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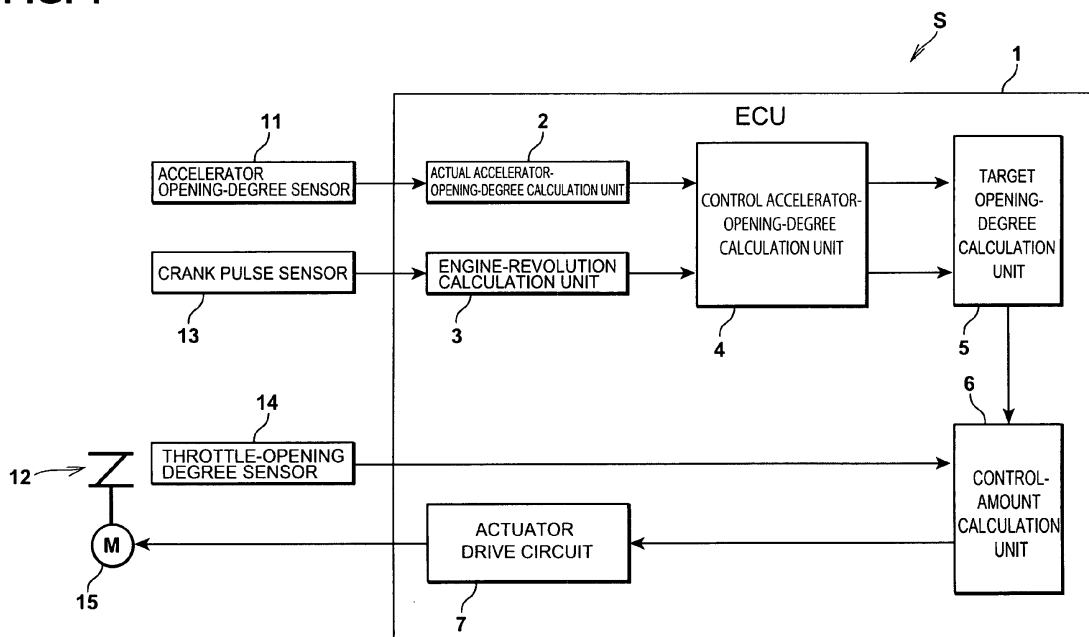
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(54) **Engine output control device**

(57) In an engine output control device that controls an engine output based on a control accelerator-opening degree, only when an amount of change in an instruction accelerator-opening degree is judged to be equal to or larger than a predetermined negative value, and an engine operating condition is judged based on the instruc-

tion accelerator-opening degree and an engine revolution number to fall within a predetermined region where an engine output is more likely to change, a control accelerator-opening-degree calculation unit 4 calculates an opening degree by dulling the instruction accelerator-opening degree, as the control accelerator-opening degree.

FIG. 1



Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to an engine output control device, and more particularly relates to an engine output control device that controls an engine output based on an instruction accelerator-opening degree.

[0002] In recent years, in an engine control of a vehicle such as a motorcycle, a target control amount of a throttle opening degree is calculated according to an instruction accelerator-opening degree, and a device to be controlled such as an electronically-controlled throttle device is feedback-controlled in such a manner that a control amount of the throttle opening degree corresponds to the target control amount, thereby executing an engine output control according to a driver's request.

[0003] In such an engine output control, when the instruction accelerator-opening degree is directly reflected on the engine output control, the engine output may change abruptly against the driver's intention to be one unintended by the driver. For example, when a motorcycle is running on a rough road and if the driver unintentionally operates an accelerator operating member due to an influence of vibrations of the motorcycle, thereby changing an instruction accelerator-opening degree, an engine output unintended by the driver may be generated.

[0004] In view of the background described above, to suppress discomfort of the driver caused by an unintended engine output, there has been proposed a technique to calculate a corrected value of an instruction accelerator-opening degree as a control accelerator-opening degree and to control an engine output based on the calculated control accelerator-opening degree.

[0005] Specifically, Japanese Patent Application Examined Publication No. H05-55698 discloses a throttle control device that controls an engine output based on a control accelerator-opening degree obtained by performing a filtering process on an instruction accelerator-opening degree.

[0006] Further, Japanese Patent Application Laid-open Publication No. 2003-328811 discloses a fuel injection device that learns a correction value of a dulling rate of an instruction accelerator-opening degree from a rate of change in the instruction accelerator-opening degree for each of plural regions corresponding to the instruction accelerator-opening degree and engine revolutions, and that calculates an instruction accelerator-opening degree changed by the corrected dulling rate as a control accelerator-opening degree.

SUMMARY OF THE INVENTION

[0007] However, according to the studies by the present inventors, it is possible in the configuration described in Japanese Patent Application Examined Publication No. H05-55698 that because a filtering coefficient

is constant regardless of a vehicle operating condition, an instruction accelerator-opening degree is dulled even in a case where an engine output is required to quickly respond to the instruction accelerator-opening degree, and therefore a driver's desired engine output cannot be obtained. Accordingly, this configuration has room for improvement.

[0008] Further, it is possible in the configuration described in Japanese Patent Application Laid-open Publication No. 2003-328811 that, when a vehicle operating condition changes in a case where the fuel injection device learns the dulling rate as a large value, an engine output does not quickly respond to the instruction accelerator-opening degree, and therefore a driver's desired engine output cannot be obtained. Accordingly, this configuration has room for improvement.

[0009] Therefore, it is currently expected to realize an engine output control device capable of suppressing discomfort of a driver caused by unintended abrupt variations in an engine output while ensuring engine output responsiveness desired by the driver. Particularly, in a vehicle such as a motorcycle, when an accelerator operating member is operated to an unnecessarily large extent on a rough road or the like, unwanted variations in the engine output are more likely to occur. It is therefore considered to be more necessary to suppress discomfort of the driver caused by unintended abrupt variations in the engine output.

[0010] The present invention has been achieved to solve the above problems, and an object of the present invention is to provide an engine output control device capable of suppressing discomfort of a driver caused by unintended abrupt variations in an engine output while ensuring engine output responsiveness desired by the driver.

[0011] To achieve the above object, a first aspect of the present invention is to provide an engine output control device including a control accelerator-opening-degree calculation unit that calculates a control accelerator-opening degree based on an instruction accelerator-opening degree according to an operation amount of an accelerator operating member and controlling an engine output based on the control accelerator-opening degree, wherein only when an amount of change in the instruction accelerator-opening degree is judged to be equal to or larger than a predetermined negative value, and an engine operating condition is judged based on the instruction accelerator-opening degree and an engine revolution number to fall within a predetermined region where an engine output is more likely to change, the control accelerator-opening-degree calculation unit calculates an opening degree by dulling the instruction accelerator-opening degree, as the control accelerator-opening degree.

[0012] According to a second aspect of the present invention, in addition to the first aspect, the predetermined region is defined using a high-opening-degree judgment value that indicates that the instruction accel-

erator-opening degree is high, and the high-opening-degree judgment value is set smaller as the engine revolution number is higher.

[0013] According to a third aspect of the present invention, in addition to the second aspect, when the engine operating condition is judged to fall within the predetermined region, the instruction accelerator-opening degree is dulled to a larger extent as the engine revolution number is higher.

[0014] According to a fourth aspect of the present invention, in addition to any of the first to third aspects, the control accelerator-opening-degree calculation unit further calculates a delay amount of the control accelerator-opening degree from the instruction accelerator-opening degree and the dulled opening degree, and calculates a value by correcting the instruction accelerator-opening degree with a limit value as the control accelerator-opening degree when the delay amount falls out of a predetermined range.

[0015] In the engine output control device according to the first aspect of the present invention, only when an amount of change in the instruction accelerator-opening degree is judged to be equal to or larger than a predetermined negative value, and an engine operating condition is judged based on the instruction accelerator-opening degree and an engine revolution number to fall within a predetermined region where an engine output is more likely to change, the control accelerator-opening-degree calculation unit calculates an opening degree by dulling the instruction accelerator-opening degree, as the control accelerator-opening degree. Therefore, only when the driver does not intend to rapidly decelerate a vehicle, and the engine operating condition falls within a region where variations in the engine output such as torque are more likely to occur due to an operation of the accelerator operating member, the control accelerator-opening-degree calculation unit can calculate the control accelerator-opening degree by dulling the instruction accelerator-opening degree. Accordingly, discomfort of the driver caused by unintended abrupt variations in the engine output can be suppressed while ensuring engine output responsiveness desired by the driver.

[0016] In the engine output control device according to the second aspect of the present invention, the predetermined region is defined using a high-opening-degree judgment value that indicates that the instruction accelerator-opening degree is high, and the high-opening-degree judgment value is set smaller as the engine revolution number is higher. Therefore, a region where it is necessary to perform an operation process for dulling the instruction accelerator-opening degree can be optimally set to appropriately dull the instruction accelerator-opening degree.

[0017] In the engine output control device according to the third aspect of the present invention, when the engine operating condition is judged to fall within the predetermined region, the instruction accelerator-opening degree is dulled to a larger extent as the engine revolution

number is higher. Therefore, the region where it is necessary to perform the operation process for dulling the instruction accelerator-opening degree can be more optimally set to more appropriately dull the instruction accelerator-opening degree.

[0018] In the engine output control device according to the fourth aspect of the present invention, the control accelerator-opening-degree calculation unit further calculates a delay amount of the control accelerator-opening degree from the instruction accelerator-opening degree and the dulled opening degree, and calculates a value by correcting the instruction accelerator-opening degree with a limit value as the control accelerator-opening degree when the delay amount falls out of a predetermined range. Therefore, the delay amount of the control accelerator-opening degree can be restricted with respect to the instruction accelerator-opening degree, and accordingly occurrence of a delay in acceleration or a delay in deceleration can be suppressed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019]

FIG. 1 is a block diagram showing a configuration of an engine output control device according to an embodiment of the present invention; and FIG. 2 is a diagram for explaining a calculation process performed by a control accelerator-opening-degree calculation unit shown in FIG. 1 in more detail.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0020] Exemplary embodiments of an engine output control device according to the present invention will be explained below in detail with reference to the accompanying drawings.

[Configuration of engine output control device]

[0021] First, a configuration of an engine output control device according to an embodiment of the present invention is explained in detail with reference to FIG. 1.

[0022] FIG. 1 is a block diagram showing a configuration of the engine output control device according to the present embodiment.

[0023] As shown in FIG. 1, an engine output control device S according to the present embodiment is installed in a vehicle (not shown), typically a motorcycle, and includes an electronic control unit (ECU) 1. The ECU 1 is a control device that operates by utilizing electric power supplied from a battery (not shown) installed in the vehicle and that can control various constituent elements of the vehicle and includes a memory and the like (not shown). The ECU 1 also includes an actual accelerator-opening-degree calculation unit 2, an engine-revolution calculation unit 3, a control accelerator-opening-

degree calculation unit 4, a target opening-degree calculation unit 5, a control-amount calculation unit 6, and an actuator drive circuit 7. The actual accelerator-opening-degree calculation unit 2, the engine-revolution calculation unit 3, the control accelerator-opening-degree calculation unit 4, the target opening-degree calculation unit 5, and the control-amount calculation unit 6 are provided in a central processing unit (CPU) (not shown) as functional blocks.

[0024] Based on a signal detected by an accelerator-opening degree sensor 11 that detects an operation position of an accelerator operating member (not shown), the actual accelerator-opening-degree calculation unit 2 calculates an instruction accelerator-opening degree corresponding to an operation amount of the accelerator operating member. The actual accelerator-opening-degree calculation unit 2 outputs the calculated instruction accelerator-opening degree to the control accelerator-opening-degree calculation unit 4. While the accelerator operating member in a motorcycle is an accelerator grip, the form of the accelerator operating member is not limited to the accelerator grip. For example, when the vehicle is a four-wheeled vehicle, the form of the accelerator operating member is an accelerator pedal.

[0025] The engine-revolution calculation unit 3 calculates an engine revolution number based on a signal detected by a crank pulse sensor 13 that detects an angle of a crankshaft of an engine (both not shown) in the vehicle. The engine-revolution calculation unit 3 outputs the calculated engine revolution number to the control accelerator-opening-degree calculation unit 4.

[0026] The control accelerator-opening-degree calculation unit 4 calculates a control accelerator-opening degree based on the instruction accelerator-opening degree input from the actual accelerator-opening-degree calculation unit 2 and on the engine revolution number input from the engine-revolution calculation unit 3. A process of calculating the control accelerator-opening degree is described later in detail. The control accelerator-opening-degree calculation unit 4 outputs the calculated control accelerator-opening degree to the target opening-degree calculation unit 5.

[0027] Based on the control accelerator-opening degree input from the control accelerator-opening-degree calculation unit 4, the target opening-degree calculation unit 5 calculates a target opening degree (hereinafter, "target throttle opening degree") of a throttle valve 12 arranged in an intake system (not shown) of the engine in the vehicle. The target opening-degree calculation unit 5 outputs the calculated target throttle opening degree to the control-amount calculation unit 6.

[0028] Based on the target throttle opening degree input from the target opening-degree calculation unit 5 and on an actual opening degree of the throttle valve 12, which is detected by a throttle-opening degree sensor 14, the control-amount calculation unit 6 calculates a control amount of a motor 15 that drives the throttle valve 12 to control the actual opening degree of the throttle valve

12 to the target throttle opening degree. The control-amount calculation unit 6 outputs the calculated control amount to the actuator drive circuit 7.

[0029] The actuator drive circuit 7 drives the motor 15 according to the control amount input from the control-amount calculation unit 6, thereby controlling the actual opening degree of the throttle valve 12 to the target throttle opening degree.

[Control accelerator-opening-degree calculation process]

[0030] In the engine output control device S having the above configuration, the control accelerator-opening-degree calculation unit 4 performs a control accelerator-opening-degree calculation process described below. Therefore, discomfort of the driver caused by unintended abrupt variations in the engine output due to an unintended operation on a rough road, an unnecessary operation under the normal condition, or the like is suppressed while ensuring engine output responsiveness desired by the vehicle driver. An operation of the control accelerator-opening-degree calculation unit 4 to perform the control accelerator-opening-degree calculation process is explained below with reference to FIG. 2.

[0031] FIG. 2 is a diagram for explaining the calculation process performed by the control accelerator-opening-degree calculation unit 4 shown in FIG. 1 in more detail.

[0032] In FIG. 2, the calculation process performed by the control accelerator-opening-degree calculation unit 4 is shown in Steps S1 to S10. The calculation process is performed by reading a predetermined program stored in the memory in advance, while using values detected by various sensors.

[0033] Specifically, when the control accelerator-opening-degree calculation unit 4 calculates a control accelerator-opening degree, the control accelerator-opening-degree calculation unit 4 first calculates a value by subtracting, from an instruction accelerator-opening degree OP (current) input from the actual accelerator-opening-degree calculation unit 2 in the current calculation process, an instruction accelerator-opening degree OP (past) in the past (a last or earlier time, which is set arbitrarily) calculation process, which has been output from the actual accelerator-opening-degree calculation unit 2 and stored in the memory in the last or earlier calculation process, thereby calculating an amount Δ OP of change in the instruction accelerator-opening degree in the current calculation process in Step S1. The control accelerator-opening-degree calculation unit 4 then judges the magnitude of the calculated amount Δ OP of change in the instruction accelerator-opening degree and primarily determines whether to perform an operation process for dulling the instruction accelerator-opening degree OP (hereinafter, "dulling operation process").

[0034] More specifically, the control accelerator-opening-degree calculation unit 4 discriminates whether the amount Δ OP of change in the instruction accelerator-

opening degree is equal or larger than a predetermined negative value a_1 . The predetermined value a_1 is set according to the type of the vehicle, the engine output characteristics, the transmission gear ratio, and the like, and is stored in the memory in advance.

[0035] In FIG. 2, for convenience of explanation, a region where the amount ΔOP of change in the instruction accelerator-opening degree is equal to or larger than the negative predetermined value a_1 is represented as a region A1, and a region where the amount ΔOP of change in the instruction accelerator-opening degree is smaller than the predetermined negative value a_1 is represented as a region A2. Further, the fact that the amount ΔOP of change in the instruction accelerator-opening degree is positive means the vehicle is in an accelerating state AL while the driver is operating the accelerator operating member in an opening direction. The fact that the amount ΔOP of change in the instruction accelerator-opening degree is negative means the vehicle is in a decelerating state DL while the driver is operating the accelerator operating member in a closing direction.

[0036] That is, the fact that the amount ΔOP of change in the instruction accelerator-opening degree falls within the region A1 where it is equal to or larger than the predetermined negative value a_1 means the driver intends to accelerate the vehicle by operating the accelerator operating member in an opening direction and the vehicle is in the accelerating state AL, or means the driver intends to decelerate the vehicle by operating the accelerator operating member in a closing direction and the vehicle is in the decelerating state DL while the driver's intention itself is to relatively gradually decelerate the vehicle. Therefore, in such a case, it is often preferable to suppress discomfort of the driver caused by unintended abrupt variations in the engine output while confirming that suppression of the discomfort is appropriate as needed. Therefore, when a result of the discrimination indicates the amount ΔOP of change in the instruction accelerator-opening degree falls within the region A1 where it is equal to or larger than the negative predetermined value a_1 , the control accelerator-opening-degree calculation unit 4 causes the calculation process to proceed to Step S2 according to the driver's intention not to rapidly decelerate the vehicle to enable the dulling operation process on the instruction accelerator-opening degree OP.

[0037] On the other hand, the fact that the amount ΔOP of change in the instruction accelerator-opening degree falls within the region A2 where it is smaller than the negative predetermined value a_1 means the driver intends to decelerate the vehicle by operating the accelerator operating member in a closing direction, the vehicle is in the decelerating state DL, and the driver's intention itself is to relatively rapidly decelerate the vehicle. Therefore, in such a case, because it is preferable to ensure engine output responsiveness desired by the driver, it is less necessary to perform the dulling operation process on the instruction accelerator-opening degree OP. Accordingly,

when a result of the discrimination indicates the amount ΔOP of change in the instruction accelerator-opening degree falls within the region A2 where it is smaller than the negative predetermined value a_1 , the control accelerator-opening-degree calculation unit 4 does not perform the dulling operation process on the instruction accelerator-opening degree OP and causes the calculation process to proceed to Step S5 so that the engine output quickly responds to the driver's intention to rapidly decelerate the vehicle.

[0038] Next, in Step S2, based on the instruction accelerator-opening degree OP input from the actual accelerator-opening-degree calculation unit 2 in the current calculation process and on the engine revolution number NE input from the engine-revolution calculation unit 3 in the current calculation process, the control accelerator-opening-degree calculation unit 4 judges an engine output region by referring to data of a predetermined map that defines a relationship between the instruction accelerator-opening degree OP and the engine revolution number NE, and performs the dulling operation process on the instruction accelerator-opening degree OP. The map data is set according to the type of the vehicle, the engine output characteristics, the transmission gear ratio, and the like, and is stored in the memory in advance.

[0039] More specifically, the control accelerator-opening-degree calculation unit 4 first discriminates whether the instruction accelerator-opening degree OP input from the actual accelerator-opening-degree calculation unit 2 in the current calculation process, and the engine revolution number NE input from the engine-revolution calculation unit 3 in the current calculation process fall within a region A3 in the map data read from the memory.

[0040] The region A3 is where the engine revolution number NE is lower than a predetermined value NE1, and the instruction accelerator-opening degree OP is lower than a predetermined value OP1, that is, an engine idle region when the engine is supposed to be operating. In the region A3, it is preferable to enhance a follow-up performance of the engine output at the time of starting the vehicle, rather than prioritizing the dulling operation process on the instruction accelerator-opening degree OP. Therefore, when a result of the discrimination indicates the engine revolution number NE and the instruction accelerator-opening degree OP with respect to the engine revolution number NE fall within the region A3, the control accelerator-opening-degree calculation unit 4 does not perform the dulling operation process on the instruction accelerator-opening degree OP and causes the calculation process to proceed to Step S5 to enhance the follow-up performance of the engine output at the time of starting the vehicle.

[0041] When the engine revolution number NE and the instruction accelerator-opening degree OP with respect to the engine revolution number NE do not fall within the region A3, the control accelerator-opening-degree calculation unit 4 discriminates whether the instruction accelerator-opening degree OP input from the actual ac-

celerator-opening-degree calculation unit 2 in the current calculation process, and the engine revolution number NE input from the engine-revolution calculation unit 3 in the current calculation process fall within a region A7 in the map data read from the memory. At this time, a predetermined high-opening-degree judgment value OPU is used, which is a judgment value for defining whether the instruction accelerator-opening degree OP is high with respect to the engine revolution number NE.

[0042] Specifically, the region A7 is a high-opening-degree region of the instruction accelerator-opening degree OP, which indicates that the instruction accelerator-opening degree OP with respect to the engine revolution number NE falls within a region where it is higher than the high-opening-degree judgment value OPU, that is, a region where the operation amount of the accelerator operating member is large in the opening direction. In the region A7, while it is less advantageous to perform the dulling operation process on the instruction accelerator-opening degree OP, it is more necessary to enhance the follow-up performance of the engine output at the time of accelerating the vehicle. From this viewpoint, the high-opening-degree judgment value OPU preferably follows a predetermined change curve with respect to the engine revolution number NE. Particularly, it is preferable to set the high-opening-degree judgment value OPU to have such characteristics that, as the engine revolution number NE becomes higher, the high-opening-degree judgment value OPU becomes smaller. For example, when the engine revolution number NE is low, the high-opening-degree judgment value OPU is set large, and when the engine revolution number NE is high, the high-opening-degree judgment value OPU is set small. The characteristics of the high-opening-degree judgment value OPU can change in stages including a linear portion, or can continuously change along a curve. Therefore, when a result of the discrimination indicates the engine revolution number NE and the instruction accelerator-opening degree OP with respect to the engine revolution number NE fall within the region A7 that is above the high-opening-degree judgment value OPU, the control accelerator-opening-degree calculation unit 4 does not perform the dulling operation process on the instruction accelerator-opening degree OP and causes the calculation process to proceed to Step S5 to enhance the follow-up performance of the engine output at the time of accelerating the vehicle.

[0043] Further, when the engine revolution number NE and the instruction accelerator-opening degree OP with respect to the engine revolution number NE do not fall within the region A3 or the region A7, the control accelerator-opening-degree calculation unit 4 discriminates whether the instruction accelerator-opening degree OP input from the actual accelerator-opening-degree calculation unit 2 in the current calculation process, and the engine revolution number NE input from the engine-revolution calculation unit 3 in the current calculation process fall within a region A4 or a region A5.

[0044] The region A4 is where the engine revolution number NE is lower than the predetermined value NE1, and the instruction accelerator-opening degree OP is equal to or larger than the predetermined value OP1 and also equal to or smaller than the high-opening-degree judgment value OPU. That is, the region A4 is a low-to-medium load region with a low engine revolution number at a time when the engine is supposed to be operating, a high gear, and a medium instruction accelerator-opening degree, where unwanted engine-output variations are more likely to occur when the accelerator operating member is operated to an unnecessarily large extent on a rough road or the like. In the region A4, while it is less advantageous to enhance the follow-up performance of the engine output at the time of accelerating the vehicle, it is more necessary to perform the dulling operation process on the instruction accelerator-opening degree OP in view of unwanted output variations tending to occur. The region A5 is where the engine revolution number NE is equal to or higher than the predetermined value NE1 and also lower than a predetermined value NE2, and the instruction accelerator-opening degree OP is equal to or smaller than the high-opening-degree judgment value OPU. That is, the region A5 is a low-to-medium load region corresponding to a vehicle cruising region and the like, where unwanted engine-output variations are more likely to occur when the accelerator operating member is operated to an unnecessarily large extent on a rough road or the like. Also in the region A5, while it is less advantageous to enhance the follow-up performance of the engine output at the time of accelerating the vehicle, it is more necessary to perform the dulling operation process on the instruction accelerator-opening degree OP in view of unwanted output variations tending to occur. Therefore, when a result of the discrimination indicates the engine revolution number NE and the instruction accelerator-opening degree OP with respect to the engine revolution number NE fall within the region A4 or the region A5, the control accelerator-opening-degree calculation unit 4 causes the calculation process to proceed to Step S4 so that the dulling operation process can be performed on the instruction accelerator-opening degree OP according to the discrimination result.

[0045] Further, when the engine revolution number NE and the instruction accelerator-opening degree OP with respect to the engine revolution number NE do not fall within the regions A3 to A5 or the region A7, the instruction accelerator-opening degree OP input from the actual accelerator-opening-degree calculation unit 2 in the current calculation process, and the engine revolution number NE input from the engine-revolution calculation unit 3 in the current calculation process are discriminated to fall within a region A6 by the control accelerator-opening-degree calculation unit 4.

[0046] The region A6 is where the engine revolution number NE is equal to or higher than the predetermined value NE2, and the instruction accelerator-opening degree OP is equal to or smaller than the high-opening-

degree judgment value OPU. That is, the region A6 is a high-load region with a high engine revolution number, a low gear, and a medium instruction accelerator-opening degree, where unwanted engine-output variations are more likely to occur when the accelerator operating member is operated to an unnecessarily large extent on a rough road or the like. In the region A6, because unwanted output variations are more likely to occur quite frequently, it is preferable to prioritize the dulling operation process on the instruction accelerator-opening degree OP, rather than enhancing the follow-up performance of the engine output at the time of accelerating the vehicle. Therefore, when a result of the discrimination indicates the engine revolution number NE and the instruction accelerator-opening degree OP with respect to the engine revolution number NE fall within the region A6, the control accelerator-opening-degree calculation unit 4 causes the calculation process to proceed to Step S3 so that the dulling operation process can be performed on the instruction accelerator-opening degree OP according to the discrimination result.

[0047] To sum up, the regions A4 to A6 are evaluated as engine operating regions where the engine output is more likely to change due to an unintended operation on a rough road, an unnecessary operation under the normal condition, or the like. The region A6 is where the engine revolution number NE is higher than that in the regions A4 and A5, and therefore is evaluated as the engine operating region where the engine output is much more likely to change. Accordingly, when the engine revolution number NE and the instruction accelerator-opening degree OP with respect to the engine revolution number NE are discriminated to fall within the region A6, it is preferable to dull the instruction accelerator-opening degree OP to a larger extent.

[0048] Next, in Step S3, the control accelerator-opening-degree calculation unit 4 sets a filtering coefficient to be used in the subsequent step to a predetermined value b smaller than 1 so that a dulling effect on an instruction accelerator-opening degree is larger than that in Step S4, which is explained next. When the filtering coefficient setting is completed, the control accelerator-opening-degree calculation unit 4 causes the calculation process to proceed to Step S6.

[0049] Next, in Step S4, the control accelerator-opening-degree calculation unit 4 sets a filtering coefficient to be used in the subsequent step to a predetermined value "a" that is smaller than 1 and larger than the predetermined value b so that the dulling effect on an instruction accelerator-opening degree is smaller than that in Step S3. When the filtering coefficient setting is completed, the control accelerator-opening-degree calculation unit 4 causes the calculation process to proceed to Step S6.

[0050] Next, in Step 5, the control accelerator-opening-degree calculation unit 4 sets a filtering coefficient to be used in the subsequent step to 1 so that the dulling effect on an instruction accelerator-opening degree is not produced. When the filtering coefficient setting is completed,

the control accelerator-opening-degree calculation unit 4 causes the calculation process to proceed to Step S6.

[0051] Next, in Step S6, the control accelerator-opening-degree calculation unit 4 calculates an accelerator filtering value by substituting an instruction accelerator-opening degree (current) input from the actual accelerator-opening-degree calculation unit 2 in the current calculation process, a control accelerator-opening degree (last) in the last calculation process, which has been output from the control accelerator-opening-degree calculation unit 4 and stored in the memory in the last calculation process, and the filtering coefficient having been set at any of Steps S3 to S5 into an equation (1) described below. When the accelerator filtering value calculation is completed, the control accelerator-opening-degree calculation unit 4 causes the calculation process to proceed to Step S7. The equation (1) is read from the memory and used.

[0052] Accelerator filtering value = Instruction accelerator-opening degree (current) \times Filtering coefficient + Control accelerator-opening degree (last) \times (1.0 - Filtering coefficient) ... Equation (1)

[0053] When the filtering coefficient value is b, the accelerator filtering value becomes a value that causes contribution of an instruction accelerator-opening degree (current) in the current calculation process to be relatively low and contribution of a control accelerator-opening degree (last) in the last calculation process to be relatively high, and therefore the instruction accelerator-opening degree (current) OP in the current calculation process has a value dulled to a relatively large extent. When the filtering coefficient value is "a", the accelerator filtering value becomes a value that causes contribution of an instruction accelerator-opening degree (current) in the current calculation process to be relatively high and contribution of a control accelerator-opening degree (last) in the last calculation process to be relatively low, and therefore the instruction accelerator-opening degree (current) OP in the current calculation process has a value dulled to a relatively small extent. When the filtering coefficient value is 1, the accelerator filtering value is equal to the instruction accelerator-opening degree (current) in the current calculation process, and the instruction accelerator-opening degree (current) OP in the current calculation process is not dulled, and becomes the accelerator filtering value itself.

[0054] That is, in a case where the instruction accelerator-opening degree OP with respect to the engine revolution number NE, which is equal to or smaller than the high-opening-degree judgment value OPU, is dulled, it suffices that the instruction accelerator-opening degree OP is dulled to a larger extent as the engine revolution number NE becomes higher, taking into consideration that when the engine revolution number NE is higher, the engine output is more likely to change due to an unintended operation on a rough road, an unnecessary operation under the normal condition, or the like. In such a case, the number of regions where the instruction accel-

erator-opening degree OP with respect to the engine revolution number NE is equal to or smaller than the high-opening-degree judgment value OPU can be increased to three or more in the map data, and three or more filtering coefficient values that are smaller than 1 can be prepared to calculate the accelerator filtering value in a more precise manner. In a case of an idle region or a case where the instruction accelerator-opening degree OP with respect to the engine revolution number NE exceeds the high-opening-degree judgment value OPU, the instruction accelerator-opening degree OP is not dulled considering that it is less necessary to reduce change in the engine output due to an unintended operation on a rough road, an unnecessary operation under the normal condition, or the like and that it is more preferable to prioritize the instruction accelerator-opening degree OP itself.

[0055] The accelerator filtering value obtained at the time of completing the above processes can be set as a control accelerator-opening degree to calculate a target throttle opening degree. However, in the present embodiment, processes in Step S7 and Step S8 explained below in detail are performed to more improve calculation accuracy of the control accelerator-opening degree.

[0056] Next, in Step S7, the control accelerator-opening-degree calculation unit 4 first calculates a value by subtracting the accelerator filtering value calculated in Step S6 from the instruction accelerator-opening degree input from the actual accelerator-opening-degree calculation unit 2 in the current calculation process, thereby calculating a filtering delay value FD in the current calculation process.

[0057] Further, based on the instruction accelerator-opening degree OP input from the actual accelerator-opening-degree calculation unit 2 in the current calculation process and on the filtering delay value FD in the current calculation process, the control accelerator-opening-degree calculation unit 4 judges a filtering delay by referring to predetermined map data that defines a relationship between the instruction accelerator-opening degree OP and the filtering delay value FD. The map data is set according to the type of a vehicle, the engine output characteristics, the transmission gear ratio, and the like, and is stored in the memory in advance.

[0058] More specifically, from the instruction accelerator-opening degree OP input from the actual accelerator-opening-degree calculation unit 2 in the current calculation process, and the filtering delay value FD in the current calculation process, the control accelerator-opening-degree calculation unit 4 discriminates a magnitude relationship between the filtering delay value FD and an upper limit value FDU (>0) and a magnitude relationship between the filtering delay value FD and a lower limit value FDL (<0) in the map data read from the memory, thereby discriminating which one of regions A8 to A10 the filtering delay value FD according to the instruction accelerator-opening degree OP falls within. In FIG. 2, the positive direction of the filtering delay value

FD corresponds to a vehicle decelerating direction DL, and the negative direction of the filtering delay value FD corresponds to a vehicle accelerating direction AL.

[0059] The region A8 indicates that the filtering delay value FD is equal to or smaller than the upper limit value FDU and also equal to or larger than the lower limit value FDL. The region A9 indicates a region outside of an accelerating direction range, where the filtering delay value FD is smaller than the lower limit value FDL. The region A10 indicates a region outside of a decelerating direction range, where the filtering delay value FD is larger than the upper limit value FDU. The upper limit value FDU and the lower limit value FDL are used to correct the instruction accelerator-opening degree OP to obtain a control accelerator-opening degree according to the magnitude of the instruction accelerator-opening degree OP. Therefore, it is preferable that the upper limit value FDU and the lower limit value FDL follow a predetermined change curve with respect to the instruction accelerator-opening degree OP. Particularly, it is preferable that when the instruction accelerator-opening degree OP is small, both the upper limit value FDU and the lower limit value FDL are set small, and when the instruction accelerator-opening degree OP is large, both the upper limit value FDU and the lower limit value FDL are set large.

[0060] When a result of the discrimination indicates the filtering delay value FD falls within the region A8 where it is equal to or smaller than the upper limit value FDU, and also equal to or larger than the lower limit value FDL, the control accelerator-opening-degree calculation unit 4 causes the calculation control process to proceed to Step S8. When the filtering delay value FD falls within the region A9 where it is smaller than the lower limit value FDL (outside of the accelerating direction range), the control accelerator-opening-degree calculation unit 4 causes the calculation process to proceed to Step S9. When the filtering delay value FD falls within the region A10 where it is larger than the upper limit value FDU (outside of the decelerating direction range), the control accelerator-opening-degree calculation unit 4 causes the calculation process to proceed to Step S10. In Step S7, the control accelerator-opening-degree calculation unit 4 can calculate a value by dividing the instruction accelerator-opening degree input from the actual accelerator-opening-degree calculation unit 2 in the current calculation process by the accelerator filtering value calculated in Step S6 as the filtering delay value FD. However, in such a case, the map has a different mode to discriminate a magnitude relationship between the filtering delay value FD and a limit value.

[0061] In Step S8, the control accelerator-opening-degree calculation unit 4 sets the accelerator filtering value calculated in Step S6 as a control accelerator-opening degree, and outputs the set control accelerator-opening degree to the target opening-degree calculation unit 5. In this manner, the control accelerator-opening-degree calculation process is finished.

[0062] In Step S9, the control accelerator-opening-de-

gree calculation unit 4 sets a value by adding the corresponding lower limit value FDL to the instruction accelerator-opening degree OP input from the actual accelerator-opening-degree calculation unit 2 in the current calculation process as a control accelerator-opening degree, and outputs the set control accelerator-opening degree to the target opening-degree calculation unit 5. In this manner, the control accelerator-opening-degree calculation process is finished.

[0063] In Step S10, the control accelerator-opening-degree calculation unit 4 sets a value by adding the corresponding upper limit value FDU to the instruction accelerator-opening degree OP input from the actual accelerator-opening-degree calculation unit 2 in the current calculation process as a control accelerator-opening degree, and outputs the set control accelerator-opening degree to the target opening-degree calculation unit 5. In this manner, the control accelerator-opening-degree calculation process is finished.

[0064] In the subsequent process, the target opening-degree calculation unit 5 calculates a target throttle opening degree based on the control accelerator-opening degree input from the control accelerator-opening-degree calculation unit 4, and outputs the calculated target throttle opening degree to the control-amount calculation unit 6. Based on the target throttle opening degree input from the target opening-degree calculation unit 5 and on an actual opening degree of the throttle valve 12 detected by the throttle-opening degree sensor 14, the control-amount calculation unit 6 calculates a control amount of the motor 15 that drives the throttle valve 12, and outputs the calculated control amount to the actuator drive circuit 7 to control the actual opening degree of the throttle valve 12 to the target throttle opening degree. The actuator drive circuit 7 drives the motor 15 according to the control amount calculated by the control-amount calculation unit 6, thereby controlling the actual opening degree of the throttle valve 12 to the target throttle opening degree.

[0065] As it is apparent from the above explanations, in the engine output control device according to the embodiment, only when an amount of change in the instruction accelerator-opening degree is judged to be equal to or larger than the negative predetermined value a1 and when the engine operating condition is judged from the instruction accelerator-opening degree OP and the engine revolution number to fall within the predetermined regions A4 to A6 where the engine output is more likely to change, the control accelerator-opening-degree calculation unit 4 calculates a control accelerator-opening degree that is an opening degree obtained by dulling the instruction accelerator-opening degree OP. That is, only when the driver does not intend to rapidly decelerate the vehicle and the engine operating condition falls within a region where variations in the engine output such as torque are more likely to occur due to an operation of an accelerator operating member, the control accelerator-opening-degree calculation unit 4 calculates a control accelerator-opening degree obtained by dulling the instruc-

tion accelerator-opening degree OP. In this manner, discomfort of the driver caused by unintended abrupt variations in the engine output can be suppressed while ensuring engine output responsiveness desired by the driver.

[0066] Further, when the accelerator operating member is judged to be operated to be opened or closed at a predetermined speed or faster, and the engine operating condition is judged from the instruction accelerator-opening degree OP and the engine revolution number to fall within a region where an engine output hardly varies, the control accelerator-opening-degree calculation unit 4 calculates a control accelerator-opening degree without dulling the instruction accelerator-opening degree OP. Therefore, a driver's intention to accelerate/decelerate the vehicle can be reflected on the engine control. Furthermore, when the accelerator operating member is rapidly operated to be closed, the control accelerator-opening-degree calculation unit 4 calculates a control accelerator-opening degree without dulling the instruction accelerator-opening degree OP. Therefore, the engine output can quickly respond to a driver's intention to decelerate the vehicle.

[0067] In the engine output control device according to the embodiment, the control accelerator-opening-degree calculation unit 4 calculates the filtering delay value FD from the instruction accelerator-opening degree OP and the accelerator filtering value, and calculates a value by correcting the instruction accelerator-opening degree OP with the upper limit value FDU or the lower limit value FDL as a control accelerator-opening degree when the filtering delay value FD falls out of a predetermined range. That is, the control accelerator-opening-degree calculation unit 4 restricts a delay amount FD of the control accelerator-opening degree (the accelerator filtering value) with respect to the instruction accelerator-opening degree OP. In this manner, occurrence of a delay in acceleration or a delay in deceleration can be suppressed.

[0068] In the present invention, the type, the arrangement, the number, and the like of the members are not limited to those in the embodiment explained above, and it is needless to mention that the constituent elements can be modified as appropriate without departing from the scope of the invention, such as appropriately replacing these elements by other ones having identical operational effects.

Claims

1. An engine output control device comprising: a control accelerator-opening-degree calculation unit that calculates a control accelerator-opening degree based on an instruction accelerator-opening degree according to an operation amount of an accelerator operating member, the engine output control device controlling an engine output based on the control accelerator-opening degree, wherein

only when an amount of change in the instruction accelerator-opening degree is judged to be equal to or larger than a predetermined negative value, and an engine operating condition is judged based on the instruction accelerator-opening degree and an engine revolution number to fall within a predetermined region where an engine output is more likely to change, the control accelerator-opening-degree calculation unit calculates an opening degree by dulling the instruction accelerator-opening degree, as the control accelerator-opening degree.

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2. The engine output control device according to claim 1, wherein the predetermined region is defined using a high-opening-degree judgment value that indicates that the instruction accelerator-opening degree is high, and the high-opening-degree judgment value is set smaller as the engine revolution number is higher.

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3. The engine output control device according to claim 1 or 2, wherein when the engine operating condition is judged to fall within the predetermined region, the instruction accelerator-opening degree is dulled to a larger extent as the engine revolution number is higher.

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4. The engine output control device according to any of claims 1 to 3, wherein the control accelerator-opening-degree calculation unit further calculates a delay amount of the control accelerator-opening degree from the instruction accelerator-opening degree and the dulled opening degree, and calculates a value by correcting the instruction accelerator-opening degree with a limit value as the control accelerator-opening degree when the delay amount falls out of a predetermined range.

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FIG. 1

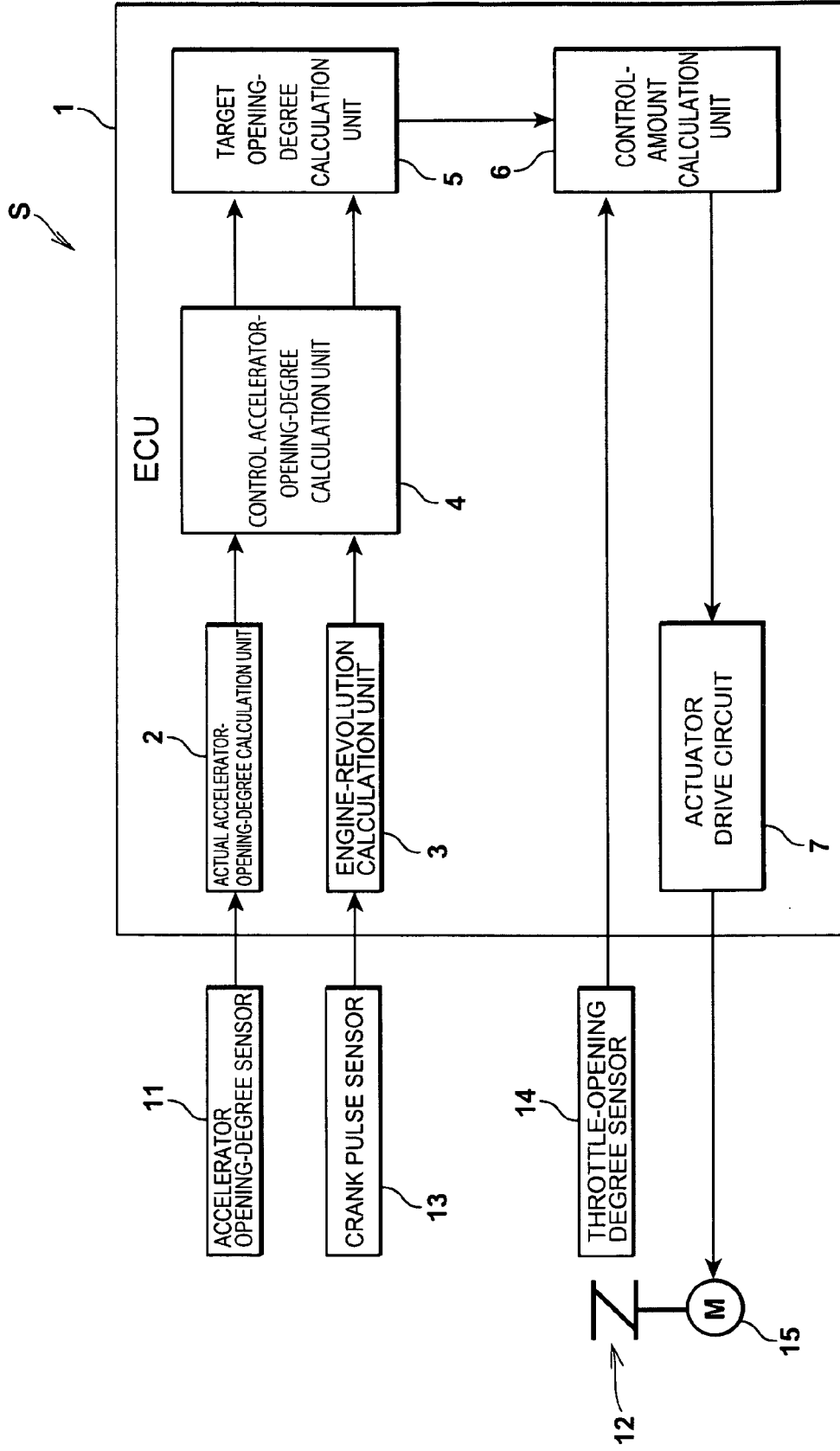
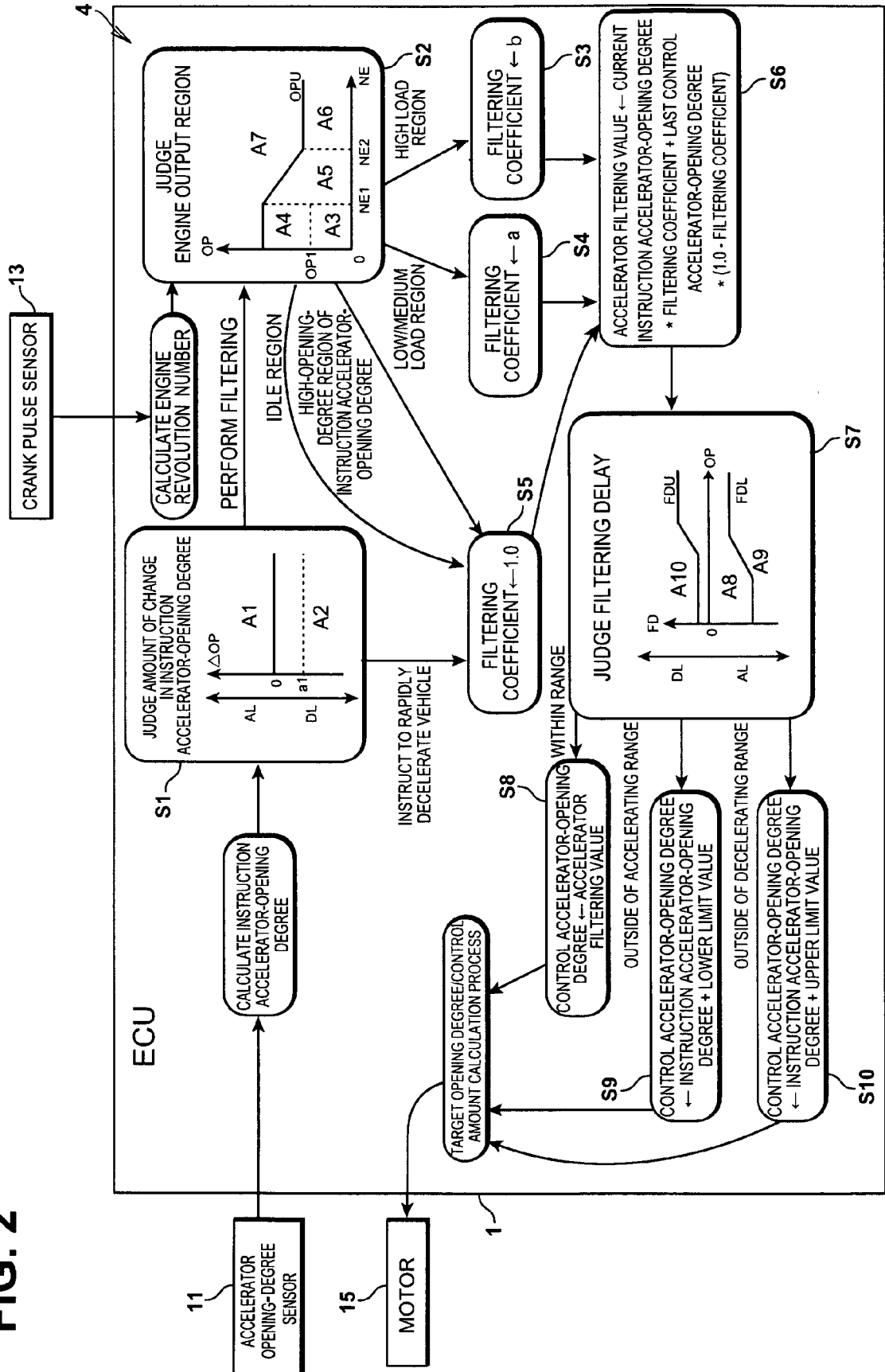


FIG. 2





EUROPEAN SEARCH REPORT

Application Number
EP 13 00 3013

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Place of search Munich		Date of completion of the search 31 October 2013	Examiner Ossanna, Luca
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