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(54) Title: A SYSTEM FOR CONTROLLING IDLE STOP START OF A VEHICLE AND A METHOD THEREOF

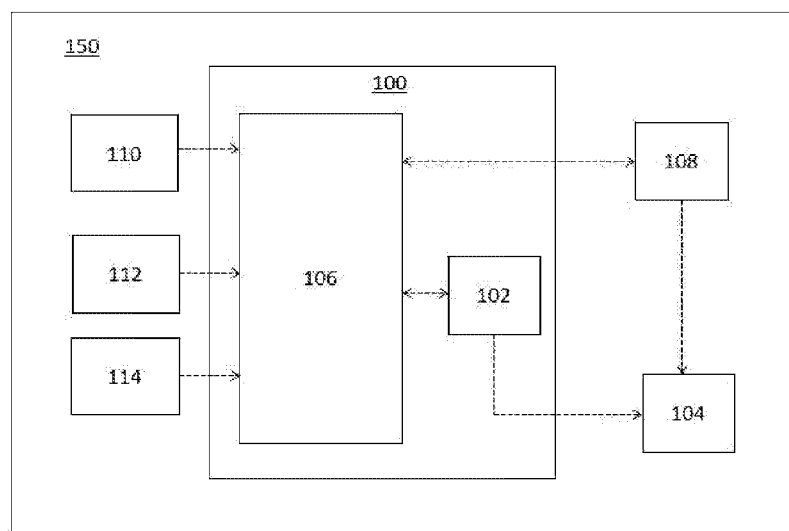


Figure 1

(57) Abstract: Present invention relates to a system (100) for controlling Idle Stop Start of the vehicle (150). The system (100) comprises a fuel injector (102) for delivering fuel to the IC engine (104). The system (100) further comprises the control unit (106) for controlling the fuel injector (102) by providing a fuel injection signal to the fuel injector (102). The control unit (106) is configured to monitor idle stop conditions of the vehicle (150). The control unit (106) is also configured to determine if the vehicle (150) is in idle stop conditions for a predetermined time. Upon determining that the vehicle (150) is in idle stop condition for the predetermined time, the control unit (106) is configured to disable the fuel injection signal thereby stopping the IC engine (104).



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TITLE OF INVENTION**A System for Controlling Idle Stop Start of a Vehicle and a Method Thereof****FIELD OF THE INVENTION**

[001] The present invention generally relates to an Idle Stop Start (ISS) system for vehicles. Particularly, the present invention relates to a system for controlling ISS in a vehicle and a method thereof.

BACKGROUND OF THE INVENTION

[002] Generally, vehicles are provided with an Idle Stop Start (ISS) system which is used to switch off the vehicle when the vehicle remains in an idle condition for a pre-determined amount of time (e.g.: idling in a congested traffic signal). The ISS system helps in improving fuel economy of the vehicle.

[003] In vehicles equipped with a carburettor system, fuel injection cut-off is not possible as the fuel delivery is controlled by a pressure difference between an intake manifold and an ambient condition. Hence, the ignition is being cut-off during an idling stop. In such systems, there is a possibility that the fuel might get accumulated in one or more locations like, a port surface, a piston top surface and a crevice volume during stop. Since the ignition is being cut-off, the fuel accumulated will not be combusted completely. This leads to a higher hydrocarbon emission during a next or a subsequent start.

[004] Extending the above-mentioned methodology of ignition cut-off to Fuel Injection (FI) based systems, it would only act against the purpose by higher hydrocarbon emissions during next start. Thus, the advantage of metered fuel injection would be negated by cutting-off the ignition during every stop start.

[005] One of the existing system included with a fuel cut-off mechanism involves cutting-off the fuel supply when the engine is in a motoring mode, i.e., when the engine is decelerating upon receiving a brake input. This mechanism may help in energy conservation during deceleration. However, it does not reduce hydrocarbon emissions due to presence of an unburnt fuel at the port surface during the engine stop situation.

[006] Yet another existing system having fuel cut-off mechanism uses vehicle speed and brake pedal inputs. In this mechanism, the fuel cut-off is enabled when the brake pedal is continuously pressed, and the vehicle speed becomes lower than a set threshold speed. Though this system discloses an aspect of bringing the engine to a stop condition, the system involves a non-desired condition of cutting-off fuel only when the brake pedal is continuously pressed. Moreover, a rider of the vehicle is not made aware that the fuel is cut-off while brake pedal is pressed for a predetermined time period, which is not advantageous.

[007] Still another existing system discloses control apparatus for controlling a fuel injection amount. The control apparatus starts an injection of a fuel into an intake passage of the engine when a certain engine start condition is satisfied and stop the injection of the fuel when a certain engine stop condition is satisfied. The control apparatus estimates an amount of fuel deposited on an intake passage and determines a fuel injection amount based on the estimated fuel deposition amount. However, such an estimation is beneficial during normal engine stop and start conditions, for example, during cold start conditions. On the other hand, idle stop start system deals with stop and restarting the engine when the engine temperature is already high, in which condition, there will not be any substantial difference between wall film quantity of fuel. Hence, such models cannot be implemented

for cutting-off fuel injection and stopping the engine during idling rpm, which is only achieved after a predetermined period of engine running.

[008] Thus, there is a need in the art for a system for controlling idle stop start of a vehicle and a method for controlling idle stop start of a vehicle which addresses at least the
5 aforementioned problems.

SUMMARY OF THE INVENTION

[009] In one aspect, the present invention is directed to a system for controlling Idle Stop Start (ISS) of a vehicle. The system includes a fuel injector for delivering fuel to an Internal
10 Combustion (IC) engine and a control unit for controlling the fuel injector by providing a fuel injection signal to the fuel injector. The control unit is configured to monitor idle stop conditions of the vehicle. The control unit is further configured to determine if the vehicle is in idle stop conditions for a predetermined time. The control unit is further configured to disable the fuel injection signal if the vehicle is in idle stop conditions for the predetermined
15 time thereby stopping the IC engine.

[010] In an embodiment of the invention, an ignition coil for generating a high voltage to create an electric spark in a spark plug to ignite the fuel inside the IC engine is provided. The ignition coil is coupled with the control unit and generates the high voltage in response to an ignition signal received from the control unit after disablement of the fuel injection by
20 the control unit.

[011] In a further embodiment of the invention, the control unit is configured to continue transmission of the ignition signal after disabling the fuel injection signal and until a threshold condition in the IC engine is attained. The threshold condition is attained upon

determining a position of a Top Dead Centre (TDC) of the IC engine. The TDC position is determined by the control unit upon receiving a signal from a crank position sensor of the vehicle.

[012] In another aspect, the present invention is directed to a method for controlling Idle Stop Start (ISS) of a vehicle. The method includes the steps of monitoring, by the control unit, idle stop conditions of the vehicle. The method further includes determining, by the control unit, if the vehicle is in idle stop conditions for a predetermined time. The method further includes disabling fuel injection signal to a fuel injector, by the control unit, if the vehicle is in idle stop conditions for the predetermined time for stopping the IC engine.

[013] In a yet another embodiment of the invention, the method includes a step of generating, a high voltage by an ignition coil to create an electric spark in a spark plug to ignite the fuel inside the IC engine. The ignition coil is coupled with the control unit and generates the high voltage in response to an ignition signal received from the control unit, after disablement of the fuel injection by the control unit.

[014] In a yet another embodiment of the invention, the method includes the step of continuing transmission of the ignition signal from the control unit to the ignition coil after disabling the fuel injection signal and until a threshold condition in the IC engine is attained, thereby ensuring combustion of a fuel accumulated in a combustion chamber and intake ports of the IC engine during Idle Stop Start. This also, reduces emission during subsequent starts.

[015] In a yet another embodiment of the invention, the method includes the step of determining a position of a Top Dead Centre (TDC) of the IC engine when the threshold condition is attained.

[016] In a yet another embodiment of the invention, the TDC position is determined by the control unit upon receiving a signal from a crank position sensor of the vehicle.

[017] In a yet another embodiment of the invention, the idle stop condition is attained when the speed of the vehicle is lower than a predetermined threshold value and the speed
5 of the IC engine is equal to a predetermined idling speed of the IC engine.

[018] In a yet another embodiment of the invention, the method includes a step of receiving, by the control unit, an engine restart signal from a clutch sensor disposed in a clutch switch of the vehicle.

[019] In a yet another embodiment of the invention, the method includes a step of
10 receiving, by the control unit, an engine restart signal from the throttle position sensor disposed at a throttle of the vehicle.

BRIEF DESCRIPTION OF THE DRAWINGS

[020] Reference will be made to embodiments of the invention, examples of which may be
15 illustrated in accompanying figures. These figures are intended to be illustrative, not limiting. Although the invention is generally described in context of these embodiments, it should be understood that it is not intended to limit the scope of the invention to these particular embodiments.

Figure 1 illustrates a schematic block diagram of a system for controlling idle stop
20 start of a vehicle, in accordance with an embodiment of the invention.

Figures 2 and 3 illustrate method flowcharts of controlling idle stop start of the vehicle, in accordance with an embodiment of the invention.

Figure 4 illustrates a graph of a data collected during idling stop, in accordance with an embodiment of the invention.

Figure 5 illustrates a graph of time v hydrocarbon emission to compare hydrocarbon emission traces during disabled injection and ignition conditions between disabled injection
5 and continued ignition conditions, in accordance with an embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[021] Various features and embodiments of the present invention here will be discernible from the following further description thereof, set out hereunder. In the ensuing exemplary
10 embodiments, the vehicle is a two wheeled vehicle. However, it is contemplated that the disclosure in the present invention may be applied to any automobile capable of accommodating the present subject matter without defeating the scope of the present invention.

[022] The present invention relates to an Idle Stop Start (ISS) system for vehicles.
15 Particularly, the present invention relates to a system for controlling ISS in a vehicle and a method thereof.

[023] Figure 1 illustrates a schematic block diagram of a system 100 for controlling an Idle Stop Start (ISS) of a vehicle 150, in accordance with an embodiment of the invention. The system 100 comprises a fuel injector 102 for delivering fuel to an Internal Combustion (IC)
20 engine 104 and a control unit 106 for controlling the fuel injector 102 by providing a fuel injection signal to the fuel injector 102.

[024] The control unit 106 is adapted to receive inputs from one or more sensors for providing the fuel injection signal to the fuel injector 102. The sensors may include, but not

limited to, a crank position sensor 110, a clutch sensor 112 disposed in a clutch switch of the vehicle 150 and a throttle position sensor 114 disposed at a throttle of the vehicle 150. Generally, the crank position sensor 110 measures the position of a crankshaft (not shown) and rotational speed of the crankshaft. The control unit 106 optimizes injection and ignition timing based on output from the crank position sensor 110. In an embodiment of the present invention, the crank position sensor 110 is adapted to determine position of Top Dead Centre (TDC) of the IC engine 104. In another embodiment, the clutch sensor 112 is adapted to provide an engine restart signal to the control unit 106. Typically, the throttle position sensor 114 measures the throttle opening percentage. The control unit 106 receives this information and detects the engine load and optimizes the fuel quantity and ignition timing. In yet another embodiment, the throttle position sensor 114 is adapted to provide an engine restart signal to the control unit 106.

[025] In some embodiment, the control unit 106 is configured within an Electronic Control Unit (ECU) (not shown) of the vehicle 150. In another embodiment, the control unit 106 is configured as a separate unit or module which can be configured to be in communication with the ECU of the vehicle 150 for controlling ISS of the vehicle 150.

[026] In an embodiment, the control unit 106 includes one or more components such as, but not limited to, a control unit, a memory unit, an input/output module, a pre-processing module etc. It may be contemplated that though the system 100 is depicted to include only one control unit 106, however, the system 100 may include more than one of same or similar control unit(s) 106.

[027] In another embodiment, the control unit 106 includes only a processor which may be required to process the received instructions / signals from one or more input devices and

process the same to communicate a set of predetermined or processed instructions to the fuel injector 102. It is to be understood that the terms 'control unit' and 'processor' are one and the same and they relate to same component. It is to be understood that the components are shown for exemplary purpose only and thus the system 100 may include
5 fewer or additional components / modules than those depicted in the Figure 1. For example, the system 100 may include or be in communication with an analytic module which may be configured to perform additional analysis of the communication information received from the one or more sensors 110, 112, 114 of the vehicle 150 known in the art.

[028] In an embodiment, the memory unit in communication with the control unit 106 is
10 capable of storing machine executable instructions. Further, the control unit 106 is capable of executing the machine executable instructions to perform the functions described herein. The control unit 106 is in communication with the components such as the pre-processing module and the analytic module. In another embodiment, the control unit 106 is embodied as a multi-core processor, a single core processor, or a combination of one or more multi-
15 core processors and one or more single core processors. For example, the control unit 106 is embodied as one or more of various processing devices, such as a coprocessor, a microprocessor, a controller, a digital signal processor (DSP), a processing circuitry with or without an accompanying DSP, or various other processing devices including integrated circuits such as, for example, an application specific integrated circuit (ASIC), a field
20 programmable gate array (FPGA), a microcontroller unit (MCU), a hardware accelerator, a special-purpose computer chip, or the like. In yet another embodiment, the control unit 106 is configured to execute hard-coded functionality. In still another embodiment, the control unit 106 is embodied as an executor of instructions, where the instructions are specifically

configured to the control unit 106 to perform the steps or operations described herein when the instructions are executed for controlling the ISS of the vehicle 150 for controlling hydrocarbon emissions in the exhaust.

[029] In an embodiment of the present invention, the control unit 106 is configured to
5 monitor idle stop conditions of the vehicle 150. The term 'idle stop condition' is defined as a condition of the vehicle 150 when the speed of the vehicle 150 is lower than a predetermined threshold value and the speed of the IC engine 104 is equal to a predetermined idling speed of the IC engine 104. In some embodiment of the present invention, the predetermined threshold value for the speed of the vehicle 150 during the
10 idle stop condition ranges from 0 to 5 kmph. In yet another embodiment, the predetermined idling speed of the IC engine 104 ranges from about 1100 to 2000 rpm.

[030] In an embodiment of present invention, the control unit 106 is configured to determine if the vehicle 150 is in idle stop conditions for a predetermined time. In an exemplary embodiment, the predetermined time ranges from 2 seconds to about 10
15 seconds. In the embodiment of present invention, the control unit 106 is configured to disable the fuel injection signal if the vehicle 150 is in idle stop conditions for the predetermined time thereby stopping the IC engine 104. The disablement of the fuel injection to the IC engine 104 will ensure that the IC engine 104 is not supplied with excess fuel thereby reducing deposition of an unburnt fuel in the IC engine 104, and thus would
20 reduce hydrocarbon emissions during subsequent start of the IC engine 104 after the idling stop.

[031] In the illustrated embodiment, the system 100 further comprises an ignition coil 108. Typically, the ignition coil 108 is configured for generating a high voltage to create an

electric spark in a spark plug (not shown) to ignite the fuel inside the IC engine 104. In the illustrated embodiment, the ignition coil 108 is coupled with the control unit 106. In another exemplary embodiment, the ignition coil 108 may be coupled with the ECU of the vehicle 150. The ignition coil 108 is configured to generate the high voltage in response to an ignition signal received from the control unit 106 after disablement of the fuel injection by the control unit 106.

[032] In another embodiment, the control unit 106 is configured to continue transmission of the ignition signal after disabling the fuel injection signal and until a threshold condition in the IC engine 104 is attained. The term 'threshold condition' may be defined as a condition of the IC engine 104 when a piston of the IC engine 104 is at Top Dead Centre (TDC). That is to say, the threshold condition is attained upon determining a position of the TDC of the IC engine 104. In an embodiment, the TDC position is determined by the control unit 106 upon receiving a signal from the crank position sensor 110 of the vehicle 150.

[033] Figure 2 illustrates a flowchart for a method 200 for controlling an Idle Stop Start (ISS) of the vehicle 150, according to another aspect of the present invention.

[034] At a step 202, the control unit 106 monitors idle stop conditions of the vehicle 150. In an embodiment, the idle stop condition is attained when the speed of the vehicle 150 is lower than the predetermined threshold value and the speed of the IC engine is equal to the predetermined idling speed of the IC engine 104.

[035] Upon determining that the IC engine 104 is in idle stop condition, the control unit 106 at a step 204, determines if the vehicle 150 is in idle stop conditions for a predetermined time. In the embodiment, the vehicle 150 should be in the idle stop condition for the predetermined time of 2 to 10 second(s).

[036] After the vehicle 150 is determined to be in idle stop conditions for the predetermined time, the control unit 106 at a step 206 disables fuel injection signal to the fuel injector 102 for stopping the IC engine 104. Once the fuel injection signal is disabled, the supply of fuel injector 102 is stopped, thereby the fuel deposit at the IC engine 104 is stopped. This in turn reduces deposition of the unburnt fuel and thus the hydrocarbon emissions during subsequent start of the IC engine 104 after idle stop is also reduced.

[037] Figure 3 illustrates further steps involved in the method for controlling the ISS of the vehicle 150. At a step 300, a high voltage is generated by the ignition coil 108 to create an electric spark in the spark plug of the vehicle 150 to ignite the fuel inside the IC engine 104.

The control unit 106 coupled to the ignition coil 108 is configured to control the operation of the ignition coil 108 and thus the ignition coil 108 generates the high voltage in response to the ignition signal received from the control unit 106. In an embodiment, the control unit 106 generates the ignition signal after disabling the fuel injection to the fuel injector 102.

[038] In another embodiment, the ignition signal is continuously transmitted from the control unit 106 to the ignition coil 108 even after disabling the fuel injection signal and until the threshold condition in the IC engine 104 is attained at a step 302. This ensures that the fuel accumulated / deposited at a combustion chamber and intake ports of the IC engine 104 during Idle Stop Start are combusted fully. Since the deposited fuel is combusted completely, the intake ports or the combustion chamber does not have any unburnt fuel and thus the hydrocarbon emission is reduced for subsequent starts after the idle stops.

[039] In yet another embodiment, the control unit 106 receives the position of TDC of the IC engine 104 in order to determine the threshold condition at a step 304. The crank

position sensor 110 disposed in the crankshaft determines the TDC position and communicates the signal to the control unit 106.

[040] In an embodiment, the method 200 further comprises a step of receiving by the control unit 106, an engine restart signal from the clutch sensor 112 disposed in the clutch switch of the vehicle 150. In another embodiment, the method 200 further comprises a step of receiving, by the control unit 106, an engine restart signal from the throttle position sensor 114 disposed at the throttle of the vehicle 150.

[041] Figure 4 illustrates a graph of a data collected during idling stop, in accordance with an embodiment of the invention. The injection signal is disabled by the control unit 106 once the idle stop status bit is set to true. After disabling the fuel injector signal to the fuel injector 102, the IC engine 104 continues to run due to the inertia and the ignition pulse or signal is not disabled by control unit 106. This ensures effective combustion of fuel accumulated in port surface, piston top surface and crevice volume in the vehicle 150.

[042] Figure 5 illustrates a graph of time vs. hydrocarbon emission to compare hydrocarbon emission traces during disabled injection and ignition conditions between disabled injection and continued ignition conditions, in accordance with an embodiment of the invention.

[043] The line 500 in the graph illustrates when both the injection signal and the ignition signal are disabled by the control unit 106 during the idle stop. The line 502 in the graph illustrates when only the injection signal is disabled by the control unit 106 and the ignition signal is continued to be transmitted to the ignition coil till the TDC is attained during the idle stop. When both the lines in the graphs are compared, it is evident that during the idle stop conditions, the hydrocarbon emission is found to be relatively less in the case when

only the injection signal is disabled, and the ignition signal is continued to be transmitted to the ignition coil 108 when compared with graph where both the injection and ignition signals are disabled. This effect is more significant during repeated stops of the vehicle 150 especially in a congested traffic condition.

5 [044] Advantageously, the system and method in the present invention reduces hydrocarbon emission during idle stop start conditions in the vehicle. The control unit in the system disables the injection signal to the fuel injector thereby when the vehicle is determined to be in the idle stop condition for a predetermined time. Owing to stopping of fuel supply to the IC engine, the deposition of unburnt fuel is reduced and thereby reducing
10 the hydrocarbon emission during the subsequent start of the engine after idle stop.

[045] After disablement of the injection signal, the ignition signal from the control unit is continuously transmitted to the ignition coil of the IC engine. The transmission of the ignition signal is transmitted till the piston in cylinder of the engine is reached to the TDC position. Owing to the operation of the ignition coil even after stopping the injection signal,
15 any residue or unburnt fuel deposited will be burnt completely. This eliminates the deposition of the unburnt fuel, thereby reducing hydrocarbon emissions and improving fuel efficiency and the fuel economy in the vehicle.

[046] While the present invention has been described with respect to certain embodiments, it will be apparent to those skilled in the art that various changes and
20 modification may be made without departing from the scope of the invention as defined in the following claims.

CLAIMS:

1. A system (100) for controlling Idle Stop Start (ISS) of a vehicle (150) comprising:
a fuel injector (102) for delivering fuel to an Internal Combustion (IC) engine (104); and
a control unit (106) for controlling the fuel injector (102) by providing a fuel injection
5 signal to the fuel injector (102), the control unit (106) configured to:
monitor idle stop conditions of the vehicle (150);
determine if the vehicle (150) is in idle stop conditions for a predetermined time; and
disable the fuel injection signal if the vehicle (150) is in idle stop conditions for the
predetermined time thereby stopping the IC engine (104).
10
2. The system (100) as claimed in claim 1 comprising: an ignition coil (108) for generating
a high voltage to create an electric spark in a spark plug to ignite the fuel inside the IC
engine (104), the ignition coil (108) coupled with the control unit (106) and generates
the high voltage in response to an ignition signal received from the control unit (106)
15 after disablement of the fuel injection by the control unit (106).
3. The system (100) as claimed in claim 2, wherein the control unit (106) is configured to
continue transmission of the ignition signal after disabling the fuel injection signal and
until a threshold condition in the IC engine (104) is attained.
20
4. The system (100) as claimed in claim 3, wherein the threshold condition is attained
upon determining a position of a Top Dead Centre (TDC) of the IC engine (104).

5. The system (100) as claimed in claim 4, wherein the TDC position is determined by the control unit (106) upon receiving a signal from a crank position sensor (110) of the vehicle (150).
- 5 6. A method (200) for controlling Idle Stop Start (ISS) of a vehicle (150), the method (200) comprising the steps of:
monitoring (202), by the control unit (106), idle stop conditions of the vehicle (150);
determining (204), by the control unit (106), if the vehicle (150) is in idle stop conditions for a predetermined time; and
10 disabling (206) fuel injection signal to a fuel injector (102), by the control unit (106), if the vehicle (150) is in idle stop conditions for the predetermined time for stopping the IC engine (104).
7. The method (200) as claimed in claim 6 comprising the step of generating (300), a high
15 voltage by an ignition coil (108) to create an electric spark in a spark plug to ignite the fuel inside the IC engine (104), wherein the ignition coil (108) is coupled with the control unit (106) generates the high voltage in response to an ignition signal received from the control unit (106).
- 20 8. The method (200) as claimed in claim 7 comprising the step of continuing transmission (302) of the ignition signal from the control unit (106) to the ignition coil (108) after disabling the fuel injection signal and until a threshold condition in the IC engine (104) is attained, thereby ensuring combustion of a fuel accumulated in a combustion

chamber and intake ports of the IC engine (104) during Idle Stop Start and emission is reduced for subsequent starts.

9. The method (200) as claimed in claim 8 comprising the step of determining (304), a
5 position of a Top Dead Centre (TDC) of the IC engine (104) when the threshold condition is attained.

10. The method (200) as claimed in claim 9, wherein the TDC position is determined by the
10 control unit (106) upon receiving a signal from a crank position sensor (110) of the vehicle (150).

11. The method (200) as claimed in claim 6, wherein the idle stop condition is attained
when the speed of the vehicle (150) is lower than a predetermined threshold value and
the speed of the IC engine (104) is equal to a predetermined idling speed of the IC
15 engine (104).

12. The method (200) as claimed in claim 6 comprising a step of receiving, by the control
unit (106), an engine restart signal from a clutch sensor (112) disposed in a clutch
switch of the vehicle (150).

13. The method (200) as claimed in claim 6 comprising a step of receiving, by the control
unit (106), an engine restart signal from the throttle position sensor (114) disposed at a
throttle of the vehicle (150).

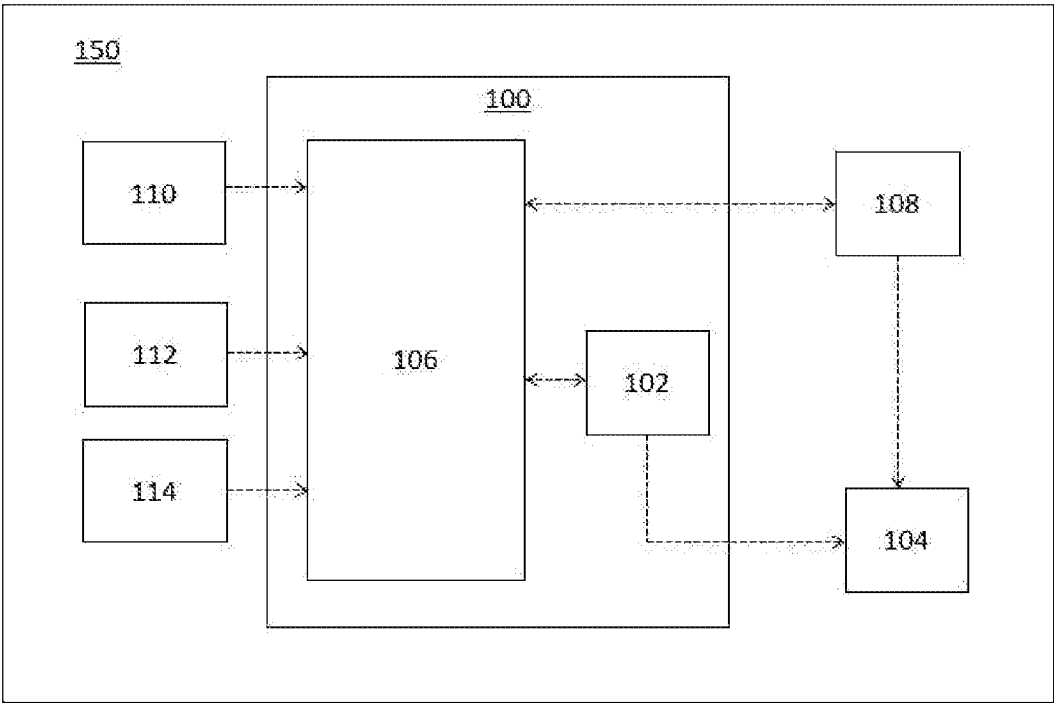


Figure 1

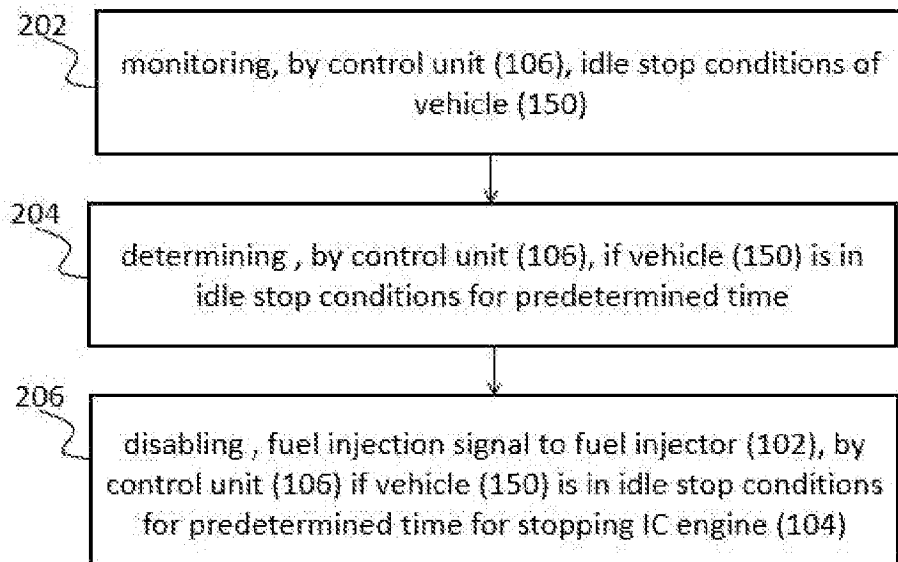
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Figure 2

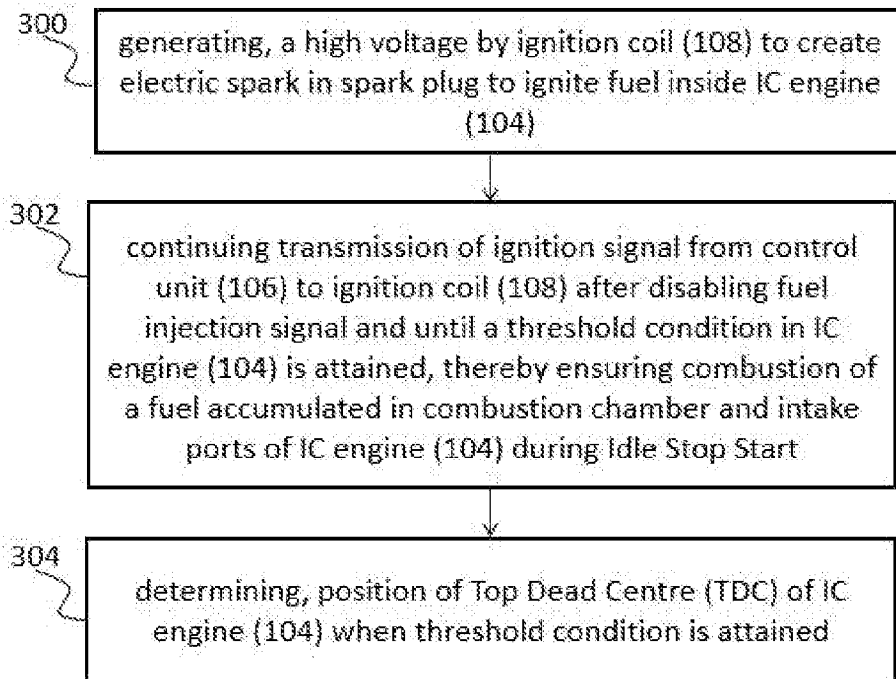


Figure 3

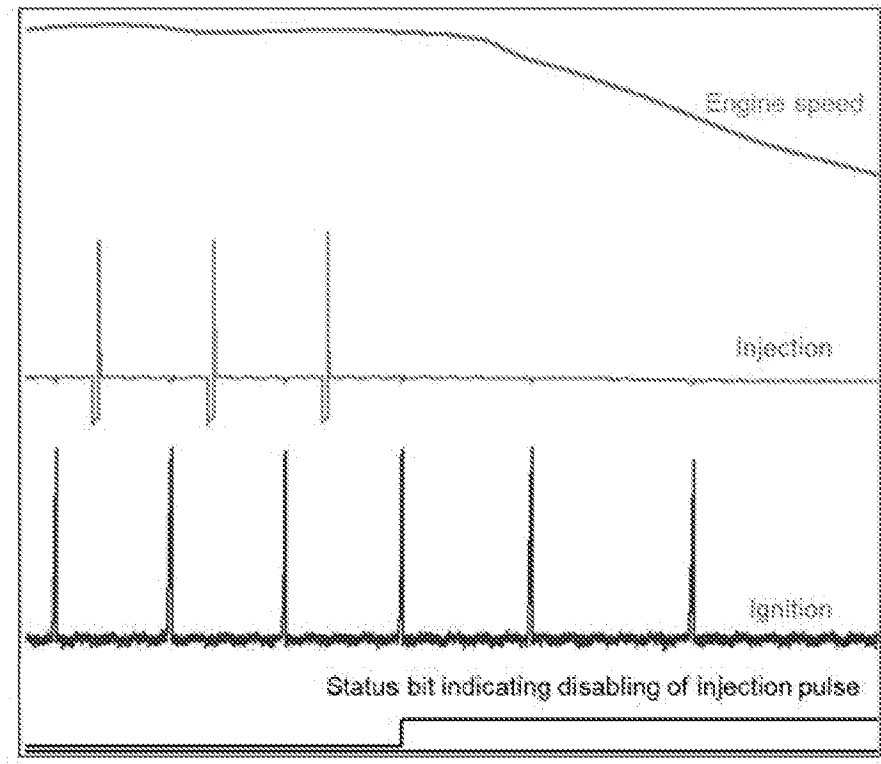


Figure 4

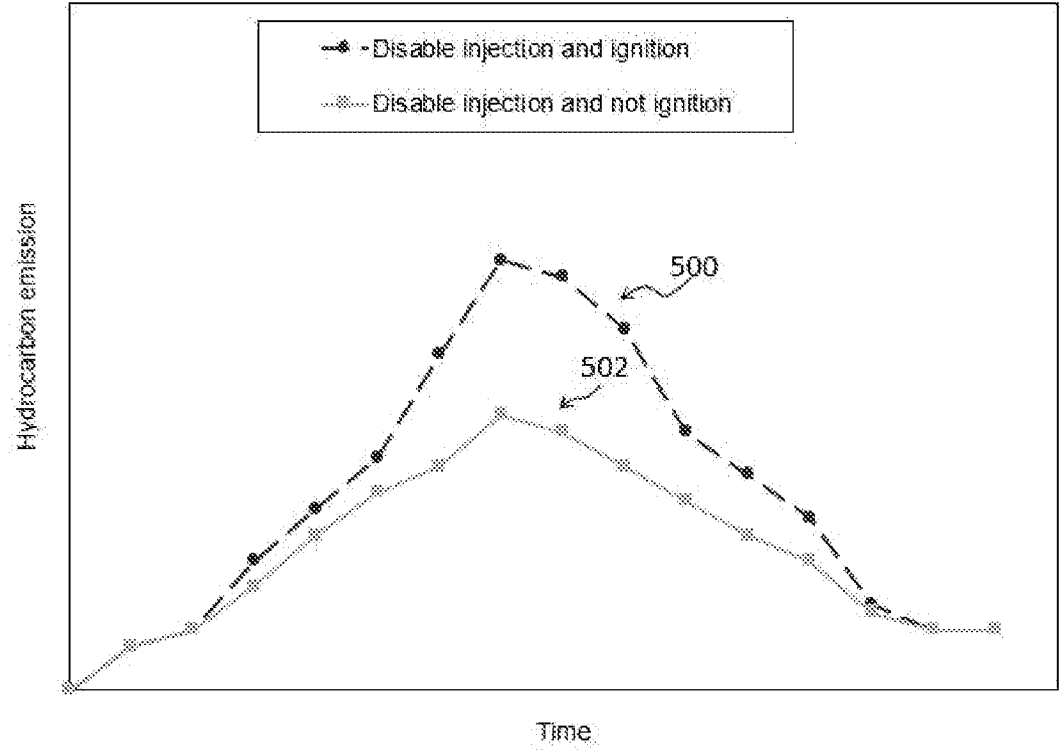


Figure 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/IN2022/050429

A. CLASSIFICATION OF SUBJECT MATTER

INV. F02D37/02 F02D41/04
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 F02N

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)

EPO-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.
X	JP 2014 141958 A (DAIHATSU MOTOR CO LTD) 7 August 2014 (2014-08-07) paragraphs [0022] - [0032]; figures 1-7 -----	1-13
X	FR 2 985 777 A1 (PEUGEOT CITROEN AUTOMOBILES SA [FR]) 19 July 2013 (2013-07-19) page 2, lines 3-15 page 4, lines 1-6; figures 1-4 -----	1-13
X	EP 2 881 566 A1 (YAMAHA MOTOR CO LTD [JP]) 10 June 2015 (2015-06-10)	1, 6
Y	columns 19,20,30; claim 1; figures 1,7-9	2,3,7,8
A	columns 46-49,52; claim 1; figures 1-9 -----	4,5,9-13
Y	DE 103 24 032 A1 (DAIMLER CHRYSLER AG [DE]) 16 December 2004 (2004-12-16) columns 9,16,17; claim 1 -----	2,3,7,8
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☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

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