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(54) Fuel injection control apparatus

(57) In an electronic control unit (10) corresponding to a fuel injection control apparatus arranged in a fuel feed system of a vehicle mounted engine having a function of carrying out a temporary amount increase correction of a fuel injection amount when detecting a change from an idle operation to a non-idle operation, the electronic control unit being provided with an acceleration determining means detecting an acceleration after changing gear, the increase correction amount is set to zero or to an amount which is decreased from a normal one when the acceleration determining means determines that the change to the non-idle operation is caused by the acceleration after changing gear. Useless fuel consumption and a deterioration of an exhaust performance can thus be avoided.

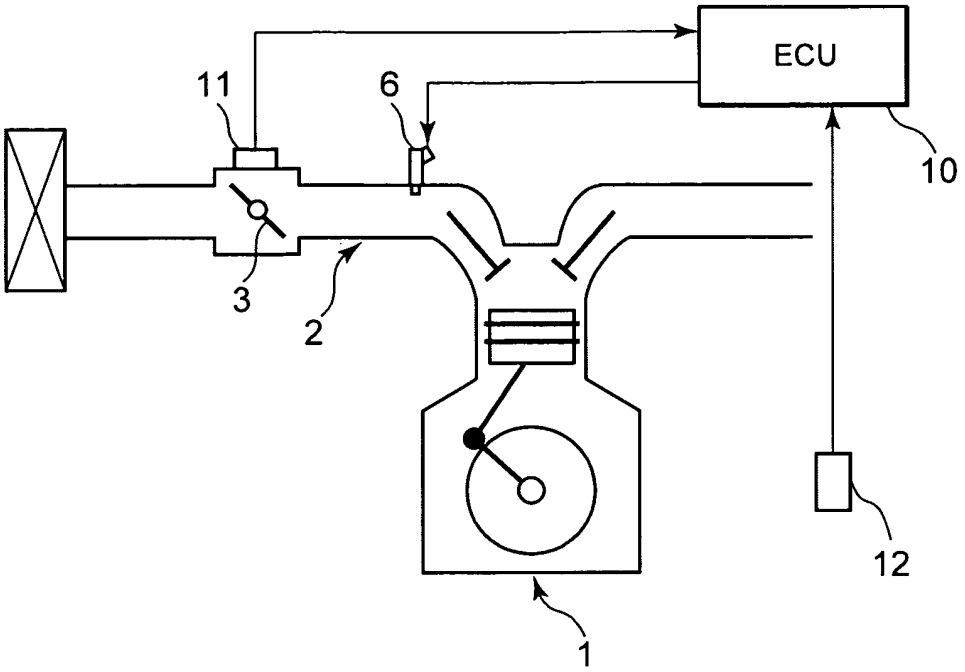

FIG. 1

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Description

Technical Field

[0001] The present invention relates to a fuel injection control apparatus controlling a drive of a fuel injection valve in correspondence to a throttle operation and an engine operational state, and more particularly to a fuel injection control apparatus arranged in a fuel feed system of a vehicle mounted engine, and having a function of regulating a fuel injection amount in correspondence to whether or not an idle operational state is established by providing an idle determining means.

Background Art

[0002] In a fuel feed system in the vehicle mounted engine in recent years, a fuel injection control is generally carried out for achieving an accurate fuel injection on the basis of various data detected by a plurality of monitors by providing a fuel injection control apparatus.

[0003] As one of the data for the control, for example, there has been known a structure which determines whether or not an idle operational state is established, by using a throttle valve opening degree sensor, as described in Japanese Unexamined Patent Publication No. 6-117301, or a structure which determines whether or not an idle operational state is established, by detecting an engine speed and an intake pipe pressure so as to compare them with a predetermined idle determination value, as described in Japanese Unexamined Patent Publication No. 5-256178, or the like.

[0004] As mentioned above, as one of purposes for determining whether or not the idle operational state is established, there can be listed up a purpose of securing a smooth start of a vehicle and a smooth ascent of an engine speed by detecting a timing of an increase in amount of the fuel, because an extra fuel is necessary temporarily in comparison with a normal time at a time of opening a throttle from an idle operation of the engine so as to change to a non-idle operation (an off idle).

[0005] However, since the increase in amount of the fuel at a time of changing to the non-idle operation from the idle operation makes the fuel richer than the normal one, a fuel consumption is increased and a deterioration of an exhaust performance is caused. Accordingly, it is preferable that a fuel amount increasing process by a fuel injection control apparatus is minimized as much as possible.

[0006] It has been known that a fuel amount increasing (Kai) process carried out at a time of changing from the idle operation to the non-idle operation is carried out during a racing or after a gear change during an acceleration of the vehicle. However, it is normal that the fuel is fully sufficient in accordance with the acceleration amount increasing process at a time of accelerating the engine, and the fuel amount increasing (Kai) process in this case becomes useless.

Disclosure of the Invention

Technical Problem

[0007] The present invention is made for the purpose of solving the problem as mentioned above, and an object of the present invention is to avoid a useless fuel consumption caused by a gear change during an acceleration and a deterioration of an exhaust performance, in a fuel injection control of a vehicle mounted engine.

Means for Solving the Problem

[0008] In accordance with the present invention, there is provided a fuel injection control apparatus arranged in a fuel feed system of a vehicle mounted engine having a function of temporarily correcting so as to increase a fuel injection amount by detecting a change from an idle operation to a non-idle operation by an idle operation determining means, wherein an amount increase correcting amount is set to zero or decreased in comparison with a normal one in the case that it is determined by an acceleration determining means at a time of changing gear that the change to the non-idle operation is caused by an acceleration after changing gear.

[0009] It is normal to temporarily correct so as to increase the fuel injection amount for the purpose of securing a smooth ascent of the engine speed or the like at a time of changing from the idle operation to the non-idle operation in the fuel injection control of the vehicle mounted engine, however, since the acceleration amount increase correction is carried out during the acceleration of the vehicle and it is unnecessary to correct so as to increase amount on the basis of the change to the non-idle operation, the useless addition of the fuel injection amount is avoided by detecting such the case so as to set the correction amount to zero or decrease the amount in comparison with the normal correction amount.

[0010] Further, in the case that the acceleration determining means at a time of changing gear is structured such as to detect an ON/OFF state of a neutral switch, detect an idle operating time and a non-idle operating time just before detecting a change to the non-idle operation, and determine an acceleration after changing gear under a condition that the detected idle operating time is shorter than a predetermined reference idle operating time, the detected non-idle operating time is equal to or longer than a predetermined reference non-idle operating time, and the neutral switch is in the ON state, it is possible to easily and securely determine the acceleration after changing gear which has a little necessity of the amount increase correction.

Advantage of the Invention

[0011] In accordance with the present invention structured such that the fuel amount is not carried out or is

decreased in comparison with the normal correcting amount in the case of the change to the non-idle operation generated by the acceleration after changing gear, it is possible to avoid the useless fuel consumption caused by the gear change during the acceleration and the deterioration of the exhaust performance.

Brief Description of the Drawings

[0012]

Fig. 1 is a layout diagram showing a first embodiment in accordance with the present invention;
Fig. 2 is a graph showing a control executed by a fuel injection control apparatus in Fig. 1;
Fig. 3 is a graph showing a control executed by a fuel injection control apparatus in accordance with a second embodiment of the present invention;
Fig. 4 is a graph showing a control executed by a fuel injection control apparatus in accordance with a prior art; and
Fig. 5 is a flow chart of the control executed by the fuel injection control apparatus in Fig. 1.

Best Mode for Carrying Out the Invention

[0013] A description will be given below of a best mode for carrying out the present invention with reference to the accompanying drawings.

[0014] Fig. 1 is a layout diagram showing a fuel feed system of a vehicle mounted engine in which an electronic control unit 10 is arranged as a fuel injection control apparatus executing a fuel injection control of an engine 1. In this fuel feed system, a throttle valve 3 is arranged in an intake passage 2 connected to the engine 1, and a fuel injection valve 6 is arranged in a downstream side thereof.

[0015] The electronic control unit 10 is constituted by a general purpose electronic control unit (ECU) provided with CPU, ROM, RAM (not shown) and the like in a hardware, and is constituted by a fuel injection control apparatus in which a fuel injection control program for executing a fuel injection control described below is stored, in a function. In this case, the electronic control unit 10 may be structured such as to be provided with a function of executing the other controls in the engine or the vehicle in addition to this function.

[0016] Further, a throttle opening degree sensor 11 is additionally provided in the throttle valve 3, and is structured such that an output signal is input to the electronic control unit 10. The throttle opening degree sensor 11 is utilized as an idle switch for detecting an idle operating state, and determines on the basis of the output signal whether or not an idle operating state determining means provided within the electronic control unit 10 is in an idle operating state, and the electronic control unit 10 recognizes a change from an idle operation to a non-idle operation on the basis of the determination.

[0017] Further, an output signal from a neutral switch 12 is input to the electronic control unit 10, and an acceleration determining means at a time of changing gear is provided in the electronic control unit 10. The acceleration determining means at a time of changing gear detects an ON/OFF state of the neutral switch 12, and detects each of times about one segmentation of the idle operation and one segmentation of the non-idle operation which were carried out just before the change to the non-idle operation, on the basis of the time detecting the change to the non-idle operation.

[0018] In this case, the acceleration determining means at a time of changing gear determines the acceleration after changing gear, under a condition that a detected idle time is shorter than a predetermined reference idle time (KAIIDONTM [S]), a detected off idle time is equal to or longer than a predetermined reference off idle time (KAIIDOFFTM [S]), and the neutral switch 12 is in the ON state.

[0019] In the case that it is determined by the acceleration determining means at a time of changing gear that the change to the non-idle operation at that time is caused by the acceleration after changing gear, the electronic control unit 10 is programmed in such a manner that the electronic control unit 10 does not carry out a temporary fuel amount increase correction which is normally carried out at a time of detecting the change from the idle operation to the non-idle operation, and this point forms a characteristic portion of the present embodiment. In this case, the reference idle time (KAIIDONTM [S]) and the reference off idle time (KAIIDOFFTM [S]) which are used for this determination may be set by simulating various engine operating states, as a result, determining both suitable numerical values corresponding only to the acceleration after changing gear.

[0020] Next, a description will be given of details of a fuel injection control method of the engine 1 executed by the electronic control unit 10 corresponding to the fuel injection control apparatus in accordance with the present embodiment, while using each of graphs in Figs. 2 to 4.

[0021] Fig. 4 is a graph of a control executed in the conventional engine fuel injection control apparatus, in which an upper side is a graph showing an ON/OFF of an idle operating state, and a lower side is a graph of a fuel amount increase (Kai) rate at a time of changing to an off idle. As shown in Fig. 4, in the conventional control, a temporary fuel amount increase (Kai) process for securing a good engine operating performance is carried out each time of changing from an idle to an off idle.

[0022] In other words, it is known that a peak of the fuel amount increase (Kai) rate is generated every changing time, and the fuel amount increase correction is carried out, in the graph of the fuel amount increase (Kai) rate at a time of changing from the idle to the off idle shown in the lower side of Fig. 4, at the timings corresponding to the vehicle starting time from the idle in a waveform view of the idle determination shown in the

upper side of Fig. 4, the accelerating time after changing gear, and the racing time of the engine. However, as mentioned above, the acceleration amount increase control has been already carried out at a time of accelerating the vehicle, and a useless fuel feed and a deterioration of the exhaust performance are caused.

[0023] Accordingly, in the present embodiment, as shown in Fig. 2, in the case that it is determined that the change from the idle to the off idle is caused by the acceleration after changing gear, the fuel amount is controlled such as not to be increased. In the acceleration determining means at a time of changing gear, the acceleration after changing gear is determined under a condition that the last idle time a is shorter than the previously stored reference idle time (KAIIDONTM [S]) defined on the basis of the data of the experiment or the like, the last off idle time B is equal to or longer than the stored reference off idle time (KAIIDOFFTM [S]) and the connected state of the gear detected by the neutral switch 12 is ON.

[0024] On the other hand, in the thereafter engine racing, the determination by the acceleration determining means at a time of changing gear is carried out in the same manner each time of changing from the idle to the off idle, however, since the last idle time A is longer than the reference idle time (KAIIDONTM [S]) on the basis of a rising time of each of the racings, or the last off idle time b is shorter than the reference off idle time (KAIIDOFFTM [S]), whereby the determination condition is not satisfied, as shown in Fig. 2, the general fuel amount increase correction is carried out.

[0025] Fig. 5 shows a flow chart showing a determining procedure executed by the acceleration determining means at a time of changing the electronic control unit 10. This procedure is started by detecting the change from the idle to the off idle, first determines whether or not the neutral switch is in an OFF state (A1), goes back if the neutral switch is in an ON state, and determines whether or not the idle time just before changing to the off idle is shorter than the reference idle time (KAIIDONTM [S]) if the neutral switch is in the OFF state (A2).

[0026] Further, the procedure goes back if the idle time is longer, determines whether or not the last off idle time is equal to or longer than the reference off idle time (KAIIDOFFTM [S]) if the idle time is shorter (A3), goes back if the idle time is shorter than the reference off idle time, and determines the acceleration after changing gear if the idle time is equal to or longer than the reference off idle time, thereby setting no fuel amount increase (Kai) process (zero %) (A4).

[0027] Since the electronic control unit 10 corresponding to the fuel injection control apparatus executes the control mentioned above, it is possible to accurately determine whether or not the acceleration is the acceleration after changing gear which is not necessary to increase the amount of the fuel, and it is possible to well maintain the engine operating performance while avoiding the waste of the fuel consumption and the deterioration of the exhaust performance without carrying out the unnecessary fuel amount increase correction.

[0028] Fig. 3 shows a graph of a control executed by a fuel injection control apparatus in an engine fuel feed system in accordance with a second embodiment of the present invention. The present embodiment is characterized by a point that in the case that the acceleration after changing the gear is determined by an acceleration determining means at a time of changing gear, the fuel amount is increased only at such an amount that comes short by only the normal acceleration amount increase correction in place of setting the fuel amount increase (Kai) to zero, thereby reducing the fuel amount increase to one half or less than the normal fuel amount increase (Kai) rate, as shown in a graph in a lower side of Fig. 3, approximately in the same manner as the first embodiment mentioned above.

[0029] As mentioned above, since the amount increase correction is carried out in such a manner as to fill up the excess and deficiency between the amount which is actually necessary to be increased in the fuel injection and the normal acceleration amount increase correction amount, in the acceleration after changing gear going with the vehicle travel, it is possible to achieve a precise fuel injection control, and it is possible to maintain the engine operating performance in a further good state.

[0030] As mentioned above, in the fuel injection control of the vehicle mounted engine, in accordance with the present invention, it is possible to effectively avoid the useless fuel consumption and the deterioration of the exhaust performance caused by the gear change during the acceleration.

Claims

1. An engine fuel injection control apparatus arranged in a fuel feed system of a vehicle mounted engine having a function of temporarily correcting so as to increase a fuel injection amount by detecting a change from an idle operation to a non-idle operation by an idle operation determining means, wherein an amount increase correcting amount is set to zero or decreased in comparison with a normal one in the case that it is determined by an acceleration determining means at a time of changing gear that the change to the non-idle operation is caused by an acceleration after changing gear.

2. An engine fuel injection control apparatus as claimed in claim 1, wherein the acceleration determining means at a time of changing gear detects an ON/OFF state of a neutral switch, detect an idle operating time and a non-idle operating time just before detecting a change to the non-idle operation, and determine an acceleration after changing gear under a condition that the detected idle operating time is shorter

than a predetermined reference idle operating time, the non-idle operating time is equal to or longer than a predetermined reference non-idle operating time, and the neutral switch is in the ON state.

3. An engine fuel injection control apparatus as claimed in claim 1 or 2, wherein the acceleration determining means at a time of changing gear detects each of times about one segmentation of the idle operation and one segmentation of the non-idle operation which were carried out just before the change to the non-idle operation, on the basis of the time detecting the change to the non-idle operation.

4. An engine fuel injection control apparatus as claimed in claim 1, 2 or 3, wherein the acceleration determining means at a time of changing gear starts the determination by detecting the change from the idle operation to the non-idle operation, determines whether or not the neutral switch is in an OFF state, and determines whether or not the idle time just before changing to the non-idle operation is shorter than a reference idle time if the neutral switch is in the OFF state.

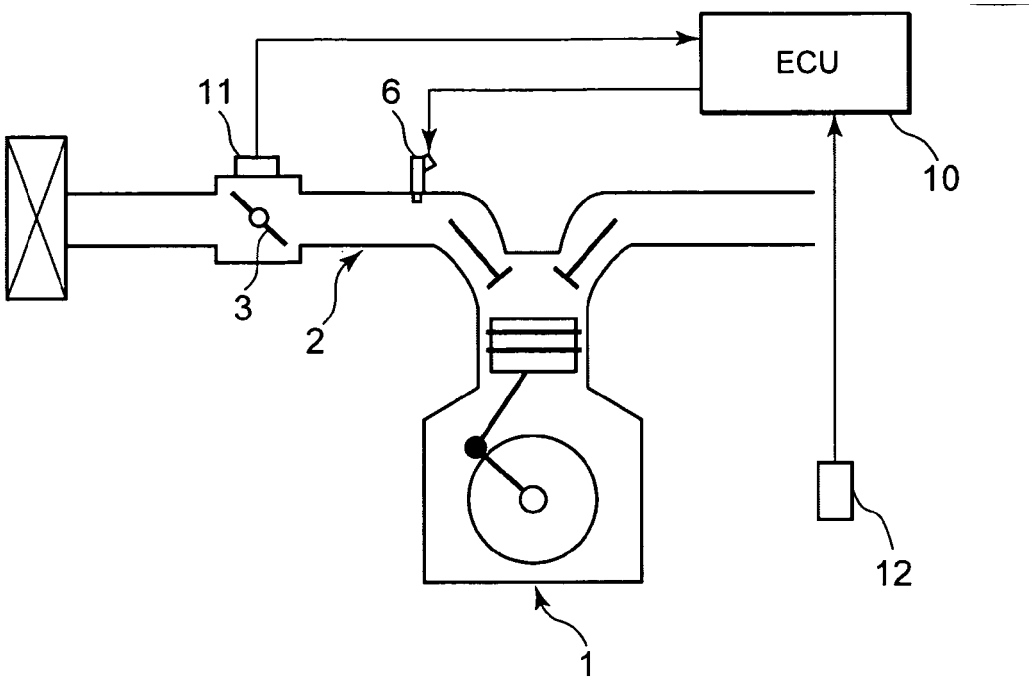
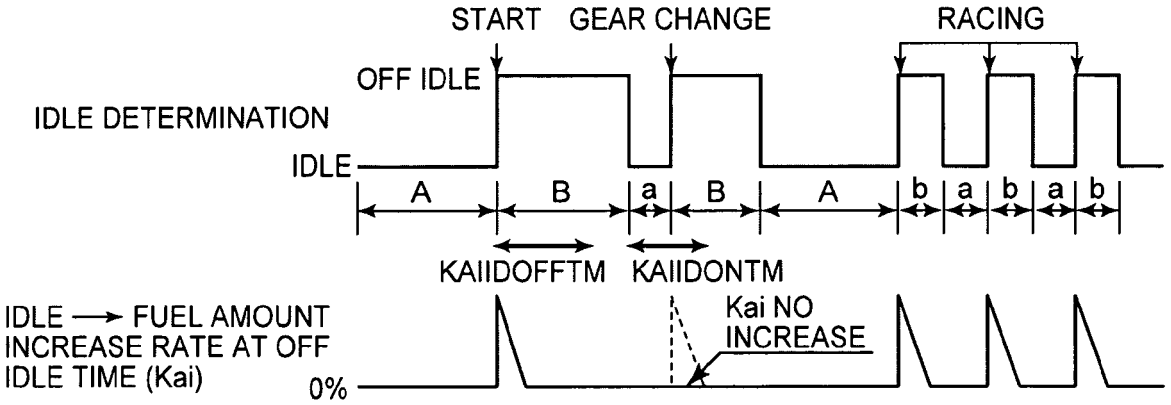


FIG. 1



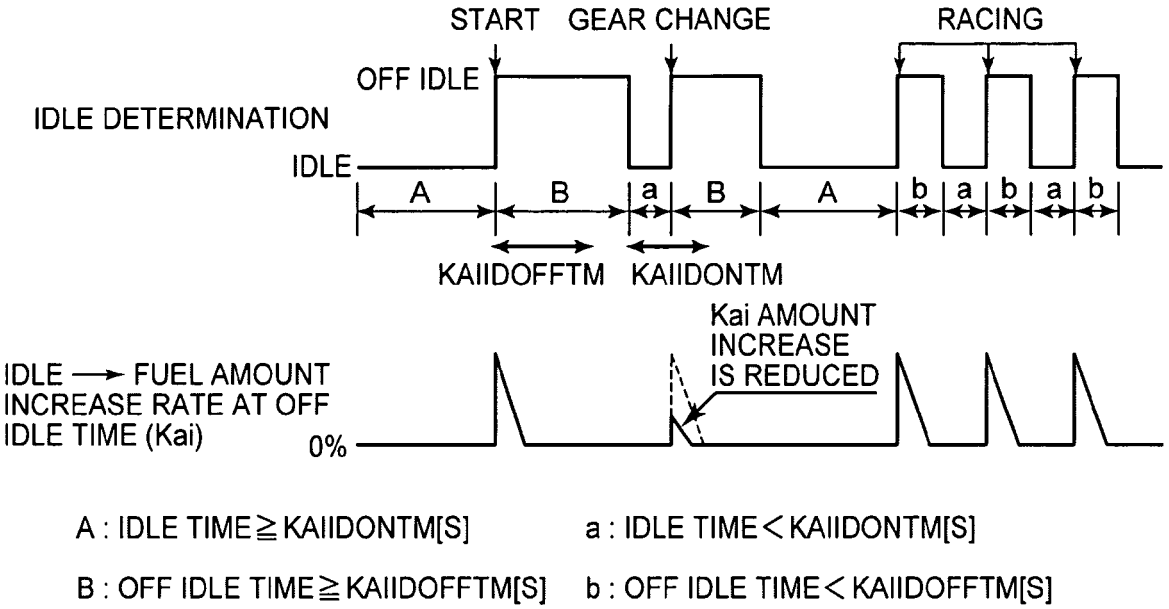
A : IDLE TIME ≧ KAIIDONTM[S]

a : IDLE TIME < KAIIDONTM[S]

B : OFF IDLE TIME ≧ KAIIDOFFTM[S]

b : OFF IDLE TIME < KAIIDOFFTM[S]

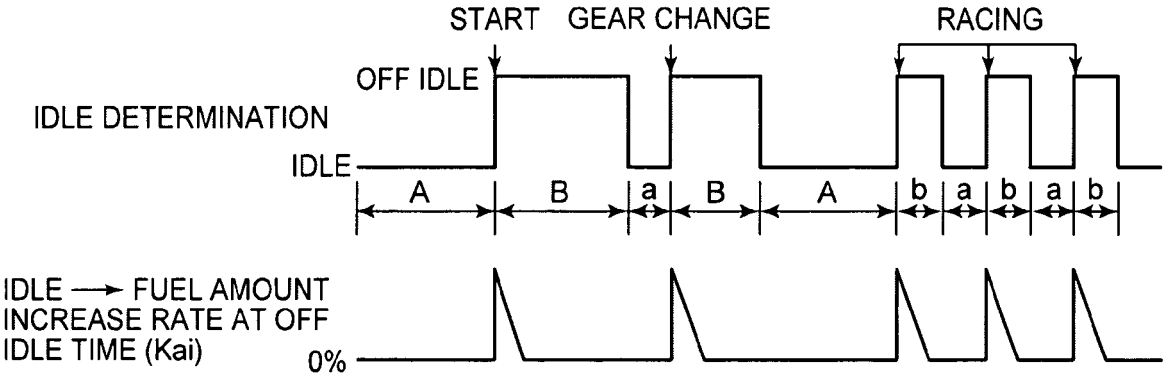
FIG. 2



A : IDLE TIME ≧ KAIIDONTM[S] a : IDLE TIME < KAIIDONTM[S]

B : OFF IDLE TIME ≧ KAIIDOFFTM[S] b : OFF IDLE TIME < KAIIDOFFTM[S]

FIG. 3



A : IDLE TIME a : IDLE TIME

B : OFF IDLE TIME b : OFF IDLE TIME

FIG. 4

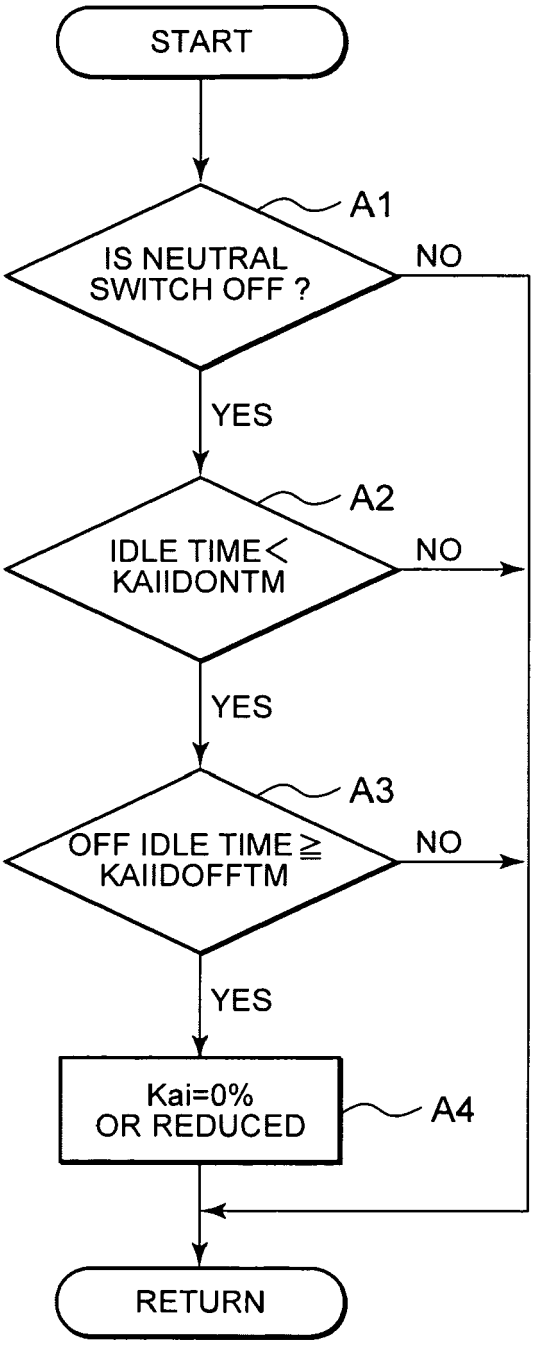

START
A1
IS NEUTRAL SWITCH OFF ?
NO
YES
A2
IDLE TIME < KAIIDONTM
NO
YES
A3
OFF IDLE TIME ≧ KAIIDOFFTM
NO
YES
Kai=0% OR REDUCED
A4
RETURN

FIG. 5

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 6117301 A **[0003]**
- JP 5256178 A **[0003]**