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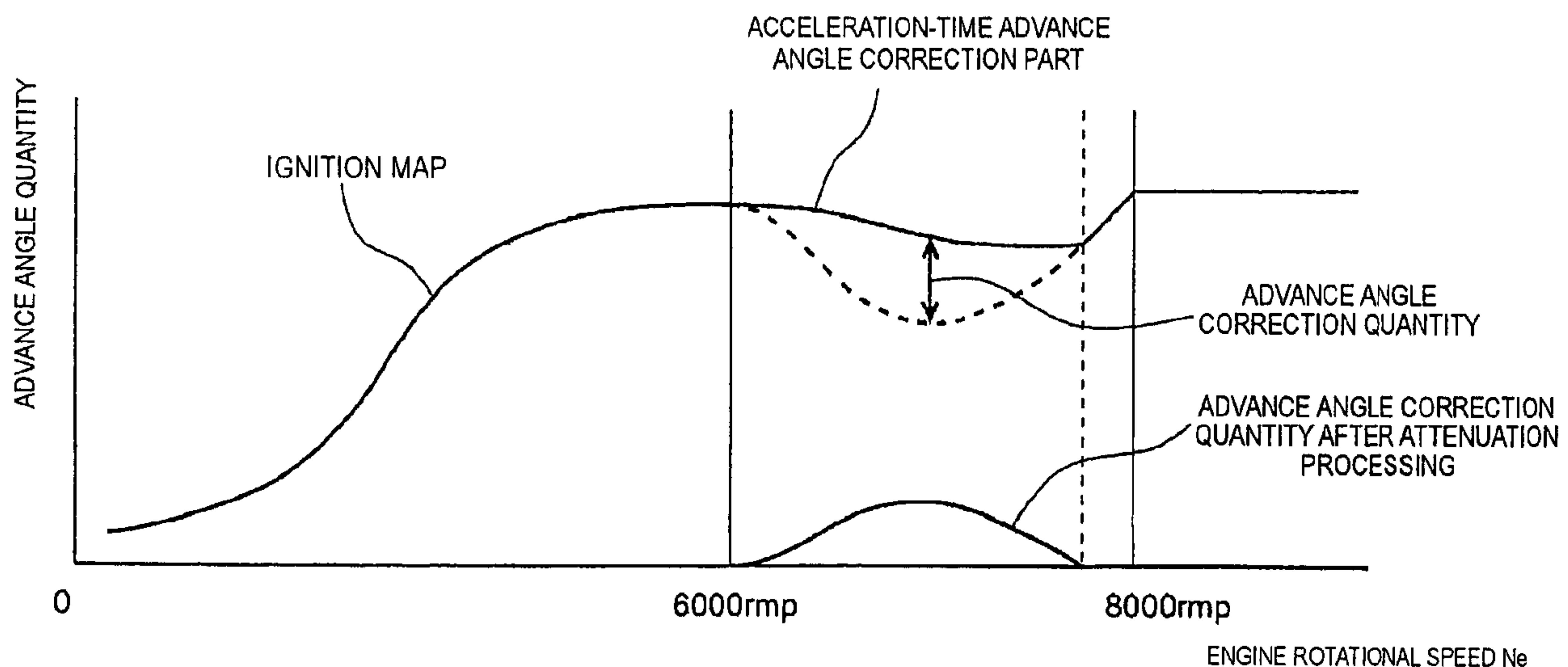
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(54) Title: ENGINE IGNITION CONTROL DEVICE



< IGNITION MAP AT THE TIME OF OPENING THROTTLE VALVE IN A FULL OPEN STATE >

(57) **Abrégé/Abstract:**

To provide an engine ignition control device which can detect an acceleration state of a vehicle based on a change rate of an engine rotational speed and can perform the advance angle correction of an ignition timing. An engine ignition control device includes: a standard ignition map which is provided for retarding ignition timing in a predetermined high rotational region where throttle opening assumes predetermined opening or more and an engine rotational speed falls within a predetermined high rotational region; an acceleration-time advance angle correction quantity map which is provided for performing advance angle correction in the control region where the engine rotational speed falls within the predetermined high rotational region; a ΔN_e detection part which is provided for detecting a change rate ΔN_e of the engine rotational speed; and an acceleration-time advance angle correction quantity setting part which is provided for setting the ignition timing at the time of correcting an advance angle. Here, the acceleration-time advance angle correction quantity setting part performs attenuation processing in which acceleration-time advance angle correction quantity setting part derives an advance angle quantity from the acceleration-time advance angle correction quantity map when the engine rotational speed falls within the high rotational region and the change ΔN_e rate is a predetermined value or more, and increases an attenuation quantity of the advance angle quantity for every ignition thus performing the advance angle correction based on the advance angle quantity after the attenuation processing.

ABSTRACT OF THE DISCLOSURE

To provide an engine ignition control device which can detect an acceleration state of a vehicle based on a change rate of an engine rotational speed and can perform the advance angle correction of an ignition timing. An engine ignition control device includes: a standard ignition map which is provided for retarding ignition timing in a predetermined high rotational region where throttle opening assumes predetermined opening or more and an engine rotational speed falls within a predetermined high rotational region; an acceleration-time advance angle correction quantity map which is provided for performing advance angle correction in the control region where the engine rotational speed falls within the predetermined high rotational region; a ΔN_e detection part which is provided for detecting a change rate ΔN_e of the engine rotational speed; and an acceleration-time advance angle correction quantity setting part which is provided for setting the ignition timing at the time of correcting an advance angle. Here, the acceleration-time advance angle correction quantity setting part performs attenuation processing in which acceleration-time advance angle correction quantity setting part derives an advance angle quantity from the acceleration-time advance angle correction quantity map when the engine rotational speed falls within the high rotational region and the change ΔN_e rate is a predetermined value or more, and increases an attenuation quantity of the advance angle quantity for every ignition thus performing the advance angle correction based on the advance angle quantity after the attenuation processing.

ENGINE IGNITION CONTROL DEVICE

FIELD OF THE INVENTION

- 5 The present invention relates to an engine ignition control device, and more particularly to an engine ignition control device which can perform the advance angle correction of ignition timing by detecting an acceleration state of a vehicle based on a change rate of an engine rotational speed.

10 **BACKGROUND OF THE INVENTION**

Conventionally, there has been known an engine ignition control device which detects an acceleration state of a vehicle and performs an ignition timing control in response to the detected acceleration state.

- 15 JP-B-7-51925 discloses an ignition timing control method which detects an acceleration operation of a rider based on a change quantity of throttle opening, and applies the retard angle correction to ignition timing when an engine rotational speed is decreased in such a state thus preventing knocking.
- 20 However, according to the method disclosed in JP-B-7-51925, the acceleration state is detected based on the change quantity of the throttle opening. Accordingly, for example, during the acceleration with the throttle opening held in a full open state, it is difficult to detect that the vehicle is in an acceleration state based on a change of the throttle opening and hence, there exists a

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drawback that it is impossible to perform a control for determining ignition timing using the change of the throttle opening as one of control parameters.

Accordingly, it is an object of the present invention to provide an engine ignition control device which can overcome the above-mentioned drawback of the related art and can detect an acceleration state of a vehicle based on a change rate of an engine rotational speed and can perform the advance angle correction of the ignition timing.

10 SUMMARY OF THE INVENTION

A first aspect of the present invention lies in an engine ignition control device which includes: a standard ignition map which is provided for retarding ignition timing in a control region where throttle opening assumes predetermined opening or more and an engine rotational speed falls within a predetermined high rotational region; an acceleration-time advance angle correction quantity map which is provided for performing the advance angle correction of the ignition timing in response to the engine rotational speed in the control region; a ΔN_e detection part which is provided for detecting a change rate of the engine rotational speed in the rising direction; and an acceleration-time advance angle correction quantity setting part which is provided for setting the ignition timing at the time of correcting an advance angle, wherein the acceleration-time advance angle correction quantity setting part performs attenuation processing in which the acceleration-time advance angle correction quantity setting part derives an advance angle quantity from the acceleration-time advance angle correction quantity map when the engine rotational speed falls within the predetermined high rotational region and the change rate is a predetermined value or more, and increases an attenuation quantity of the advance angle quantity for every ignition thus performing the advance angle correction based on the advance angle quantity after the attenuation processing.

Further, a second aspect of the present invention lies in that the attenuation quantity used in the attenuation processing is set to be increased at a fixed rate

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for every ignition from a point of time that the advance angle correction is started.

According to the first aspect of the present invention, in the engine ignition
5 control device which includes: the standard ignition map which is provided for
retarding ignition timing in the control region where throttle opening assumes
predetermined opening or more and an engine rotational speed falls within the
predetermined high rotational region; the acceleration-time advance angle
10 correction quantity map which is provided for performing advance angle
correction of the ignition timing in response to the engine rotational speed in the
control region; the ΔN_e detection part which is provided for detecting the change
rate of the engine rotational speed in the rising direction; and the acceleration-
time advance angle correction quantity setting part which is provided for setting
15 time advance angle correction quantity setting part performs attenuation
processing in which the acceleration-time advance angle correction quantity
setting part derives the advance angle quantity from the acceleration-time
advance angle correction quantity map when the engine rotational speed falls
within the predetermined high rotational region and the change rate is a
20 predetermined value or more, and increases the attenuation quantity of the
advance angle quantity for every ignition thus performing the advance angle
correction based on the advance angle quantity after the attenuation processing.
Due to such constitution, different from a technique which detects an acceleration
state of a vehicle based on a change of throttle opening, even when the throttle
25 opening is held at fixed opening such as a full open state, it is possible to perform
the advance angle correction of the ignition timing by detecting the acceleration
state of the vehicle. Accordingly, in an acceleration state in which the throttle
opening is fixed and there is no possibility of occurrence of knocking or the like
due to a high rising rate of the engine rotational speed, it is possible to enhance
30 an engine output by performing the advance angle correction of ignition timing
of the standard ignition map. Further, the advance angle correction quantity is
subject to the attenuation processing for every ignition and hence, the influence
of the advance angle correction on the engine can be reduced by shortening the
advance angle correction period and, at the same time, it is possible to smoothly

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return the ignition control from the ignition control in a state that the advance angle correction is performed to the ignition control based on the standard ignition map.

- 5 According to the second aspect of the present invention, the attenuation quantity used in the attenuation processing is set to be increased at a fixed rate for every ignition from a point of time that the advance angle correction is started and hence, it is possible to easily set the number of times of ignition until the ignition control returns to the ignition control based on the standard ignition map after
10 starting the ignition control based on the advance angle correction quantity.

BRIEF DESCRIPTION OF THE DRAWINGS

- 15 Preferred embodiments of the invention are shown in the drawings, wherein:

Fig. 1 is a block diagram showing the constitution of an engine ignition control device according to one embodiment according to the present invention.

- 20 Fig. 2 is a flowchart showing the flow of an acceleration-time advance angle correction control according to one embodiment of the present invention.

Fig. 3 is a standard ignition map (throttle valve in a full open state) according to one embodiment of the present invention.

25

Fig. 4 is an acceleration-time advance angle correction quantity map according to one embodiment of the present invention.

- 30 Fig. 5 is a graph showing the relationship between an ignition map after advance angle correction and an advance angle correction quantity after attenuation processing.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A preferred embodiment of the present invention is explained in detail hereinafter in conjunction with drawings. Fig. 1 is a block diagram showing the constitution of an engine ignition control device 100 according to one
5 embodiment of the present invention. A crankshaft 1 of an engine is provided with a pair which is constituted of a crank pulser rotor 2 having a non-toothed portion and a pulse generator 3 and outputs 13 crank pulses for every one rotation of the crankshaft 1. 13 pieces of projecting portions are arranged at intervals of 22.5 degrees, and an angle of the non-toothed portion is set to 90
10 degrees. An output signal transmitted from the pulse generator 3 is inputted to a phase detection part 501 housed in an ECU 5.

The phase detection part 501 detects a phase of the crankshaft 1 based on crank pulses. An Ne detection part 503 detects an engine rotational speed Ne based on
15 a detection result of the phase detection part 501 and an output signal from a timer 502. Further, a Δ Ne detection part 504 detects a change rate Δ Ne of the engine rotational speed between two predetermined measuring points based on an output signal from the Ne detection part 503.

20 To an acceleration-time advance angle correction quantity setting part 505, output signals from the Ne detection part 503, the Δ Ne detection part 504, a throttle opening sensor 4 which detects throttle opening of the engine, a standard ignition map 507 and a correction attenuation quantity arithmetic operation part 508 are inputted. The acceleration-time advance angle correction quantity setting
25 part 505 determines ignition timing of the engine based on these output signals, and transmits the ignition timing to an ignition device control part 506. The ignition device 6 consisting of an ignition plug and the like ignites an air-fuel mixture in a combustion chamber at predetermined ignition timing based on a command from the ignition device control part 506.

30 The above-mentioned standard ignition map 507 is a data map for deriving the ignition timing at the time of performing usual driving based on the throttle opening and the engine rotational speed Ne. In usual driving, the acceleration-time advance angle correction quantity setting part 505 determines the ignition

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timing to be transmitted to the ignition device control part 506 by applying the information from the throttle opening sensor 4 and the Ne detection part 503 to the standard ignition map 507. On the other hand, a correction attenuation quantity arithmetic operation part 508 has a function of calculating the correction
5 quantity of the ignition timing which is applicable only when the vehicle is in a particular acceleration state based on the information from an acceleration-time advance angle correction quantity map 509 and an ignition time counter 510.

Fig. 2 is a flowchart showing the flow of an acceleration-time advance angle
10 correction control according to one embodiment of the present invention. Further, Fig. 3 shows the standard ignition map 507 in a throttle full open state. The acceleration-time advance angle correction control of this embodiment is effectively applicable to a case that the standard ignition map 507 is set such that the ignition timing is retarded for protecting the engine when the throttle
15 opening is in a predetermined largely-opened state (for example, a full open state) and the engine rotational speed Ne is in a predetermined high rotation region.

The standard ignition map 507 according to this embodiment is set such that the
20 ignition timing is retarded in a predetermined high-rotational region of 6000 to 8000 rpm in a throttle-valve full open state. Such retardation setting of the ignition timing is effectively used as a means which surely protects the engine by preventing the occurrence of knocking when the engine is in a high load state and hence, a throttle valve is in a full open state. However, for example, even if
25 the throttle valve is in a full open state, when a rising rate of the engine rotational speed is high, that is, when a vehicle body is smoothly accelerated, the reduction of retardation quantity does not cause a problem provided that the reduction of retardation quantity occurs instantaneously. By performing the reduction of the retardation quantity, the engine output at the time of acceleration can be
30 instantaneously enhanced thus realizing the acquisition of the output characteristic with high feeling of acceleration.

However, in a method which detects an acceleration state of the vehicle body based on a change quantity of a throttle opening sensor, when the throttle

opening is fixed to a full open state, it is impossible to detect the acceleration state of the vehicle body and hence, the advance angle correction cannot be performed. To the contrary, according to the engine ignition control device of this embodiment, the engine ignition control device is configured such that by
5 detecting the acceleration state of the vehicle based on the change rate of the engine rotational speed, the advance angle correction of the ignition timing can be performed even at the time of acceleration in which the throttle valve is in a full open state.

10 Returning to the flowchart shown in Fig. 2, in step S1, the engine rotational speed N_e is detected by the N_e detection part 504. Next, in step S2, it is determined whether or not the engine rotational speed N_e is 6000rpm or more and 8000rpm or less, that is, it is determined whether or not the engine rotational speed N_e is in a predetermined high rotation region. If the determination is affirmative, the
15 processing advances to step S3.

In step S3, the detection of the throttle opening Th is performed by the throttle opening sensor 4. In step S4, it is determined whether or not the throttle opening Th is predetermined opening or more (a full open state in this embodiment). If
20 the determination is affirmative, the processing advances to step S5. In succeeding step S5, the change rate ΔN_e of the engine rotational speed is calculated by the ΔN_e detection part 504. Then, in step S6, it is determined whether or not the change rate ΔN_e is a predetermined change rate or more, and if the determination is affirmative, the processing advances to step S7.

25 When the affirmative determinations are made in the above-mentioned steps S2, S4 and S6, it is determined that a vehicle is in an acceleration state with ignition timing retarded based on the standard ignition map 507. Accordingly, the advance angle correction control is performed by executing processing in step S7
30 and succeeding steps. Here, if the negative determination is made in steps 2, 4 and 6, it is determined that the vehicle is not in an operation state in which the acceleration-time advance angle correction control according to this embodiment is applicable to the vehicle, and a series of control is finished.

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As described previously, the engine ignition control device of this embodiment includes the acceleration-time advance angle correction quantity map 509 for performing the advance angle correction in addition to the standard ignition map 507 which is used in usual driving. The acceleration-time advance angle
5 correction quantity map 509, as shown in Fig. 4, defines an advance angle quantity (correction data C) in a predetermined high rotation range of 6000rpm to 8000rpm. Here, "advance angle correction quantity after attenuation processing" indicated by a broken line in the drawing is described later.

10 Returning to the flowchart shown in Fig. 2, in step S7, the correction data C corresponding to the current engine rotational speed N_e is derived from the acceleration-time advance angle correction quantity map 509. In subsequent step S8, a correction attenuation quantity D is calculated. This calculation determines an attenuation quantity of the correction data C. In this embodiment, the
15 correction attenuation quantity D is obtained by a calculation formula $D=1-(0.01 \times n)$. Here, n is the number of times of ignition after starting the advance angle correction and is measured by the above-mentioned ignition time counter 510 (see Fig. 1). According to this calculation, for example, the correction attenuation quantity D becomes 0.99 ($D=0.99$) in the ignition ($n=1$) which follows
20 the ignition with which the advance angle correction is started, the correction attenuation quantity D becomes 0.98 ($D=0.98$) in the second ignition ($n=2$) after starting the advance angle correction, and the correction attenuation quantity D becomes zero ($D=0$) in the 100th ignition ($n=100$) after starting the advance angle correction.

25 In step S9, the advance angle correction quantity E (acceleration-time advance angle correction quantity E) after attenuation processing is calculated based on the above-mentioned correction data C $\times$ correction attenuation quantity D. In subsequent step S10, as shown in Fig. 5, the advance angle correction is applied
30 to a retarded portion set within 6000 to 8000rpm of the standard ignition map 507 using the advance angle correction quantity E after attenuation processing, and the ignition device is driven using the ignition timing after advance angle correction. Then, in step S11, a numerical value of the ignition time counter 510 is incremented and the processing advances to step S12.

In step S12, it is determined whether or not the correction attenuation quantity D becomes zero ($D=0$). If the determination in step S12 is negative, the processing returns to step S1. On the other hand, if the determination in step S12 is affirmative, a series of control is finished. The correction attenuation quantity D in step S8 becomes zero when the number of times of ignition becomes 100 as described previously. Accordingly, irrespective of the value of the correction data C corresponding to the engine rotational speed, with the 100th ignition after starting the advance angle correction, the advance angle correction quantity E also becomes zero.

As described above, in the engine ignition control device according to the present invention, the fact that the vehicle is in an acceleration state is detected based on the change rate ΔN_e of the engine rotational speed N_e . Accordingly, even when the standard ignition map is set so as to retard the ignition timing in the predetermined high speed region with the throttle opening in a full open state, it is possible to perform the advance angle correction of the retarded portion in conformity with the acceleration state of the vehicle. Further, the advance angle correction quantity is set such that the advance angle correction quantity is attenuated at a fixed rate for every ignition after starting the advance angle correction and hence, the advance angle correction can be accurately finished with the predetermined number of times of ignition. Further, due to the continuous advance angle correction, there is no possibility that a load is imposed on the engine and hence, an engine output at the time of acceleration can be enhanced thus enabling the acquisition of output characteristic with high feeling of acceleration. Further, since the advance angle quantity is subject to the attenuation processing for every ignition, the ignition control can be smoothly shifted from the control in an advance angle correction state to the control based on the standard ignition map.

Here, the throttle opening for performing the advance angle correction is not limited to the throttle opening fixed to a full-open state in the above-mentioned embodiment, and may be set to opening of 90% or more depending on the setting of the standard ignition map. Further, modes or set values of the

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standard ignition map and the acceleration-time advance angle correction map, values of predetermined high rotation regions for retarding the ignition timing with the standard ignition map, an arithmetic operation formula of correction attenuation quantity, setting of the number of times of ignition for performing
5 the advance angle correction and the like are not limited to the above-mentioned embodiment and various modifications are conceivable.

Although various preferred embodiments of the present invention have been described herein in detail, it will be appreciated by those skilled in the art, that
10 variations may be made thereto without departing from the spirit of the invention or the scope of the appended claims.

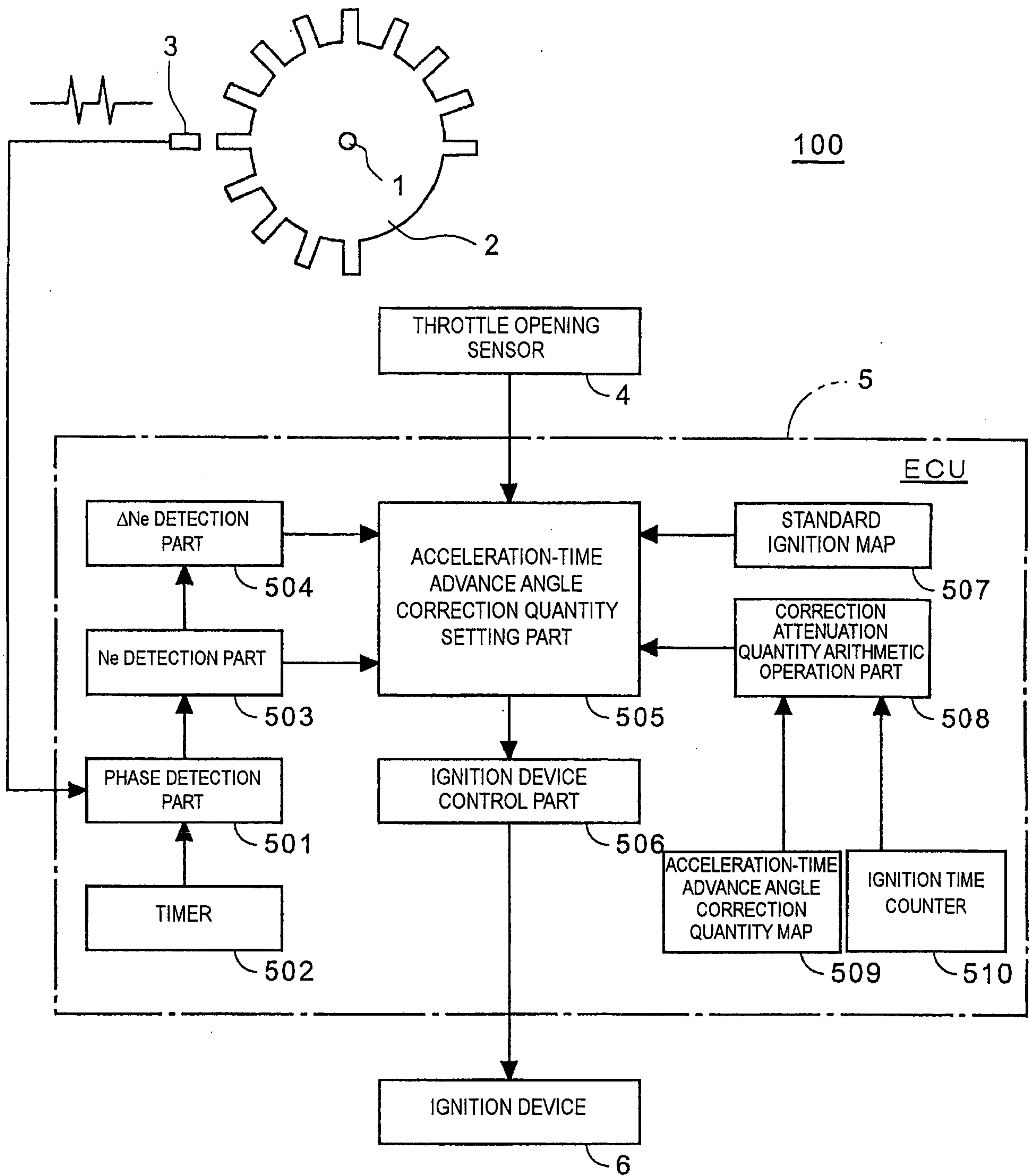
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THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

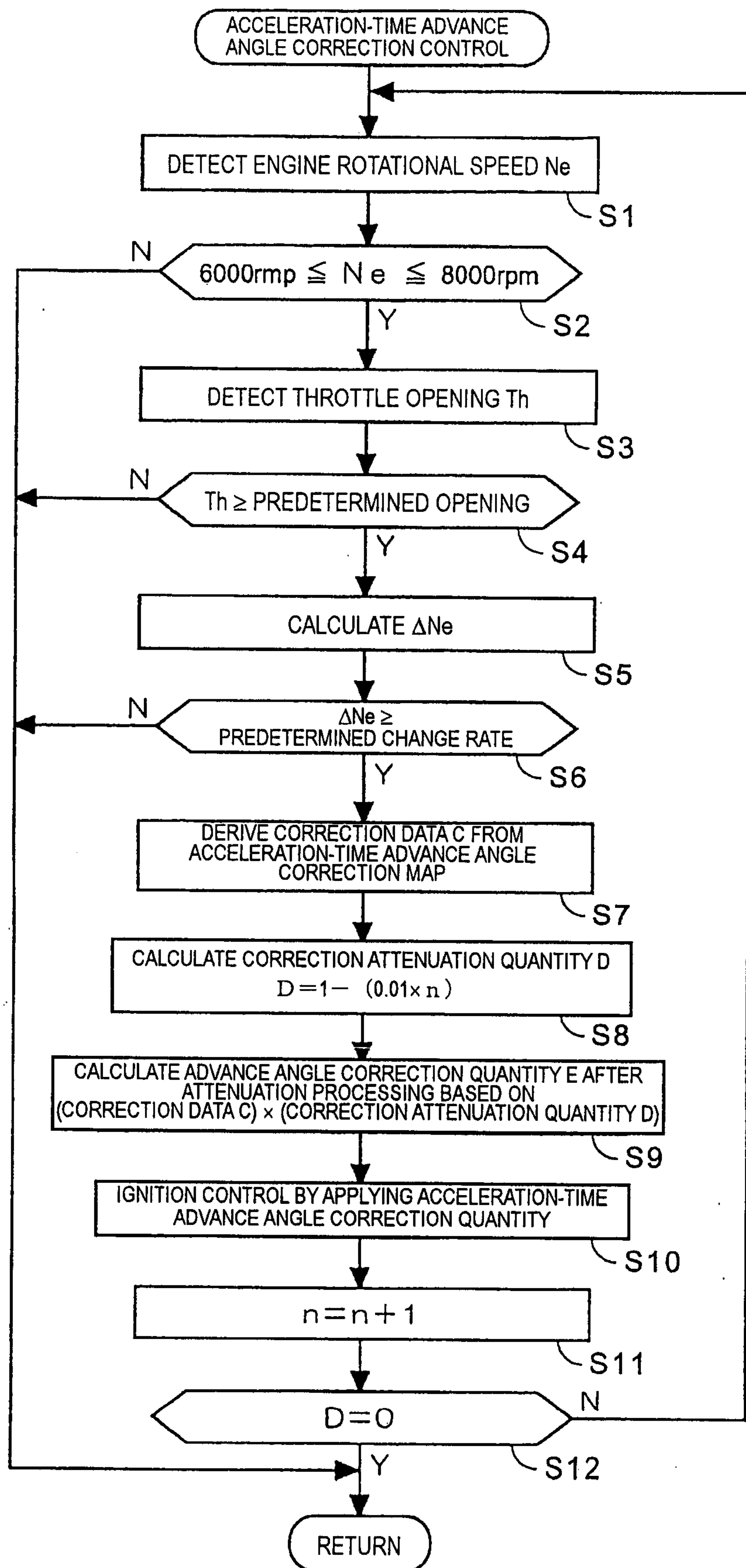
1. An engine ignition control device comprising:
 - 5 a standard ignition map which is provided for retarding ignition timing in a control region where throttle opening assumes predetermined opening or more and an engine rotational speed falls within a predetermined high rotational region;
 - an acceleration-time advance angle correction quantity map which is provided for performing advance angle correction of the ignition timing in response to the engine rotational speed in the control region;
 - a ΔN_e detection part which is provided for detecting a change rate of the engine rotational speed in the rising direction; and
 - an acceleration-time advance angle correction quantity setting part which is provided for setting the ignition timing at the time of correcting an advance angle, wherein
 - 20 the acceleration-time advance angle correction quantity setting part performs attenuation processing in which the acceleration-time advance angle correction quantity setting part derives an advance angle quantity from the acceleration-time advance angle correction quantity map when the engine rotational speed falls within the predetermined high rotational region and the change rate is equal to or more than a predetermined value, and increases an attenuation quantity of the advance angle quantity for every ignition thus performing the advance angle correction based on the advance angle quantity
 - 25 after the attenuation processing.
2. An engine ignition control device according to claim 1, wherein the attenuation quantity used in the attenuation processing is set to be increased at a fixed rate for every ignition from a point of time that the advance angle
- 30 correction is started.

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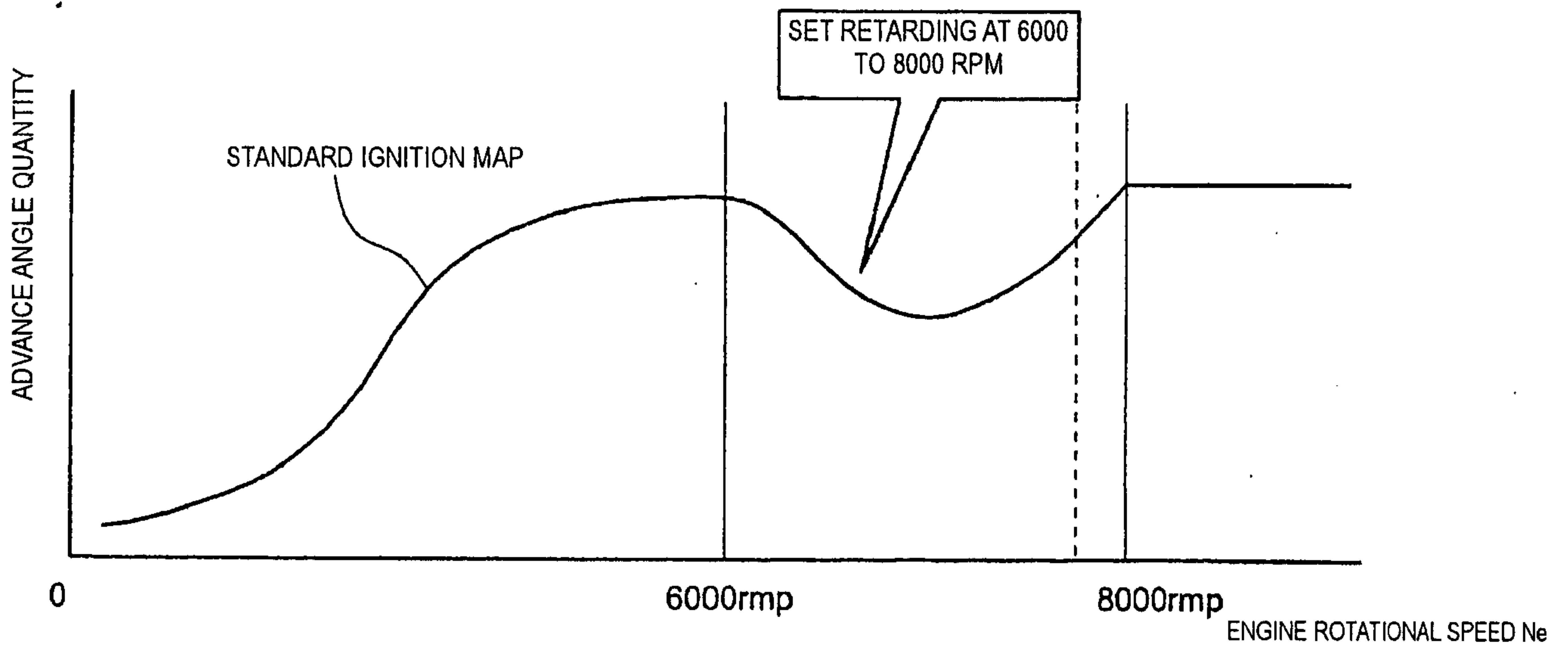
[Fig. 1]



[Fig. 2]

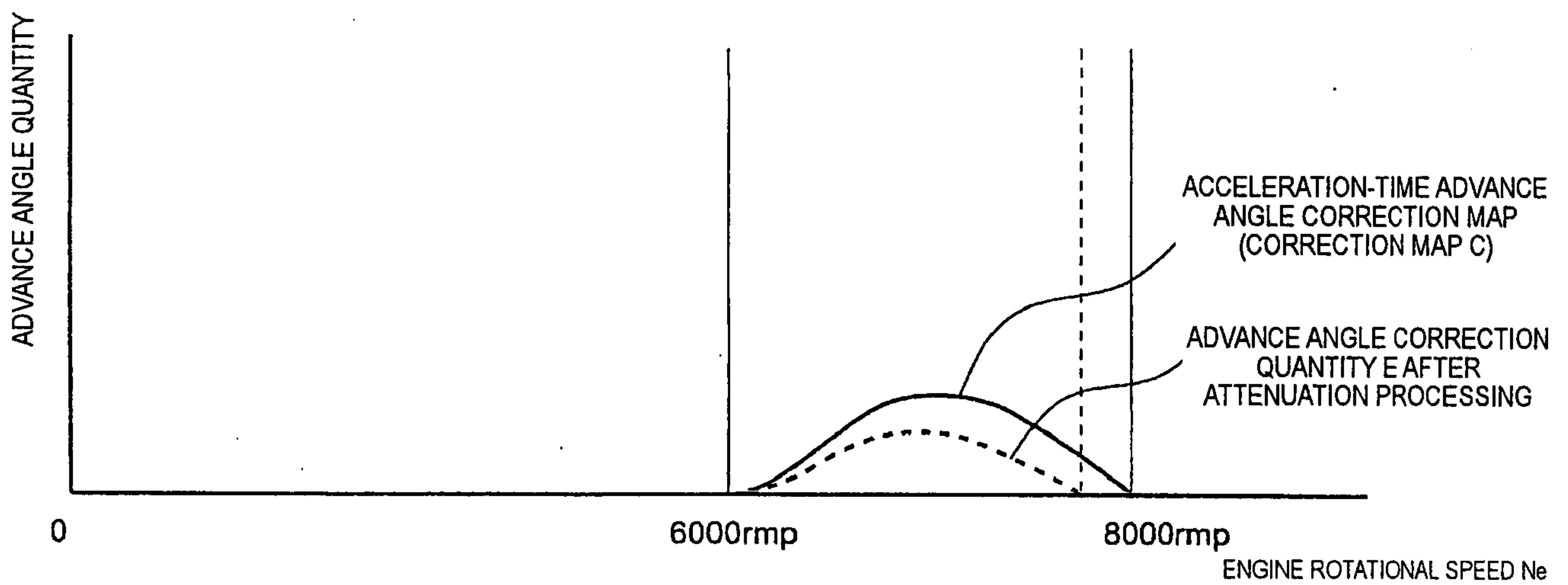


[Fig. 3]



< STANDARD IGNITION MAP AT THE TIME OF OPENING THROTTLE VALVE IN A FULL OPEN STATE >

[FIG 4]



< ACCELERATION-TIME ADVANCE ANGLE CORRECTION MAP >

[Fig. 5]

