



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
06.03.2013 Bulletin 2013/10

(51) Int Cl.:
F02D 17/00 (2006.01) **F02D 29/02** (2006.01)
F02D 41/06 (2006.01)

(21) Application number: **10850693.2**

(86) International application number:
PCT/JP2010/057475

(22) Date of filing: **27.04.2010**

(87) International publication number:
WO 2011/135674 (03.11.2011 Gazette 2011/44)

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR

(72) Inventor: **ENOMOTO, Hiroshi**
Toyota-shi, Aichi 471-8571 (JP)

(71) Applicant: **TOYOTA JIDOSHA KABUSHIKI KAISHA**
Toyota-shi,
Aichi-ken, 471-8571 (JP)

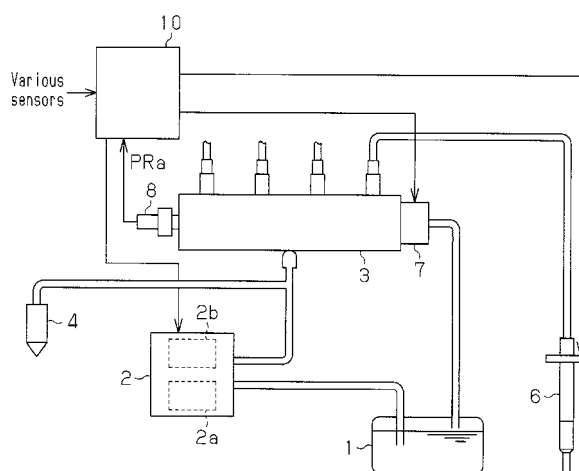
(74) Representative: **Winter, Brandl, Fűrnis, Hübner, Röss, Kaiser, Polte - Partnerschaft**
Bavariaring 10
80336 München (DE)

(54) **CONTROLLER FOR DIESEL ENGINE**

(57) Disclosed is an electronic controller for a diesel engine that includes a supply pump (2) for supplying fuel under pressure to a common rail (3) provided on a fuel supply line, the supply pressure level of the supply pump (2) being controllable, and a pressure reducing valve (7) for reducing the pressure of fuel in the common rail (3) (the rail pressure). The controller (10) automatically stops the engine when predetermined automatic stop conditions are satisfied during idling of the engine as well as restarts the engine when predetermined restart conditions are satisfied while the engine is at an automatic

standstill. Furthermore, the controller (10) controls the supply pressure level of the supply pump (2) so as to make the rail pressure higher for the engine at an automatic standstill than a target value (PR_{idle}) of the rail pressure during idling. The controller (10) also holds the pressure reducing valve (7) closed while the engine is at an automatic standstill and as well provides control to the degree of opening of the pressure reducing valve (7) so that when the engine is restarted, the rail pressure is at a target pressure (target rail pressure at restart) that is required for a restart.

Fig.1



Description

TECHNICAL FIELD

[0001] The present invention relates to a controller for a diesel engine that automatically stops an engine when a predetermined automatic stop condition is met during idling of the engine, and restarts the engine when a predetermined restart condition is met during the automatic stop of the engine.

BACKGROUND ART

[0002] Such a type of controller for a diesel engine, for example, is disclosed in Patent Document 1. Conventional typical controllers for a diesel engine including the controller disclosed in Patent Document 1 automatically stop an engine by stopping fuel injection when an automatic stop condition is met, that is, when stepping of an accelerator pedal is removed during idling of the engine, a brake pedal is stepped on, and the traveling of the vehicle is stopped. Furthermore, the conventional general controller for a diesel engine performs cranking by driving a starter and performs the restart of the engine by performing the fuel injection when a restart condition is met, that is, the stepping of the brake pedal is removed during the automatic stop of the engine. As described above, unnecessary fuel injection is prevented when the traveling of the vehicle is stopped, resulting in a reduction of fuel consumption or emission of carbon dioxide.

[0003] Furthermore, the diesel engine is provided with a fuel pump capable of pressure-feeding fuel to an accumulator container provided in a fuel supply system of the engine and controlling a pressure-feeding mode of the fuel, and a pressure reducing valve for reducing fuel pressure in the accumulator container. The diesel engine allows the accumulator container to be in a substantially sealed state by closing the pressure reducing valve during the automatic stop of the engine, thereby maintaining a high fuel pressure. In this way, the diesel engine promptly performs initial fuel injection at the time of the restart of the engine, thereby shortening the start-up time.

PRIOR ART DOCUMENT

Patent Document

[0004]

Patent Document 1: Japanese Laid-Open Patent Publication No. 2010-24848

SUMMARY OF THE INVENTION

Problems that the Invention is to Solve

[0005] However, in the diesel engine, during the automatic stop of the engine, fuel leaks, although slightly,

from each part constituting the fuel supply system, such as the fuel injection valve, the fuel pump, or the pressure reducing valve. Therefore, in the state in which the automatic stop of the engine continues for a certain period of time, the fuel pressure in the accumulator container is reduced when the restart of the engine starts. As a consequence, at the time of the restart, it is not possible to perform initial fuel injection until the fuel pressure is increased to a predetermined degree through the fuel pressure-feeding by the fuel pump, and thus, there is a problem that it is not possible to reliably shorten the start-up time.

[0006] Accordingly, it is an objective of the present invention to provide a controller for a diesel engine capable of reliably shortening start-up time at the restart of the engine.

Means for Solving the Problems

[0007] Hereinafter, means for solving the above-described problems and the operation and effect thereof will be described.

[0008] The present invention provides a controller for a diesel engine being applied to a diesel engine. The diesel engine is provided with a fuel pump for pressure-feeding fuel to an accumulator container provided in a fuel supply system of the engine and capable of controlling a pressure-feeding mode of the fuel and a pressure reducing valve for reducing fuel pressure in the accumulator container. The controller automatically stops the engine when a predetermined automatic stop condition is met during idling of the engine and restarts the engine when a predetermined restart condition is met during the automatic stop of the engine. The controller includes a pump control unit and an opening degree control unit. The pump control unit controls a pressure-feeding mode of the fuel pump such that the fuel pressure in the accumulator container at the automatic stop of the engine is higher than a target value of fuel pressure during idling. The opening degree control unit controls an opening degree of the pressure reducing valve such that the pressure reducing valve is maintained in a valve-closed state during the automatic stop of the engine, and that the fuel pressure in the accumulator container at the restart of the engine becomes equal to a target pressure required at a time of restart.

[0009] With such a configuration, when the fuel pressure in the accumulator container at the automatic stop of the engine is higher than the target value of the fuel pressure during idling, and the pressure reducing valve is maintained in a valve-closed state during the automatic stop of the engine, the fuel pressure in the accumulator container when the engine is restarted can be increased, as compared with the case in which such control is not performed. Furthermore, at the restart of the engine, for example, if the fuel pressure in the accumulator container is higher than the target pressure, the pressure reducing valve is opened, and the fuel pressure can thereby be

made to reach the target pressure easily and promptly, so that initial fuel injection can be promptly performed at the time of the restart. Consequently, at the restart of the engine, it is possible to reliably shorten the start-up time.

[0010] The opening degree control unit may control the opening degree of the pressure reducing valve such that the fuel pressure in the accumulator container at the automatic stop of the engine becomes equal to a predetermined pressure higher than the target value. With such a configuration, at the automatic stop of the engine, the opening degree of the pressure reducing valve is controlled in addition to the control of the pressure-feeding mode of the fuel pump. In this way, it is possible to easily allow the fuel pressure in the accumulator container to be a predetermined pressure higher than the target value of the fuel pressure during idling through the opening degree control of the pressure reducing valve. In this case, for example, it is possible to employ a control mode in which the pressure reducing valve is closed when the fuel pressure in the accumulator container is lower than the predetermined pressure, but is opened when the fuel pressure in the accumulator container is equal to or more than the predetermined pressure.

[0011] The pump control unit may control the pressure-feeding mode of the fuel pump such that the fuel pressure in the accumulator container at the automatic stop of the engine becomes equal to the predetermined pressure higher than the target value.

[0012] The fuel pump may include a control valve, which adjusts an intake amount of fuel, and an engine-driven type pressurizing unit. In this case, as with such a configuration, for example, when the fuel pressure in the accumulator container is equal to or more than the target pressure, the pump control unit controls the opening degree of the control valve to a second opening degree smaller than a first opening degree, thereby restricting the pressure-feeding amount of fuel by the fuel pump. This suppresses an increase in the engine load caused by the driving of the fuel pump.

[0013] At the restart of the engine, the pump control unit may control the opening degree of the control valve to be in a fully-opened state when the fuel pressure in the accumulator container is lower than the target pressure, and controls the opening degree of the control valve to be in a half-opened state when the fuel pressure in the accumulator container is equal to or more than the target pressure. In this case, as compared to a configuration in which the opening degree of the control valve is controlled to be in a fully closed state when the fuel pressure in the accumulator container is equal to or more than the target pressure, it is possible to facilitate the fuel pressure-feeding when the control valve is fully opened and the fuel pressure-feeding is performed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

Fig. 1 is a schematic configuration diagram illustrating a fuel supply system of a diesel engine with respect to a controller for a diesel engine according to the present invention;

Fig. 2 is a flowchart illustrating a processing procedure of fuel pressure control at the time of automatic stop in an embodiment; and

Fig. 3 is a flowchart illustrating a processing procedure of fuel pressure control at the time of restart in the embodiment.

MODES FOR CARRYING OUT THE INVENTION

[0015] Hereinafter, a controller for a diesel engine according to one embodiment of the present invention will be described. In the embodiment, the controller is embodied as a controller for a common rail type diesel engine mounted on a vehicle.

[0016] Fig. 1 illustrates a schematic configuration of a fuel supply system of a diesel engine (hereinafter, referred to as an engine) in the present embodiment.

[0017] As illustrated in Fig. 1, the fuel supply system of the engine is provided with a supply pump 2 that pumps fuel from a fuel tank 1 and pressurizes and discharges the fuel. The supply pump 2 is provided with a plunger that reciprocates in synchronization with rotation of an engine output shaft, intakes fuel from the fuel tank 1 through the reciprocation of the plunger, and pressure-feeds the fuel to a common rail 3, which is an accumulator container. The supply amount of fuel by the supply pump 2 is adjusted based on an open and close operation of a control valve 2a. The control valve 2a is electrically opened and closed. The configuration of the supply pump 2 for pressing fuel through the plunger corresponds to a pressurizing unit 2b according to the present invention. Also, the supply pump 2 supplies the pressurized fuel to a fuel addition valve 4 that adds fuel also to an exhaust system of the engine.

[0018] An injector 6 of each cylinder of the engine is connected to the common rail 3. Furthermore, the common rail 3 is provided with a pressure reducing valve 7, which reduces the fuel pressure (hereinafter, referred to as rail pressure) in the common rail 3, and a fuel pressure sensor 8, which detects the actual rail pressure (hereinafter, referred to as actual rail pressure PRa). The pressure reducing valve 7 is electrically opened and closed.

[0019] The engine provided with the fuel supply system is controlled by an electronic controller 10. The electronic controller 10 is provided with a central processing unit (hereinafter, referred to as CPU), a read only memory (hereinafter, referred to as ROM), a random access memory (hereinafter, referred to as RAM), and an input/output port (hereinafter, referred to as I/O). The CPU performs various arithmetic processes related to engine control, and the ROM stores programs and data to be used for the engine control. Furthermore, the RAM temporarily stores arithmetic results of the CPU, detection results of sensors, and the like, and the I/O allows signals

to be transmitted/received to/from the exterior. In addition to the actual rail pressure PRa detected by the fuel pressure sensor 8, the electronic controller 10 receives detection results of the engine speed, the accelerator operation amount, the air intake amount, the air intake pressure, the temperature of engine cooling water, the outside air temperature, the running speed of the vehicle, the stepping state of the brake pedal, the shift operation position of the transmission (not illustrated), and the like, or information on an engine start command, an engine stop command and the like from the ignition switch.

[0020] As a part of the engine control, the electronic controller 10 controls the operation of the supply pump 2, specifically, the opening degree of the control valve 2a, based on the detection results of the fuel pressure sensor 8 and the like in order to ensure required rail pressure. Furthermore, the electronic controller 10 controls the operation of the injector 6, thereby performing fuel injection control.

[0021] Moreover, even though an OFF operation of the ignition switch is not performed, when a predetermined automatic stop condition is met, the electronic controller 10 determines that the engine stop command is output to the engine to stop fuel injection from the injector 6, thereby automatically stopping the engine.

[0022] Furthermore, even though an ON operation of the ignition switch is not performed, when a predetermined restart condition is met during the automatic stop of the engine, the electronic controller 10 determines that the engine start command is output to the engine to perform the energization of the starter motor, thereby performing the restart of the engine.

[0023] During the automatic stop of the engine, the electronic controller 10 allows the common rail 3 to be in a substantially sealed state by closing the pressure reducing valve 7, thereby maintaining the rail pressure in a high state. In this way, the diesel engine promptly performs initial fuel injection at the time of the restart of the engine, thereby shortening the start-up time.

[0024] However, as described above, in the diesel engine, during the automatic stop of the engine, fuel actually leaks, although slightly, from each part constituting the fuel supply system, such as the injector 6, the supply pump 2, or the pressure reducing valve 7. Therefore, in the state in which the automatic stop of the engine has continued to a certain degree, the rail pressure is reduced when the restart of the engine starts. As a consequence, at the time of the restart, since it is not possible to perform initial fuel injection until the rail pressure is increased to a predetermined degree through the fuel pressure-feeding by the supply pump 2, there is a problem that it is not possible to reliably shorten the start-up time.

[0025] In this regard, in the present embodiment, the pressure-feeding mode of the supply pump 2 is controlled through the electronic controller 10 such that the rail pressure at the automatic stop of the engine is higher than a target value $PRidle$ of the rail pressure during idling, specifically, that the rail pressure becomes equal to a pre-

determined pressure (hereinafter, referred to as target rail pressure $PRstp$ at the time of automatic stop) higher than the target value $PRidle$. Furthermore, the opening degree of the pressure reducing valve 7 is controlled such that the pressure reducing valve 7 is maintained in a valve-closed state during the automatic stop of the engine, and the rail pressure at the restart of the engine becomes equal to a target pressure (a target rail pressure $PRstrt$ at the time of restart) required at the time of restart. In this way, the rail pressure when it starts to restart the engine is increased, so that the start-up time is thereby reliably shortened.

[0026] With reference to the flowchart of Fig. 2, the fuel pressure control at the time of the automatic stop will be described. A series of processes illustrated in the flowchart is repeated with a predetermined cycle during the energization of the electronic controller 10.

[0027] As illustrated in Fig. 2, in the series of processes, it is first determined whether the automatic stop condition is met (step S11). For example, it is determined whether the automatic stop condition is met according to whether conditions (a) to (d) illustrated below are met.

- (a) The shift operation position is the neutral position or the drive position.
- (b) The running speed of the vehicle is equal to or less than a predetermined speed.
- (c) The accelerator stepping amount is 0.
- (d) The brake pedal is stepped on.

[0028] When all the conditions (a) to (d) are met, it is determined that the automatic stop condition is met in the determination process of step S11 (step S11: YES), and then it is determined whether engine stop determination has not been performed in step S12. It is determined whether the engine speed is 0. Immediately after the automatic stop of the engine is made, the engine speed has not dropped to 0. Therefore, determination is made that the engine stop determination has not been performed in the determination process of step S12 (step S12: YES), and then the automatic stop target rail pressure $PRstp$, which is a target value of the rail pressure at the time of the automatic stop, is read in step S13. The automatic stop target rail pressure $PRstp$ has been set as a value larger than the target value $PRidle$ of the rail pressure during idling ($PRstp > PRidle$). Then, in step S14, the actual rail pressure PRa at that time is read. Then, in step S15, the control valve 2a is fully opened to drive the supply pump 2.

[0029] Then, in step S16, it is determined whether the actual rail pressure PRa is equal to or more than the automatic stop target rail pressure $PRstp$. When the rail pressure is the automatic stop target rail pressure $PRstp$, if the engine has been automatically stopped over a standard automatic stop period, the automatic stop target rail pressure $PRstp$ is a value for guaranteeing that the rail pressure at the time of the subsequent restart becomes equal to the restarting target rail pressure $PRstrt$,

which will be described below. In the present embodiment, the automatic stop target rail pressure PR_{stp} is set through experimentations. The automatic stop target rail pressure PR_{stp} has been set as a fixed value higher than the restarting target rail pressure PR_{strt} ($PR_{stp} > PR_{strt}$). When the actual rail pressure PR_a is equal to or more than the automatic stop target rail pressure PR_{stp} (step S16: YES), the rail pressure is to be reduced, and then the pressure reducing valve 7 is opened in step S17, and the series of processes is temporarily suspended.

[0030] If the actual rail pressure PR_a is smaller than the automatic stop target rail pressure PR_{stp} (step S16: NO), the pressure reducing valve 7 is closed to increase the rail pressure in step S18, and the series of processes is temporarily suspended.

[0031] When the engine speed drops to 0 while the series of processes is repeated, it is determined that the engine stop determination has been performed in the determination process of step S12 (step S12: NO), and then the pressure reducing valve 7 is closed in step S18. Then, the series of processes is temporarily suspended.

[0032] However, when the automatic stop condition is not met in step S11, execution timing of the present process is determined not to be reached, and the series of processes is temporarily suspended.

[0033] Subsequently, with reference to the flowchart of Fig. 3, the fuel pressure control at the time of the restart will be described. A series of processes illustrated in the flowchart is repeated with a predetermined cycle during the energization of the electronic controller 10.

[0034] As illustrated in Fig. 3, in the series of processes, it is first determined whether the restart condition is met (step S31). When any one of the conditions (a) to (d) is not met, it is determined that the automatic stop condition is not met, that is, the restart condition is met. Then, in step S32, it is determined whether restart completion determination has not been performed. It is determined whether the engine speed is equal to or more than a restart completion determination speed. Immediately after the restart of the engine is made, the engine speed is lower than the restart completion determination speed. Therefore, determination is made that the restart completion determination has not been performed in the determination process of step S32 (step S32: YES), and then the restarting target rail pressure PR_{strt} , which is a target value of the rail pressure at the time of the restart, is read in step S33. If the rail pressure is the restarting target rail pressure PR_{strt} , the restarting target rail pressure PR_{strt} is a value for guaranteeing that the rail pressure will be increased, through the fuel pressure-feeding from the supply pump 2, to a degree at which it is possible to perform fuel injection into a cylinder initially that undergoes the compression stroke at a predetermined timing in the compression stroke after the cylinder determination has been performed at the time of the restart. The target rail pressure is set through experimentation in the present embodiment. The restarting target rail pressure PR_{strt} has been set as a value lower than the automatic

stop target rail pressure PR_{stp} ($PR_{strt} < PR_{stp}$). Then, in step S34, the actual rail pressure PR_a at that time is read.

[0035] Then, in step S35, it is determined whether the actual rail pressure PR_a is equal to or more than the restarting target rail pressure PR_{strt} . If the actual rail pressure PR_a is equal to or more than the restarting target rail pressure PR_{strt} (step S35: YES), step S36 is executed to lower the rail pressure. Specifically, the supply pump 2 is operated with the control valve 2a half-opened, so that active fuel pressure-feeding by the supply pump 2 is not performed. Then, in step S37, the pressure reducing valve 7 is opened, and the series of processes is temporarily suspended.

[0036] On the other hand, if the actual rail pressure PR_a is smaller than the restarting target rail pressure PR_{strt} (step S35: NO), step S38 is executed to increase the rail pressure. Specifically, the supply pump 2 is operated with the control valve 2a fully opened, so that the active fuel pressure-feeding by the supply pump 2 is performed. Then, step S39 is executed to increase the rail pressure. Specifically, the pressure reducing valve 7 is closed. The series of processes is then temporarily suspended.

[0037] While the series of processes is being repeated, if the engine speed is equal to or more than the restart completion determination speed, it is determined that the restart completion determination has been performed in the determination process of step S32 (step S32: NO). Therefore, the series of processes is temporarily suspended.

[0038] However, if the restart condition is not met in step S31, the series of processes is temporarily suspended.

[0039] With the controller for the diesel engine according to the present embodiment as described above, the advantages are obtained.

(1) The present embodiment employs a configuration in which the pressure-feeding mode of the supply pump 2 is controlled through the electronic controller 10 such that the fuel pressure (the rail pressure) in the common rail 3 at the automatic stop of the engine is higher than the target value PR_{idle} of the rail pressure during idling, specifically, that the rail pressure becomes equal to the predetermined pressure (the automatic stop target rail pressure PR_{stp}) higher than the target value PR_{idle} . Furthermore, the present embodiment employs a configuration in which the opening degree of the pressure reducing valve 7 is controlled such that the pressure reducing valve 7 is maintained in a valve-closed state during the automatic stop of the engine, and the rail pressure at the restart of the engine becomes equal to the target pressure (the restarting target rail pressure PR_{strt}) required at the time of the restart. As described above, the rail pressure at the automatic stop of the engine is made higher than the target

value PR_{idle} of the fuel pressure during idling, and the pressure reducing valve 7 is maintained in the valve-closed state during the automatic stop of the engine. This makes the rail pressure when the restart of the engine higher than that in the case in which such control is not performed. Furthermore, at the restart of the engine, for example, when the rail pressure is higher than the restarting target rail pressure PR_{strt} , the pressure reducing valve 7 is opened, so that the rail pressure can be made to reach the restarting target rail pressure PR_{strt} easily and promptly. This allows initial fuel injection at the time of the restart to be promptly performed. Consequently, at the restart of the engine, it is possible to reliably shorten the start-up time.

(2) Furthermore, the present embodiment employs a configuration in which the opening degree of the pressure reducing valve 7 is controlled such that the actual rail pressure PR_a at the automatic stop of the engine becomes equal to the automatic stop target rail pressure PR_{stp} . As described above, at the automatic stop of the engine, the opening degree of the pressure reducing valve 7 is controlled in addition to the control of the pressure-feeding mode of the supply pump 2, so that it is possible to easily allow the actual rail pressure PR_a to be the automatic stop target rail pressure PR_{stp} through the opening degree control of the pressure reducing valve 7.

(3) Furthermore, in the present embodiment, at the restart of the engine, the electronic

controller 10 controls the opening degree of the control valve 2a to be in a fully-opened state when the actual rail pressure PR_a is lower than the restarting target rail pressure PR_{strt} , but controls the opening degree of the control valve 2a to be in a half-opened state when the actual rail pressure PR_a is equal to or more than the restarting target rail pressure PR_{strt} . In this way, when the actual rail pressure PR_a is equal to or more than the restarting target rail pressure PR_{strt} , the pressure-feeding amount of the fuel by the supply pump 2 is restricted, so that it is possible to suppress an increase in an engine load caused by the driving of the supply pump 2. Furthermore, as compared with a configuration in which the opening degree of the control valve 2a is controlled to be in a fully closed state when the actual rail pressure PR_a is equal to or more than the restarting target rail pressure PR_{strt} , when the control valve 2a is fully opened and the fuel pressure-feeding is performed, it is possible to facilitate the fuel pressure-feeding.

[0040] However, the controller for the diesel engine according to the present invention is not limited to the configuration described in the above embodiment, and, for example, can be implemented as the following example obtained by appropriately modifying the embodiment.

[0041] The automatic stop condition and the restart condition of the diesel engine are not limited to the conditions described in the above embodiment, and may be

modified to arbitrary conditions.

[0042] In the above embodiment, the automatic stop target rail pressure PR_{stp} is set as a fixed value. However, the setting of the predetermined pressure according to the present invention is not limited thereto. For example, even when the automatic stop period of the engine is the same, leak amounts of fuel from parts constituting the fuel supply system of the engine, such as the fuel injection valve, the fuel pump, or the pressure reducing valve, are different from each other. Thus the automatic stop target rail pressure PR_{stp} may be corrected based on the rail pressure at the time of the restart of the engine. That is, when it is determined that the rail pressure at the time of the restart of the engine is likely to be lower than the restarting target rail pressure PR_{strt} , the automatic stop target rail pressure PR_{stp} may be corrected to be a larger value. Meanwhile, when it is determined that the rail pressure at the time of the restart of the engine is likely to be higher than the restarting target rail pressure PR_{strt} , the automatic stop target rail pressure PR_{stp} may be corrected to be a smaller value.

[0043] The above embodiment employs a configuration in which at the restart of the engine, the electronic controller 10 controls the opening degree of the control valve 2a to be in a fully-opened state when the rail pressure is lower than the restarting target rail pressure PR_{strt} , but controls the opening degree of the control valve 2a to be in a half-opened state when the rail pressure is equal to or more than the restarting target rail pressure PR_{strt} . However, the opening degree control of the control valve at the time of the restart is not limited thereto. At the restart of the engine, if the opening degree of the control valve 2a is controlled to a first opening degree when the rail pressure is lower than the restarting target rail pressure PR_{strt} , but the opening degree of the control valve 2a is controlled to a second opening degree, which is smaller than the first opening degree, when the rail pressure is equal to or more than the restarting target rail pressure PR_{strt} , the first opening degree and the second opening degree can be appropriately changed.

[0044] In the above embodiment, the opening degree of the pressure reducing valve 7 is controlled such that the rail pressure at the automatic stop of the engine becomes equal to the automatic stop target rail pressure PR_{stp} . However, a control configuration for allowing the rail pressure to be the automatic stop target rail pressure PR_{stp} is not limited thereto. For example, at the automatic stop of the engine, the pressure reducing valve 7 is maintained in a valve-closed state and the pressure-feeding mode of the supply pump 2 is controlled, so that it is possible to allow the rail pressure to become equal to the automatic stop target rail pressure PR_{stp} .

[0045] In the above embodiment, the supply pump 2 having the control valve 2a for adjusting the intake amount of fuel and the engine-driven type pressurizing unit 2b is described as an example. However, the configuration of the fuel pump according to the present invention is not limited thereto. In short, it is sufficient if it

is possible to pressure-feed fuel to the accumulator container provided in the fuel supply system of the engine and to control the pressure-feeding mode thereof.

DESCRIPTION OF THE REFERENCE NUMERALS

[0046] 1 Fuel tank; 2 Supply pump; 2a Control valve; 2b Pressurizing unit; 3 Common rail; 4 Fuel addition valve; 6 Injector; 7 Pressure reducing valve; 8 Fuel pressure sensor; 10 Electronic controller (Pump control unit, Opening degree control unit)

Claims

1. A controller for a diesel engine being applied to a diesel engine provided with:

a fuel pump for pressure-feeding fuel to an accumulator container provided in a fuel supply system of the engine and capable of controlling a pressure-feeding mode of the fuel; and a pressure reducing valve for reducing fuel pressure in the accumulator container, wherein the controller automatically stops the engine when a predetermined automatic stop condition is met during idling of the engine and restarts the engine when a predetermined restart condition is met during the automatic stop of the engine, the controller being **characterized by:**

a pump control unit that controls a pressure-feeding mode of the fuel pump such that the fuel pressure in the accumulator container at the automatic stop of the engine is higher than a target value of fuel pressure during idling; and an opening degree control unit that controls an opening degree of the pressure reducing valve such that the pressure reducing valve is maintained in a valve-closed state during the automatic stop of the engine, and that the fuel pressure in the accumulator container at the restart of the engine becomes equal to a target pressure required at a time of restart.

2. The controller for a diesel engine according to claim 1, **characterized in that** the opening degree control unit controls the opening degree of the pressure reducing valve such that the fuel pressure in the accumulator container at the automatic stop of the engine becomes equal to a predetermined pressure higher than the target value.
3. The controller for a diesel engine according to claim 1 or 2, **characterized in that** the pump control unit

controls the pressure-feeding mode of the fuel pump such that the fuel pressure in the accumulator container at the automatic stop of the engine becomes equal to the predetermined pressure higher than the target value.

4. The controller for a diesel engine according to any one of claims 1 to 3, **characterized in that** the fuel pump includes a control valve, which adjusts an intake amount of fuel, and an engine-driven type pressurizing unit, and at the restart of the engine, the pump control unit controls an opening degree of the control valve to be a first opening degree when the fuel pressure in the accumulator container is lower than the target pressure, and controls the opening degree of the control valve to be a second opening degree, which is smaller than the first opening degree, when the fuel pressure in the accumulator container is equal or more than the target pressure.
5. The controller for a diesel engine according to claim 4, **characterized in that** at the restart of the engine, the pump control unit controls the opening degree of the control valve to be in a fully-opened state when the fuel pressure in the accumulator container is lower than the target pressure, and controls the opening degree of the control valve to be in a half-opened state when the fuel pressure in the accumulator container is equal to or more than the target pressure.

Fig.1

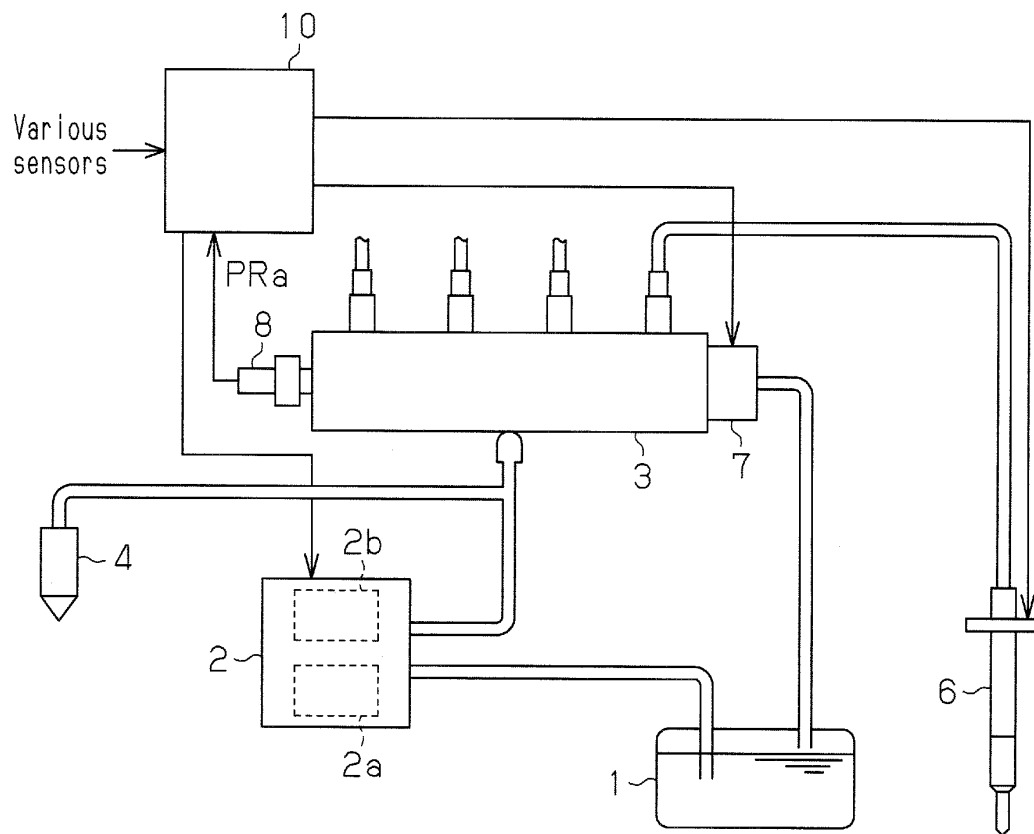


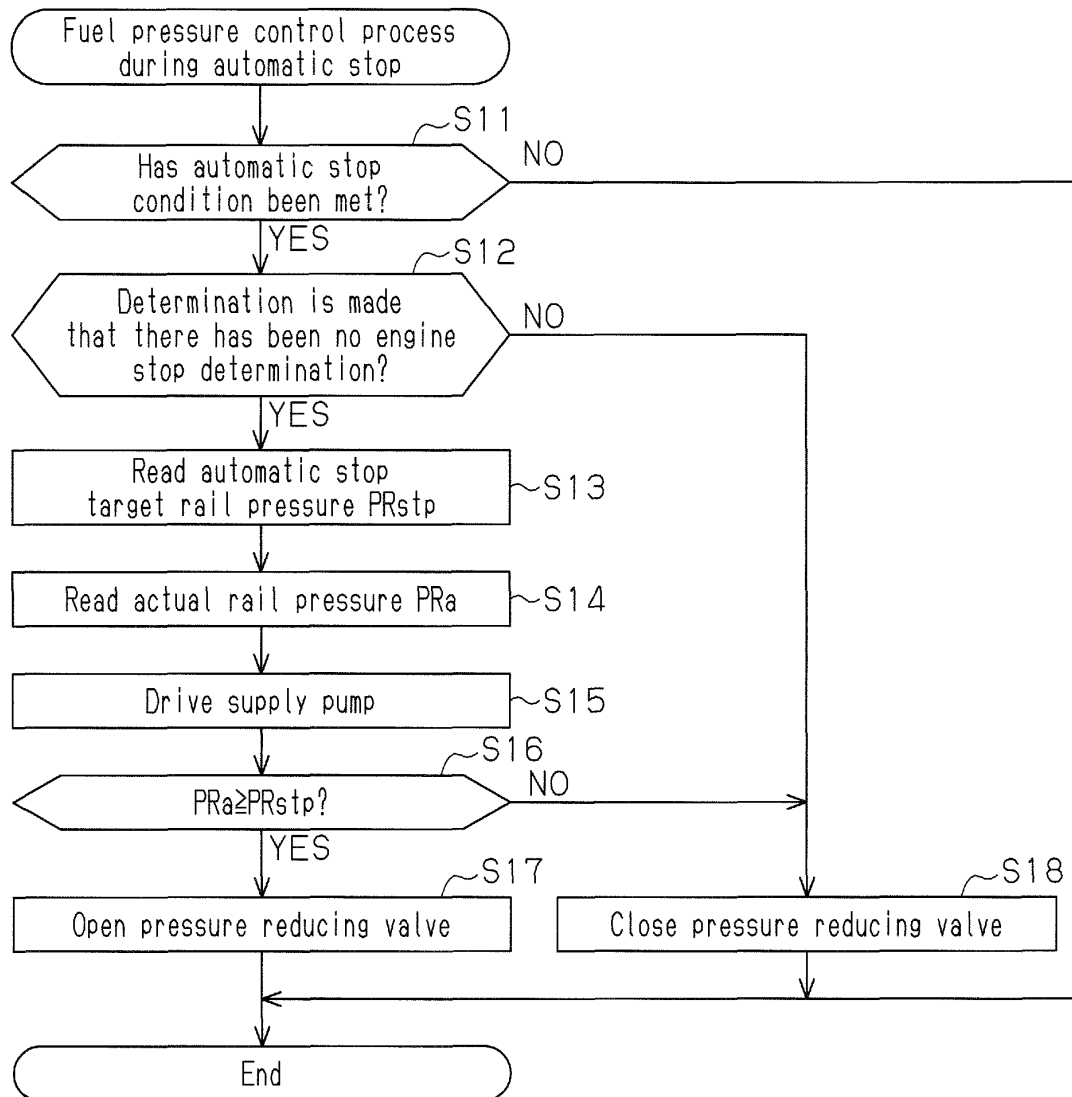
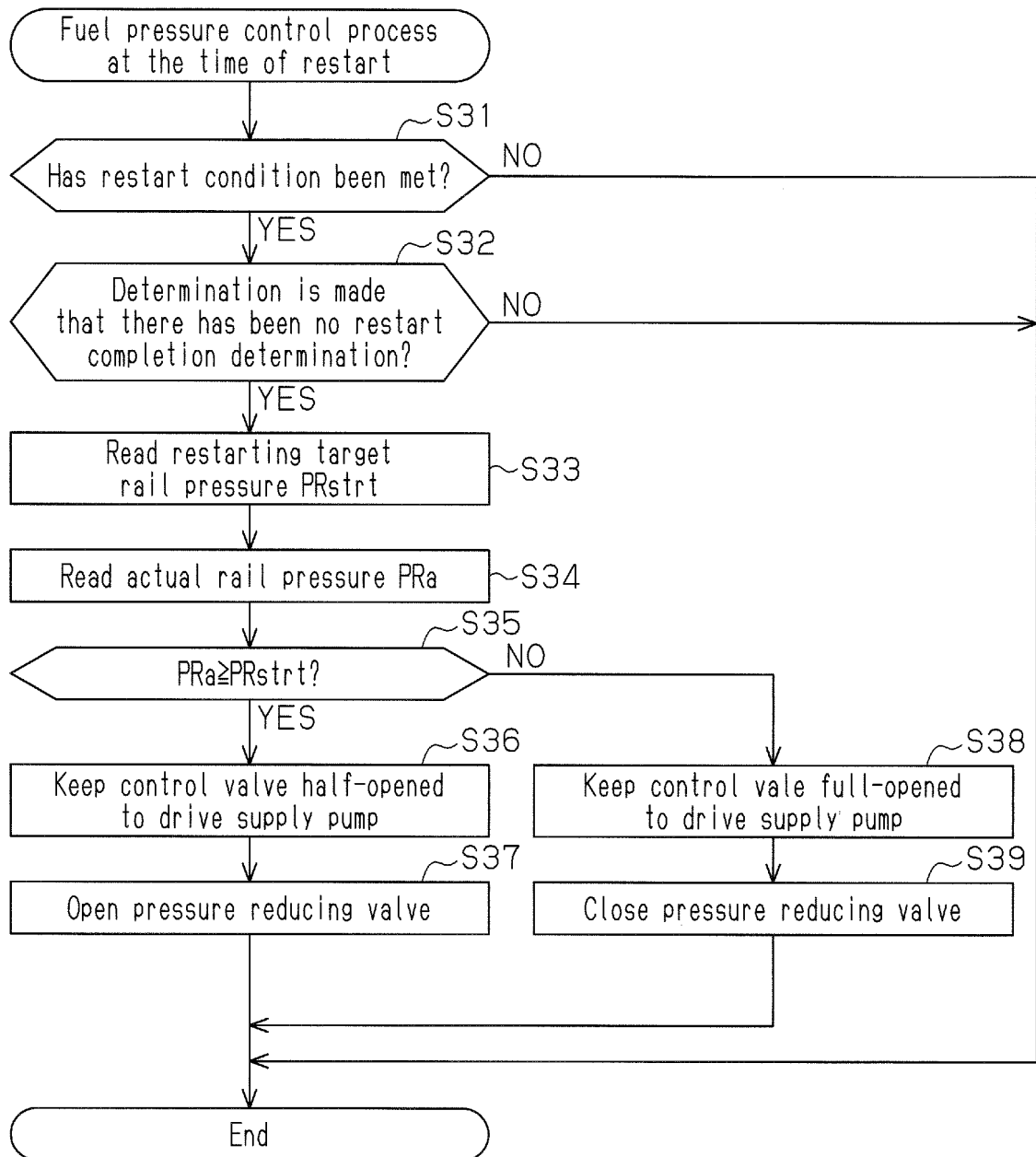
Fig.2

Fig.3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2010/057475

A. CLASSIFICATION OF SUBJECT MATTER

F02D17/00 (2006.01) i, F02D29/02 (2006.01) i, F02D41/06 (2006.01) i

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)

F02D17/00, F02D29/02, F02D41/06

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2010

Kokai Jitsuyo Shinan Koho 1971-2010 Toroku Jitsuyo Shinan Koho 1994-2010

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2010-25088 A (Mazda Motor Corp.), 04 February 2010 (04.02.2010), paragraphs [0009] to [0011] (Family: none)	1-5
Y	JP 11-50881 A (Toyota Motor Corp.), 23 February 1999 (23.02.1999), claim 7; paragraphs [0115] to [0118] & EP 896145 A2	1-5
Y	JP 2004-190628 A (Isuzu Motors Ltd.), 08 July 2004 (08.07.2004), paragraph [0029] & US 2004/0112340 A1 & EP 1429013 A2	4, 5

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
14 May, 2010 (14.05.10)Date of mailing of the international search report
25 May, 2010 (25.05.10)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2010/057475

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2009-250192 A (Denso Corp.), 29 October 2009 (29.10.2009), paragraph [0033] & GB 2459018 A & DE 102009002099 A	1-5
A	JP 2006-348908 A (Fujitsu Ten Ltd.), 28 December 2006 (28.12.2006), claim 1 (Family: none)	1-5

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2010024848 A [0004]