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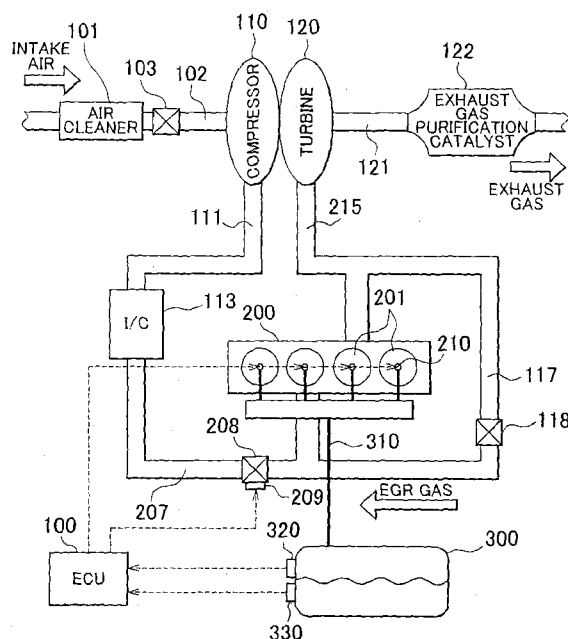
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(54) Title: CONTROL DEVICE AND CONTROL METHOD FOR INTERNAL COMBUSTION ENGINE

FIG. 1



(57) Abstract: A control device (100) controls an internal combustion engine (200) that uses any one of light oil and alcohol solely as fuel or a blend of light oil and alcohol as fuel. The control device includes: an alcohol concentration detection unit (420) that detects an alcohol concentration in the fuel; a load detection unit (430) that detects a load of the internal combustion engine; a fuel pressure adjustment unit (450) that changes an injection pressure of the fuel; and a control unit (440) that controls the fuel pressure adjustment unit so as to decrease the injection pressure of the fuel as the alcohol concentration in the fuel increases and as the load of the internal combustion engine decreases.



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CONTROL DEVICE AND CONTROL METHOD FOR INTERNAL COMBUSTION ENGINE

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BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The invention relates to the technical field of a control device and control method for an internal combustion engine that is able to use blended fuel that is a blend of light oil and alcohol.

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2. Description of Related Art

[0002] There is known an internal combustion engine of this type that uses blended fuel that is a blend of multiple fuels (for example, blended fuel of light oil and alcohol). The blend ratio of blended fuel may be variable by, for example, storing the multiple fuels respectively in different fuel tanks and then blending the multiple fuels. In this case, the blend ratio of blended fuel is determined on the basis of various conditions, such as the operating condition of the internal combustion engine, where appropriate. For example, Japanese Patent Application Publication No. 06-307307 (JP 06-307307 A) suggests a technique for controlling a blend ratio so as to fall within a set concentration range in order to prevent only one of fuels from being excessively injected so as to deteriorate exhaust gas property.

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[0003] On the other hand, the injection amount of blended fuel may be controlled on the basis of the types and blend ratio of fuels blended. For example, Japanese Patent Application Publication No. 2009-079582 (JP 2009-079582 A) suggests a technique for correcting an injection amount on the basis of whether blended fuel contains alcohol because there occurs a phenomenon that the volatility of blended fuel that contains alcohol increases when the starting temperature of an internal combustion

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engine falls within a predetermined range.

[0004] For example, in the case of blended fuel that is a blend of light oil and alcohol, when the rate of light oil is reduced, generation of black smoke after combustion may be suppressed; however, as light oil reduces, ignitability tends to deteriorate. In this way, the characteristic of blended fuel varies as the blend ratio varies, so it is desirable to execute fuel control on the basis of the blend ratio. In other words, if fuel control based on the blend ratio cannot be executed, various inconveniences may practically occur. Specifically, when appropriate fuel control is not executed in the case where the above described blended fuel of light oil and alcohol is used, unburned fuel may increase because of excessively lean air-fuel mixture or adhesion of air-fuel mixture to a wall surface.

[0005] Here, JP 06-307307 A describes control over the blend ratio of blended fuel but does not describe injection amount control over blended fuel that is blended in advance. In addition, JP 2009-079582 A describes control over the injection amount of blended fuel, which contains alcohol fuel, in a starting period but does not consider anything about occurrence of the above described excessively lean air-fuel mixture or adhesion of air-fuel mixture to a wall surface. Thus, these techniques cannot appropriately execute fuel control on the basis of the blend ratio of blended fuel and, as a result, it is difficult to avoid inconvenience, such as an increase in unburned fuel.

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SUMMARY OF THE INVENTION

[0006] The invention provides a control device and control method for an internal combustion engine, which are able to reduce unburned fuel in the internal combustion engine that uses blended fuel containing alcohol.

[0007] An aspect of the invention relates to a control device for an internal combustion engine that uses any one of light oil and alcohol solely as fuel or a blend of light oil and alcohol as fuel. The control device includes: an alcohol concentration detection unit that detects an alcohol concentration in the fuel; a load detection unit that detects a load of the internal combustion engine; a fuel pressure adjustment unit that

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changes an injection pressure of the fuel; and a control unit that controls the fuel pressure adjustment unit so as to decrease the injection pressure of the fuel as the alcohol concentration in the fuel increases and as the load of the internal combustion engine decreases.

5 [0008] The internal combustion engine according to the aspect of the invention is, for example, an internal combustion engine mounted on a vehicle and is able to use any one of light oil and alcohol solely as fuel or a blend of light oil and alcohol as fuel. That is, the internal combustion engine according to the aspect of the invention may be operated using blended fuel having various blend ratios of light oil and alcohol. The
10 internal combustion engine is configured to be able to extract force generated at the time when the above described blended fuel combusts in a fuel combustion chamber inside a cylinder as driving force via physical or mechanical transmitting portions, such as a piston, a connecting rod and a crankshaft, where appropriate.

 [0009] The control device controls the above described internal combustion
15 engine, and may be, for example, configured as a single or plurality of central processing units (CPUs), micro processing units (MPU), various processors or various controllers or may be configured as various computer systems, such as various processing units, various controllers and microcomputer devices, such as a single or plurality of electronic control
20 units (ECUs) that can further include various storage units, such as a read only memory (ROM), a random access memory (RAM), a buffer memory and a flash memory, where appropriate.

 [0010] During operation of the control device according to the aspect of the invention, the alcohol concentration detection unit detects the alcohol concentration in the fuel. The alcohol concentration detection unit is configured to include an alcohol
25 concentration sensor, or the like, provided in, for example, a fuel tank in which blended fuel is stored. The alcohol concentration detection unit may be configured to detect the alcohol concentration in the fuel as a specific numeric value or may be configured to detect whether the alcohol concentration in the fuel is higher than or lower than a preset reference value.

[0011] During operation of the control device according to the aspect of the invention, furthermore, the load detection unit detects the load of the internal combustion engine. The load detection unit is, for example, configured to include a sensor, or the like, that detects a throttle opening degree, an intake air mass, an accelerator operation
5 amount, or the like. The load detection unit may be configured to detect the load of the internal combustion engine as a specific numeric value or may be configured to detect whether the load of the internal combustion engine is higher than or lower than a preset reference value.

[0012] With the control device according to the aspect of the invention, the
10 injection pressure of the fuel is adjusted on the basis of the alcohol concentration detected by the above described alcohol concentration detection unit and the load of the internal combustion engine, detected by the load detection unit. Specifically, the fuel pressure adjustment unit that changes the injection pressure of the fuel is controlled by the control unit that determines the injection pressure on the basis of the alcohol concentration and
15 the load of the internal combustion engine.

[0013] Particularly, the control unit controls the fuel pressure adjustment unit so as to decrease the injection pressure of the fuel as the alcohol concentration in the fuel increases or as the load of the internal combustion engine decreases. The control unit, for example, stores a plurality of maps that indicate the correlation between the load of
20 the internal combustion engine and the injection pressure of the fuel by alcohol concentrations. Then, the control unit appropriately changes the map on the basis of the detected alcohol concentration to thereby determine the injection pressure of the fuel.

[0014] Here, as compared with light oil, alcohol is longer in period of time required for ignition because of a low cetane number, earlier in vaporization of fuel
25 because of a low boiling point and sprayed alcohol is easily atomized and vaporized because of a low kinematic viscosity and a low surface tension. Therefore, as the blend rate of alcohol (in other words, the alcohol concentration) in blended fuel increases, lean air-fuel mixture or adhesion of fuel to a combustion chamber wall surface may be suppressed. Particularly, in a low load condition that the compression end temperature

is low, such an advantageous effect is remarkably exercised.

[0015] Thus, when the injection pressure of fuel is decreased in the case where the alcohol concentration is high and the load of the internal combustion engine is low, unburned fuel may be reduced. Note that, in exchange for this, formation of air-fuel mixture deteriorates; however, alcohol produces a less amount of particulate matter (PM) than light oil. Thus, in the case of a high alcohol concentration, even when the injection pressure of fuel is decreased, it is possible to suppress production of PM.

[0016] As described above, with the control device according to the aspect of the invention, it is possible to reduce unburned fuel while suppressing production of PM in the internal combustion engine that uses blended fuel containing alcohol.

[0017] The control device according to the aspect of the invention may further include a refueling detection unit that detects refueling with the fuel, wherein the alcohol concentration detection unit may detect the alcohol concentration in the fuel each time the refueling has been detected.

[0018] According to this aspect, refueling of the internal combustion engine with the fuel is monitored by the refueling detection unit. The refueling detection unit is, for example, configured to include a sensor, or the like, that detects the amount of fuel stored in the fuel tank, and detects refueling when the amount of stored fuel increases.

[0019] In the above aspect, particularly, the alcohol concentration detection unit detects the alcohol concentration when refueling has been detected by the above described refueling detection unit. That is, the alcohol concentration detection unit does not constantly or periodically detect the alcohol concentration but it detects the alcohol concentration when refueling has been detected (more specifically, after refueling has been completed).

[0020] The alcohol concentration of blended fuel stored in the fuel tank fluctuates when the fuel tank is refueled with blended fuel having a different blend ratio. In other words, it is presumable that the alcohol concentration of blended fuel does not significantly fluctuate unless the fuel tank is refueled. Thus, when the alcohol concentration is detected in the case where refueling has been detected, it is possible to

efficiently detect the alcohol concentration at the timing at which the alcohol concentration can vary.

[0021] A second aspect of the invention relates to a control method for an internal combustion engine that uses any one of light oil and alcohol solely as fuel or a blend of light oil and alcohol as fuel. The control method includes: detecting an alcohol concentration in the fuel; detecting a load of the internal combustion engine; and decreasing an injection pressure of the fuel as the alcohol concentration in the fuel increases and as the load of the internal combustion engine decreases.

[0022] The operations and other advantages of the aspects of the invention will become apparent from the embodiment described below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] Features, advantages, and technical and industrial significance of exemplary embodiments of the invention will be described below with reference to the accompanying drawings, in which like numerals denote like elements, and wherein:

FIG. 1 is a schematic view that shows the overall configuration of an engine system;

FIG. 2 is a block diagram that shows the configuration of an ECU;

FIG. 3 is a flow chart that shows the process of changing a control map of a fuel injection pressure, executed by a control device for an internal combustion engine according to an embodiment;

FIG. 4 is a graph that shows the correlation between an alcohol concentration and a fuel injection pressure;

FIG. 5 is a flow chart that shows fuel injection control process executed by the control device for an internal combustion engine according to the embodiment; and

FIG. 6 is a graph that shows the correlation between an engine load and a fuel injection pressure.

DETAILED DESCRIPTION OF EMBODIMENTS

[0024] Hereinafter, an embodiment of the invention will be described with

reference to the accompanying drawings.

[0025] First, the overall configuration of an engine system according to the present embodiment will be described with reference to FIG. 1. Here, FIG. 1 is a schematic view that shows the overall configuration of the engine system. Note that, in
5 FIG. 1, for the sake of convenience of description, only elements deeply involved in the present embodiment within elements that constitute the engine system are selectively shown, and the other elements are omitted where appropriate.

[0026] In FIG. 1, the engine system according to the present embodiment is mainly formed of an ECU 100, a compressor 110, a turbine 120, an engine 200 and a fuel
10 tank 300.

[0027] The ECU 100 is an example of a "control device for an internal combustion engine" according to the aspect of the invention. The ECU 100 is an electronic control unit that, for example, includes a CPU, a ROM, a RAM, and the like, and that controls the overall operations of the engine system. The ECU 100 is
15 configured to be able to execute various controls in accordance with control programs stored in, for example, the ROM, or the like. The specific configuration of the ECU 100 will be described in detail later.

[0028] The compressor 110 compresses intake air and supplies the compressed air to the downstream side. The turbine 120 rotates as it is driven by exhaust gas
20 supplied from the engine 200 via an exhaust pipe 215. The turbine 120 is coupled to the compressor 110 via a shaft, and is configured to be able to rotate integrally with the compressor 110. That is, a turbocharger is formed of the turbine 120 and the compressor 110.

[0029] The engine 200 is a diesel engine that is a power source of a vehicle,
25 such as an automobile, and is an example of an "internal combustion engine" according to the aspect of the invention. The engine 200 is an in-line four-cylinder engine that is formed such that four cylinders 201 are arranged in line in a cylinder block.

[0030] An air cleaner 101, an intake air control valve 103, the compressor 110, an intercooler 113 and a throttle valve 208 are provided on the intake side of the engine

200 (that is, the upstream side of the cylinders 201).

[0031] The air cleaner 101 purifies air taken in from the outside, and supplies the air to the compressor 110 via an intake pipe 102. The mass of air supplied from the air cleaner 101 is controlled by the intake air control valve 103. The intercooler 113
5 provided downstream of the compressor 110 is configured to be able to cool intake air to thereby increase the supercharging efficiency of air.

[0032] A throttle valve 208 is installed downstream of the intercooler 113. The throttle valve 208 is configured such that the driving state of the throttle valve 208 is controlled by a throttle valve motor 209 that is electrically connected to the ECU 100.
10 Basically, the throttle valve motor 209 is controlled so as to be able to obtain the throttle opening degree of the throttle valve 208, corresponding to the operation amount of an accelerator pedal (not shown); instead, the throttle valve 208 may be configured to adjust the throttle opening degree through operation control over the throttle valve motor 209 without intervening an intention of a driver. That is, the throttle valve 208 is configured
15 as a kind of electronically controlled throttle valve.

[0033] Air-fuel mixture led from the intake side into any one of the cylinders 201 is ignited in a compression ignition manner and is subjected to the combustion stroke in that cylinder 201. As the combustion stroke ends, combusted air-fuel mixture (partially containing unburned air-fuel mixture) is emitted to a corresponding one of
20 exhaust ports (not shown) in the exhaust stroke subsequent to the combustion stroke. Exhaust gas emitted to the exhaust port is led to the exhaust pipe 215.

[0034] An EGR pipe 117, an HPLEGR control valve 118, the turbine 120 and an exhaust gas purification catalyst 122 are provided on the exhaust side of the engine 200 (that is, the downstream side of the cylinders 201).

25 [0035] The EGR pipe 117 is able to return exhaust gas, which is emitted from the engine 200 and flows in the exhaust pipe 215, to the intake pipe 207 that is the intake side of the engine 200. The EGR control valve 118 is provided in the EGR pipe 117, and is configured to be able to adjust the amount of EGR gas. The EGR control valve 118 is an electromagnetic on-off valve that is able to take, for example, binary fully open

and fully closed states. The EGR control valve 118 is electrically connected to the ECU 100, and the open/close state of the EGR control valve 118 is controlled by the ECU 100.

[0036] The exhaust gas purification catalyst 122 is provided in the exhaust pipe 121, and purifies HC (hydrocarbons), CO₂ (carbon dioxide) and NO_x (nitrogen oxides) contained in exhaust gas passing through the turbine 120.

[0037] The fuel tank 300 stores blended fuel of light oil and alcohol, which is used as fuel in the engine 200. Fuel stored in the fuel tank 300 is supplied to injectors 210 via a fuel supply pipe 310. The injectors 210 inject fuel to the corresponding cylinders 201. Note that the fuel injection pressure in each injector 210 is variable, and is controlled by the ECU 100.

[0038] The amount of fuel stored in the fuel tank 300 is detected by a fuel sensor 320, and may be transmitted to the ECU 100. In addition, the alcohol concentration of fuel is detected by an alcohol concentration sensor 330, and may be transmitted to the ECU 100. Note that the alcohol concentration of fuel may be detected not in the fuel tank 300 but in the fuel supply pipe 310, or the like.

[0039] Next, the specific configuration of the ECU 100 that is the control device for an internal combustion engine according to the present embodiment will be described with reference to FIG. 2. Here, FIG. 2 is a block diagram that shows the configuration of the ECU.

[0040] In FIG. 2, the ECU 100 includes a refueling detection unit 410, an alcohol concentration detection unit 420, an engine load detection unit 430, a fuel injection pressure determination unit 440 and a fuel injection pressure control unit 450.

[0041] The refueling detection unit 410 is an example of a "refueling detection unit" according to the aspect of the invention, and detects refueling of the fuel tank 300. Specifically, the refueling detection unit 410 uses the fuel sensor 320 to detect the residual amount of fuel in the fuel tank 300, and detects that refueling has been performed when the residual amount of fuel increases. Refueling detected by the refueling detection unit 410 may be transmitted to the alcohol concentration detection unit 420.

[0042] The alcohol concentration detection unit 420 is an example of an "alcohol concentration detection unit" according to the aspect of the invention, and detects the alcohol concentration of fuel stored in the fuel tank 300. The alcohol concentration detection unit 420 uses the alcohol concentration sensor 330 provided in the fuel tank 300 to detect the alcohol concentration of fuel. Note that the alcohol concentration may not be directly detected but it may be an indirectly calculated value (that is, an estimated value). The detected alcohol concentration may be transmitted to the fuel injection pressure determination unit 440.

[0043] The engine load detection unit 430 is an example of a "load detection unit" according to the aspect of the invention, and detects the load of the engine 200. The engine load detection unit 430 uses, for example, a throttle opening degree, an intake air mass, an accelerator operation amount, or the like, to detect (in other words, estimate) the load of the engine 200. The detected load of the engine 200 may be transmitted to the fuel injection pressure determination unit 440.

[0044] The fuel injection pressure determination unit 440 is an example of a "control unit" according to the aspect of the invention, and determines the pressure of fuel to be injected from each of the injectors 210. Specifically, the fuel injection pressure determination unit 440 determines the injection pressure of fuel on the basis of the alcohol concentration of fuel, detected by the alcohol concentration detection unit 420, and the load of the engine 200, detected by the engine load detection unit 430. The fuel injection pressure determination unit 440 stores, for example, a map, a mathematical expression, and the like, that indicates the correlation among the alcohol concentration of fuel, the load of the engine 200 and the injection pressure of fuel, and uses those maps, mathematical expression, and the like, to determine the fuel injection pressure.

[0045] The fuel injection pressure control unit 450 is an example of a "fuel pressure adjustment unit" according to the aspect of the invention, and is able to adjust the pressure of fuel injected from each of the injectors 210. The fuel injection pressure control unit 450 controls the injectors 210, and the like, so as to achieve the injection pressure determined by the above described fuel injection pressure determination unit

440.

[0046] The ECU 100 configured to include the above described units is an integrally configured electronic control unit, and is configured to execute all the operations associated with the above described units. However, the physical, mechanical and electrical configuration of the above described units according to the aspect of the invention is not limited to the above configuration. For example, these units may be formed of various computer systems, such as a plurality of ECUs, various processing units, various controllers and microcomputer devices.

[0047] Next, the process executed by the ECU 100 that is the control device for an internal combustion engine according to the present embodiment and the advantageous effects thereof will be described with reference to FIG. 3 to FIG. 6.

[0048] First, the process of changing the control map of the fuel injection pressure on the basis of the alcohol concentration will be described with reference to FIG. 3 and FIG. 4. Here, FIG. 3 is a flow chart that shows the process of changing the control map of the fuel injection pressure, executed by the control device for an internal combustion engine according to the present embodiment. In addition, FIG. 4 is a graph that shows the correlation between an alcohol concentration and a fuel injection pressure. In FIG. 3, during operation of the control device for an internal combustion engine according to the present embodiment, first, the refueling detection unit 410 detects whether the internal combustion engine has been refueled with fuel (step S101). Note that, when refueling has not been detected (NO in step S101), the following processes are omitted. That is, the following processes set refueling as a starting condition.

[0049] When the refueling detection unit 410 detects refueling with fuel (YES in step S101), the alcohol concentration detection unit 420 detects the alcohol concentration of fuel (step S102). The alcohol concentration of blended fuel stored in the fuel tank 300 fluctuates when the fuel tank 300 is refueled with blended fuel having a different blend ratio. In other words, it is presumable that the alcohol concentration of blended fuel does not significantly fluctuate unless the fuel tank 300 is refueled. Thus, when the alcohol concentration is detected in the case where refueling has been detected,

it is possible to efficiently detect the alcohol concentration at the timing at which the alcohol concentration can vary.

[0050] When the alcohol concentration has been detected, the fuel injection pressure determination unit 440 changes the control map for determining the fuel injection pressure on the basis of the detected alcohol concentration (step S103). Specifically, the fuel injection pressure determination unit 440 stores a plurality of control maps by alcohol concentrations for determining the fuel injection pressure. Then, the fuel injection pressure determination unit 440 selects the control map, corresponding to the detected alcohol concentration, from among the plurality of control maps. By so doing, fuel injection control based on the alcohol concentration is executed.

[0051] Here, particularly, the control maps for determining the fuel injection pressure each are set such that, as the alcohol concentration increases, the fuel injection pressure decreases. Thus, the correlation between an alcohol concentration and a fuel injection pressure is, for example, as shown in FIG. 4.

[0052] Next, a fuel injection control process based on the control map of the fuel injection pressure will be described with reference to FIG. 5 and FIG. 6. Here, FIG. 5 is a flow chart that shows the fuel injection control process executed by the control device for an internal combustion engine according to the present embodiment. In addition, FIG. 6 is a graph that shows the correlation between an engine load and a fuel injection pressure.

[0053] In FIG. 5, when fuel injection control is executed, first, the engine load detection unit 430 detects the load of the engine 200 (step S201).

[0054] When the load of the engine 200 has been detected, the fuel injection pressure determination unit 440 determines the fuel injection pressure using the control map (step S202). Specifically, the control map used by the fuel injection pressure determination unit 440 is a map that indicates the correlation between a load of the engine 200 and a fuel injection pressure as shown in FIG. 6, and, as the load of the engine 200 decreases, the fuel injection pressure is determined so as to be a lower value.

[0055] Note that the map shown in FIG. 6 is selected from among the plurality

of maps on the basis of the alcohol concentration as described above. Thus, the fuel injection pressure is determined so as to be a lower value as the alcohol concentration increases and as the load of the engine 200 decreases.

[0056] When the fuel injection pressure determination unit 440 determines the fuel injection pressure, the fuel injection pressure control unit 450 executes fuel injection control based on the determined value. By so doing, in the injectors 210 that inject fuel, the injection pressure determined by the fuel injection pressure determination unit 440 is achieved.

[0057] Here, as compared with light oil, alcohol contained in blended fuel is longer in period of time required for ignition because of a low cetane number, earlier in vaporization of fuel because of a low boiling point and sprayed alcohol is easily atomized and vaporized because of a low kinematic viscosity and a low surface tension. Therefore, as the blend rate of alcohol (in other words, the alcohol concentration) in blended fuel increases, lean air-fuel mixture or adhesion of fuel to a combustion chamber wall surface may be suppressed. Particularly, in a low load condition that the compression end temperature is low, such an advantageous effect is remarkably exercised.

[0058] Thus, as described above, when the injection pressure of fuel is decreased in the case where the alcohol concentration is high and the load of the internal combustion engine is low, unburned fuel may be reduced. Note that, in exchange for this, formation of air-fuel mixture deteriorates; however, alcohol produces a less amount of PM than light oil. Thus, in the case of a high alcohol concentration, even when the injection pressure of fuel is decreased, it is possible to suppress production of PM.

[0059] As described above, with the control device for an internal combustion engine according to the present embodiment, it is possible to reduce unburned fuel while suppressing production of PM in the internal combustion engine that uses blended fuel containing alcohol.

[0060] Note that, in the above described embodiment, the method in which the control map is selected on the basis of the alcohol concentration and then the fuel

injection pressure is determined on the basis of the load of the engine 200 is described; however, as long as a method that determines the fuel injection pressure so as to be a lower value as the alcohol concentration increases and as the load of the engine 200 decreases, another method may also be used. That is, a specific method for determining
5 the fuel injection pressure is not specifically limited.

[0061] The aspect of the invention is not limited to the above described embodiment but it may be appropriately modified within the scope of the appended claims and without departing from the summary or idea of the invention read from the entire specification, and the control device for an internal combustion engine, modified in
10 such a way, is also included in the technical scope of the invention.

CLAIMS:

1. A control device for an internal combustion engine that uses any one of light oil and alcohol solely as fuel or a blend of light oil and alcohol as fuel, characterized by comprising:

an alcohol concentration detection unit that detects an alcohol concentration in the fuel;

a load detection unit that detects a load of the internal combustion engine;

a fuel pressure adjustment unit that changes an injection pressure of the fuel; and

a control unit that controls the fuel pressure adjustment unit so as to decrease the injection pressure of the fuel as the alcohol concentration in the fuel increases and as the load of the internal combustion engine decreases.

2. The control device according to claim 1, further comprising a refueling detection unit that detects refueling with the fuel, wherein

the alcohol concentration detection unit detects the alcohol concentration in the fuel each time the refueling has been detected.

3. A control method for an internal combustion engine that uses any one of light oil and alcohol solely as fuel or a blend of light oil and alcohol as fuel, characterized by comprising:

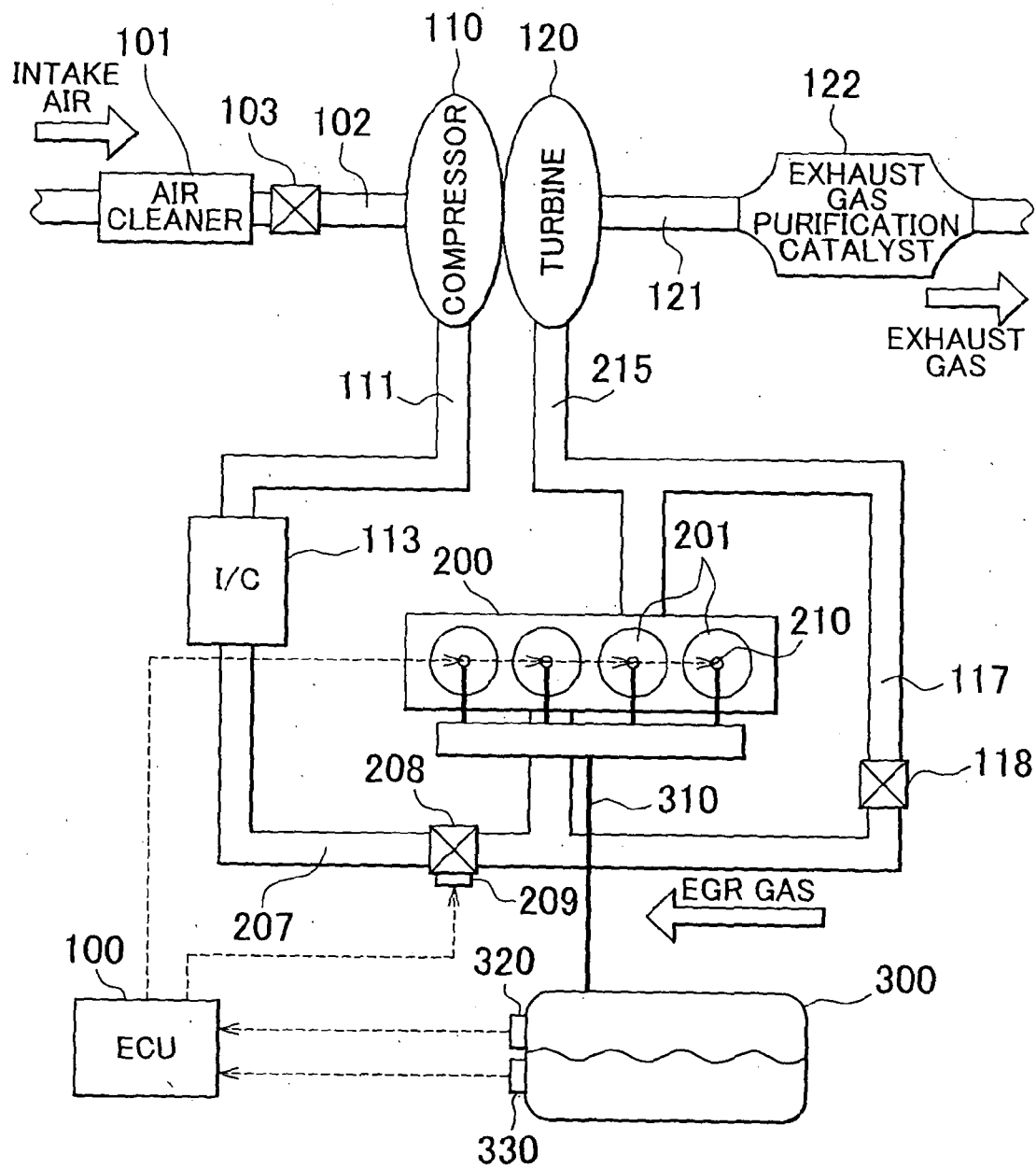
detecting an alcohol concentration in the fuel;

detecting a load of the internal combustion engine; and

decreasing an injection pressure of the fuel as the alcohol concentration in the fuel increases and as the load of the internal combustion engine decreases.

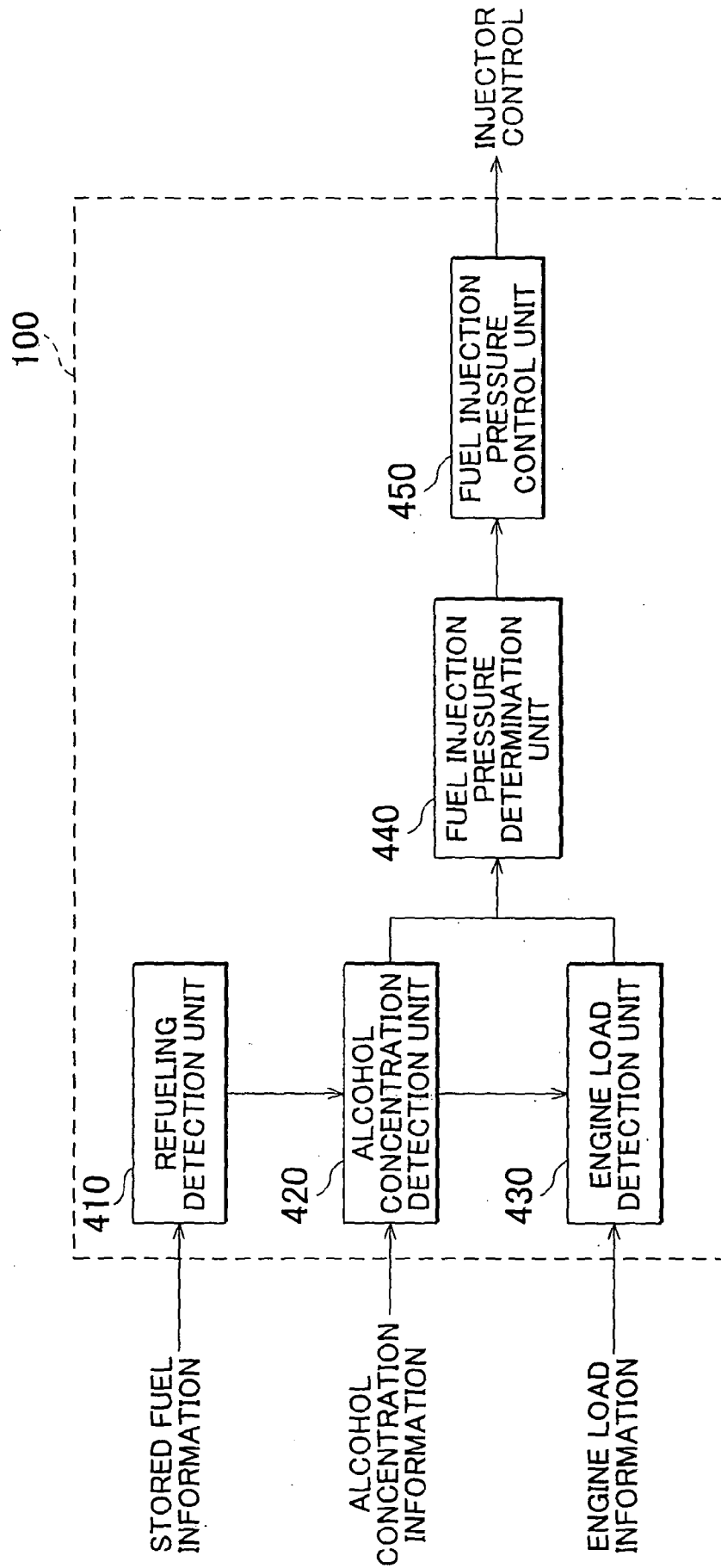
4. The control method according to claim 3, wherein the alcohol concentration in the fuel is detected each time the refueling has been detected.

FIG. 1



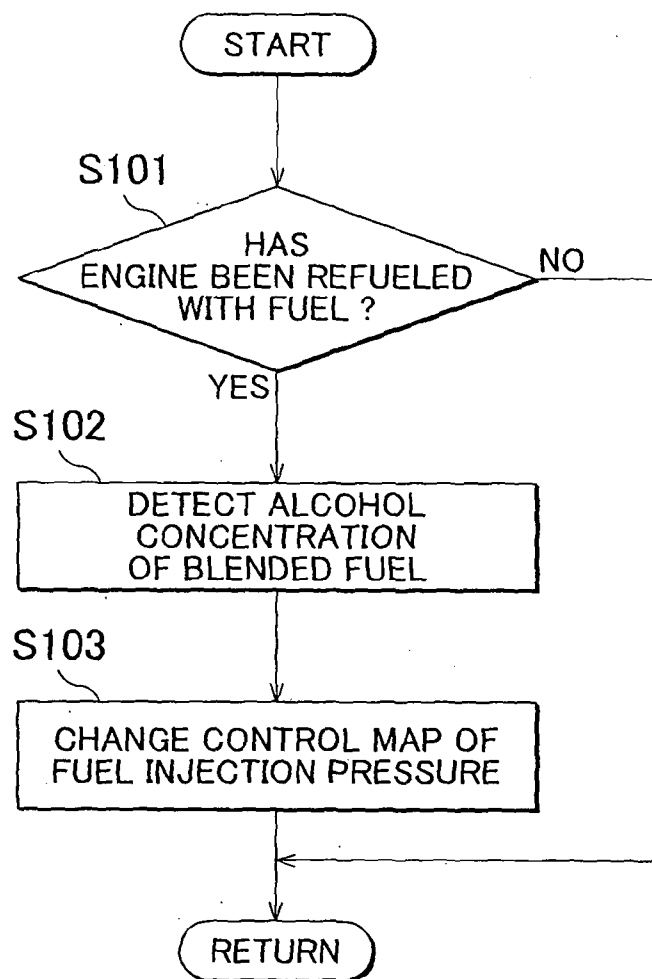
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FIG. 2



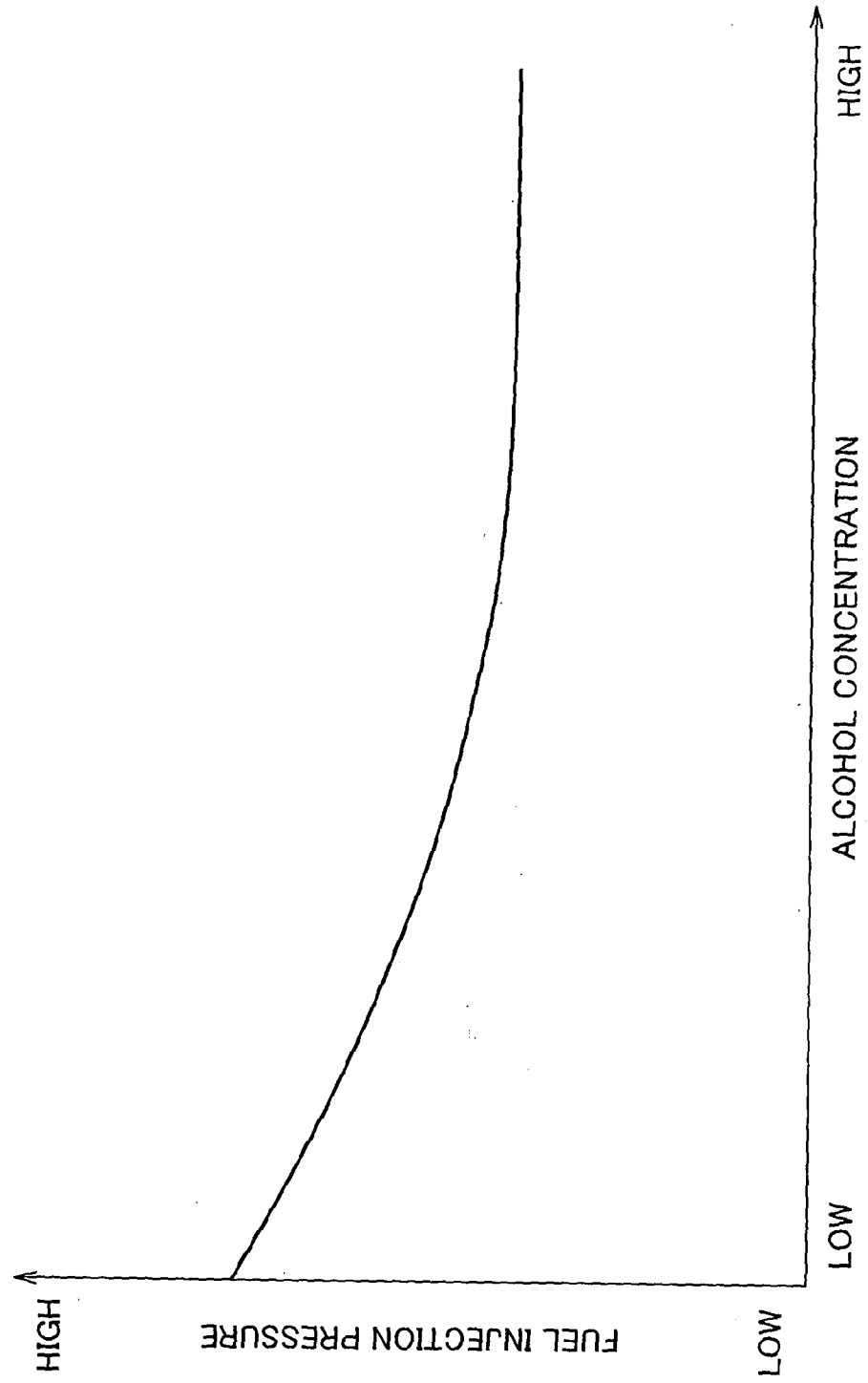
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FIG. 3



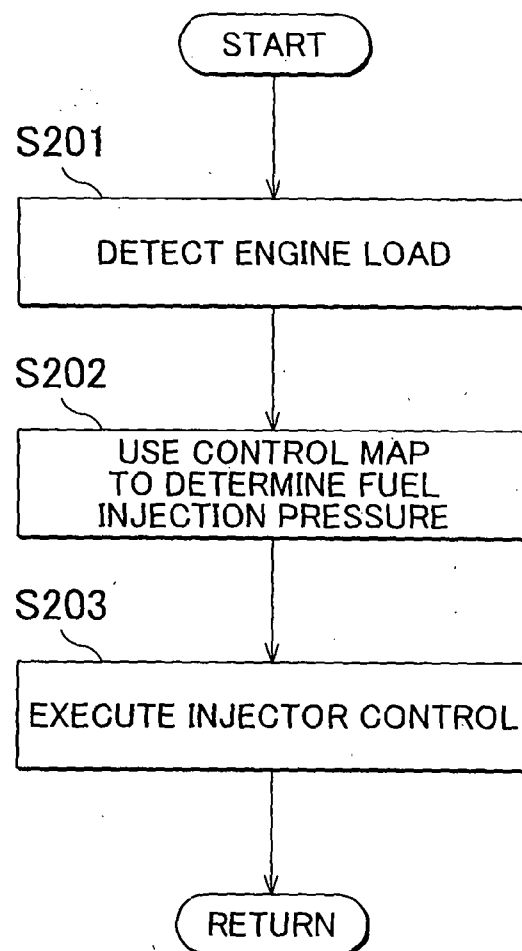
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FIG. 4



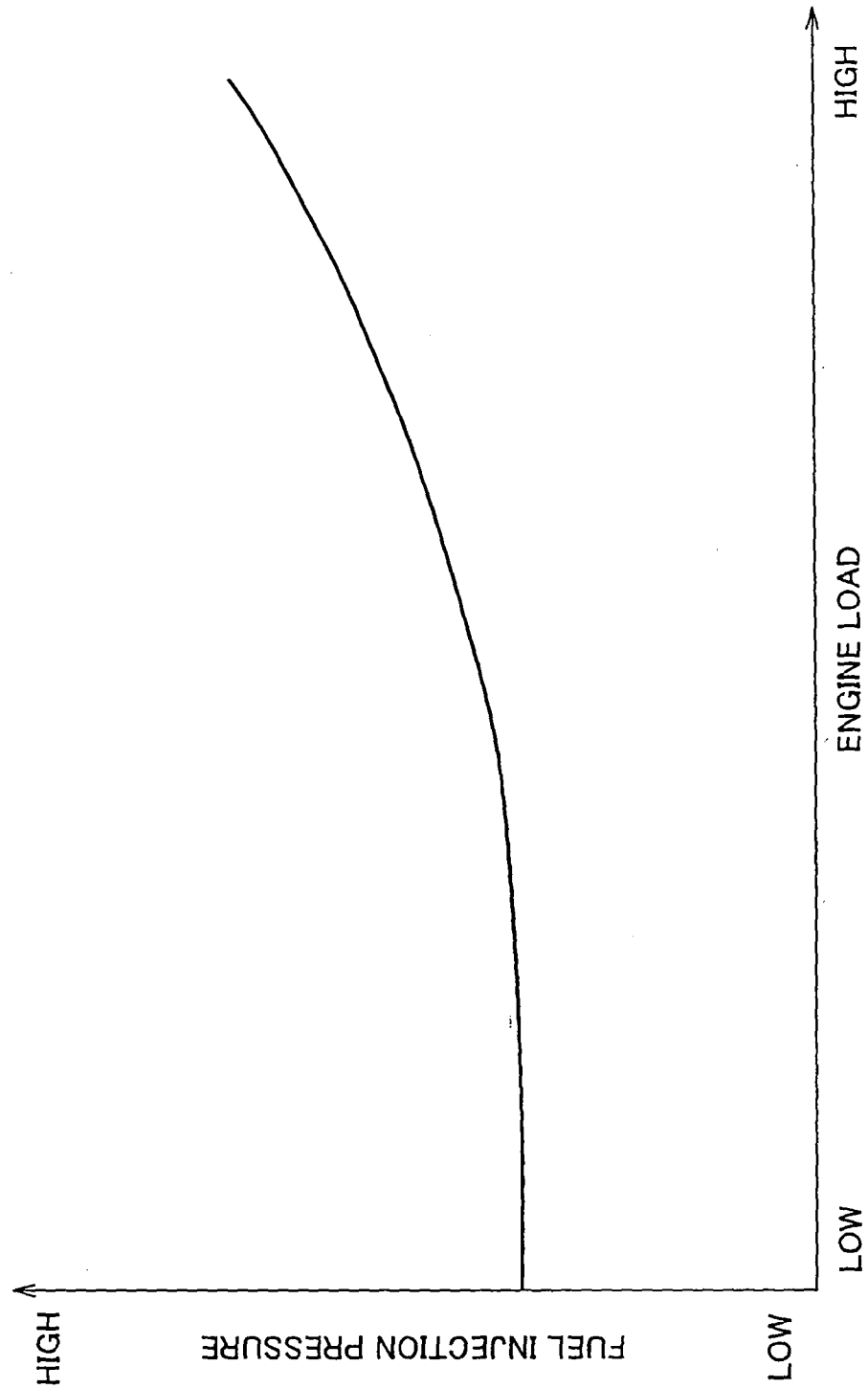
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FIG. 5



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FIG. 6



INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2012/001200

A. CLASSIFICATION OF SUBJECT MATTER

INV. F02D19/08 F02D19/06 F02D41/38 F02D41/00
ADD.

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)
F02D

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

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

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

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International application No
PCT/IB2012/001200

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