



(11) **EP 4 818 502 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
07.10.2026 Bulletin 2026/41

(21) Application number: **26163821.7**

(22) Date of filing: **11.03.2026**

(51) International Patent Classification (IPC):
F02D 11/10 ^(2006.01) **F02D 41/06** ^(2006.01)
F02D 11/02 ^(2006.01) **F02D 11/04** ^(2006.01)
F02D 35/00 ^(2006.01) **F02M 69/32** ^(2006.01)
F02D 41/00 ^(2006.01) **F02D 31/00** ^(2006.01)

(52) Cooperative Patent Classification (CPC):
F02D 11/02; F02D 11/04; F02D 35/003;
F02D 41/0002; F02D 41/06; F02D 41/062;
F02D 41/064; F02D 41/067; F02D 41/068;
F02M 69/32; F02D 31/005; F02D 41/061;
F02D 2200/0404; F02D 2200/101; F02D 2200/1012

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
GE KH LA MA MD TN

(30) Priority: **31.03.2025 JP 2025060029**

(71) Applicant: **HONDA MOTOR CO., LTD.**
Tokyo 105-8404 (JP)

(72) Inventors:
• **ONO, Junya**
Tokyo, 105-8404 (JP)
• **RYUZAKI, Tatsuya**
Tokyo, 105-8404 (JP)
• **ISHII, Daichi**
Tokyo, 105-8404 (JP)

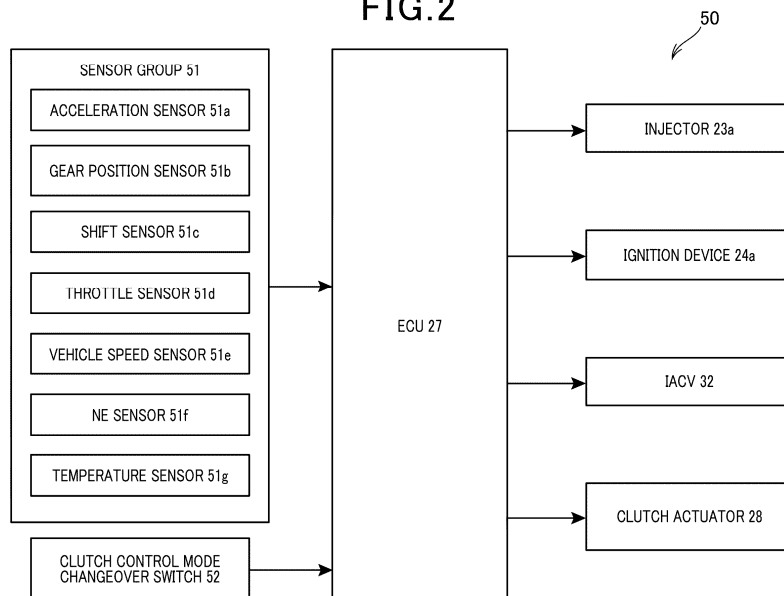
(74) Representative: **Kiwit, Benedikt**
Mitscherlich PartmbB
Karlstraße 7
80333 München (DE)

(54) **CONTROL SYSTEM OF ENGINE**

(57) It is possible to suppress excessive revving of an engine with respect to a throttle operation during a warm-up operation. A control system (50) of an engine (21) which performs control to increase an engine speed during a warm-up operation includes: a detection unit

(51a) which detects a throttle operation; and a control unit (27) which performs intake control to suppress an amount of intake air according to a throttle operation during a warm-up operation.

FIG.2



EP 4 818 502 A1

Description

BACKGROUND

Technical Field

[0001] The present invention relates to a control system of an engine.

Related Art

[0002] There is known a control system of an engine which performs control to increase an engine speed by operating a first idle function or a choke during a warm-up operation. This type of technique also discloses a technique for correcting an opening of an air control valve on the basis of a temperature of the engine and an air-fuel ratio of an exhaust gas during the warm-up operation (for example, JP 2015-140794 A).

SUMMARY

[0003] In the conventional technique, when a throttle is operated during the warm-up operation, an amount of intake air to the engine further increases, so that revving of the engine may become excessive. Since the technique described in JP 2015-140794 A is intended to stabilize an idle speed, it is not possible to suppress excessive revving with respect to a throttle operation.

[0004] The present invention has been made in view of the above circumstances, and an object of the present invention is to suppress excessive revving of an engine with respect to a throttle operation during a warm-up operation.

[0005] As one aspect of the present disclosure, provided is a control system of an engine which performs control to increase an engine speed during a warm-up operation, including: a detection unit which detects a throttle operation; and a control unit which performs intake control to suppress an amount of intake air according to a throttle operation during a warm-up operation.

[0006] It is possible to suppress excessive revving of the engine with respect to the throttle operation during the warm-up operation.

BRIEF DESCRIPTION OF DRAWINGS

[0007]

FIG. 1 is a view illustrating a saddle-ride vehicle equipped with a control system according to a first embodiment;

FIG. 2 is a block diagram illustrating the control system;

FIG. 3 is a diagram for describing conventional engine control during a warm-up operation and engine control during the warm-up operation according to the first embodiment;

FIG. 4 is a flowchart illustrating control of an IACV; FIG. 5 is a diagram illustrating an example of IACV opening correction processing in step S4a;

FIG. 6 is a diagram illustrating an example of table data Da;

FIG. 7 is a diagram for describing a modification;

FIG. 8 is a diagram for describing a modification;

FIG. 9 is a block diagram illustrating a control system according to a second embodiment;

FIG. 10 is a diagram for describing the conventional engine control during the warm-up operation and engine control during the warm-up operation of the second embodiment;

FIG. 11 is a flowchart illustrating an example of control of a throttle opening;

FIG. 12 is a diagram illustrating an example of correction processing of the throttle opening in step S4b; and

FIG. 13 is a diagram illustrating an example of table data Dc.

DETAILED DESCRIPTION

[0008] Embodiments of the present invention will be described below with reference to the drawings.

[First Embodiment]

[0009] FIG. 1 is a view illustrating a saddle-ride vehicle 10 equipped with a control system 50 according to a first embodiment. FIG. 2 is a block diagram illustrating the control system 50.

[0010] As illustrated in FIG. 1, the saddle-ride vehicle 10 is a motorcycle, and includes a front wheel 11 which is a steering wheel and a rear wheel 12 which is a drive wheel. In order to drive the rear wheel 12 according to driving of a driver, the saddle-ride vehicle 10 includes an engine 21 which functions as a drive source, an engine intake system 22, a fuel supply system 23, an engine ignition system 24, a transmission mechanism 25, a clutch mechanism 26 which interrupts power transmission between the engine 21 and the transmission mechanism 25, and an ECU 27 which functions as a control unit which controls each unit.

[0011] The engine 21 is an internal combustion engine. The engine intake system 22 includes a throttle device 31 which adjusts an amount of air to the engine 21 and an intake air control valve (IACV) 32.

[0012] The throttle device 31 is a mechanical throttle system in which a throttle valve 31a is directly operated by a throttle operation of the driver. The IACV 32 functions as an air control valve which adjusts an amount of air to the engine 21 by using a bypass passage. However, the IACV 32 may not be limited to one using the bypass passage.

[0013] The fuel supply system 23 is configured to supply fuel to the engine 21, and includes an injector 23a which injects fuel as illustrated in FIG. 2. The engine

ignition system 24 is configured to ignite an air-fuel mixture including air and fuel supplied to the engine 21, and includes an ignition device 24a as illustrated in FIG. 2. The transmission mechanism 25 is a manual type having multiple gear positions, and is also referred to as a manual transmission mechanism or a constantly meshing transmission mechanism.

[0014] The clutch mechanism 26 functions as a manual clutch mechanism manually operated by the driver, and also functions as an automatic clutch mechanism automatically controlled by a clutch actuator 28.

[0015] The ECU 27 includes a processor, a memory, and a peripheral circuit, and functions as a computer which controls each unit of the saddle-ride vehicle 10 by the processor reading and executing a control program stored in the memory.

[0016] As illustrated in FIG. 2, the ECU 27 controls the injector 23a, the ignition device 24a, the IACV 32, the clutch actuator 28, and the like on the basis of a detection result of a sensor group 51. The sensor group 51 includes an acceleration sensor 51a which detects the behavior of a vehicle body, a gear position sensor 51b which detects the gear position of the transmission mechanism 25, a shift sensor (for example, a shift load sensor) 51c which detects the operation of a shift pedal that is a shift operator, a throttle sensor 51d which detects the throttle operation of the driver, a vehicle speed sensor 51e which detects a vehicle speed, an engine speed sensor 51f which detects an engine speed, a temperature sensor 51g which detects the temperature of the engine 21, and the like. The temperature sensor 51g is a sensor which detects the temperature of cooling water of the engine 21 when the engine 21 is of a water-cooling type, and is a sensor which detects the temperature of the cylinder head of the engine 21 when the engine is not of the water-cooling type.

[0017] The ECU 27 realizes a plurality of clutch control modes. The clutch control modes include an automatic mode in which the clutch mechanism 26 is automatically controlled and a manual mode in which the clutch mechanism 26 is driven by a manual operation by the driver. The ECU 27 switches the clutch control modes according to the operation of a clutch control mode changeover switch 52 or the like.

[0018] The automatic mode is a mode in which the clutch actuator 28 controls the clutch mechanism 26, and a shift is realized only by a shift operation by the driver, and a clutch capacity is controlled to be suitable for various situations such as startup. In addition, in the manual mode, the clutch mechanism 26 is basically driven by a manual operation, but the clutch capacity may be controlled according to the operation amount of a clutch lever which is a clutch operator.

[0019] In addition, the ECU 27 also performs control to increase the engine speed during a warm-up operation. This control includes a first idle control in which the engine speed is temporarily increased in an engine cold period, and in the first idle control, control to open the

IACV 32 to increase the amount of intake air is executed.

[0020] Conventional engine control during the warm-up operation using the IACV 32 and engine control during the warm-up operation according to the first embodiment will be briefly described with reference to FIG. 3.

[0021] Reference sign α in FIG. 3 is a diagram illustrating an example of the conventional engine control during the warm-up operation.

[0022] A horizontal axis X indicates time, and a vertical axis Y indicates an engine speed NE1 during the warm-up operation, a throttle opening TH, an opening Va1 (hereinafter, IACV opening Va1) of the IACV 32 during the warm-up operation, an engine speed NE2 after the warm-up operation, and an opening Va2 (hereinafter, IACV opening Va2) of the IACV 32 after the warm-up operation.

[0023] In the conventional engine control, the amount of intake air to the engine 21 is increased by maintaining the IACV opening Va1 in a state opened to a predetermined opening Vh during the engine cold period, and the engine speed NE1 during the warm-up operation is increased to be higher than the engine speed NE2 after the warm-up operation corresponding to a normal engine speed. Note that a fuel supply amount to the engine 21 is also adjusted along with the increase in the amount of intake air.

[0024] Therefore, when the temperature of the cooling water detected by the temperature sensor 51g is low, the engine speed is controlled to the high engine speed NE1, and when the detected temperature is high, the engine speed is controlled to a predetermined target idle engine speed.

[0025] The conventional engine control illustrated in FIG. 3 also illustrates a case where the mechanical throttle system is adopted. Therefore, when the throttle opening TH increases by the throttle operation by the driver at time t1, the amount of intake air to the engine 21 increases accordingly.

[0026] During the warm-up operation, the amount of intake air is increased by the IACV 32, and thus, when the amount of intake air is rapidly increased by the throttle operation, as indicated by a region Ar1 in FIG. 3, excessive revving of the engine 21 may occur, in other words, excessive response of the engine 21 to the throttle operation may occur.

[0027] On the other hand, in the engine control of the present embodiment, as indicated by reference sign β in FIG. 3, when an engine speed NE is increased by the throttle operation during the warm-up operation, the intake control of reducing the IACV opening with reference to timing t2 at which the throttle opening TH exceeds a predetermined threshold TH_a is executed. Accordingly, the amount of intake air to the engine 21 is suppressed, excessive revving with respect to the throttle operation is suppressed, and an excessive response of the engine 21 is suppressed.

[0028] FIG. 4 is a flowchart illustrating control of the IACV 32 according to the present embodiment.

[0029] After starting the engine 21, the ECU 27 determines whether or not the warm-up operation is being performed (step S1a). For example, the ECU 27 determines that the warm-up operation is being performed, when the target idle engine speed exceeds a threshold speed set to a value higher than the normal idle engine speed (step S1a: YES). In addition, when the target idle engine speed is less than the threshold speed, the ECU 27 determines that the warm-up operation is not being performed (step S1a: NO). Note that the idle engine speed corresponds to the engine speed at the time of throttle off.

[0030] When the warm-up operation is being performed (step S1a: YES), the ECU 27 determines whether or not the throttle opening TH is greater than or equal to the predetermined threshold TH_a (step S2a). The predetermined threshold TH_a is set to a value capable of specifying a timing at which the engine speed starts to increase from the idle engine speed by the throttle operation.

[0031] When the throttle opening TH is greater than or equal to the threshold TH_a (step S2a: YES), the ECU 27 determines whether or not start control is being performed (step S3a).

[0032] The determination in step S3a as to whether or not the start control is being performed is, for example, processing in which, in a case where both conditions that the clutch mechanism 26 is in a so-called half-clutch state and that the vehicle is starting from the vehicle speed of 0 (zero) are satisfied or in a case where either one of the conditions is satisfied, it is determined that the start control is being performed. Note that in a case where the vehicle speed is less than or equal to a predetermined speed, it is desirable to determine that in a case where both conditions are satisfied, the start control is being performed.

[0033] Whether or not the clutch mechanism 26 is in the half-clutch state can be determined, for example, by detecting the position of a member related to the operation of the clutch mechanism 26. As an example, whether or not the clutch mechanism 26 is in the half-clutch state can be determined by detecting the angle of a release shaft which operates the clutch mechanism 26. In addition, whether or not the vehicle is starting from the vehicle speed of 0 can be determined on the basis of the detected vehicle speed.

[0034] In a case where it is determined that the start control is being performed (step S3a: YES), the ECU 27 executes the IACV opening correction processing as the intake control to suppress the amount of intake air to the engine 21 (step S4a). The processing of step S4a will be described later.

[0035] On the other hand, in a case where the throttle opening TH is less than the predetermined threshold TH_a (step S2a: NO) or in a case where the start control is not being performed (step S3a: NO), the ECU 27 proceeds to the processing of step S1a.

[0036] In a case where it is determined in step S1a that

the warm-up operation is not being performed (step S1a: NO), the ECU 27 executes normal control (step S5a). The normal control is engine control executed during an operation other than the warm-up operation, and for example, the IACV 32 is maintained in a closed state (IACV opening Va2 in FIG. 3), and the engine speed NE is controlled on the basis of the throttle opening TH and the throttle operation speed so as to be the engine speed NE corresponding to the throttle operation of the driver.

[0037] FIG. 5 is a diagram illustrating an example of IACV opening correction processing in step S4a.

[0038] As illustrated in FIG. 5, the ECU 27 calculates an NE difference formed by a difference between the current engine speed NE and a target idle engine speed NE_{tag}, and refers to the table data Da set in advance on the basis of the NE difference to specify a correction coefficient Ki for specifying the correction amount of the IACV opening. As illustrated in an example in FIG. 6, the table data Da is data in which the NE difference and the correction coefficient Ki are associated with each other.

[0039] The table data Da is set as data that realizes an intake characteristic that suppresses excessive revving with respect to the throttle operation, and is basically set as data that reduces the IACV opening in this example. The correction coefficient Ki is treated as a value indicating a ratio to the pre-correction IACV opening. The correction coefficient Ki is set to a value of 1 when the NE difference is 0 (zero), the correction coefficient Ki is set to a value approaching 0 as the NE difference approaches 1000 rpm, and the correction coefficient Ki is set to 0 when the NE difference is 1000 rpm or more.

[0040] As illustrated in FIG. 5, the ECU 27 multiplies the IACV opening Vh (see FIG. 3) at the time of throttle off, which is the pre-correction IACV opening, by the specified correction coefficient Ki, to specify the post-correction IACV opening Va1.

[0041] That is, the post-correction IACV opening Va1 = (correction coefficient Ki) × pre-correction IACV opening (the IACV opening at the time of throttle off) is set.

[0042] Accordingly, as indicated by reference sign β in FIG. 3, the IACV opening Va1 gradually decreases at timing t2 when the throttle opening TH exceeds the predetermined threshold TH_a, and it is possible to suppress excessive revving with respect to the throttle operation.

[0043] When the NE difference is small, the correction coefficient Ki is set to a value close to the value of 1, so that the correction amount from the pre-correction IACV opening is set to a value close to 0. Accordingly, it is possible to perform engine control with a high degree of following the throttle operation by the driver as in the conventional case.

[0044] Note that although a case where the correction coefficient Ki is set on the basis of the NE difference has been exemplified, as illustrated in FIG. 7, the correction coefficient Ki may be set by referring to table data Db set in advance on the basis of a change rate [deg/ms] of the

throttle opening TH or the throttle opening TH [deg]. In this case, for example, the table data Db is formed as data for setting the correction coefficient Ki that reduces the post-correction IACV opening as the change rate of the throttle opening TH increases. Accordingly, in a case where the throttle operation by the driver is early during the warm-up operation, the IACV opening Va1 gradually decreases at timing t2 when the throttle opening TH exceeds the predetermined threshold TH_a, similarly to the case indicated by reference sign β in FIG. 3, and it is possible to suppress excessive revving with respect to the throttle operation.

[0045] In addition, a case where the IACV opening is reduced during the warm-up operation to suppress excessive revving with respect to the throttle operation has been described, but the present invention is not limited thereto. For example, in a case where the throttle device 31 of a throttle by wire (TBW) system for motor-driving the throttle valve 31a is adopted, instead of the control to reduce the IACV opening, control to reduce the change rate [deg/ms] of the throttle opening TH may be performed to suppress an increase in the amount of intake air and suppress excessive revving.

[0046] In this case, as illustrated in an example in FIG. 8, the ECU 27 may specify the change rate of the post-correction throttle opening TH by multiplying the change rate of the pre-correction throttle opening TH by the correction coefficient Ki specified from the table data Da illustrated in FIG. 6. Accordingly, it is possible to suppress excessive revving. In addition, the correction coefficient Ki is not limited to the configuration set on the basis of the NE difference, and may be set on the basis of, for example, the change rate [deg/ms] of the throttle opening TH.

[0047] As described above, the control system 50 of the present embodiment includes the throttle sensor 51d which functions as a detection unit which detects a throttle operation, and the ECU 27 which functions as a control unit which performs intake control to suppress an amount of intake air according to the throttle operation during the warm-up operation. Accordingly, it is possible to suppress excessive revving of the engine 21 with respect to the throttle operation during the warm-up operation.

[0048] In addition, the control system 50 includes the IACV 32 which functions as an air control valve, and intake control is executed using the IACV 32. Accordingly, it is possible to suppress excessive revving of the engine 21 based on the throttle operation by utilizing the existing IACV 32.

[0049] In addition, in the intake control, the correction coefficient Ki which is correction information is set on the basis of a difference between the current engine speed NE and the target idle engine speed NE_tag, and the amount of intake air is controlled on the basis of the correction coefficient Ki. The correction coefficient Ki is information that suppresses the amount of intake air as the difference increases. According to this configuration, the characteristic of suppressing the amount of intake air

with respect to the throttle operation can be easily adjusted by adjusting the correction coefficient Ki, and thus, it is possible to realize control in which the discomfort of the driver is reduced and to improve the degree of freedom in design.

[0050] In addition, the intake control is executed only during the start control during the warm-up operation. Accordingly, except at the startup in the warm-up operation, the intake control to suppress an intake flow rate is not performed, and it is possible to reduce the discomfort of the driver with respect to the throttle operation. However, within a range where the discomfort of the driver in the throttle operation is sufficiently suppressed, the intake control may be performed during the warm-up operation, regardless of whether or not it is the startup.

[0051] In addition, as illustrated in FIG. 8, in a case where the throttle device 31 of the TBW system is provided, the intake control is executed by using the throttle device 31, so that the throttle device 31 can be directly controlled to suppress the amount of intake air. Accordingly, it is possible to suppress excessive revving of the engine 21 with a quick response to the throttle operation.

[0052] In addition, in the present embodiment, the ECU 27 may not execute the intake control to suppress the amount of intake air in the manual mode in which the clutch mechanism 26 is manually operated, and may execute the intake control to suppress the amount of intake air in the automatic mode in which the clutch mechanism 26 is automatically controlled. Accordingly, it is possible to control the engine 21 with priority given to the manual operation by the driver.

[Second Embodiment]

[0053] FIG. 9 is a block diagram illustrating the control system 50 according to a second embodiment. In the present description, the same components as those in the first embodiment are denoted by the same reference numerals, and redundant description will be omitted.

[0054] In the second embodiment, the saddle-ride vehicle 10 adopts the TBW system in which the throttle valve 31a is motor-driven, and does not include the IACV 32.

[0055] The ECU 27 controls the throttle valve 31a, the injector 23a, the ignition device 24a, the clutch actuator 28, and the like on the basis of the detection result of the sensor group 51.

[0056] The conventional engine control during the warm-up operation using the TBW system and engine control during the warm-up operation of the second embodiment will be briefly described with reference to FIG. 10.

[0057] Reference sign α in FIG. 10 is a diagram illustrating an example of the conventional engine control during the warm-up operation. A horizontal axis X indicates time, and a vertical axis Y indicates the engine speed NE1 during the warm-up operation, the opening of a throttle grip (hereinafter, grip opening Gr), the throttle

opening TH (the opening of the throttle valve 31a), and the engine speed NE2 after the warm-up operation.

[0058] In the conventional engine control, the engine speed NE1 during the warm-up operation is increased to be higher than the engine speed NE2 after the warm-up operation corresponding to the normal engine speed, by performing the first idle control in which the throttle opening TH in the engine cold period is controlled to an opening larger than the throttle opening corresponding to the grip opening Gr.

[0059] During the warm-up operation, the amount of intake air is increased by the first idle control, and thus, when the amount of intake air is rapidly increased by the throttle operation, as indicated by the region Ar1, excessive revving of the engine 21 may occur, in other words, excessive response of the engine 21 to the throttle operation may occur.

[0060] On the other hand, in the engine control of the present embodiment, as indicated by reference sign β in FIG. 10, when the engine speed NE is increased by the throttle operation during the warm-up operation, the intake control of suppressing an increase in the throttle opening TH with reference to timing t2 at which the throttle opening TH exceeds the predetermined threshold TH_a is executed. Accordingly, the amount of intake air to the engine 21 is suppressed, excessive revving with respect to the throttle operation is suppressed, and an excessive response of the engine 21 is suppressed.

[0061] FIG. 11 is a flowchart illustrating an example of control of the throttle opening TH of the present embodiment. Note that processing similar to that in FIG. 4 is denoted by the same reference sign, and different portions will be described in detail.

[0062] As illustrated in FIG. 11, in a case where the warm-up operation is being performed (step S1a: YES), the throttle opening TH is greater than or equal to the predetermined threshold TH_a (step S2a: YES), and the start control is being performed (step S3a: YES), the ECU 27 executes correction processing of the throttle opening TH (step S4b).

[0063] In a case where the throttle opening TH is less than the predetermined threshold TH_a (step S2a: NO) or a case where the start control is not being performed (step S3a: NO), the ECU 27 proceeds to the processing of step S1a, and in a case where the warm-up operation is not being performed (step S1a: NO), the ECU 27 executes the normal control (step S5a). The normal control is engine control executed during an operation other than the warm-up operation, and the engine speed NE is controlled on the basis of the grip opening Gr and the throttle operation speed so as to be the engine speed NE corresponding to the throttle operation by the driver.

[0064] FIG. 12 is a diagram illustrating an example of correction processing of the throttle opening TH in step S4b.

[0065] As illustrated in FIG. 12, the ECU 27 calculates an NE difference formed by a difference between the current engine speed NE and the target idle engine speed

NE_tag, and refers to the table data Dc set in advance on the basis of the NE difference to specify a correction coefficient Kth for specifying the correction amount of the throttle opening TH. As illustrated in an example in FIG. 13, the table data Dc is data in which the NE difference and the correction coefficient Kth are associated with each other.

[0066] The table data Dc is set as data that realizes an intake characteristic that suppresses excessive revving with respect to the throttle operation. In this example, in a region where the NE difference is small, the data is set to reduce the throttle opening TH, and in a region where the NE difference is large, the data is set such that, as the NE difference increases, the throttle opening TH approaches the throttle opening corresponding to the throttle operation of the driver. The correction coefficient Kth is treated as a value indicating a ratio with respect to the pre-correction throttle opening TH. In a range where the NE difference is smaller than a reference value S (FIG. 13), a small value less than a value of 1 is maintained, and in a range where the NE difference is larger than the reference value S (FIG. 13), the correction coefficient Kth is set to a value that approaches the value 1 as the NE difference approaches 1500 rpm.

[0067] As illustrated in FIG. 12, the ECU 27 multiplies the change rate [deg/ms] of the pre-correction throttle opening TH by the specified correction coefficient Kth, to specify the change rate [deg/ms] of the post-correction throttle opening TH.

[0068] That is, the change rate [deg/ms] of the post-correction throttle opening TH = (correction coefficient Kth) $\times$ the change rate [deg/ms] of the pre-correction throttle opening TH is set.

[0069] Accordingly, as indicated by reference sign β in FIG. 10, a change in the throttle opening TH is suppressed at timing t2 when the throttle opening TH exceeds the predetermined threshold TH_a, and it is possible to suppress excessive revving with respect to the throttle operation.

[0070] In addition, since the correction coefficient Kth is maintained at a small value in a range where the NE difference is small, it is possible to effectively suppress an increase in the throttle opening TH in a range where the throttle starts to be opened (corresponding to a range of timings t2 to t3 in FIG. 10).

[0071] In addition, since, in a range where the NE difference is large, the correction coefficient Kth is set to a value that approaches a value of 1 as the NE difference approaches 1500 rpm, it is possible to realize the throttle opening TH which gradually follows the throttle operation of the driver in a range where the throttle is opened to some extent (corresponding to a range of timings t3 to t4 in FIG. 10). In addition, when the NE difference is 1500 rpm or more (corresponding to a range from timing t4 in FIG. 10), it is possible to realize the throttle opening TH that follows the throttle operation of the driver.

[0072] Note that although a case where the excessive

revving with respect to the throttle operation is suppressed by correcting the change rate of the throttle opening TH has been described, the present invention is not limited thereto. For example, as illustrated in FIG. 12, a method of setting, as the post-correction throttle opening TH, a value obtained by multiplying the pre-correction throttle opening TH by the correction coefficient Kth may be applied. Also in this case, it is possible to obtain a similar effect that the opening amount of the throttle opening TH can be effectively suppressed in a range where the throttle starts to be opened.

[0073] As described above, the ECU 27 performs control using the throttle device 31 of the TBW system as the intake control to suppress the amount of intake air according to the throttle operation during the warm-up operation, so that it is possible to suppress excessive revving of the engine 21 with a quick response to the throttle operation.

[0074] In addition, the intake control executes control to suppress the change rate of the throttle opening TH corresponding to the throttle operation or control to suppress the opening amount of the throttle opening TH during the warm-up operation. Accordingly, by controlling the change rate of the throttle opening TH or the opening amount of the throttle opening TH, it is possible to efficiently suppress excessive revving of the engine 21 based on the throttle operation.

[0075] In addition, in the second embodiment, the intake control sets the correction coefficient Kth that is correction information, on the basis of a difference between the current engine speed NE and the target idle engine speed NE_tag, and controls the amount of intake air on the basis of the correction coefficient Kth. The correction coefficient Kth is information for suppressing the amount of intake air in the range of the difference corresponding to the range where the throttle starts to be opened, so that it is possible to efficiently suppress excessive revving of the engine 21 when the throttle starts to be opened. In addition, the correction coefficient Kth reduces suppression of the amount of intake air in a range of a difference corresponding to a range where the throttle is opened to some extent, so that it is possible to make the throttle opening TH approach the throttle opening corresponding to the throttle operation of the driver.

[0076] In addition, in the second embodiment, the ECU 27 does not execute the intake control to suppress the amount of intake air in the manual mode in which the clutch mechanism 26 is manually operated, and executes the intake control to suppress the amount of intake air in the automatic mode in which the clutch mechanism 26 is automatically controlled, so that it is possible to control the engine 21 with priority given to the manual operation by the driver.

[Other Embodiments]

[0077] Each of the above embodiments is merely an

embodiment of the present invention, and can be optionally modified, improved, and applied without departing from the gist of the present invention.

[0078] For example, in each embodiment, as the intake control to suppress the amount of intake air to the engine 21, in a case where the throttle operation corresponds to a sudden operation, a suppression amount of the amount of intake air may be reduced or the suppression amount may be eliminated. The sudden operation of the throttle operation is a case where the throttle opening TH increases by a predetermined amount or more in a short time within a predetermined time, and is, for example, a case where an angle of 15 degrees or more is operated at less than 0.5 S. This throttle operation can also be said to be a throttle operation corresponding to an acceleration request. By performing this processing, the suppression amount of the amount of intake air can be suppressed with respect to an acceleration request operation of an operator who is a rider, so that the traveling intended by the operator becomes possible.

[0079] In addition, although a case where the present invention is applied to the control system 50 of the engine 21 of the saddle-ride vehicle 10 illustrated in FIG. 1 has been described, the present invention may be applied to a control system of an engine of any moving body including other saddle-ride vehicle and four-wheeled vehicle. In addition, the present invention may be applied to a control system of an engine used other than a moving body.

[Configurations Supported by Above Embodiments]

[0080] The embodiments described above support the following configurations.

[0081] (Configuration 1) A control system of an engine which performs control to increase an engine speed during a warm-up operation, including: a detection unit which detects a throttle operation; and a control unit which performs intake control to suppress an amount of intake air according to a throttle operation during a warm-up operation.

[0082] According to this configuration, it is possible to suppress excessive revving of the engine with respect to the throttle operation during the warm-up operation.

[0083] (Configuration 2) The control system of the engine according to Configuration 1, including: an IACV which functions as an air control valve, in which the intake control is performed using the IACV.

[0084] According to this configuration, it is possible to suppress excessive revving of the engine based on the throttle operation by utilizing the existing IACV.

[0085] (Configuration 3) The control system of the engine according to Configuration 1 or 2, including a throttle device of a throttle by wire system, in which the intake control is executed using the throttle device.

[0086] According to this configuration, since the throttle device is directly controlled, it is possible to suppress excessive revving of the engine with a quick response to the throttle operation.

[0087] (Configuration 4) The control system of the engine according to any one of Configurations 1 to 3, in which the intake control executes control to suppress a change rate of a throttle opening corresponding to the throttle operation during the warm-up operation.

[0088] According to this configuration, by controlling the change rate of the throttle opening, it is possible to efficiently suppress excessive revving of the engine based on the throttle operation.

[0089] (Configuration 5) The control system of the engine according to any one of Configurations 1 to 4, in which the intake control executes control to suppress an opening amount of a throttle opening corresponding to the throttle operation during the warm-up operation.

[0090] According to this configuration, by controlling the opening amount of the throttle opening, it is possible to efficiently suppress excessive revving of the engine based on the throttle operation.

[0091] (Configuration 6) The control system of the engine according to any one of Configurations 1 to 5, in which the intake control sets correction information on the basis of a difference between a current engine speed and a target idle engine speed, and controls an amount of intake air on the basis of the correction information, and the correction information is information for suppressing an amount of intake air as the difference increases.

[0092] According to this configuration, the characteristic of suppressing the amount of intake air with respect to the throttle operation can be easily adjusted by adjusting the correction information, and thus, it is possible to realize control in which the discomfort of the operator is reduced and to improve the degree of freedom in design.

[0093] (Configuration 7) The control system of the engine according to any one of Configurations 1 to 6, in which the intake control is executed only during start control during a warm-up operation.

[0094] According to this configuration, except at the startup during the warm-up operation, the intake control to suppress the amount of intake air is not performed, and thus it is possible to reduce the discomfort of the operator with respect to the throttle operation.

[0095] (Configuration 8) The control system of the engine according to any one of Configurations 1 to 7, in which during the warm-up operation, the intake control reduces a suppression amount of the amount of intake air or eliminates the suppression amount in a case where the throttle operation corresponds to a sudden operation.

[0096] According to this configuration, the suppression amount of the amount of intake air can be suppressed with respect to an acceleration request operation of the operator, so that the engine control intended by the operator becomes possible.

[0097] (Configuration 9) The control system of the engine according to any one of Configurations 1 to 8, in which the control system is mounted on a vehicle capable of driving a clutch mechanism by a manual operation and automatic control, and does not execute the intake control when the clutch mechanism is in a state

of being manually operated.

[0098] According to this configuration, it is possible to control the engine with priority given to the manual operation by the operator.

Reference Signs List

[0099]

10	10	Saddle-ride vehicle
	21	Engine
	26	Clutch mechanism
	27	ECU (control unit)
	31	Throttle device
15	32	IACV (air control valve)
	50	Control system
	51d	Throttle sensor (detection unit)
	Ki, Kth	Correction coefficient (correction information)

Claims

1. A control system of an engine which performs control to increase an engine speed during a warm-up operation, **characterized by** comprising:
 - a detection unit (51a) which detects a throttle operation; and
 - a control unit (27) which performs intake control to suppress an amount of intake air according to a throttle operation during a warm-up operation.
2. The control system of the engine according to claim 1, comprising an IACV which functions as an air control valve, wherein the intake control is executed using the IACV.
3. The control system of the engine according to claim 1 or 2, comprising a throttle device of a throttle by wire system, wherein the intake control is executed using the throttle device (31).
4. The control system of the engine according to any one of claims 1 to 3, wherein the intake control executes control to suppress a change rate of a throttle opening corresponding to the throttle operation during the warm-up operation.
5. The control system of the engine according to any one of claims 1 to 4, wherein the intake control executes control to suppress an opening amount of a throttle opening corresponding to the throttle operation during the warm-up operation.
6. The control system of the engine according to any one of claims 1 to 5, wherein

the intake control sets correction information (K_i , K_{th}) on a basis of a difference between a current engine speed and a target idle engine speed, and controls an amount of intake air on a basis of the correction information (K_i , K_{th}), and the correction information (K_i , K_{th}) is information for suppressing an amount of intake air as the difference increases.

5

7. The control system of the engine according to any one of claims 1 to 6, wherein the intake control is executed only during start control during a warm-up operation. 10
8. The control system of the engine according to any one of claims 1 to 7, wherein during the warm-up operation, the intake control reduces a suppression amount of the amount of intake air or eliminates the suppression amount in a case where the throttle operation corresponds to a sudden operation. 15 20
9. The control system of the engine according to any one of claims 1 to 8, wherein the control system is mounted on a vehicle capable of driving a clutch mechanism (26) by a manual operation and automatic control, and does not execute the intake control when the clutch mechanism (26) is in a state of being manually operated. 25 30

35

40

45

50

55

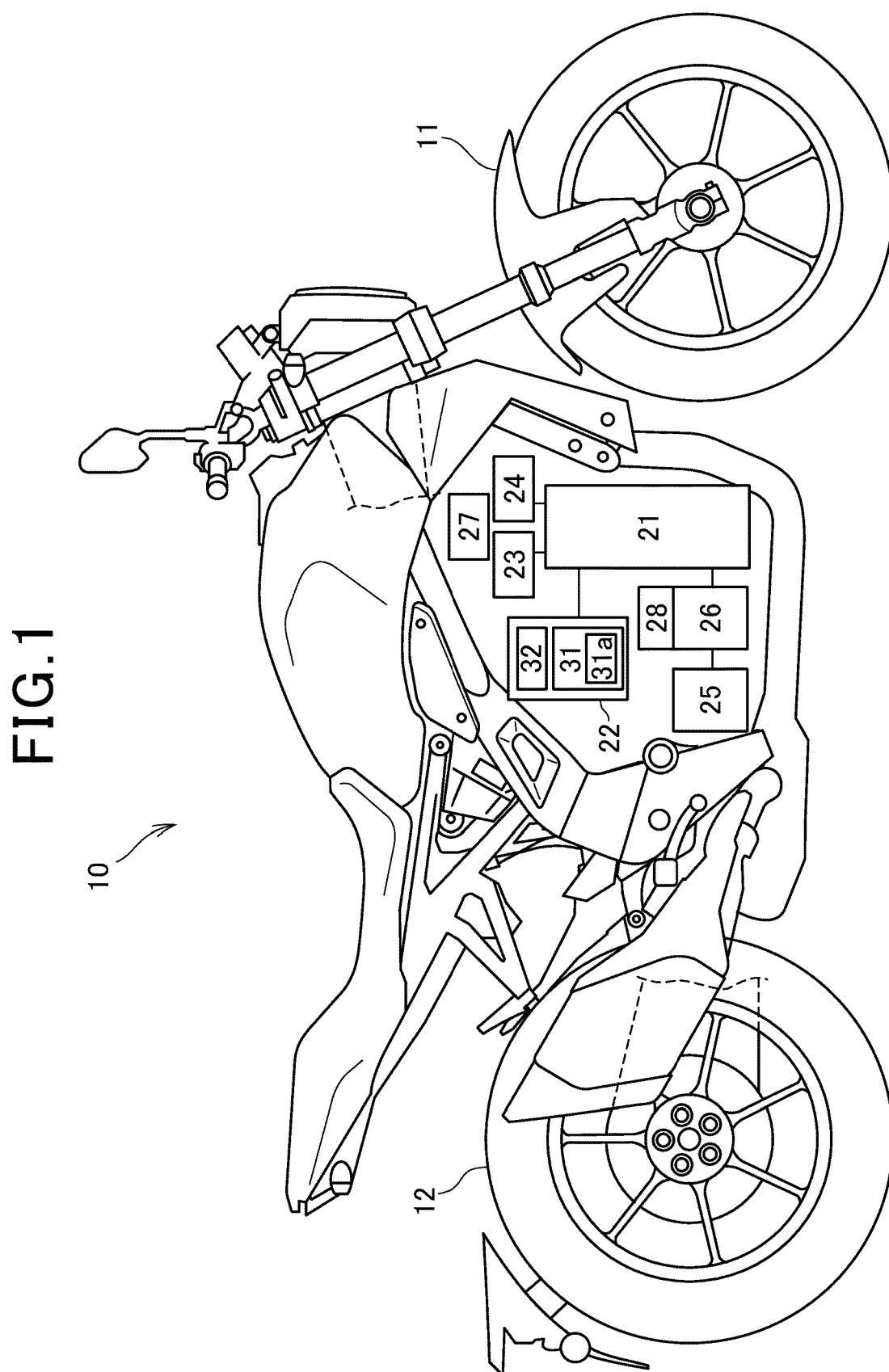


FIG.2

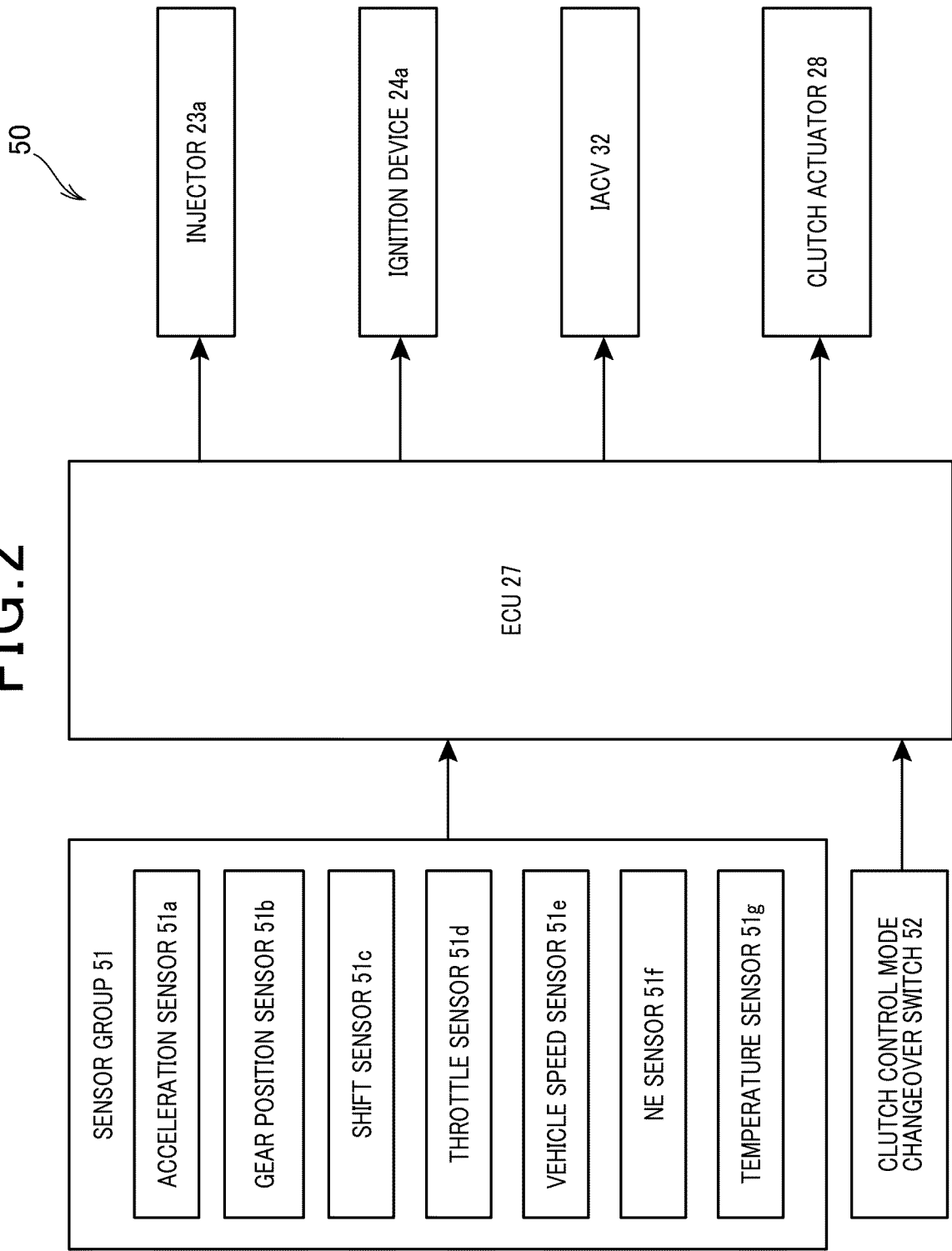


FIG.3

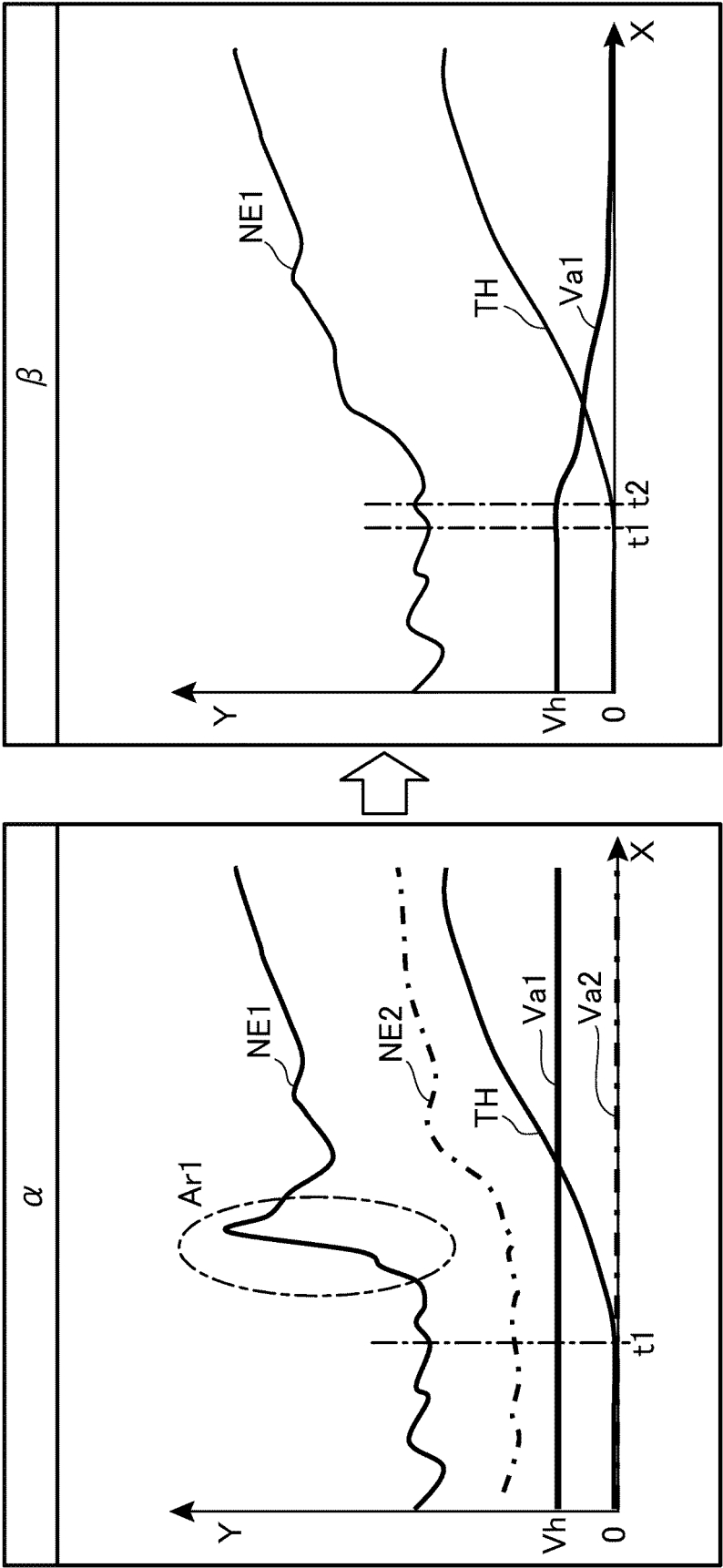


FIG.4

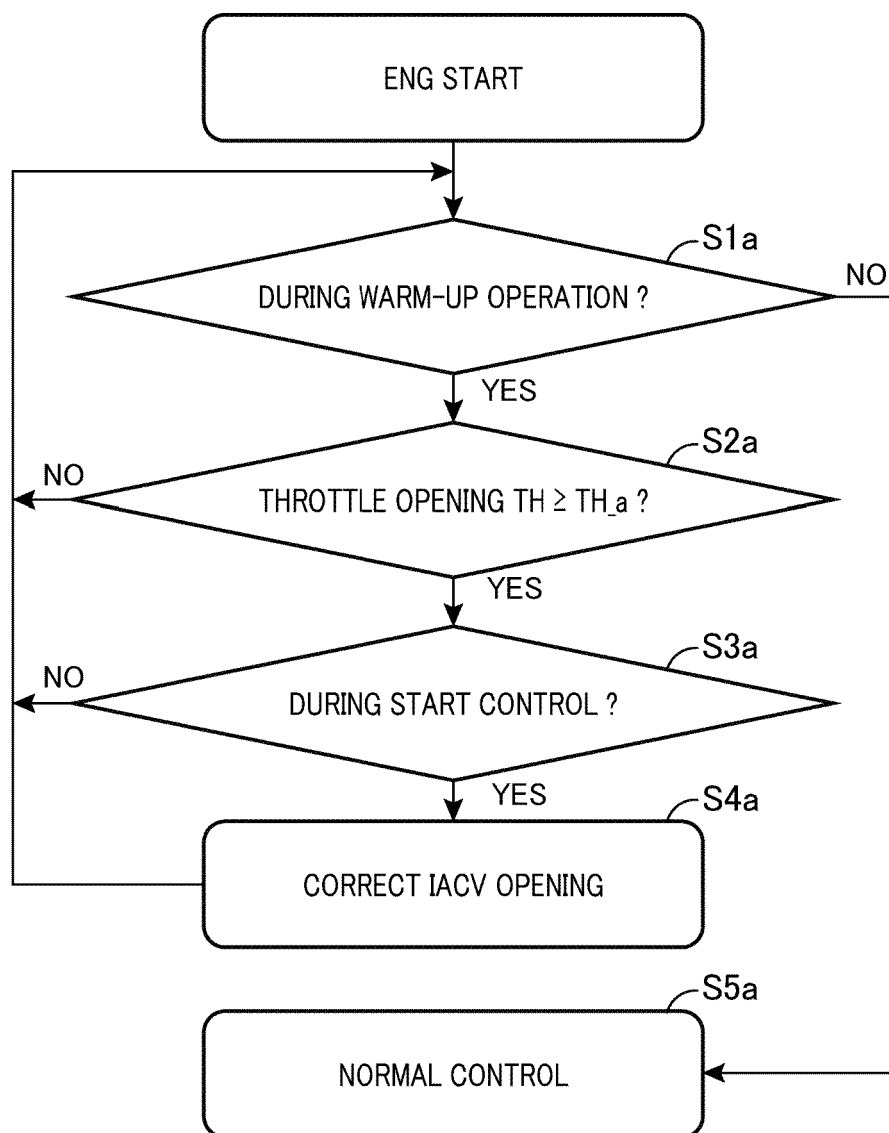


FIG.5

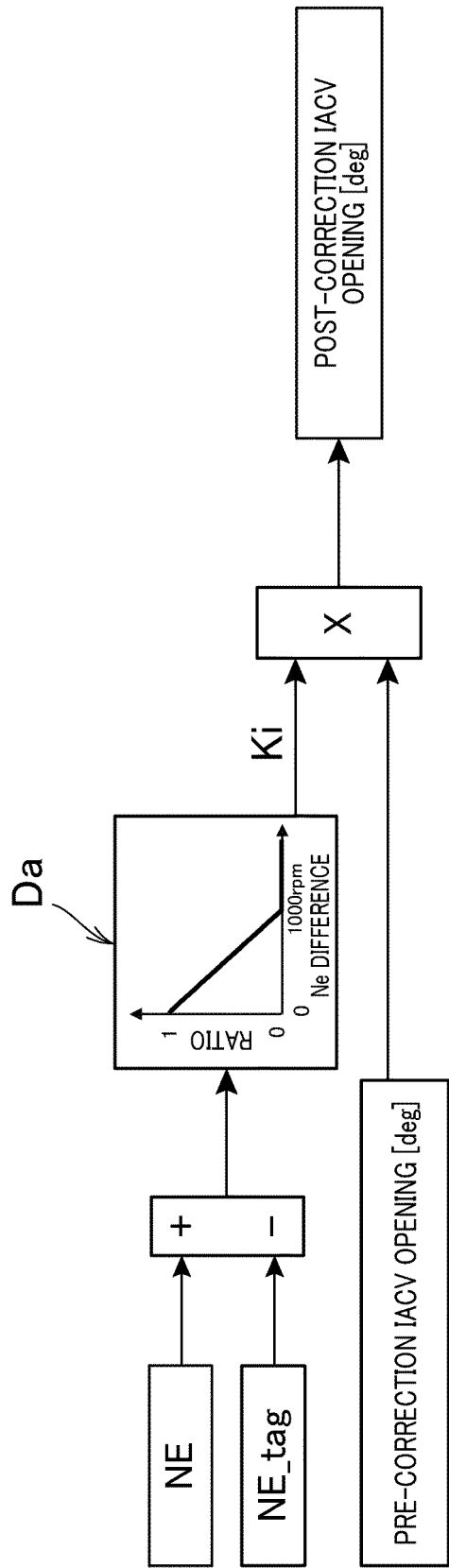


FIG.6

Da

NE-NE_tag[rpm]	0	100	...	500	...	1000	1100	...
CORRECTION COEFFICIENT Ki	1.0	0.9	...	0.5	...	0	0	0

FIG.7

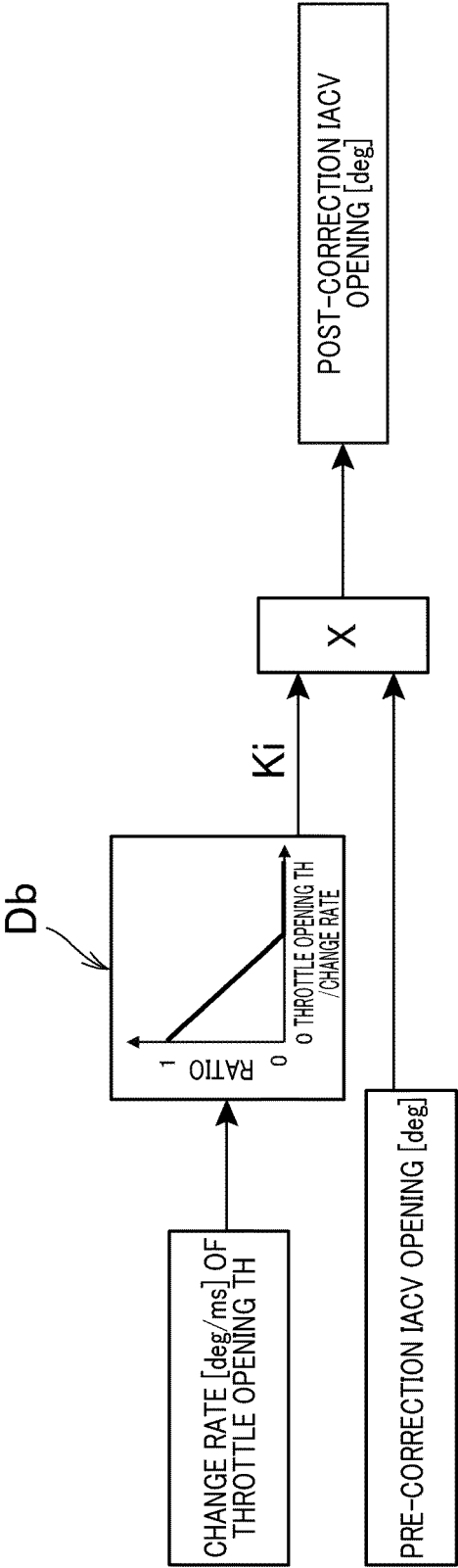
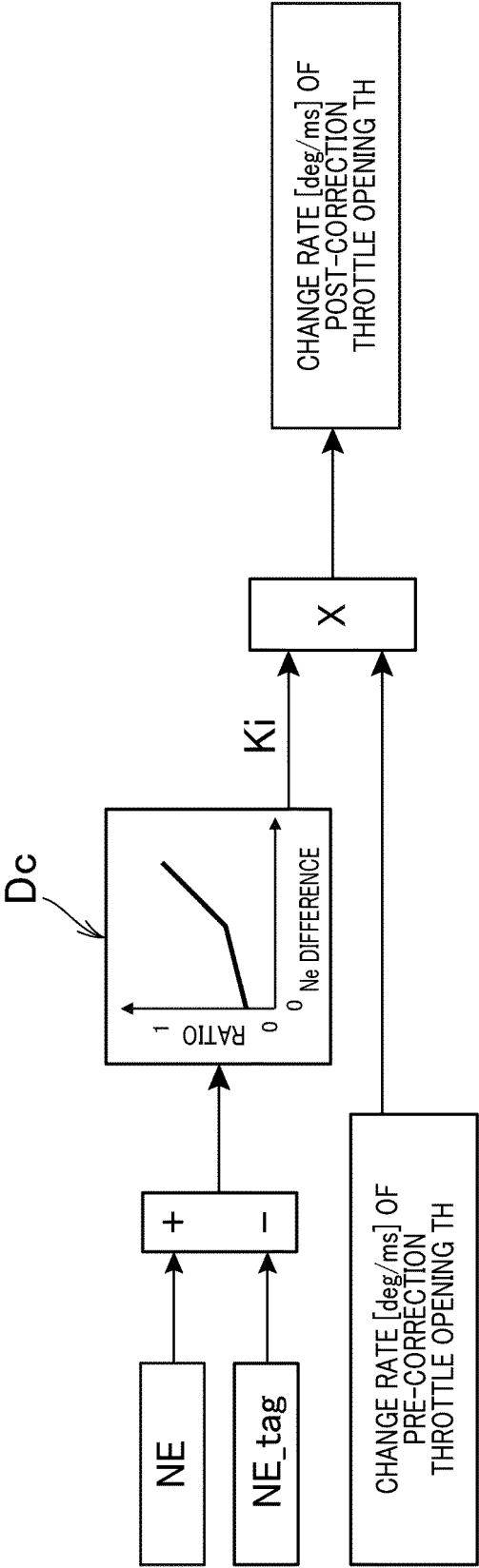


FIG.8



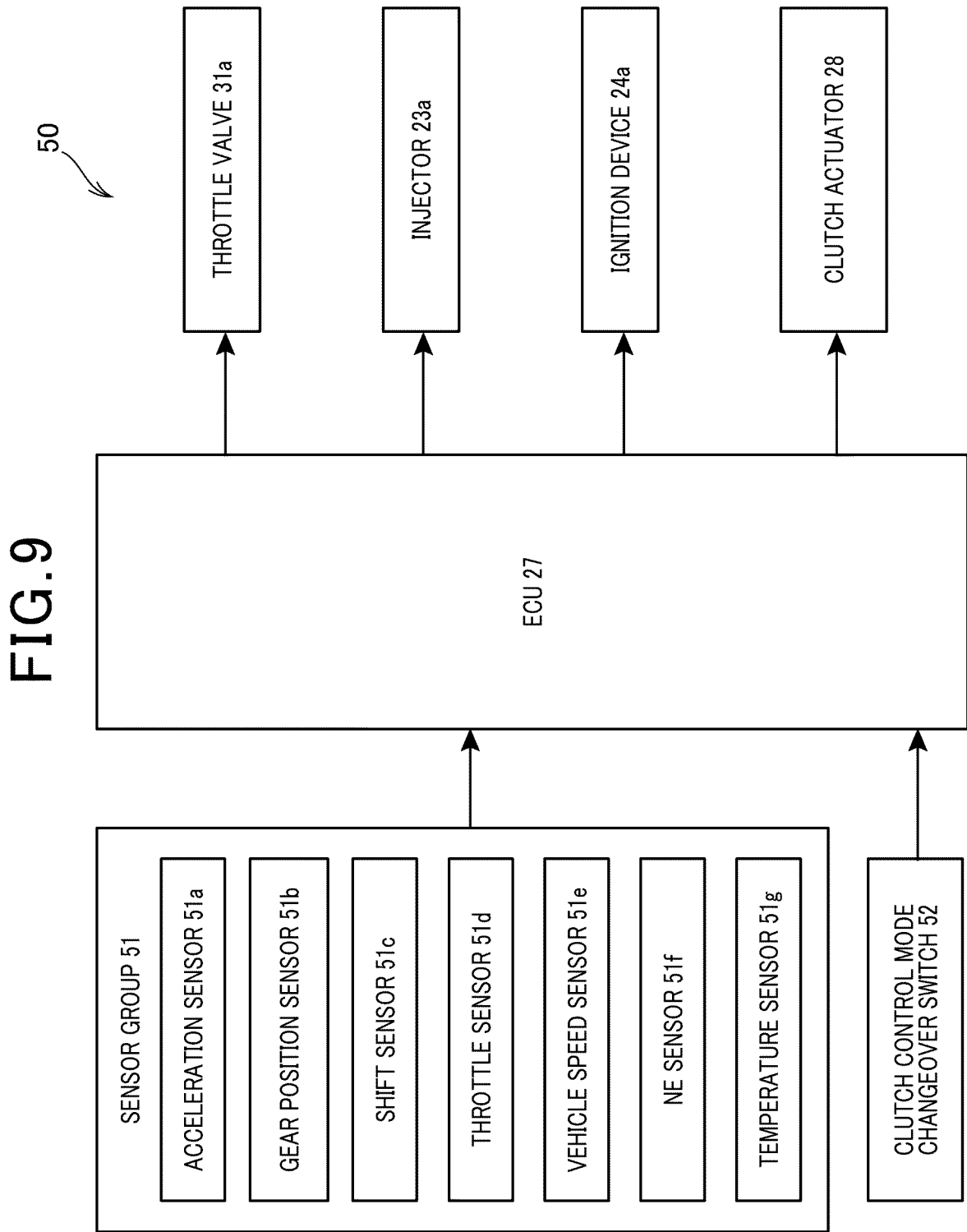


FIG.10

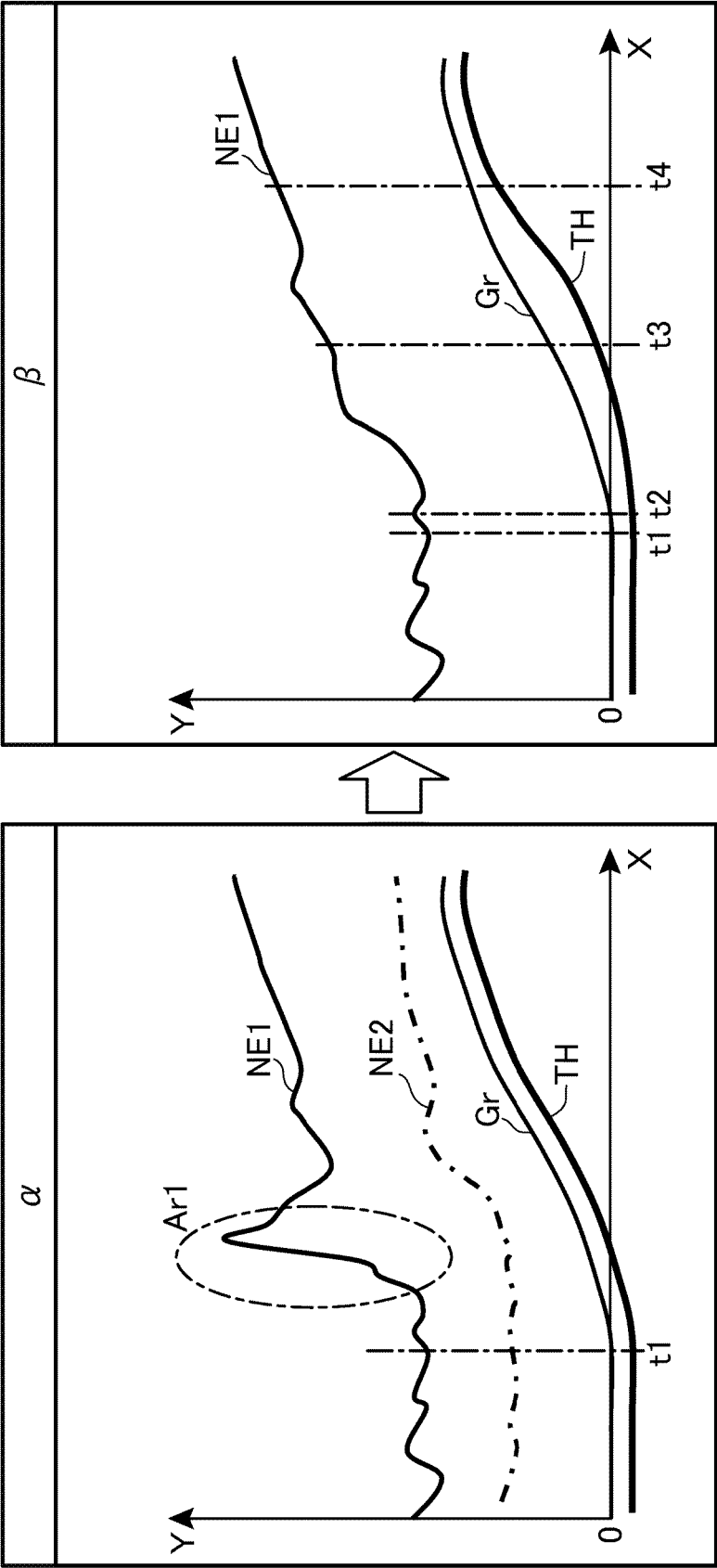


FIG.11

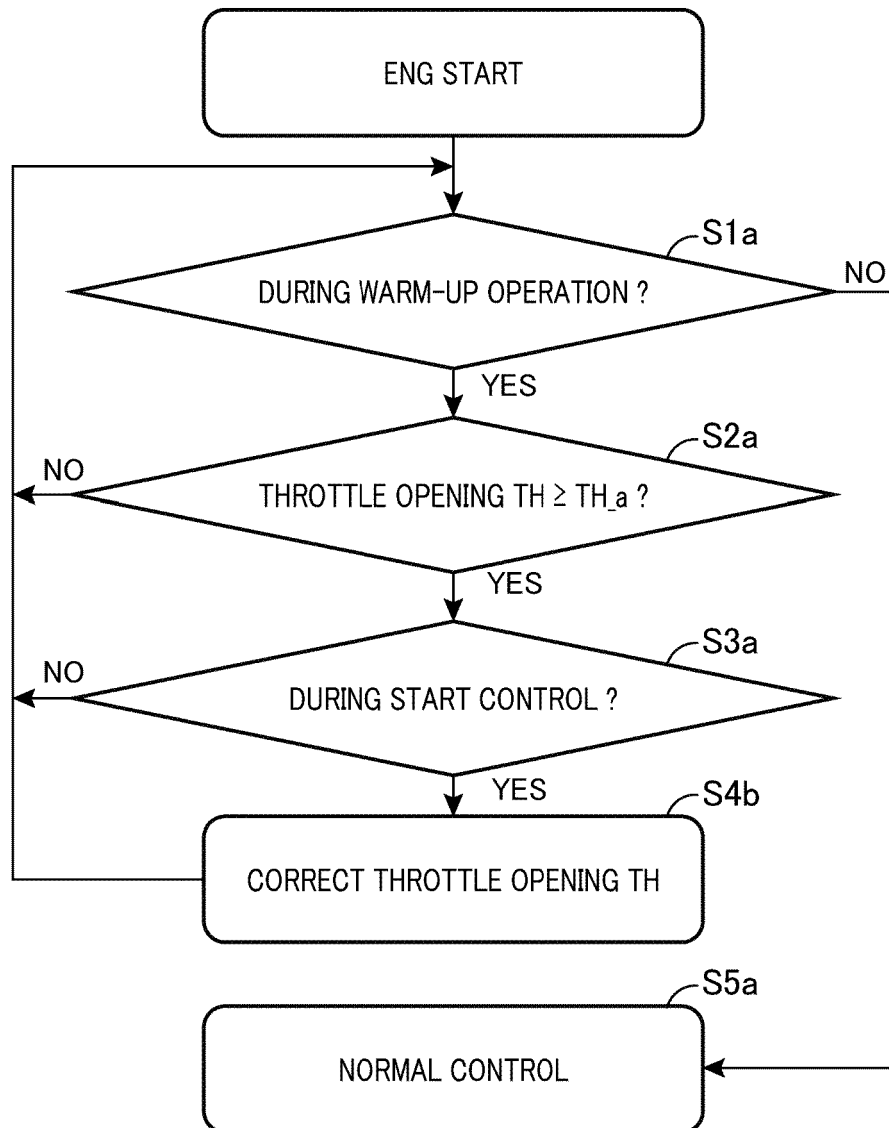


FIG.12

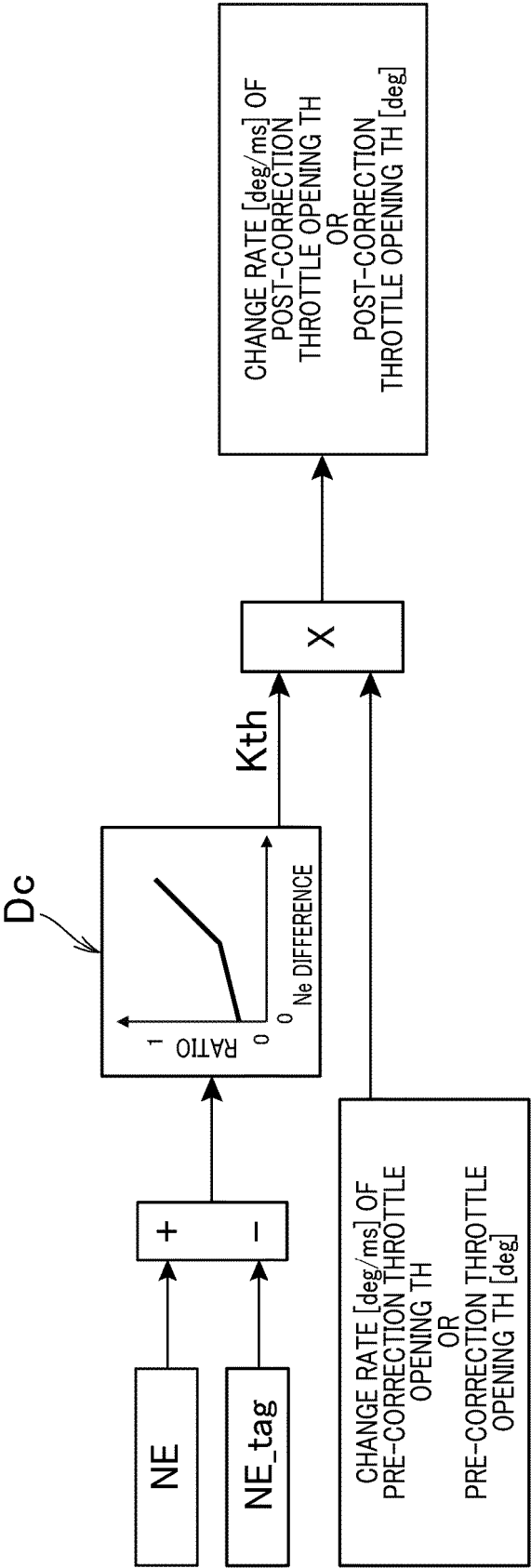
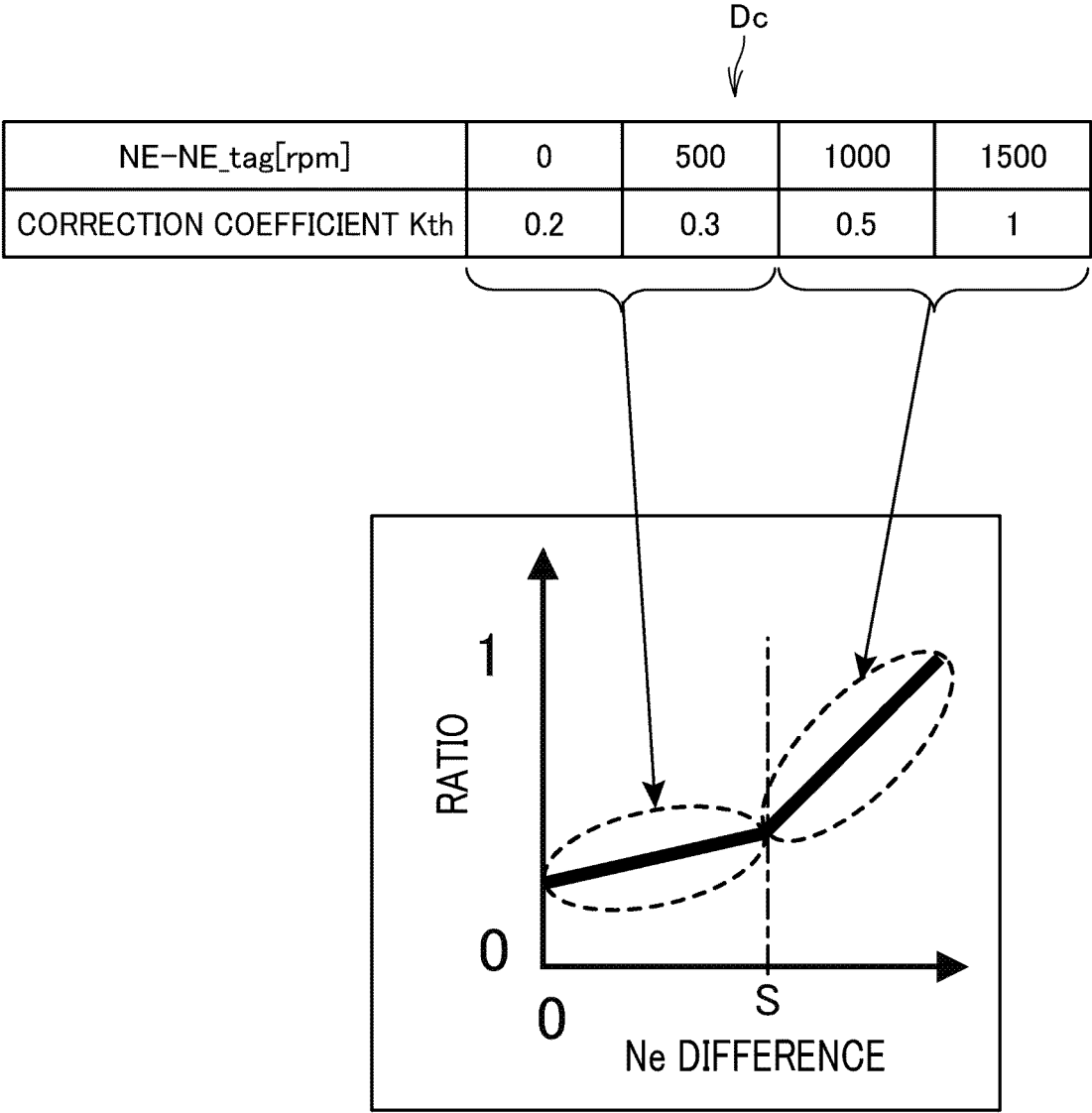


FIG.13





EUROPEAN SEARCH REPORT

Application Number

EP 26 16 3821

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2009/194068 A1 (USUKURA YASUTAKA [JP] ET AL) 6 August 2009 (2009-08-06) * paragraphs [0005], [0011], [0012], [0014] - [0018], [0037], [0040], [0051], [0061], [0068]; claims 1-20; figures 1-11 *	1-9	INV. F02D11/10 F02D41/06 F02D11/02 F02D11/04 F02D35/00 F02M69/32
A	DE 103 15 252 A1 (MITSUBISHI MOTORS CORP [JP]) 30 October 2003 (2003-10-30) * paragraphs [0002] - [0005], [0045] - [0057]; claims 1-9; figures 1-14 *	1-9	ADD. F02D41/00 F02D31/00
A	US 9 200 586 B2 (YAMAHA MOTOR CO LTD [JP]) 1 December 2015 (2015-12-01) * claims 1-15; figures 1-10 *	1-9	
A	US 2005/272320 A1 (MASUI HIDEAKI [JP] ET AL) 8 December 2005 (2005-12-08) * paragraph [0038]; claim 1; figures 1,2 *	1-9	
A	JP 2015 140794 A (DAIHATSU MOTOR CO LTD) 3 August 2015 (2015-08-03) * claim 1; figure 1 *	1-9	TECHNICAL FIELDS SEARCHED (IPC) F02D F02M
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		23 July 2026	Boye, Michael
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			
T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P24C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 26 16 3821

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

23-07-2026

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2009194068 A1	06-08-2009	JP 5090945 B2	05-12-2012
		JP 2009180201 A	13-08-2009
		US 2009194068 A1	06-08-2009
-----		-----	
DE 10315252 A1	30-10-2003	DE 10315252 A1	30-10-2003
		JP 4410454 B2	03-02-2010
		JP 2003293833 A	15-10-2003
		KR 20030079758 A	10-10-2003
		US 2003221665 A1	04-12-2003
-----		-----	
US 9200586 B2	01-12-2015	JP 2014013015 A	23-01-2014
		US 2014007839 A1	09-01-2014
-----		-----	
US 2005272320 A1	08-12-2005	JP 4201195 B2	24-12-2008
		JP 2005299482 A	27-10-2005
		US 2005272320 A1	08-12-2005
-----		-----	
JP 2015140794 A	03-08-2015	NONE	
-----		-----	

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 2015140794 A [0002] [0003]