sub>x</sub> compounds are trapped in, or released from, the catalyzer 320 per unit of time. A positive NO<sub>x</sub> accumulator derivate indicates how many NO<sub>x</sub> compounds are trapped in the catalyzer per unit of time. Correspondingly, a negative derivate describes how many NO<sub>x</sub> compounds are released from the catalyzer per unit of time.

The temperatures T5, T6 and T7 indicate various temperatures in the vehicle's exhaust manifold 140. T5 is the lowest temperature and T7 is the highest temperature. It can be seen from the figure that a smaller quantity of NO<sub>x</sub> compounds is trapped in the catalyzer per unit of time for a given temperature when  $\lambda$  is reduced. The figure shows in a schematic way how the NO<sub>x</sub> accumulator derivate can be controlled by regulating  $\lambda$ . The control unit 48 can control the regulation of  $\lambda$ . In an alternative embodiment, the control unit 45 can control the regulation of  $\lambda$ .

According to an embodiment of the invention, an accumulator model is stored in the second control unit. The second control unit is arranged to simulate how the collection in or release from the catalyzer varies with time, by using the accumulator model with various entered data, such as engine torque 201, exhaust temperature 202, engine output 203, vehicle acceleration 204, exhaust back pressure 205, fuel consumption 206 and lambda value 210. According to another embodiment, several accumulator models are stored in the second control unit, and the control unit

can select the most adequate model, given a criterion entered in the second control unit. Simulations can be carried out for a relatively long period of time into the future.

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According to an embodiment, it is possible using sensors to measure the NO<sub>x</sub> accumulator derivate with regard to time, and implicitly thereby also the accumulated quantity of NO<sub>x</sub> that is in the catalyzer.

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An indication that cleaning of the catalyzer is necessary can be obtained as a result of the simulations and measurements. This indication can contain information about when cleaning should be carried out. A suitable time for cleaning can be immediately or at a time in the future.

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According to an embodiment, the second control unit is arranged, in the event of an indication that cleaning of the catalyzer is necessary within the immediate future is desirable, to adjust the temperature in the vehicle's exhaust manifold to optimize the conversion ratio for NO<sub>x</sub> and HC compounds in the catalyzer.

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According to an embodiment, the second control unit is arranged, in the event of an indication that cleaning of the catalyzer is necessary within the immediate future and in the event of an indication that cleaning, if necessary, is desirable, to adjust the temperature in the vehicle's exhaust manifold to optimize the conversion ratio for NO<sub>x</sub> and HC compounds in the catalyzer.

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The second control unit is also arranged, in the event of an indication that cleaning of the catalyzer is necessary and in the event of an indication that a cleaning, if necessary, is desirable, to adjust  $\lambda$  according to the stored model in order to improve, and

according to an embodiment optimize, the conversion ratio for NO<sub>x</sub> and HC compounds in the catalyzer.

5 The adjustments of the temperature T and  $\lambda$  according to the above can be carried out simultaneously and dependent upon each other.

10 Figure 4a shows a flow chart illustrating a method for obtaining lower quantities of harmful emissions in a enginedriven vehicle according to an embodiment of the invention.

15 The method comprises the step s401 for achieving more environmentally-friendly emissions during operation of a vehicle comprising a combustion engine 10 that emits exhaust gases to an exhaust system 140, a catalyzer 320 located in the exhaust system and a transmission 90 that is driven by the engine. The method comprises the step of introducing a reducing agent into the exhaust  
20 system. The reducing agent can be fuel, for example diesel.

25 In addition, the method comprises the step of selecting a gear in the vehicle's transmission in response to information about the temperature T in the exhaust system and the air/fuel ratio ( $\lambda$ ) so that the selected gear controls the temperature in the exhaust system in such a way that the introduced fuel causes a chemical reaction between the introduced fuel and NO<sub>x</sub>  
30 compounds in the catalyzer.

35 Alternatively, the latter step can be to select a gear in the vehicle's transmission in response to at least information to the effect that catalytic conversion is required and information about the temperature T in the exhaust system and the air/fuel ratio  $\lambda$ , so that the selected gear regulates the temperature in the exhaust system in a predetermined way.

According to an embodiment of the invention, the reducing agent, generated by the fuel, can react with NO<sub>x</sub> gases under the influence of temperature in the catalyzer 320. The reducing agent can preferably be atomized, in the form of a mist. Residual products from this reaction can then be transported out of the exhaust system via the pipe 150. According to an embodiment, the fuel is diesel.

In addition, it can be calculated how the lambda value is to be regulated over time in order to obtain an improved catalysis in the catalyzer. The lambda value can be regulated by controlling the regulation of the introduction of the reducing agent into the exhaust manifold. The introduction of the reducing agent into the exhaust manifold can be carried out by post-injection. The introduction of the reducing agent into the exhaust manifold can be carried out by pre-injection. The lambda value can thus be adjusted over time by post-injection or pre-injection. Alternatively, the lambda value can be adjusted over time by post-injection and pre-injection.

The selected gear is to regulate the temperature in the exhaust manifold in such a way that a reaction between the reducing agent introduced into the exhaust manifold and the NO<sub>x</sub> compounds takes place with an improved conversion ratio. The level of optimization is preferably optimal.

Figure 4b shows a more detailed flow chart illustrating a method according to an embodiment of the invention. The method comprises the step s425 of receiving an indication in the second control unit 45 to the effect that cleaning of the catalyzer 320 is necessary. The indication can be a result of a simulation that was carried out in the first control unit 48. The

indication can, alternatively, be a result of a calculation that was carried out in the second control unit 45 in response to measured journey data such as, for example, engine torque 201, exhaust temperature 202, engine output 203, vehicle acceleration 204, exhaust back pressure 205, fuel consumption 206 and lambda value 210 from detectors 110. Alternatively, a direct indication to the effect that cleaning of the catalyzer 320 is necessary can be sent from detectors 210 to the second control unit. Simulations can be carried out in the second control unit 45 in order to predict when and to what extent cleaning should be carried out in the future.

In step s435, a control is carried out of the temperature T. T can be a qualitative value of the exhaust temperature in the exhaust system in the vehicle. T can also be the temperature in the manifold 140. T can also be the temperature of the manifold 140. T can be the temperature of the catalyzer.

The temperature should be within a range between a first and a second limit value, T1 and T2 respectively, in order to obtain a qualitative catalysis in the catalyzer 320. T1 is a lower limit. T1 can be 250°C. T2 is an upper limit. T2 can be 500°C. According to another embodiment, T1 can be 275°C and T2 can be 475°C.

In step s435, the measured value T is compared in the second control unit 45 with the stored, predetermined temperature values T1 and T2. If T is greater than T2, this is an indication that there is a need to reduce the temperature in the exhaust system. If the comparison shows that T is less than T1, this is an indication that there is a need to increase the temperature in the exhaust system. If the temperature T

is not within the abovementioned range, step s445 follows.

5 In an embodiment of the invention, the temperature range is reduced automatically by the second control unit, in response to a control signal input by the driver, in order to achieve an optimizing of said conversion ratio for NO<sub>x</sub> compounds to nitrogen, among other things, which is illustrated schematically in 10 Figure 3b. The system can automatically reset the reduced range T1-T2 when required.

In step s435, it is also compared whether the possibilities for further temperature regulation have 15 been exhausted. If there are further possibilities for regulating the temperature, step s445 follows. Thus, if the temperature T is not within the abovementioned range, or if there are further possibilities for regulating the temperature, step s445 follows.

20 In addition, if the temperature T is within the abovementioned range, or if there are no further possibilities for regulating the temperature, step s445 follows.

25 In step s445, the gear is changed in the vehicle's driveline. A gear in the vehicle's transmission is selected in such a way that the temperature of the exhaust system is regulated to be within a range 30 between a first temperature T1 and a second temperature T2, where the first temperature T1 is at least 250 degrees Celsius and the second temperature T2 is at most 500 degrees Celsius. The gear can be changed in one or several steps. For example, the gear can be 35 changed from a fifth gear to a third gear in order to achieve a reduction in temperature in the exhaust system for a particular period of time. The change of gear in the vehicle's driveline and the length of the

period of time are in response to simulations carried out in the second control unit 45. A gear is selected in the vehicle's transmission in response to a comparison between information indicating the temperature of the exhaust system and information concerning a predetermined limit value.

The simulations are qualitative optimizations of which gear is best in order to obtain a desired result concerning temperature regulation in the exhaust system. The optimization can be based on a plurality of different parameters, such as, for example, gear in the driveline and time in changed gear in the driveline. Thus it is determined how long to stay in any changed gear in the vehicle's driveline and what result it is desirable to obtain, that is, for example, what final temperature the exhaust system is to achieve. The optimization can be carried out in response to a gear selection strategy stored in the second control unit 45.

In step 455, cleaning of the catalyzer 320 is carried out in response to at least the temperature in the vehicle's exhaust system.

In step 465, the result of the procedure is evaluated. This can be carried out using models stored in the first control unit in response to input data from detectors 110. If the result is the one desired or is sufficiently good, the method is terminated, otherwise there is a return to step s455.

Figure 5 shows an apparatus 500, according to an embodiment of the invention, comprising a non-volatile memory 520, a processor 510 and a read and write memory 560. The memory 520 has a first memory part 530, in which a computer program for controlling the apparatus 500 is stored. The computer program in the memory part

530 for controlling the apparatus 500 can be an operating system.

5 The apparatus 500 can be comprised in, for example, a control unit, such as the control unit 45 or 48. The data-processing unit 510 can comprise, for example, a microcomputer.

10 The memory 520 also has a second memory part 540, in which a program for achieving a smaller quantity of harmful emissions in a enginedriven vehicle is stored. In an alternative embodiment, the program for exhaust cleaning in a enginedriven vehicle is stored in a separate non-volatile data-storage medium 550, such as,  
15 for example, a CD or a plug-in semiconductor memory. The program can be stored in an executable form or in a compressed state.

20 When it is described in the following that the data-processing unit 510 executes a special function, it should be clear that the data-processing unit 510 executes a special part of the program which is stored in the memory 540 or a special part of the program which is stored on the non-volatile recording medium  
25 550.

The data-processing unit 510 is arranged to communicate with the memory 550 by means of a databus 514. The data-processing unit 510 is also arranged to  
30 communicate with the memory 520 by means of a databus 512. In addition, the data-processing unit 510 is arranged to communicate with the memory 560 by means of a databus 511. The data-processing unit 510 is also arranged to communicate with a data port 590 by means of  
35 a databus 515.

The methods which are described in Figure 4a and Figure 4b can be carried out by the data-processing unit 510

- 19 -

by means of the data-processing unit 510 executing the program which is stored in the memory 540 or the program which is stored on the non-volatile recording medium 550.

**Claims**

1. A method for achieving lower emissions when operating a vehicle comprising a combustion engine (10) that emits exhaust gases to an exhaust system (140; 120), a catalyzer (320) located in the exhaust system, and a transmission (90) that is driven by the engine, characterized in that the method comprises the steps of:
- carrying out simulations continually with the object of predicting when cleaning of the catalyzer (320) should be carried out in the future,
  - selecting a gear in the vehicle's transmission in response to at least information from said simulations, so that the temperature (T) in the exhaust system (140; 120) is regulated by the selected gear in a predetermined way, and
  - cleaning of the catalyzer (320) is carried out in response to said temperature regulation.
2. The method as claimed in claim 1, characterized in that a gear in the vehicle's transmission is selected (s445) in response to a comparison between said information indicating the temperature of the exhaust system and information concerning predetermined limit values.
3. The method as claimed in claim 1 or 2, characterized in that a reducing agent is introduced into the exhaust system.
4. The method as claimed in claim 3, characterized in that the reducing agent is a fuel.
5. The method as claimed in claims 1-4, characterized in that the cleaning is carried out in response to an adjustment of an air/fuel ratio (?) so

that a catalytic conversion of NO<sub>x</sub> compounds takes place.

5 6. The method as claimed in claim 5, characterized in that the adjustment of the air/fuel ratio (?) is carried out by means of pre- or post-injection of the fuel.

10 7. The method as claimed in any one of claims 1-6, characterized in that the selected gear is selected in such a way that a temperature is obtained that brings about a reaction between the reducing agent and the NO<sub>x</sub> compounds with an optimized conversion ratio.

15 8. The method as claimed in claim 1 or 2, characterized in that a gear in the vehicle's transmission is selected (s445) in such a way that the temperature of the exhaust system is regulated to be within a range between a first temperature (T1) and a  
20 second temperature (T2), where the first temperature (T1) is at least 250 degrees Celsius and the second temperature (T2) is at most 500 degrees Celsius.

25 9. A engine driven vehicle comprising a combustion engine (10) that, when operating, emits exhaust gases to an exhaust system (140; 120) comprising a catalyzer (320), and a transmission (90) that is driven by the engine and control devices (48; 45) that are arranged to introduce a reducing agent into the exhaust system  
30 by means of devices (110; 310), characterized in that the control devices (48; 45) are arranged to continually carry out simulations in order to predict when cleaning of the catalyzer (320) should be carried out in the future, and in that the control devices (48;  
35 45) are also arranged to select a gear in the vehicle's transmission in response to information from said simulations, so that the temperature (T) in the exhaust system (140; 120) is regulated by the selected gear in

a predetermined way, with cleaning of the catalyzer (320) being carried out in response to said temperature regulation.

5      10. The engine driven vehicle as claimed in claim 9, characterized in that, in addition, the control devices (48; 45) are arranged to adjust an air/fuel ratio (?) in such a way that a catalytic conversion of NO<sub>x</sub> compounds is carried out in order to clean the  
10      catalyzer.

11. The engine driven vehicle as claimed in claim 9 or 10, characterized in that, in addition, the control devices (48; 45) are arranged to adjust the air/fuel  
15      ratio (?) by means of pre- or post-injection.

12. The engine driven vehicle as claimed in claim 9 or 10, characterized in that at least one injector (310; 110) is arranged to introduce reducing agent  
20      directly into the exhaust system.

13. The engine driven vehicle as claimed in any one of claims 9-12, characterized in that the control devices (48; 45) are arranged to select a gear in the  
25      vehicle's transmission in response to a comparison of information indicating the temperature of the exhaust system and information concerning a predetermined limit value.

30      14. The engine driven vehicle as claimed in any one of claims 9-13, characterized in that the control devices (48; 45) are arranged to select a gear in the vehicle's transmission in such a way that a temperature of the exhaust system is regulated to be within a range  
35      between a first temperature (T1) and a second temperature (T2), where the first temperature (T1) is at least 250 degrees Celsius and the second temperature (T2) is at most 500 degrees Celsius.

15. The enginedriven vehicle as claimed in any one of claims 9 to 14, characterized in that said reducing agent is generated by fuel.

5

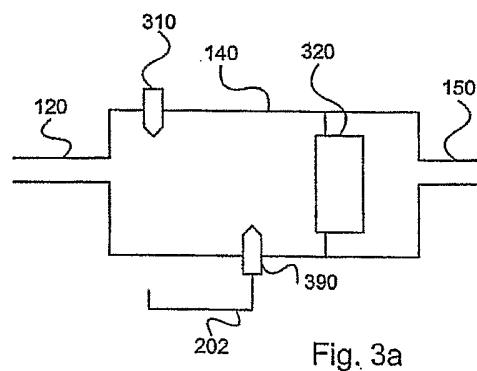
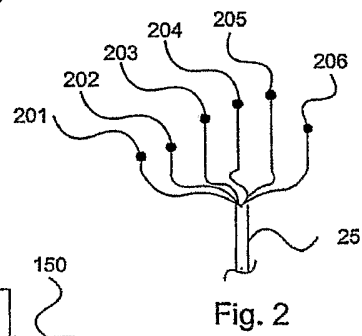
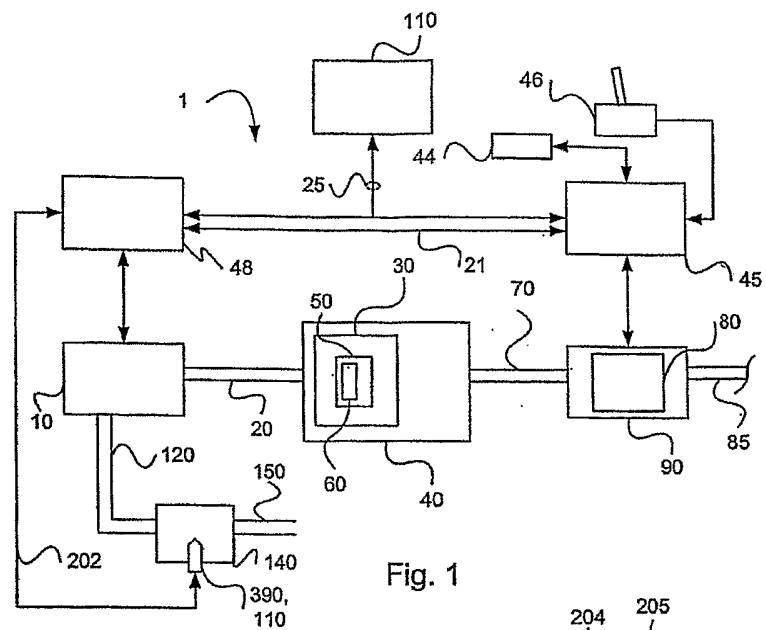
16. A computer program comprising program code for carrying out the steps in any one of claims 1-8, when said computer program is executed in a computer.

10

17. A computer program product comprising program code stored on a medium that can be read by a computer for carrying out the steps in any one of claims 1-8, when said computer program is executed in the computer.

15

18. A computer program product that can be loaded directly into an internal memory in a computer, comprising a computer program for carrying out the steps as claimed in any one of claims 1-8, when said computer program product is executed in the computer.



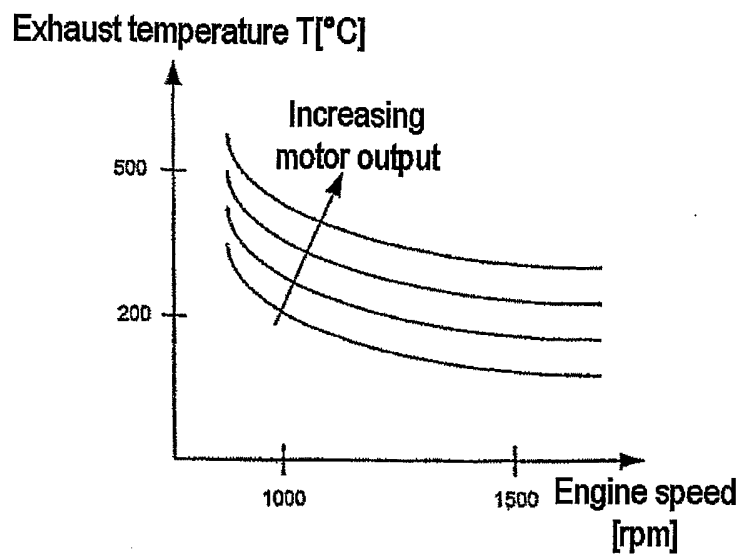


Fig. 3c

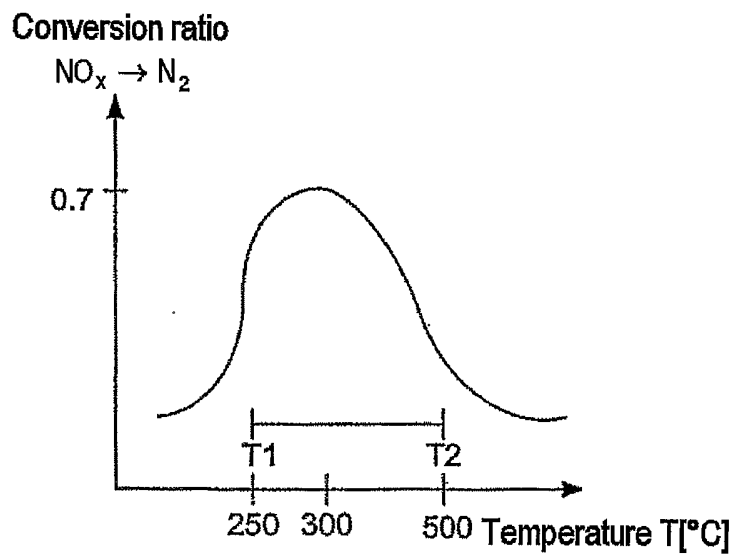


Fig. 3b

3/5

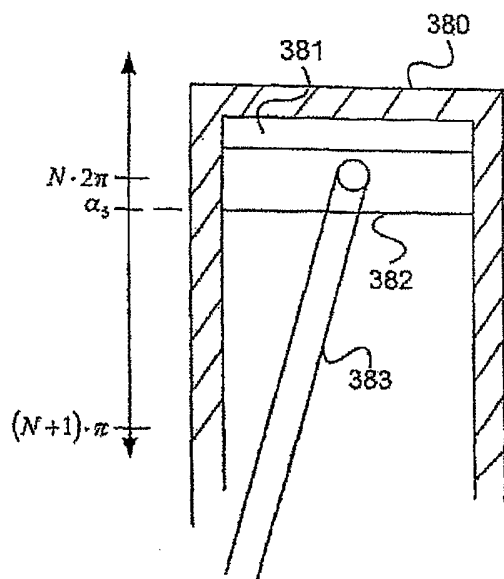


Fig. 3d

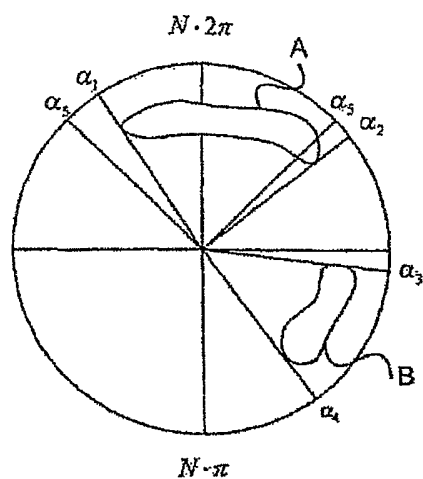


Fig. 3e

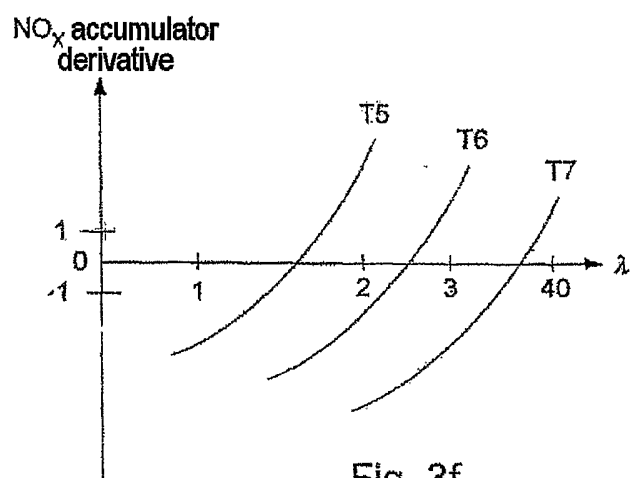


Fig. 3f

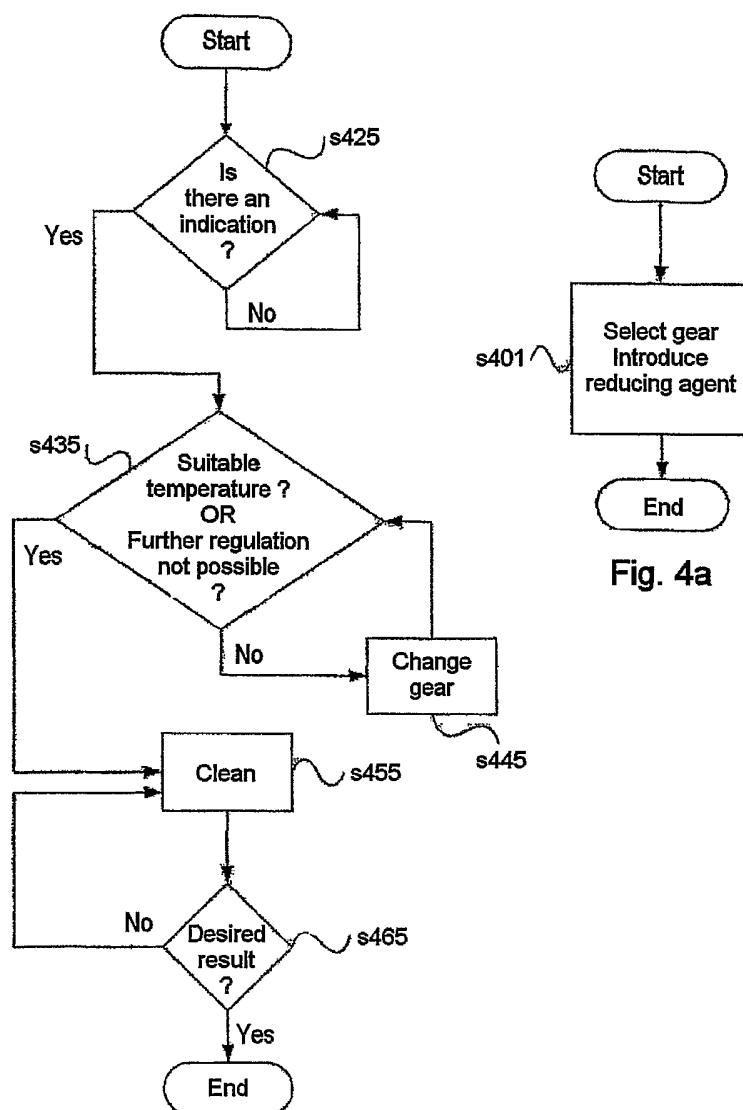


Fig. 4a

Fig. 4b

5/5

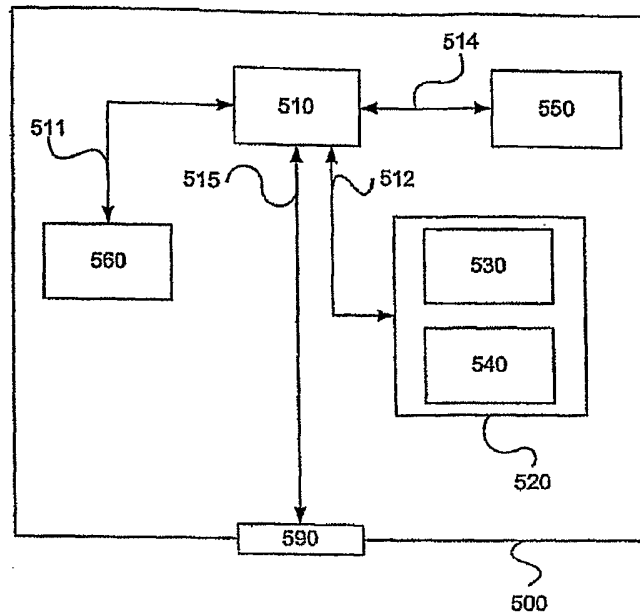


Fig. 5

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 2004/000926

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: F01N 3/20

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)

IPC7: 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)

WPI DATA, EPO INTERNAL, PAJ, INSPEC, COMPDX

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                                          | Relevant to claim No. |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| X         | PATENT ABSTRACTS OF JAPAN<br>vol. 199, no. 510,<br>30 November 1995 (1995-11-30)<br>& JP 71 86785 A (TOYOTA MOTOR CORP),<br>25 July 1995 (1995-07-25)<br>abstract<br><br>-- | 1-18                  |
| A         | US 6467255 B1 (FERDINAND GROB ET AL),<br>22 October 2002 (22.10.2002), column 2 - column 3,<br>figure 2, claim 1, abstract<br><br>--                                        | 1-18                  |

☒ 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

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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

"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

"&amp;" document member of the same patent family

Date of the actual completion of the international search

26 August 2004

Date of mailing of the international search report

09-09-2004

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 2004/000926

| C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT |                                                                                                                                                                                                                                     |                       |
|-------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
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| A                                                     | <p>DATABASE WPI<br/> Week 200266<br/> Derwent Publications Ltd., London, GB;<br/> Class Q51, AN 2002-610817<br/> &amp; FR 2820462 A1 (PEUGEOT CITROEN AUTOMOBILES SA),<br/> 9 August 2002 (2002-08-09)<br/> abstract</p> <p>--</p>  | 1-18                  |
| A                                                     | <p>EP 1229231 A2 (TOYOTA JIDOSHA KABUSHIKI KAISHA),<br/> 7 August 2002 (07.08.2002), [0003],[0005],[0006]</p> <p>--</p>                                                                                                             | 1-18                  |
| A                                                     | <p>US 5881552 A (YOICHI IWATA ET AL), 16 March 1999<br/> (16.03.1999), column 7, line 53 - column 8, line 4,<br/> claim 1, abstract</p> <p>--</p>                                                                                   | 1-18                  |
| A                                                     | <p>US 5997434 A (FRIEDRICH GRAF ET AL),<br/> 7 December 1999 (07.12.1999), column 2,<br/> line 5 - line 17; column 3, line 53 - line 59;<br/> column 4, line 5 - line 9, claim 1,<br/> abstract</p> <p>--</p>                       | 1-18                  |
| A                                                     | <p>DATABASE WPI<br/> Week 199534<br/> Derwent Publications Ltd., Londo, GB;<br/> Class Q13, AN 1995-261917<br/> &amp; JP 30 85065 B2 (TOYOTA JIDOSHA KK),<br/> 4 September 2000 (2000-09-04)<br/> abstract</p> <p>--<br/> -----</p> | 1-18                  |

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

International application No.  
**PCT/SE 2004/000926**

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|       |         |    |            | EP | 0888921    | A,B | 07/01/1999 |
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