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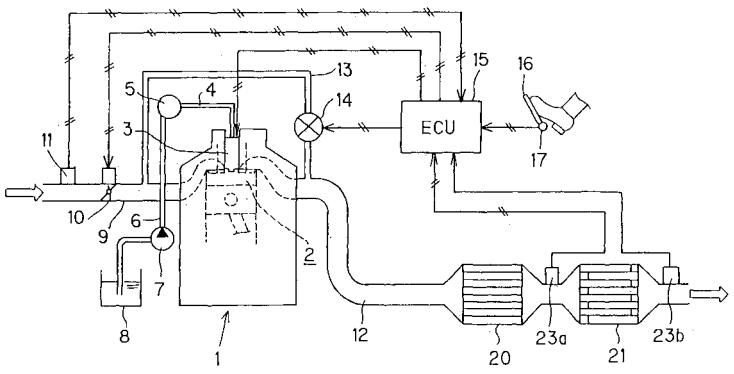
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(54) Fuel injection control device for internal combustion engine

(57) Based on conventional control considering a smoke concentration, a basic fuel injection quantity Q_B or a fuel injection quantity Q_{smoke} according to smoke concentration regulation, whichever is smaller, is taken as an injection quantity Q_0. Basically, if the outlet temperature of a DPF (21) detected by a sensor (23b) reaches a temperature at which PM can be burned off, a correction for increasing according to this temperature is made to the injection quantity Q_0 to give an injection quantity Q_F. As auxiliary control, if the inlet temperature of the DPF (21) detected by a sensor (23a) is low even when the outlet temperature is high, the correction for increasing, which has been made according to the outlet temperature, is cancelled, and the injection quantity Q_0 is given as the injection quantity Q_F after correction, because the entire DPF (21) is in a filter state suitable for burning off PM.

FIG. 1



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Description

[0001] This invention relates to a fuel injection control device for an internal combustion engine and, more particularly, to a technique for properly controlling an internal combustion engine having a diesel particulate filter (DPF).

[0002] Generally, the output control of an internal combustion engine is exercised based on the smoke concentration (theconcentration mainly ofparticulate matter (hereinafter referred to as PM)) in an exhaust gas, in the light of environmental problems posed in recent years. That is, the control of output is performed to confine the smoke concentration to a prescribed value or below, because the smoke concentration increases as the output increases.

[0003] As the method of output control in consideration of the smoke concentration, it is generally common practice, for example, to give a maximum injection quantity responsive to a boost pressure by a map, or correct a basic injection quantity with a boost pressure, since the smoke concentration in a tailpipe depends on the intake air quantity of the internal combustion engine.

[0004] The exhaust gas discharged from a diesel engine contains a large amount of PM as well as HC, CO and NOx. In recent years, therefore, a diesel particulate filter (hereinafter referred to as DPF), which traps PM and burns off it, has found practical use as an exhaust emission control device for the diesel engine.

[0005] As mentioned above, DPF is a filter for trapping PM, etc. , and a vehicle furnished with such DPFminimally discharges smoke from the tailpipe. With an internal combustion engine having DPF, therefore, there is no need for output regulation in accordance with the smoke concentration from the tailpipe, and it is possible to set a fuel injection quantity which generates maximum torque in response to a predetermined intake air quantity.

[0006] Actually, however, smoke is discharged from the outlet of the internal combustion engine (engine outlet). Even if the fuel injection quantity generating maximum torque can be set, continuous operation of the internal combustion engine in the presence of an excessive smoke discharge results in a continued increase in PM buildup or deposition within DPF. The resultant increase in the filter pressure loss of DPF raises the exhaust pressure, inducing a pumping loss and causing deteriorated fuel economy or a worse exhaust gas. If PM is excessively accumulated in DPF, self-ignition of PM in a heavy load operation may damage DPF.

[0007] In response to increased PM accumulation within DPF, it is conceivable to burn away PM by natural regeneration of DPF, or to burn off PM forcibly by post-injection or the like (forced regeneration). However, natural regeneration cannot be expected greatly from the diesel engine whose exhaust gas temperature is relatively low. An increased frequency of forced regeneration, on the other hand, poses the problem of aggravating fuel economy.

[0008] If output control is effected based on the concentration of smoke discharged from the outlet of the internal combustion engine equipped with DPF, the aforementioned problems due to excessive smoke discharge can be resolved. However, theproblemarises that output torque is suppressed.

[0009] Japanese Patent Publication No. 1993-34499 describes a technology in which if the temperature of DPF is higher than the temperature of PM during normal combustion, a relatively large amount of fuel is supplied into a combustion chamber to lower the heat of reaction of an oxidation catalyst provided upstream of DPF and prevent the abnormal temperature elevation of DPF.

[0010] However, this technology merely shows action to be taken when DPF is at an abnormally high temperature. An improvement should be achieved in this technology from the point of view that an increase in the output torque of the internal combustion engine during normal use, and the suppression of excessive buildup of PM in DPF should both be realized at a higher level.

[0011] The present invention has been accomplished in the light of the above-mentioned circumstances. It is an object of the present invention to provide a technology which is concerned with a fuel injection control device for an internal combustion engine, and which can increase the output of the internal combustion engine while suppressing excessive buildup of PM in DPF.

[0012] A fuel injection control device for an internal combustion engine according to the present invention, aimed at attaining the above-described object, comprises:

fuel injection means for supplying a fuel to the internal combustion engine;
a filter, provided in an exhaust passage of the internal combustion engine, for trapping particulate matter in an exhaust gas;
filter state detection means for detecting an index correlating with capacity of the filter to burn off the particulate matter discharged from the internal combustion engine;
operating state detection means for detecting an operating state of the internal combustion engine; and
injection control means for controlling the fuel injection means in accordance with a target fuel injection quantity corresponding value determined by a detection output of the operating state detection means, and
is characterized in that the injection control means corrects the target fuel injection quantity corresponding value so as to be increased, based on a detection output of the filter state detection means.

[0013] According to the present invention, the fuel injection quantity can be increased according to the capacity of the filter to remove PM, and the output torque of the internal combustion engine can be increased while suppressing excessive buildup of PM in the filter.

[0014] The index correlating with the capacity of the filter to burn off the particulate matter refers, for example, to a DPF temperature (the temperature of the exhaust gas), or an oxygen concentration in the exhaust gas, which determines the capacity of DPF to burn and remove PM. If DPF is found, based on any such index, to have a surplus capacity to remove PM, the fuel injection quantity is not kept at the target fuel injection quantity, but is corrected to be increased, thereby attempting to increase output.

[0015] In a preferred mode of the present invention, for attaining the above object,

> the filter state detection means detects an index correlating with the temperature of the filter, and
> the injection control means carries out the above correction for increasing, if the filter is found, based on the above index, to be able to burn off the particulate matter.

[0016] According to this preferred mode, the ability of the filter to burn and remove the particulate matter is judged by the index correlating with the temperature of the filter, and a correction for increasing is unerringly performed. This can prevent excessive accumulation of PM in the filter as a result of the fuel injection quantity being increased under a situation where it is uncertain whether the particulate matter can be burned off.

[0017] In another preferred mode of the present invention, for attaining the object,

> the injection control means sets the increase correction to be larger as the index is on a higher temperature side.

[0018] According to this preferredmode, the correction for a fuel increase corresponding to the PM removing capacity of the filter can be achieved, and the output torque of the internal combustion engine can be increased efficiently.

[0019] In another preferred mode of the present invention, for attaining the object,

> the filter state detection means detects exhaust temperature downstream of the filter, and
> the injection control means sets the increase correction to be large in accordance with the exhaust temperature downstream of the filter if the exhaust temperature downstream of the filter is a first predetermined temperature or higher.

[0020] According to this preferred embodiment, PM can be prevented from being excessively accumulated in the filter as a result of the fuel injection quantity being increased under a situation where it is uncertain whether the particulate matter can be burned off. Moreover, the correction for a fuel increase corresponding to the PM removing capacity of the filter can be achieved, and the output torque of the internal combustion engine can be increased efficiently.

[0021] In another preferred mode of the present invention, for attaining the object,

> the filter state detection means detects exhaust temperature upstream of the filter and exhaust temperature downstream of the filter, and
> the injection control means makes the correction for increasing on conditions that the exhaust temperature downstream of the filter is a first predetermined temperature or higher, and the exhaust temperature upstream of the filter is a second predetermined temperature or higher.

[0022] According to this preferred mode, the filter state is grasped from the temperature of the exhaust gas passing through DPF, and an unerring judgment for the correction for increasing is made. As a result, the situation where PM is stably burned off by the filter can be detected unerringly. This can prevent excessive accumulation of PM in the filter as a result of the fuel injection quantity being increased under a situation where it is uncertain whether the particulate matter can be burned off.

[0023] In another preferred mode of the present invention, for attaining the object,

> the filter state detection means detects exhaust temperature upstream of the filter and exhaust temperature downstream of the filter, and
> the injection control means makes the correction for increasing in accordance with the exhaust temperature downstream of the filter and the exhaust temperature upstream of the filter.

[0024] DPF, which has a predetermined length in the flowing direction of the exhaust gas, may have a nonuniform temperature in its interior. Furthermore, the PM removing capacity of DPF depends on the DPF temperature. According to this preferred mode, therefore, correction for increasing in accordance with the exhaust temperature downstream of the filter and the exhaust temperature upstream of the filter is performed, whereby the filter state is grasped unerringly, and an unerring correction for increasing is made. Thus, the correction for a fuel increase unerringly corresponding to the PM removing capacity of the filter can be achieved, and the output torque of the internal combustion engine can be increased efficiently.

[0025] In another preferred mode of the present invention, for attaining the object,

> the target fuel injection quantity corresponding value is restricted such that the concentration of smoke discharged from the internal combustion engine is a predetermined value or lower.

[0026] A predetermined control value may be set for

the smoke concentration in the exhaust gas under laws and regulations and from the viewpoint of appearance of the exhaust gas while the vehicle is driving. If fuel injection control for fulfilling this control value is exercised for all operating states, the problem of an inadequate engine output occurs. According to this preferred mode, therefore, insufficiency in output, which is caused by exercising conventional fuel injection control in consideration of the smoke concentration in all operating states, is eliminated, and the surplus capacity of DPF to remove PM is effectively used, whereby engine output can be increased.

[0027] In another preferred mode of the present invention, for attaining the object,

> the injection control means sets the target fuel injection quantity corresponding value within limits corresponding to the boost pressure of the internal combustion engine, and corrects the target fuel injection quantity corresponding value, based on the detection output of the filter state detection means, so as to be increased beyond the limits.

[0028] According to this preferred mode, engine output can be efficiently increased by making effective use of the PM purifying capacity of DPF, with smoke discharged from the internal combustion engine being controlled appropriately.

[0029] The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying drawings which are given by way of illustration only, and thus are not limitative of the present invention, and wherein:

> FIG. 1 is a schematic configurational drawing showing a fuel injection control device for an internal combustion engine according to an embodiment of the present invention;
> FIG. 2 is a graph showing the relationshipbetween the temperature of DPF and changes over time in pre-DPF/post-DPF differential pressure obtained from tests;
> FIG. 3 is a graph showing PM buildup within DPF in terms of the relationship between the concentration of smoke discharged from engine and the temperature of DPF; and
> FIG. 4 is a view showing the method of control in the fuel injection control device for the internal combustion engine according to the embodiment of the present invention.

[0030] An embodiment of the present invention will now be described in detail with reference to the accompanying drawings, but this embodiment does not limit the present invention. FIG. 1 is a schematic configurational drawing showing a fuel injection control device for an internal combustion engine according to the embodiment of the present invention.

[0031] As shown in FIG. 1, an engine 1, which is an internal combustion engine, is, for example, a common-rail type in-line four-cylinder diesel engine. In the common-rail type engine 1, an electromagnetic fuel injection nozzle 3 (fuel injection means) facing a combustion chamber 2 is provided in each cylinder, and each fuel injection nozzle 3 is connected to a common rail 5 by a high pressure pipe 4. The common rail 5 is connected to a fuel tank 8 via a high pressure pipe 6 having a high pressure pump 7 interposed therein. Since the engine 1 is a diesel engine, a light oil is used as a fuel.

[0032] An electromagnetic intake throttle valve 10 is provided in an intake passage 9 for the engine 1. An EGR passage 13 extends from an upstream portion of an exhaust passage 12, and the terminating end of the EGR passage 13 is connected to a portion of the intake passage 9 downstream of the intake throttle valve 10. An electromagnetic EGR valve 14 is interposed in the EGR passage 13.

[0033] An exhaust emission control device is interposed in a downstream portion of the exhaust passage 12. The exhaust emission control device is constructed by providing an oxidation catalyst (DOC) 20 upstream of a diesel particulate filter (DPF) 21. The exhaust emission control device is designed to produce an oxidizing agent (NO_2) in the oxidation catalyst 20, and constantly and uninterruptedly oxidize and remove particulate matter (PM) accumulated in the downstream DPF 21 by the resulting oxidizing agent.

[0034] To the input side of an electronic controller (ECU) 15 (operating state detection means), there are connected various sensors, such as an air flow sensor 11 for detecting an intake air quantity Qa, a pre-DPF temperature sensor 23a and a post-DPF temperature sensor 23b (filter state detection means) for detecting the temperatures of exhaust gases upstream of and downstream of the DPF 21, an accelerator opening sensor 17 for detecting the depression amount of an accelerator pedal 16, namely, an accelerator opening AP_S, a sensor for detecting the rotational speed Ne of the engine 1, and a sensor for detecting the pressure P_B of an intake manifold. To the output side of the electronic controller 15 (ECU), various devices, such as the fuel injection nozzle 3, the high pressure pump 7, the intake throttle valve 10, and the EGR valve 14, are connected.

[0035] Thus, the various devices are controlled based on various pieces of input information, so that the engine 1 is appropriately operated and controlled. The fuel injection control device for the internal combustion engine according to the present embodiment has the function of controlling the target fuel injection quantity of the fuel injection nozzle 3, for example, based on the operating state of the engine 1. This fuel injection control device is designed to control the target fuel injection quantity restrictively so that the concentration of smoke discharged from the engine 1 is not higher than a predetermined concentration if the temperature of the DPF 21 is lower than a predetermined temperature. If the temperature of

the DPF 21 is not lower than the predetermined temperature, on the other hand, the fuel injection control device is adapted to correct the target fuel injection quantity to be increased in accordance with the temperature of the DPF 21.

[0036] Whether the temperature of the DPF 21 is lower than the predetermined temperature, or is the predetermined temperature or higher, makes a difference in the type of control of the target fuel injection quantity. The predetermined temperature set here is an example of an index corresponding to the capacity of the DPF 21 to burn off accumulated PM. That is, the PM removing capacity of the DPF 21 depends on the temperature of the DPF 21. For example, the lower limit value of the temperature, which ensures a filter state where the DPF 21 can completely continue to remove PM accumulated as the engine 1 is operated, namely, continuous regeneration of the filter is possible, is set as the predetermined temperature.

[0037] Assume that the temperature of the DPF 21 is lower than the predetermined temperature, and PM cannot completely be removed, but keeps deposited within the DPF 21. Under these conditions, the target fuel injection quantity is restrictively controlled so that the smoke concentration becomes the predetermined concentration or lower. By so doing, discharge of smoke is suppressed, and the problem of PM accumulation within the DPF 21 is resolved.

[0038] Assume, on the other hand, that the temperature of the DPF 21 is the predetermined temperature or higher, and continuous regeneration of the DPF 21 is possible. Under these conditions, the target fuel injection quantity is corrected to be increased. By this measure, the output of the engine 1 can be increased with the effective use of the surplus capacity of the DPF 21 to remove PM. At the predetermined temperature or higher, the DPF 21 has the capacity to remove the amount of PM in excess of the amount of discharged PM determined by the target fuel injection quantity. Even if the injection quantity is increased to raise the smoke concentration, PM in the smoke is dealt with within the DPF 21, and smoke regulation is complied with. Thus, control effected in the above-described manner can increase the output of the engine 1 while suppressing smoke discharge.

[0039] FIG. 2 is a graph showing the relationship between the temperature of DPF and changes over time in pre-DPF/post-DPF differential pressure obtained from tests. In this graph, the vertical axis represents a differential pressure (in KPa) as a difference between the pressure of an exhaust gas upstream of DPF and the pressure of an exhaust gas downstream of DPF, and the horizontal axis represents time (in seconds). The graph shows changes with the passage of time in the pre-DPF/post-DPF differential pressure at the DPF temperature of 426°C, 556°C and 647°C upon discharge of an exhaust gas having a smoke concentration of 20% from the engine.

[0040] DPF is a filter having a predetermined length in the flowing direction of the exhaust gas. There may be a case in which the temperature at the entrance to the DPF and the temperature at the exit of DPF are different from each other. However, the inlet temperature and the outlet temperature of DPF were set at the same value for execution of tests, by rendering the operating state a steady state.

[0041] As FIG. 2 shows, when the temperature of DPF is 426°C, the pre-DPF/post-DPF differential pressure is seen to increase over time. This is because the temperature of DPF is relatively low, so that PM in a concentration of 20% contained in the exhaust gas cannot be completely burned off, and PM continues to accumulate within DPF. Since the degree of PM accumulation is remarkable, the differential pressure is presumed to increase markedly.

[0042] When the temperature of DPF is 556°C or 647°C, by contrast, the pre-DPF/post-DPF differential pressure is found to be stable. This is because the temperature of DPF is relatively high, so that PM in a concentration of 20% contained in the exhaust gas can be completely burned off. That is, when PM flows into DPF, PM can be burned off at the same time. Even if PM accumulates in DPF, its accumulation is not excessive, and is to such a degree as not to influence the pre-DPF/post-DPF differential pressure.

[0043] FIG. 3 is a graph showing PM buildup or accumulation within DPF in terms of the relationship between the concentration of smoke discharged from the engine and the temperature of DPF. In this drawing, the amount of PM (g/h) accumulating per unit time in DPF is plotted on a map, with the vertical axis representing the concentration (%) of smoke in the exhaust gas discharged from the engine, and the horizontal axis representing the temperature (°C) of DPF. As in FIG. 2, the inlet temperature and the outlet temperature of DPF were set at the same value for execution of tests, by rendering the operating state a steady state.

[0044] An example of how FIG. 3 should be seen is shown. Let the temperature of DPFbe 650°C, for example. Inflow of the exhaust gas having a smoke concentration of 20% results in an accumulation rate of 0 g/h, because the amount of PM flowing in and the amount of PM being burned off in DPF are equal. When the exhaust gas having a smoke concentration of 35% is flowed in, the accumulation rate is 10 g/h, because the amount of PM flowing in is larger than the amount of PM being burned off in DPF. When the exhaust gas having a smoke concentration of less than 20% is flowed in, the accumulation rate is 0 g/h, because the amount of PM flowing in is smaller than the amount of PM being burned off in DPF. These findings are proof that under such conditions, DPF has a surplus capacity to remove PM (continuous regeneration region).

[0045] When the exhaust gas having a smoke concentration of 20% is flowed in, the accumulation rate is as follows: The accumulation rate is 0 g/h, if the temperature of DPF is 650°C, because the amount of PM flowing in

is equal to the amount of PM being burned off in DPF; the accumulation rate is 10 g/h, if the temperature of DPF is 575°C, because the amount of PM flowing in is larger than the amount of PM being burned off in DPF; the accumulation rate is 0 g/h, if the temperature of DPF is higher than 650°C, because the amount of PM flowing in is smaller than the amount of PM being burned off in DPF. These findings are proof that under such conditions, DPF has a surplus capacity to remove PM (continuous regeneration region).

[0046] FIG. 3 shows, in particular, the presence of a beneficial region downward of a region representing conditions under which the amount of PM flowing in is equal to the amount of PM being burned off in DPF and the accumulation rate of PM is 0 g/h, namely, a continuous regeneration region in which DPF has a surplus PM removing capacity and, even if the output of the engine is enhanced to increase the smoke concentration, the smoke regulation can be cleared, with the problems due to PM accumulation within DPF being resolved.

[0047] Even under conditions under which the amount of PM flowing in is larger than the amount of PM being burned off in DPF and the accumulation rate of PM is several grams/h, if the accumulation rate does not affect the pre-DPF/post-DPF differential pressure, there is likewise such a region in which even if the output of the engine is enhanced to increase the smoke concentration, the smoke regulation can be cleared, with the problems due to PM accumulation within DPF being resolved.

[0048] In the present embodiment, the above-described beneficial region is utilized in exercising control for increasing the output of the internal combustion engine while suppressing the excessive accumulation of PM in DPF. FIG. 4 is a view showing the method of control in the fuel injection control device for the internal combustion engine according to the present embodiment.

[0049] As shown in FIG. 4, a basic fuel injection quantity Q_B (numeral 31) is determined by the accelerator opening AP_s and the rotational speed Ne of the engine 1. Separately, a fuel injection quantity Q_{smoke} (numeral 32) according to the smoke concentration regulation is determined by the boost pressure P_B of the intake manifold and the rotational speed Ne of the engine 1. The smaller of these injection quantities is taken as an injection quantity Q_0 (numeral 33).

[0050] In detail, if the engine 1 is operated with the basic fuel injection quantity Q_B, the concentration of smoke discharged from the engine 1 may be higher than the predetermined concentration. Thus, regulation is effected by the fuel injection quantity Q_{smoke} determined by the map including the boost pressure P_B and the engine rotational speed Ne. The method of control over the internal combustion engine based on the so obtained injection quantity Q_0 is the conventional method of output control in consideration of the smoke concentration.

[0051] According to the present embodiment, if the temperature of the DPF 21 is lower than the predetermined temperature, the engine 1 is controlled based on the injection quantity Q_0. If the temperature of the DPF 21 is the predetermined temperature or higher, however, a correction for increasing (numeral 34) according to the DPF temperature is made to the injection quantity Q_0 for control of the engine 1.

[0052] The correction for increasing, made to the injection quantity Q_0 according to the temperature of the DPF 21, is made in the following manner: Basically, the correction for increasing (numeral 34) is made based on the outlet temperature (numeral 35) of the DPF 21 detected by the sensor 23b. That is, if the DPF outlet temperature reaches a temperature at which PM can be burned off, the correction for increasing according to this temperature is made to the injection quantity Q_0 to obtain an injection quantity Q_F.

[0053] The reason behind this procedure is as follows: If the DPF outlet temperature is high, the DPF inlet temperature is also generally high, so that the entire DPF 21 is in a filter state suitable for burning off PM. On the other hand, there is a case where the inlet temperature is high, while the outlet temperature is low. In this case, there is a possibility that PM cannot be removed in a low-temperature portion of the DPF 21.

[0054] As an auxiliary way of control, a correction is made (numeral 34) based on the inlet temperature (numeral 36) of the DPF 21 detected by the sensor 23a. This is because there is a case where the DPF outlet temperature is high, while the inlet temperature is low. Such a filter state does not mean that the entire DPF 21 is in a filter state suitable for burning off PM. Thus, the correction for increasing, which has been made according to the outlet temperature, is cancelled, and the injection quantity Q_0 is given as the injection quantity Q_F after correction.

[0055] A concrete correction for increasing will be explained. If the temperature of the DPF 21 was 680°C (both outlet temperature and inlet temperature), for example, the conventional control considering the smoke concentration used a smoke concentration not higher than the permissible smoke concentration of 30% (PM accumulation rate: 0 g/h), for example, a smoke concentration of 15%. Thus, the fuel injection quantity is corrected to be increased so that the smoke concentration will increase from 15% to 30%, whereby the engine output is increased.

[0056] In the above-mentioned case, the permissible smoke concentration may be set at 30% or higher, at an accumulation rate which does not influence the pre-DPF/post-DPF differential pressure of the DPF 21. In this case, the engine output can be increased further.

[0057] While the present invention has been described in the foregoing fashion, it is to be understood that the invention is not limited thereby, but may be varied in many other ways. In the above-described present embodiment, for example, fuel control is exercised based on the injection quantity Q_F, which has been obtained by making a correction according to the temperature of the DPF 21 to the injection quantity Q_0 obtained according to the

smoke regulation. However, fuel control may be effected based on an injection quantity obtained by direct temperature-dependent correction on the smoke concentration regulation injection quantity Q_{smoke}, or the basic fuel injection quantity Q_B, whichever is smaller. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the appended claims.

Claims

1. A fuel injection control device for an internal combustion engine, comprising:

fuel injection means (3) for supplying fuel to the internal combustion engine (1);
a filter (21), provided in an exhaust passage (12) of the internal combustion engine (1), for trapping particulate matter in an exhaust gas;
filter state detection means (23a, 23b) for detecting an index correlating with capacity of the filter (21) to burn off the particulate matter discharged from the internal combustion engine (1);
operating state detection means (15) for detecting an operating state of the internal combustion engine (1); and
injection control means (15) for controlling the fuel injection means (3) in accordance with a target fuel injection quantity corresponding value determined by a detection output of the operating state detection means (15), and

wherein the injection control means (15) corrects the target fuel injection quantity corresponding value so as to be increased, based on a detection output of the filter state detection means (23a, 23b).

2. The fuel injection control device for an internal combustion engine according to claim 1, **characterized in that**

the filter state detection means (23a, 23b) detects an index correlating with temperature of the filter (21), and
the injection control means (15) carries out the correction for increasing, if the filter (21) is found, based on the index, to be able to burn off the particulate matter.

3. The fuel injection control device for an internal combustion engine according to claim 2, **characterized in that**

the injection control means (15) sets the increase correction to be larger as the index is on a higher temperature side.

4. The fuel injection control device for an internal combustion engine according to claim 1, 2, or 3, **characterized in that**

the filter state detection means (23a, 23b) detects exhaust temperature downstream of the filter (21), and
the injection control means (15) sets the increase correction to be large in accordance with the exhaust temperature downstream of the filter (21) if the exhaust temperature downstream of the filter (21) is a first predetermined temperature or higher.

5. The fuel injection control device for an internal combustion engine according to claim 1, 2, or 3, **characterized in that**

the filter state detection means (23a, 23b) detects exhaust temperature upstream of the filter (21) and exhaust temperature downstream of the filter (21), and
the injection control means (15) makes the correction for increasing on conditions that the exhaust temperature downstream of the filter (21) is a first predetermined temperature or higher, and the exhaust temperature upstream of the filter (21) is a second predetermined temperature or higher.

6. The fuel injection control device for an internal combustion engine according to claim 1, 2, or 3, **characterized in that**

the filter state detection means (23a, 23b) detects exhaust temperature upstreamof the filter (21) and exhaust temperature downstream of the filter (21), and
the injection control means (15) makes the correction for increasing in accordance with the exhaust temperature downstream of the filter (21) and the exhaust temperature upstream of the filter (21).

7. The fuel injection control device for an internal combustion engine according to any of claims 1 to 6, **characterized in that**

the target fuel injection quantity corresponding value is restricted such that a concentration of smoke discharged from the internal combustion engine (1) is a predetermined concentration or lower.

8. The fuel injection control device for an internal combustion engine according to any of claims 1 to 7,

characterized in that

the injection control means (15) sets the target fuel injection quantity corresponding value within limits corresponding to boost pressure of the internal combustion engine (1), and corrects the target fuel injection quantity corresponding value, based on a detection output of the filter state detection means (23a, 23b), so as to be increased beyond the limits.

FIG. 1

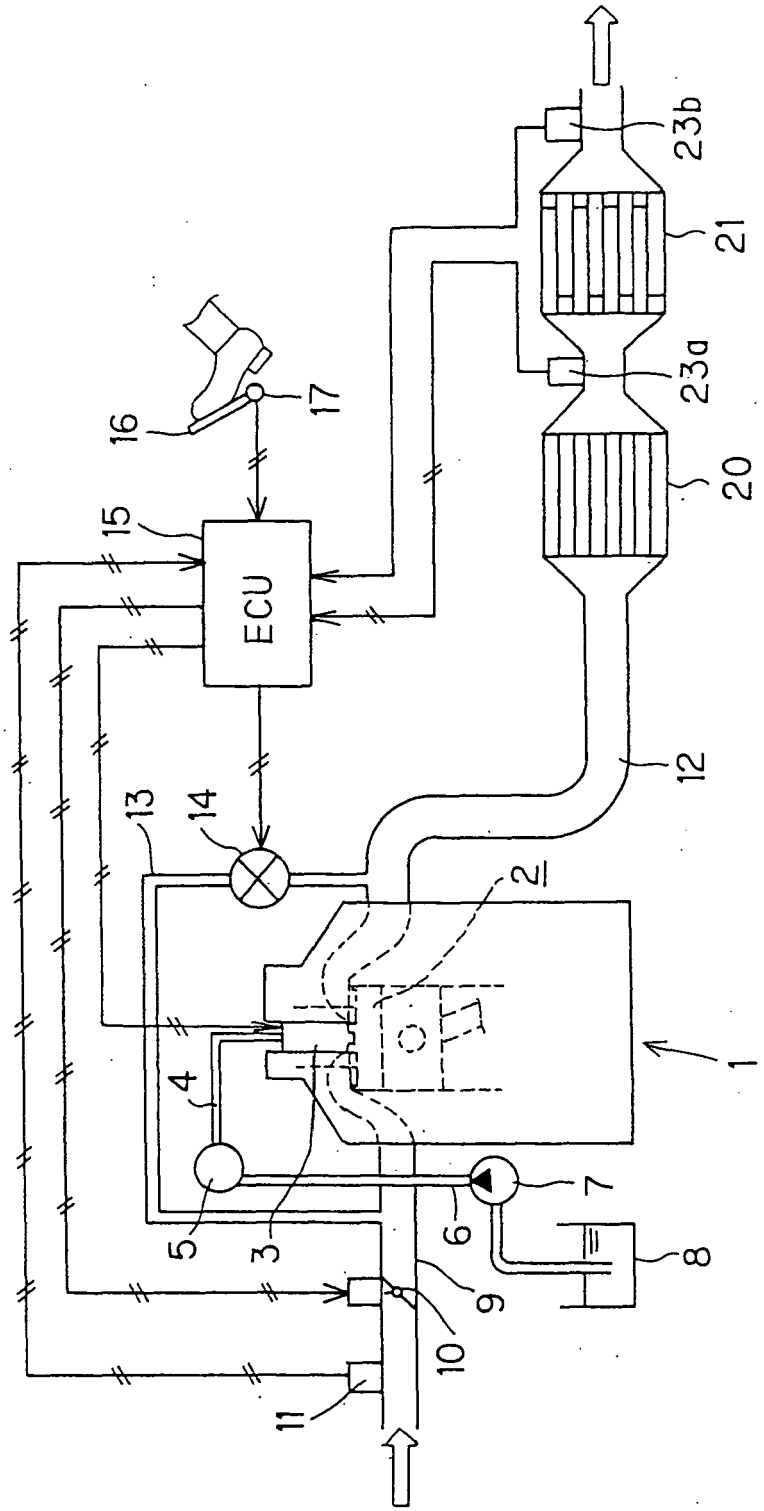


FIG. 2

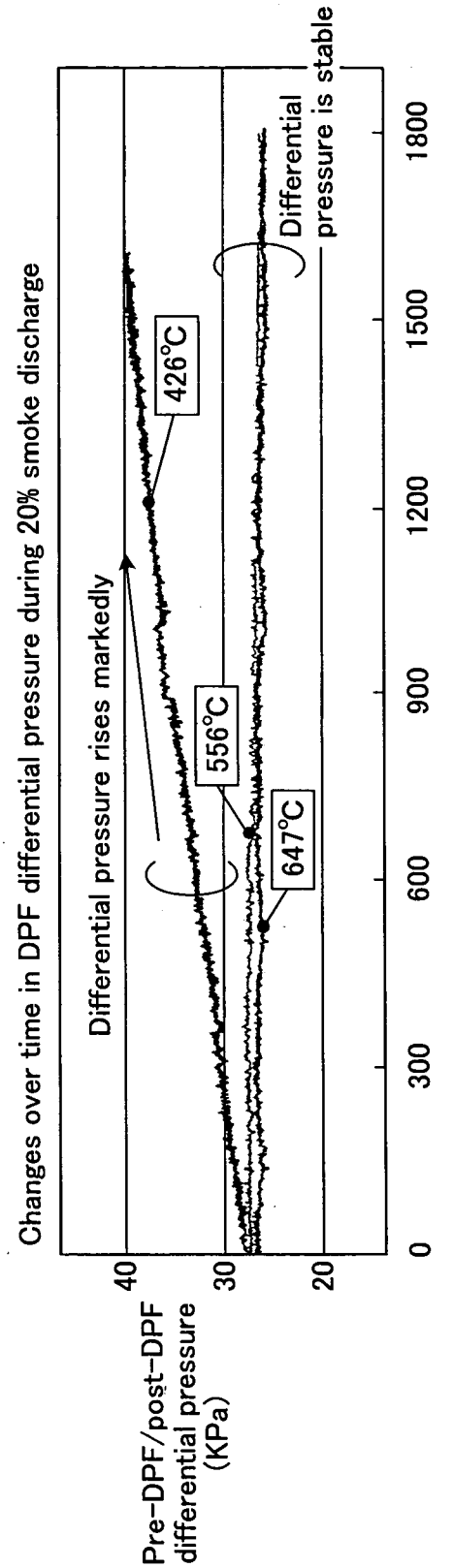

Changes over time in DPF differential pressure during 20% smoke discharge
Differential pressure rises markedly
426°C
556°C
647°C
Differential pressure is stable
Pre-DPF/post-DPF differential pressure (KPa)
40
30
20
0
300
600
900
1200
1500
1800
Time (seconds)

FIG. 3

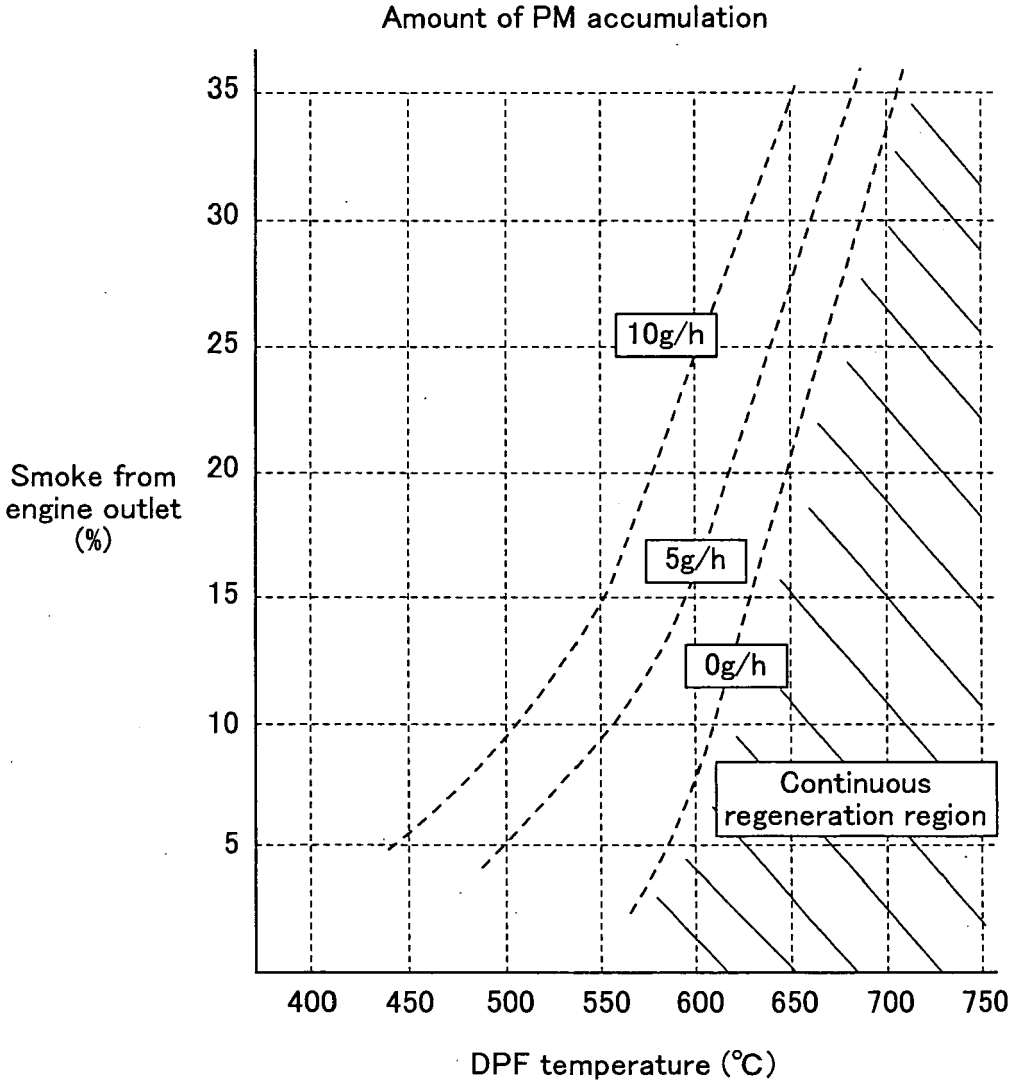
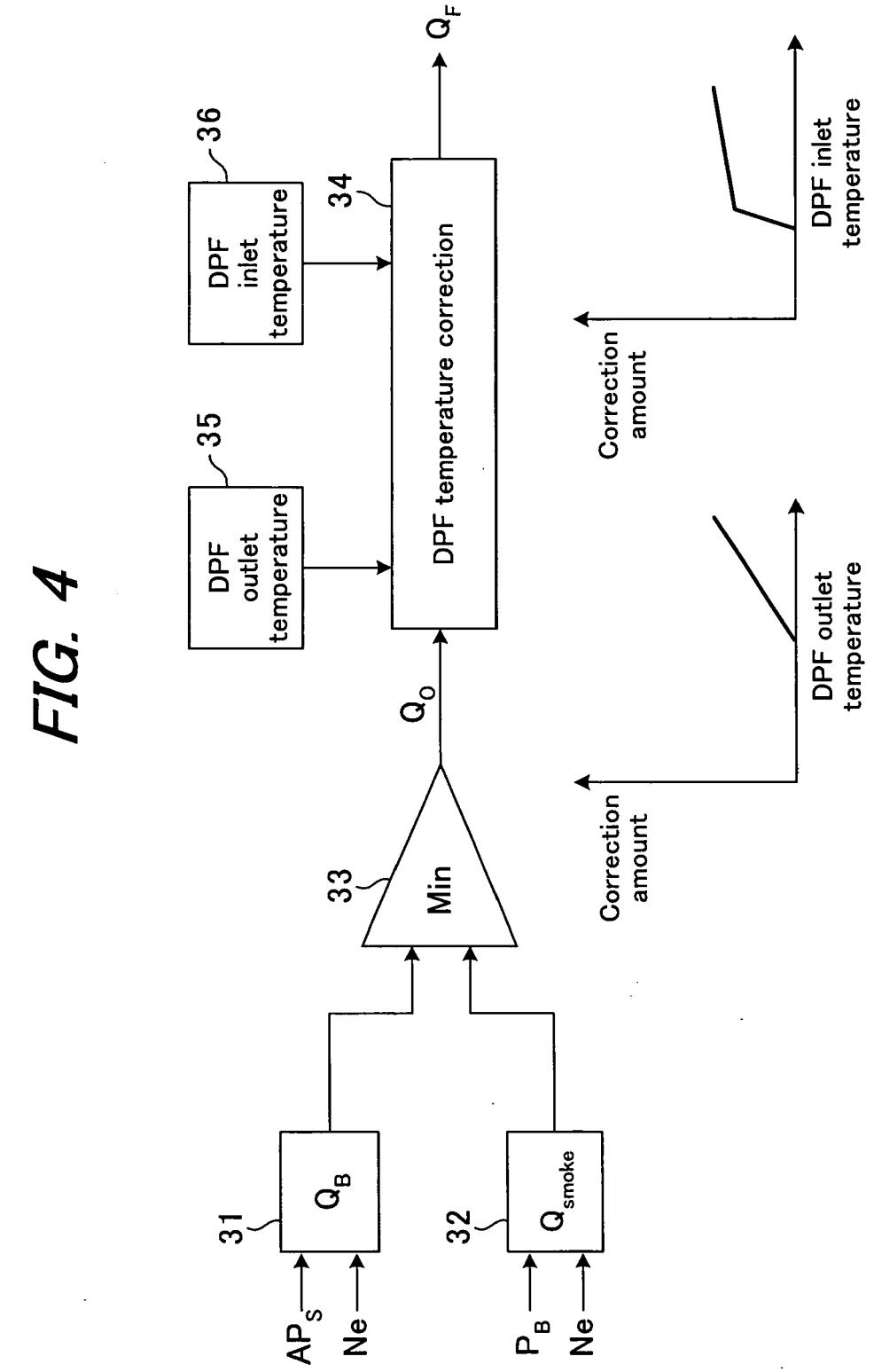

Amount of PM accumulation
35
30
25
20
15
10
5
Smoke from engine outlet (%)
10g/h
5g/h
0g/h
Continuous regeneration region
400
450
500
550
600
650
700
750
DPF temperature (°C)

FIG. 4


Q_F
36
DPF inlet temperature
34
DPF temperature correction
35
DPF outlet temperature
Q_O
33
Min
31
Q_B
32
Q_{smoke}
AP_S
Ne
P_B
Ne
Correction amount
DPF inlet temperature
Correction amount
DPF outlet temperature

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EUROPEAN SEARCH REPORT

Application Number
EP 05 02 2621

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	13 January 2006	Calabrese, N

CATEGORY OF CITED DOCUMENTS

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