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MODE REGULATION**(30) **Foreign Application Priority Data**

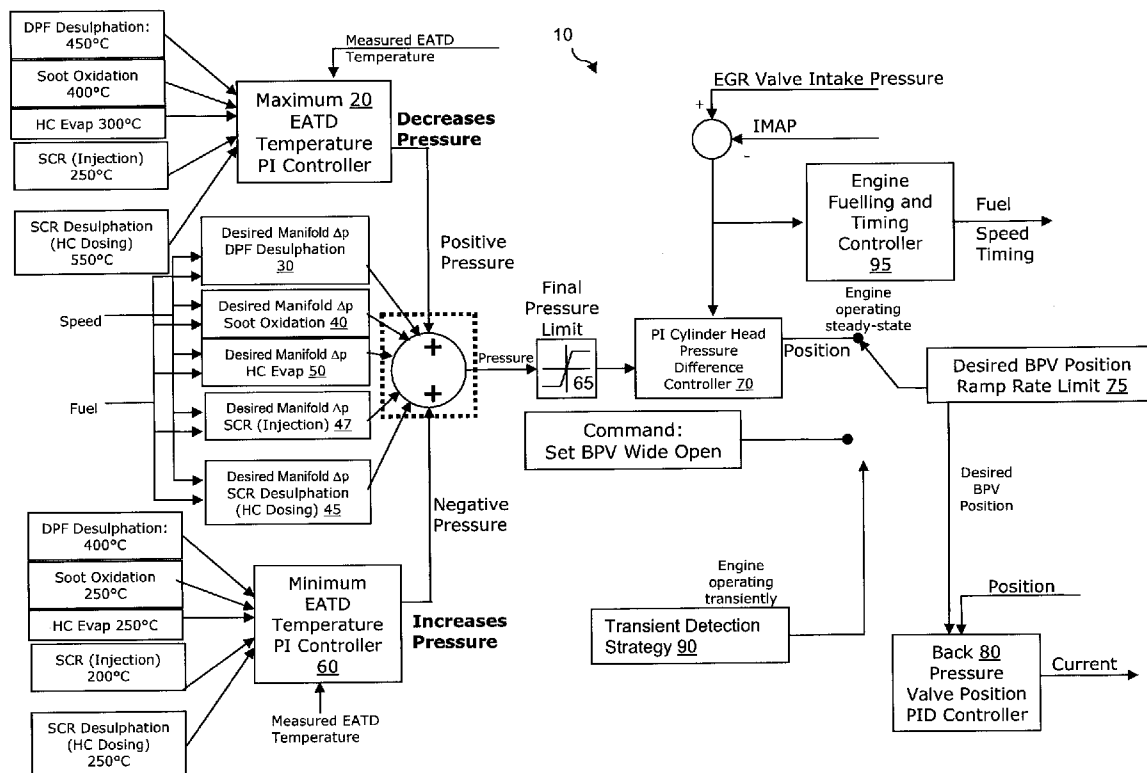
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§ 371 (c)(1),

(2), (4) Date: **Jan. 30, 2014****ABSTRACT**

Method and system for controlling the temperature dependent mode of an exhaust after treatment device, EATD, within an engine system comprising: identifying a target EATD mode. Regulating an EATD temperature to within a temperature range corresponding with the target mode by controlling a gas pressure difference of the engine system between a first location and a second location.



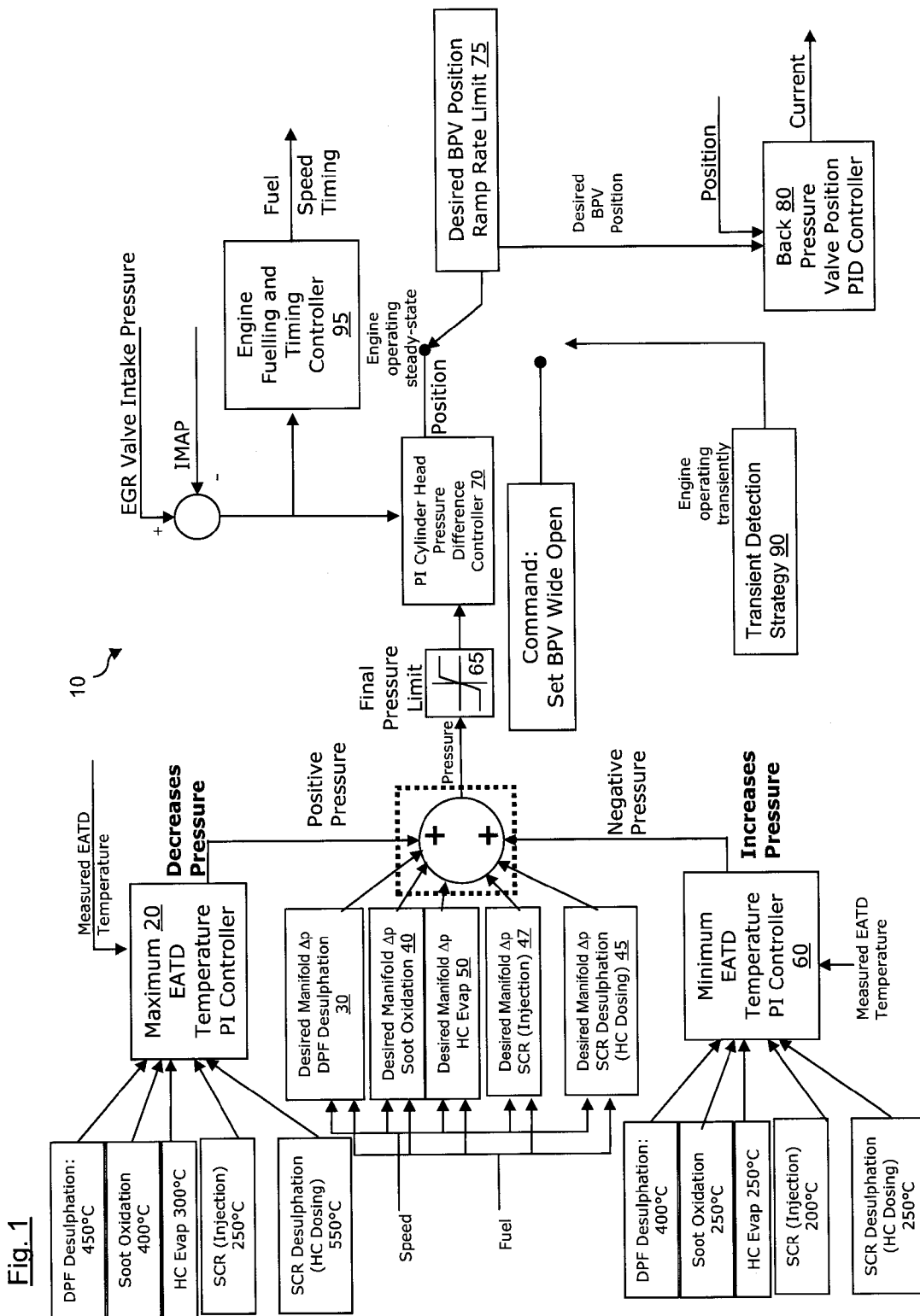
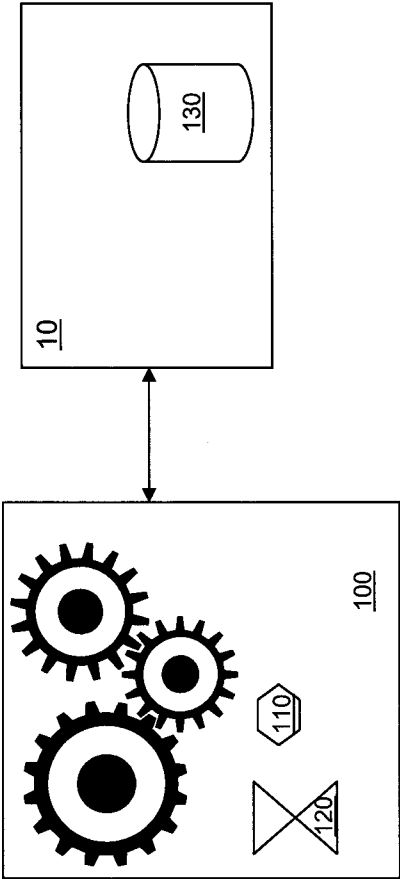


Fig.2



EXHAUST AFTER TREATMENT DEVICE MODE REGULATION

TECHNICAL FIELD

[0001] The present disclosure relates to a method and system for regulating exhaust after treatment device modes of operation.

BACKGROUND

[0002] Internal combustion engines and diesel engines in particular, produce a number of waste products emitted from their exhaust systems. These waste products include gases such as nitrogen oxides and carbon monoxide, solid particulate matter including soot as well as unburned or partially burned fuel in the form of hydrocarbons. In order to reduce exhaust emissions, exhaust after treatment devices (EATD) and systems may be employed. These may include diesel particulate filters (DPF) that remove portions of the exhaust emissions before leaving an engine system in to the atmosphere and selective catalytic reduction systems.

[0003] A DPF may include several components for removing multiple different types of waste products. For example, the DPF may act as a physical filter for trapping soot particles, a catalyst may be utilised to absorb or convert the gaseous constituents of the exhaust and any hydrocarbons may also be absorbed or converted into inert fluids or gases. However, after prolonged use, the DPF may become clogged or ineffective, leading again to higher exhaust emissions or an increase in exhaust back pressure.

[0004] In order to revert the DPF to its previously higher filtering efficiency, one or more regeneration techniques may be used. Regeneration may be initiated and activated by raising the temperature of the DPF into particular temperature ranges specific to one or more regeneration modes. For example, a build up of hydrocarbons may be removed by modestly raising the temperature of the DPF to evaporate off these components. Raising the temperature further may oxidise the carbon based soot and burn it off. Higher temperatures still may result in removal of sulphur containing compounds.

[0005] Various EATD temperature dependent modes of operation (not limited to regeneration modes) may also be necessary under different engine conditions.

[0006] US 2009/0000604 describes an engine after treatment system that initiates DPF regeneration by incorporating a heater into the air intake system to raise the temperature of exhaust gases, which raises the temperature of the DPF to provide regeneration. Upstream and downstream pressure sensors are used to determine whether a DPF is clogged and increasing exhaust back pressure. Temperature sensors are used to monitor the exhaust gases.

[0007] However, heating the air intake requires additional fuel and decreases efficiency. Furthermore, this does not provide very much control over the exhaust gas temperature or DPF regeneration.

[0008] Therefore, there is required a method and system that overcomes these problems.

SUMMARY OF THE DISCLOSURE

[0009] Against this background and in accordance with a first aspect there is provided a method of controlling a mode of an exhaust after treatment device, EATD, having a plurality of modes, within an engine system, the method comprising

the steps of: identifying a target EATD mode out of the plurality of modes; and regulating an EATD temperature to within a temperature range corresponding with the target mode by controlling a gas pressure difference of the engine system between a first location and a second location.

[0010] In accordance with a second aspect there is provided an exhaust treatment system for an engine system comprising: an exhaust after treatment device, EATD, having a plurality of modes; one or more valves configured to adjust a gas pressure difference of the engine system between a first location and a second location; a controller in communication with the one or more valves and configured to identify a target EATD thermal management mode out of the plurality of temperature dependent thermal management modes, and control the temperature dependent EATD thermal management mode of the EATD by regulating the gas pressure difference using the one or more valves. Therefore, the EATD mode may be regulated more precisely and efficiently.

[0011] In accordance with a third aspect there is provided an engine comprising the exhaust treatment system according to the second aspect.

[0012] The mode or plurality of modes in any of these aspects may include any one or more of temperature dependent modes, temperature dependent thermal management modes, regeneration modes, operation modes, temperature dependent operation modes, and/or thermal management modes, for example.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The present disclosure may be put into practice in a number of ways and embodiments will now be described by way of example only and with reference to the accompanying drawings, in which:

[0014] FIG. 1 shows a schematic diagram of an algorithm for parametric control of an exhaust after treatment device mode within an engine system, given by way of example only; and

[0015] FIG. 2 shows a schematic diagram of an engine system including a controller for executing the algorithm of FIG. 1.

[0016] It should be noted that the figures are illustrated for simplicity and are not necessarily drawn to scale.

DETAILED DESCRIPTION

[0017] Exhaust after treatment devices (EATD) may have several modes of operation including warm-up modes, normal operation modes and regeneration modes. Various parameters may be used to determine when and how to change an EATD mode. For example, a soot sensor may detect when too much soot has built up on a diesel particulate filter (DPF), which is one type of EATD. A differential pressure sensor across the DPF may also be used to determine if the DPF has become clogged and requires regeneration. Regeneration of an EATD may occur during periods of high engine load, which consequently result in elevated exhaust temperatures. However, should the EATD require regeneration during extended idle periods or when the engine is not under load, as detected by monitoring engine speed and fuel delivery, for example, then this information may be used to arrive at a decision whether or not to assist in the regeneration process and so change the EATD mode from normal operation mode to one of perhaps several temperature dependent regeneration modes.

[0018] In an example, the EATD may be a DPF, which may include a diesel oxidation catalyst (DOC) that may be activated operated at or regenerated at different temperatures. Other strategies may be used to determine if the DPF should operate in its normal or regenerative mode (i.e. changing engine operation in order to raise (or lower) exhaust temperature so that a particular mode may be entered) and which particular target mode may be required. Various sensors, including pressure and temperature sensors, throughout an engine system may provide information in order to base these decisions. The sensor or sensors may be formed from one or more pressure transducers or operate indirectly to measure pressures or pressure differences. A temperature sensor may be located within the exhaust system to measure the temperature of exhaust gases at or around the EATD.

[0019] A controller or engine computer unit may receive such signals and data and decide on which particular target mode or regeneration scheme to operate within and for how long. This mode may be regulated by monitoring and controlling a pressure difference between parts of the engine system, which changes the engine's operation and in turn may control the temperature of exhaust gases around the EATD.

[0020] FIG. 1 illustrates an algorithm using particular parameters to decide how to operate pressures within the engine in order to change exhaust gas temperatures and therefore how to regulate a temperature dependent mode of an EATD. This algorithm also assists in the regeneration of the EATD and/or its thermal management by changing engine operation to support a DPF and/or selective catalytic reduction (SCR) device, for example. A controller 10 may receive these data and parameters and may issue instructions for controlling various valves and other components to control engine pressures and therefore exhaust gas temperature. The configuration or settings of the valve or valves may be set or adjusted directly or indirectly. For example, the state of a valve may be set in percentage terms or set to open or close until a particular pressure or pressure difference is measured. Furthermore, a valve configuration may be set by determining a particular pressure difference and this pressure difference or change in pressure difference may be associated with a particular valve configuration or change and then applied using actuators or motors, for example.

[0021] A decision to assist the regeneration process using a back pressure control strategy may be based on engine speed and fuel delivery, for example.

[0022] In the embodiment shown, five separate modes are illustrated for the EATD. These modes include but are not limited to regeneration modes. In this example, the EATD includes a DPF and a SCR. DPF hydrocarbon evaporation may be the first mode and takes place with exhaust gas temperatures between 250° C. and 300° C. The second mode may be used to support aqueous urea injection (e.g. AdBlue® in a SCR system and this typically operates between 200° C. and 300° C. This mode may also be known as SCR or AdBlue® warm-up. The third mode may be DPF soot oxidation (regeneration) and this typically operates between 250° C. and 400° C. The fourth mode may be DPF desulphation (regeneration) and typically operates between 400° C. and 450° C. in this particular example. The fifth example mode may be SCR desulphation (regeneration) of a DOC and DPF and typically operates between 400° C. and 550° C. (i.e. an example range of input temperatures at the DOC allowing hydrocarbon dosing to generate higher temperatures). The EATD may comprise a single component for carrying out each particular

filtering operation or may comprise separate components particular to each filter requirement. Other modes or regeneration modes may be used.

[0023] The exhaust gas temperature may be altered by adjusting and regulating various pressure differences between particular locations or positions within the engine and exhaust system. In the embodiment shown, a first location may be defined as an air inlet manifold. In this example, an exhaust gas recirculation (EGR) valve (not shown in this figure) may be utilised and the second pressure evaluation point or location may be defined as the EGR valve intake. A difference in pressure between the first location and the second location may be used to regulate exhaust gas temperature and therefore EATD temperature. For example, decreasing the pressure difference between the air inlet manifold and the EGR valve intake may reduce exhaust gas temperature. Increasing the pressure difference may increase the exhaust gas temperature. The use of pressure differences rather than absolute pressure may reduce calibration requirements as changes in ambient pressure may be accommodated automatically. One of the two locations may be outside of the engine or exhaust system and may be used to monitor ambient or atmospheric pressure. Pressure differences between further locations (e.g. third, forth, fifth, etc.) may also be used in the method or algorithm.

[0024] In the embodiment shown, a maximum EATD temperature controller 20 may be one aspect or component of the controller 10, which monitors that a maximum allowable temperature for the EATD and exhaust gases may not be exceeded, therefore maintaining the EATD within a particular mode temperature range.

[0025] The measured temperature of the EATD may be received by the maximum EATD temperature controller 20 and then this measured temperature may be compared with the maximum allowable temperature for the desired mode. Should the temperature increase beyond this maximum, then the maximum EATD temperature controller 20 may provide an instruction to decrease the pressure difference.

[0026] In the embodiment shown, a minimum EATD temperature controller 60 may be a further aspect of the controller 10 and operates to maintain a minimum EATD temperature to ensure that a determined mode the EATD continues. The measured temperature of the EATD may also be received by the minimum EATD temperature controller 60 and then this measured temperature may be compared with the minimum allowable temperature for the desired regeneration mode. Should the temperature of or at the EATD be measured or detected as being below the minimum for a particular requested or desired mode, then the minimum EATD temperature controller 60 may provide an instruction to increase the pressure difference and therefore increase the exhaust gas temperature.

[0027] In the embodiment shown, the engine speed and fuel consumption may be monitored and this information may be provided to the controller 10. Other engine sensor may also be used. Step 30 of the algorithm may provide an instruction to achieve DPF desulphation by providing an instruction to achieve a particular pressure difference or Δp . Step 40 may be initiated when the input parameters of engine speed and fuel consumption indicate a build up of soot on the DPF and therefore soot oxidation may be required as the regeneration mode for the DPF. In this case, a particular pressure difference or Δp may be instructed to provide a corresponding EATD temperature within the soot oxidation regeneration mode

temperature range. When the input parameters indicate that SCR desulphation is required then step 45 may be initiated and a particular pressure difference, Δp , associated with this regeneration mode temperature range may be instructed. When the input parameters indicate that hydrocarbon evaporation may be necessary as the EATD mode, then step 50 may be initiated and a particular difference associated with this mode temperature range may be instructed.

[0028] When aqueous urea injection is required for SCR operation or mode then step 47 is initiated and the particular temperature range for this mode is initiated and regulated.

[0029] In summary, a decision may be made on which particular mode to achieve based on input parameters provided by detectors or sensors throughout the engine system. For example, a DPF soot quantity detector may indicate excessive soot build-up. A particular EATD mode may be chosen elsewhere in the control strategy. Maximum and minimum EATD temperature controllers may be used to maintain the particular chosen EATD mode by regulating the pressure difference to keep the EATD (e.g. DPF and/or SCR) within a particular associated temperature range, which may be associated with the selected mode or regeneration mode. The temperature ranges may be wide or narrow or substantially fixed to one particular temperature.

[0030] An engine fuelling and timing controller 95 may additionally monitor the engine parameters (including fuel, speed and timing) as well as determining when the engine is approaching a requested pressure difference (i.e. to raise or lower the temperature of the DPF to change modes or move into or out of regeneration). As the pressure difference approaches a commanded value, the engine fuelling and timing controller may change the timing and fuelling conditions to increase or decrease heat. In other words, a proportion of the elevated exhaust gas temperature (and EATD temperature) may be derived from the increased pressure difference to increase engine load but additional heat may also be provided by switching to an alternative set of setpoint maps for the number of injection events, the timing and delivery quantity of each of those injection events, and the fuel injection pressure.

[0031] The engine fuelling and timing controller 95 may use a calibration map to determine the actual changes to engine parameters required, as well as provide information on when and how to apply these changes in order to regulate EATD temperature both up and down.

[0032] FIG. 2 shows a schematic diagram of an engine system 100 and controller 10 arranged to execute the algorithm or method described with reference to FIG. 1. The engine system may include one or more sensors 110 and one or more valves 120 used to alter gas pressures within the engine system 100. The sensors 110 may be connected to the controller 10 which may receive these signals and act accordingly.

[0033] A final pressure limit (FPL) controller 65 may check whether the commanded pressure difference value is within a safe or predetermined range to reduce or prevent damage. The FPL controller 65 may therefore check and adjust as appropriate the pressure difference value before being applied to the engine. The limit may be set as a value for the particular engine or determined based on current operating conditions, for example.

[0034] In the embodiment shown, the EGR valve intake pressure and inlet manifold air pressure (IMAP) pressures may be monitored by sensors 110 and provide inputs to a

cylinder head pressure difference controller 70, which may be a further aspect of the controller 10 and may receive a commanded pressure value, based on the previously described determining steps, after being checked by the FPL controller 65. Where the commanded or desired pressure difference is the same as the recorded or sensed pressure difference between the EGR valve intake pressure and IMAP, then no changes are made. However, where the actual difference between the EGR valve intake pressure and IMAP and the commanded pressure difference are determined to differ, by the cylinder head pressure difference controller 70, then changes in valve configurations may be determined to be necessary to alter the pressure difference. One or more valves 120 within the engine system 100 and/or exhaust gas system may be controlled to achieve the desired pressure difference. The particular current position of these valves 120 may be supplied to a back pressure valve position controller 80. In other words, the cylinder head pressure difference controller 70 may determine whether changes are necessary and transform the commanded pressure difference value into valve displacement to be applied to one or more valves.

[0035] Where a different pressure difference may be required, then the cylinder head pressure difference controller 70 may instruct the back pressure valve position controller 80 to change valve position or configuration. In this situation, the back pressure valve position controller 80 may provide a controlling signal or current to the valve that requires adjustment and the valve position and therefore pressure difference may be adjusted accordingly.

[0036] For example, if the measured temperature of the EATD is greater than the maximum temperature as determined by the maximum EATD temperature controller 20, then a reduction in Δp may be commanded by this controller. For example, when a DPF desulphation mode is required (i.e. 400°-450° C. range) and the measured temperature is 500° C. then the maximum temperature may be determined to be exceeded by 50° C. Therefore, the maximum EATD temperature controller 20 may provide a negative pressure, for instance -20 kPa, and this may be added to a desired manifold pressure difference parameter or tally resulting in a lower required pressure difference. After being checked by the FPL controller 65, this lower commanded pressure difference may be provided to the cylinder head pressure difference controller 70, which converts the commanded pressure difference into valve displacement or configuration parameters that are sent to valve position controllers (e.g. the back pressure valve position controller 80) to open a valve to reduce the EGR valve intake pressure by 20 kPa.

[0037] After a particular time delay to allow for the exhaust gas temperature to settle to a new value, further measurements may be taken and the algorithm may repeat to regulate the desired temperature range or make further adjustments as become necessary. Alternatively, measurements may be taken continuously.

[0038] The method may further include determining if the temperature of the EATD is within the temperature range corresponding with the target mode and adjusting the gas pressure difference if the temperature of the EATD is outside of the temperature range corresponding with the target mode.

[0039] The method may further include the step of measuring the EATD temperature. The exhaust gas temperature may also be measured to indicate the EATD temperature.

[0040] The method may further include measuring the gas pressure difference between the first location and the second

location. This may improve the accuracy of mode control including regeneration mode control, and improves variability. Alternatively, the pressure difference may be controlled without measurement by changing engine parameters that alter the pressure of various points within the system and in turn change the EATD temperature and mode.

[0041] Controlling a gas pressure difference may further include adjusting the one or more pressure controlling valves **120** at the first location and/or at the second location. The valves **120** may take many different forms but in some way alter gas flow to change gas pressure.

[0042] Various safeguards and smoothing functions may be used. In the embodiment shown, a ramp rate limiter or rate of change limiter **75** may be used in order to reduce rapid changes in the valve position, which could result in noise, vibration and decrease in engine speed control stability. For example, changes in valve position to or from fully open to fully closed (or fractional changes) may be restricted to no faster than 30 seconds for the full range.

[0043] In the embodiment shown, a transient detection strategy **90** may deliberately open a valve (e.g. a back pressure valve) to reduce the pressure difference (decrease Δp) when the engine is accelerating or comes under load so that the performance of the engine is not hindered (i.e. degrade engine performance). This may act as a "Switch" triggered by engine transient operation detector and may include debounce functionality. A delay aspect may also prevent the pressure difference from rising again (i.e. closing the valve) unless the engine conditions are detected to be suitable or appropriate and the regeneration mode or thermal management mode is still required. The transient detection strategy **90** may provide a predetermined time delay before increasing (or decreasing) the pressure difference, and this time delay may be calibrated based on soot level observed in the DPF, for example.

[0044] In order to determine particular valve positions associated with requested pressure differences as well as particular pressure difference changes associated with temperature adjustments, one or more data sets **130** or lookup tables may be used. For example, a lookup table may associate an EATD temperature or temperature range with a particular pressure difference between the two positions in the engine system. The data set **130** may include a list or an array of temperature changes and associated pressure difference changes (e.g. a temperature change of 50° C. may correspond with a pressure difference change of 20 kPa). As a further example, a particular temperature or temperature change may be associated with a particular valve position or valve position change. For instance, a temperature change of 20° C. may correspond with a valve position change of 10% or an absolute exhaust gas temperature of 300° C. may correspond with a valve position of 50%. The data set **130** or data array may be stored within a memory storage device such as a ROM or FLASH memory and may be predetermined from a series of tests or calculations based on a standard engine system or may result from a particular calibration of the current engine system. These data may be corrected or updated at intervals depending on engine performance or age. The data may be updated, corrected, stored or deleted as necessary.

[0045] The data set **130** may comprise DPF temperature or target regeneration mode and corresponding gas pressure difference or valve configuration. The data set **130** may be stored as a database, array, lookup table or similar as an electronic record in memory. The data set **130** may include one or more

entries or a range of entries spread across the operating modes and regeneration modes of the DPF.

[0046] The data set **130** may comprise changes in EATD temperature corresponding with changes in gas pressure difference or changes in valve configuration. The data set **130** may include one or more entries or a range of entries spread across the operating modes and regeneration modes of the EATD.

[0047] The temperature and pressure sensors **110** used throughout the system may be transducers familiar to the skilled person.

[0048] The controller **10** may be integrated and be part of an engine system such as a diesel engine or be separate to it. A separate exhaust gas treatment system may incorporate the controller **10** and be added as a separate system to existing engines.

[0049] As will be appreciated by the skilled person, details of the above embodiment may be varied without departing from the scope of the present disclosure, as defined by the appended claims.

[0050] For example, although a DPF and SCR system have been described as being the EATD, this disclosure may be used with other EATDs. The engine may or may not be fitted with an exhaust gas recirculation system. Where an EGR system is used during periods of DPF regeneration, an EGR control valve may be opened or closed to reduce or elevate exhaust gas pressures, respectively. Typical operating pressure differences may be in the range of 160 kPa-200 kPa for DPF regeneration, but this may vary somewhat depending speed and load on the engine. For series turbo engines, the pressure differences may be higher and potentially up to 230 kPa. Typical EATD (e.g. DPF) temperatures may be in the range of 250° C-290° C. when operating in regeneration mode, but this may depend on engine idle speed, turbo charger arrangement, engine-to-EATD pipe length, ambient temperature and other factors. These temperatures and pressures may be dependent on engine calibration.

[0051] Other regeneration modes with different or the same temperature ranges may be used.

[0052] The exhaust treatment system may further comprise a temperature sensor arranged to measure the temperature of the EATD and provide an EATD temperature signal to the controller.

[0053] The controller may be further configured to: determine a configuration of the one or more valves necessary to bring the EATD temperature within a temperature range corresponding with a target regeneration mode and adjust the one or more valves by the determined configuration.

[0054] The EATD may be a diesel particulate filter.

[0055] Other pressure measurements locations may be used and deliver EATD mode control and regulation. Regulation may included maintaining a particular mode or changing between modes. For example, instead of the intake manifold pressure, a turbo compressor-out (pre-charge cooler) pressure sensor may be used, a pre-turbo compressor (post-air filter) or true ambient pressure sensor may also be used. Instead of the EGR valve intake location, pressure may be measured at an exhaust manifold, within an interstage ducting in a series-turbo charged engine, or between a turbo outlet and a back pressure valve.

[0056] The first location may be selected from the group consisting of: air intake; intake manifold; turbo compressor-out; pre-charge cooler; pre-turbo compressor;

[0057] post air filter; and ambient pressure outside of the engine system. Other locations may be used.

[0058] The second location may be selected from the group consisting of: exhaust manifold; an inter-stage within a series turbo charger; between a turbo charger outlet and a back pressure valve; a back pressure valve and exhaust gas regeneration valve intake. Other locations may be used.

[0059] One particular benefit of controlling pressure difference between a point somewhere in the exhaust system and somewhere in the intake system (or barometric pressure) is that the controller or method may inherently compensate for changes in altitude and ambient pressure, which in turn simplifies set point generation, reducing calibration complexity.

[0060] The system and method may provide a smoother transition between normal and regeneration modes. Back pressure valve control may be decoupled from a fuel governor. Greater control of DPF temperature may result in increased optimisation of regeneration conditions within acceptable limits. Pressure difference setpoints may be determined and recorded during operation to prevent deviating from low temperature regeneration of the EATD.

[0061] The EATD may be a DPF with a SCR catalyst (e.g. copper-zeolite type) coating (known as combined DPF and SCR or CDS), for example. This SCR catalyst may be used to reduce NOx emissions and uses aqueous urea as the reducing agent. Diesel fuel may be deliberately injected into the exhaust system fitted with an SCR component and this diesel fuel may be oxidised on a DOC in order to remove urea deposits and desulphating the SCR catalyst. This may be known as HC dosing as illustrated in FIG. 1.

[0062] The method or algorithm may be performed as a computer program comprising program instructions that may be executed on a computer.

[0063] The computer program may be stored or recorded on computer-readable medium or sent as a signal.

[0064] The exhaust after treatment device (EATD) mode or modes may also be described as and include temperature dependent thermal management, thermal management mode(s), regeneration mode(s) or thermal mode(s) throughout. Such mode or modes include operation modes and regeneration modes.

[0065] Regeneration may include DOC thermal management, HC dosing, desulphation of a selective catalytic reduction (SCR) etc.

[0066] Different modes may include or be selected from any one or more of:

[0067] Thermal management for hydrocarbon evaporation from the DOC/DPF;

[0068] Thermal management to support low-temperature soot oxidation process in the DPF (this could be termed regeneration);

[0069] Thermal management to support desulphation of the DOC/DPF after the engine has been run on high-sulphur fuel; and

[0070] Thermal management to elevate the DOC temperature in support of HC oxidation on the DOC, enabling urea deposit removal and SCR desulphation, as well as others, for example.

[0071] The plurality of modes may include one mode of normal operation and one regeneration mode (i.e. two modes), for example.

[0072] The plurality of modes may include two or more modes of normal operation and one, two or more regeneration modes (i.e. three, four or more modes).

[0073] The plurality of modes may include one or more modes of normal operation and two or more regeneration modes, for example.

[0074] Therefore, there may be three or more modes including at least one normal (non-regenerative) and one regenerative mode.

[0075] Each mode (normal or regeneration) may have its own separate or overlapping temperature range, for example. The regeneration modes may correspond with particular normal modes of operation.

[0076] A normal mode may be a non-regenerative mode.

[0077] Many combinations, modifications, or alterations to the features of the above embodiments will be readily apparent to the skilled person and are intended to form part of the invention. Any of the features described specifically relating to one embodiment or example may be used in any other embodiment by making the appropriate changes.

1. A method of controlling a temperature dependent mode of an exhaust after treatment device, EATD, having a plurality of modes, within an engine system, the method comprising the steps of:

identifying a target EATD mode out of the plurality of modes; and

regulating an EATD temperature to within a temperature range corresponding with the target EATD mode by controlling a gas pressure difference of the engine system between a first location and a second location.

2. The method of claim 1 further comprising the steps of: determining if the temperature of the EATD is within the temperature range corresponding with the target EATD mode; and

adjusting the gas pressure difference if the temperature of the EATD is outside of the temperature range corresponding with the target EATD mode.

3. The method of claim 2 further comprising the step of measuring the EATD or exhaust gas temperature.

4. The method according to claim 3 further comprising the step of measuring the gas pressure difference between the first location and the second location.

5. The method according to claim 4, wherein the step of controlling a gas pressure difference further comprises the step of adjusting one or more pressure controlling valves at the first location and/or at the second location.

6. The method according to claim 5, wherein the first location is selected from the group consisting of: air intake; intake manifold; turbo compressor-out; pre-charge cooler; pre-turbo compressor; post air filter; and ambient pressure outside of the engine system, and

further wherein the second location is selected from the group consisting of: exhaust manifold; an inter-stage duct within a series turbo charger; between a turbo charger outlet and a back pressure valve; a back pressure valve and exhaust gas recirculation valve intake.

7. The method according to claim 6, wherein the target EATD mode is selected from the group consisting of: diesel particulate filter, DPF, desulphation; diesel oxidation catalyst, DOC, desulphation; DPF soot oxidation; hydrocarbon evaporation; thermal management of selective catalytic reduction, SCR, aqueous urea injection; SCR urea deposit removal; thermal management of hydrocarbon dosing to remove urea deposits; and SCR desulphation.

8. The method according to claim 7, wherein the step of regulating the EATD temperature further comprises deter-

mining a required change in temperature to bring the EATD temperature within the temperature range corresponding with the target EATD mode;

determining a change in gas pressure difference necessary to bring the EATD temperature within the temperature range corresponding with the target EATD mode; and adjusting the gas pressure difference by the determined change.

9. The method of claim **8**, wherein determining the change in gas pressure difference further comprises reading from a data set of EATD temperature or target EATD mode and corresponding gas pressure difference or pressure controlling valve configuration.

10. The method according to claim **9** further comprising the step of closing or opening a Back Pressure Valve, BPV, to regulate EATD temperature.

11. The method according to claim **10** further comprising the step of applying changes to fuelling and/or engine timing control to regulate the EATD temperature.

12. The method according to claim **11**, wherein the one or more EATD modes are regenerative EATD modes.

13. An exhaust treatment system for an engine system comprising:

an exhaust after treatment device, EATD, having a plurality of modes;

one or more valves configured to adjust a gas pressure difference of the engine system between a first location and a second location;

a controller in communication with the one or more valves and configured to identify a target EATD mode out of the plurality of modes, and control the temperature dependent EATD mode of the EATD by regulating the gas pressure difference using the one or more valves.

14. The exhaust treatment system of claim **13** further comprising a pressure difference sensor arranged to measure the gas pressure difference between the first location and the second location.

15. The exhaust treatment system of claim **14**, wherein the pressure difference sensor comprises a first pressure sensor located at the first location and a second pressure sensor located at the second location.

16. The exhaust treatment system according to claim **15**, wherein the EATD includes a diesel oxidation catalyst, DOC and/or a selective catalytic reduction system.

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