(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 909 886 A2

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
21.04.1999 Bulletin 1999/16

(51) Int. Cl.⁶: **F02D 11/10**

(21) Application number: **98117772.8**

(22) Date of filing: **18.09.1998**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **17.10.1997 JP 285442/97**

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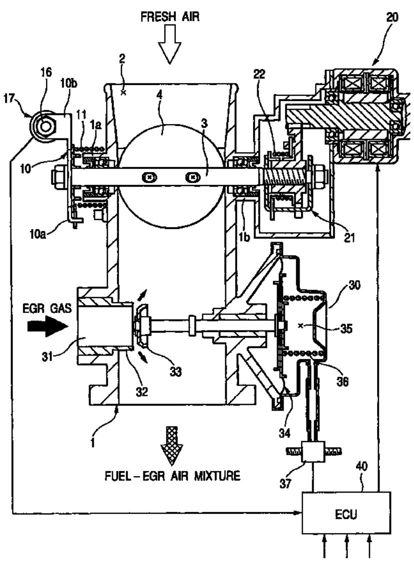
(54) Position controller

(57) A position controller comprising: a step motor (20) which drives an apparatus (4); a reference position detection device (17) which detects that said apparatus (4) is located at a reference position and outputs a reference position detection signal; and a control device (40) which, based on the reference position detection signal from said reference position detection device (17), controls said step motor (20) so as to control a position of said apparatus (4), wherein, when said apparatus (4) is moved and said reference position detection device (17) is to be adjusted, said control device (17) drives said step motor (20) by an angle smaller than the regular angle.

FIG. 1



Description

BACKGROUND OF INVENTION

[0001] The present invention relates to a position controller useful in, for example, an intake throttle device for an engine of the type in which a throttle valve for opening and closing an intake passage is driven by a step motor.

[0002] The configuration of an intake throttle device for a diesel engine will be described with reference to Figs. 1 and 2. Fig. 1 is a front section view of the device, and Fig. 2 is a left-side view.

[0003] The body 1 which is to be incorporated into an air intake system of a diesel engine has a substantially cylindrical shape. An intake passage 2 is formed in the body.

[0004] Bosses 1a and 1b are formed on the side walls of the body 1, respectively. A throttle shaft 3 is rotatably supported on the side walls via bearings fitted into the bosses 1a and 1b.

[0005] A throttle valve 4 which opens and closes the intake passage 2 is attached to the throttle shaft 3. As shown in Fig. 3, during a normal running state, the throttle valve 4 is opened and closed between the full-open position and the idling position, and, when the engine is to be stopped, set to be the full-close position where the closed state is further advanced than the idling position. A diesel engine is not particularly required to have an ignition device, and, when the engine once starts, continues to spontaneously operate. In order to surely stop the engine, therefor, it is preferable to interrupt both the fuel and the air. Consequently, when the engine is to be stopped, the throttle valve 4 is fully closed.

[0006] A lever 10 having an engaging piece 10a and an attachment piece 10b is fixed to a left end portion of the throttle shaft 3. A spring 11 is disposed between the engaging piece 10a and the body 1. The spring urges the lever 10 in the full-opening direction (in Fig. 2, in a counterclockwise direction) with respect to the body 1.

[0007] Two attachment projections 12 and 13 are formed on the lift side face of the body 1, and respectively in front and in rear of the engaging piece 10a of the lever 10. A full-opening stopper 14 is disposed on the front attachment projection 12, and a full-closing stopper 15 on the rear attachment projection 13. The full-opening stopper 14 abuts against the engaging piece 10a of the lever 10 which is indicated by a solid line in Fig. 2, so that the throttle valve 4 is stopped at a valve-opening limiting position (see the position indicated by a broken line in Fig. 2), thereby preventing the lever 10 from being further rotated in the valve-opening direction. The full-closing stopper 15 abuts against the engaging piece 10a of the lever 10 (see the position indicated by a solid line in Fig. 2), so that the throttle valve 4 is stopped at a valve-closing limiting position, thereby preventing the lever 10 from being further rotated in the valve-closing direction (in Fig. 2, in a clockwise direction). In each of the full-opening and full-closing stoppers 14 and 15, the position where the stopper abuts against the engaging piece 10a can be adjusted by means of a screw.

[0008] A switch pressing member 16 is attached to a tip end portion of the attachment piece 10b of the lever 10. A full-opening switch 17 for detecting that the throttle valve 4 is at the full-opening position is attached to the left side face of the body 1. The full-opening switch 17 supplies a full-opening position detection signal to a control device (hereinafter, referred to as "ECU") 40. The signal is turned ON or OFF when a detection end 17a of the full-opening switch is pressed by or released from the switch pressing member 16 in accordance with the opening or closing operation of the throttle valve 4 in the vicinity of the full-opening position. In the switch pressing member 16, the position where the member abuts against the detection end 17a of the full-opening switch 17 can be adjusted by means of a screw.

[0009] Fig. 5 shows relationships between the output signal of the full-opening switch 17 and the throttle opening of the throttle valve 4. When the throttle valve 4 is moved in the opening direction, the full-opening switch 17 is turned ON at a certain opening. The full-opening switch 17 is turned OFF at an opening where the throttle valve 4 is further closed by a certain degree from the opening where the full-opening switch 17 is turned ON. This is because the full-opening switch 17 has hysteresis. The degree of the hysteresis of the full-opening switch 17 varies depending on individuals and over time. Therefore, the judgment on the switch output must be unifiedly performed in either of the transition from OFF to ON or that of from ON to OFF. Hereinafter, it is assumed that the position where the switch output is changed from OFF to ON is used as the reference. The valve-closing limiting position of the throttle valve 4 and formed by the full-opening stopper 14 is set to a position where the dispersion of the ON-position of the full-opening switch 17 is absorbed.

[0010] The driving force of a step motor 20 serving as a driving device which drives the throttle valve 4 is coupled to the right end portion of the throttle shaft 3 via a power transmission device 21. The step motor 20 is controlled by the ECU 40.

[0011] The power transmission device 21 consists of a second spring 22 which urges the throttle shaft 3 in the valve-closing direction with respect to the body 1, gears, etc. The urging force of the second spring 22 is set to be stronger than that of the first spring 11 and smaller than the rotation torque due to the driving of the step motor 20. The urging force of the first spring 11 is set to be weaker than the stopping torque due to the detent torque of the step motor 20.

[0012] An EGR valve 30 of an EGR control device which controls the exhaust gas recirculation (hereinafter, referred to as "EGR") is incorporated into the downstream side of the throttle valve 4 of the body 1. The EGR valve 30 comprises a valve element 33 which opens and closes a valve seat 32 disposed in an end portion of an EGR gas passage 31 communicating with the intake passage 2. The valve is configured so that, when a negative pressure introduced into a negative pressure chamber 35 partitioned off by a diaphragm 34 is weaker than the urging force of a diaphragm spring 36, the valve element 33 is closed, and, when the negative pressure is stronger than the urging force, the valve element 33 is opened. The negative pressure chamber 35 is caused to communicate with the atmosphere or a negative pressure source by the switching operation of a negative pressure control valve 37 which is controlled by the ECU 40.

[0013] In the case where the valve element 33 is opened and the EGR gas passage 31 communicates with the intake passage 2, when the EGR gas is higher in pressure than the intake air (also called fresh air or suction air) flowing through the intake passage 2, the EGR gas flows into the intake passage 2 and then supplied in the form of a fuel-air mixture to the engine. When a large amount of the EGR gas is to be rapidly supplied to the engine, the throttle valve 4 is closed so that the pressure of the fresh air flowing through the intake passage 2 is lowered.

[0014] Fig. 4 is a block diagram of the ECU 40.

[0015] The ECU 40 comprises a CPU 44 to which the full-opening position detection signal is supplied from the full-opening switch 17 via an I/O interface 41, and to which an output signal from an accelerator sensor 19 for detecting the stepping amount of the accelerator is supplied via an I/O interface 42 and an A/D converter 43. A part of a RAM 47 is used as a motor counter 45 which indicates the current position of the step motor 20, in the form of a counted number (step number).

[0016] The CPU 44 converts the opening degree of the throttle valve 4 which corresponds to the output signal of the accelerator sensor 19, into the counted number of the motor counter 45, and supplies driving pulses to the step motor 20 via a driving circuit 48 so that the counted number of the motor counter 45 coincides with the converted counted number. At this time, the counted number of the motor counter 45 is increased or decreased in accordance with the rotation direction of the step motor 20 and the number of supplied driving pulses.

[0017] In the case where the step number of the step motor 20 which drives the throttle valve 4 is controlled on the basis of the counted number of the motor counter 45 as described above, the opening degree of the throttle valve 4 and the counted number may sometimes fail to coincide with each other. When the throttle valve 4 is located at the reference position, therefore, a process of initializing the motor counter 45 is performed (this is also called initialization).

[0018] When the step motor 20 is controlled so as to move the throttle valve 4 in the opening direction and it is detected by means of the full-opening switch 17 that the throttle valve 4 is located at the full-opening position, for example, the counted number of the motor counter 45 is initialized to zero. Specifically, the throttle valve 4 is moved in the opening direction until the full-opening switch 17 is turned ON, and the initializing process is performed with using the position where the full-opening switch 17 is turned ON, as the reference position.

[0019] In the case where, at the full-opening position, the counted number of the motor counter 45 is reset to zero, the counted number of the motor counter 45 indicates the step number from the full-opening position of the throttle valve 4.

[0020] In order to initialize the motor counter 45 at the full-opening position, the full-opening switch 17 must be adjusted during, for example, a step of incorporating the switch into the throttle body.

[0021] A conventional method of adjusting the full-opening switch 17 will be described with reference to a flowchart of Fig. 14 which shows the process of adjusting the full-opening switch. It is assumed that the switch is adjusted so that the state of the switch is changed from OFF to ON when the step is advanced from 67th step counted from the idling position to 68th step as shown in Fig. 15. An adjustment step number is used only in adjustment, and means a value which is zero, for example, at the idling position and increased when the throttle valve is moved in the opening direction. The adjustment step number is different from the step number in an actual control.

[0022] First, the step motor 20 is controlled and the throttle valve 4 is moved to the idling position (step 201). Thereafter, the adjustment step number is set to zero (step 202).

[0023] Next, the throttle valve 4 is opened to the position which precedes the ON-position of the full-opening switch 17 by one step, or to, for example, the position at 67 steps from the idling position in the opening direction (step 203).

[0024] It is then judged whether the full-opening switch 17 is OFF at this position or not (step 204).

[0025] If the full-opening switch 17 is ON, the full-opening switch 17 is adjusted so as to be turned OFF, by using the screw disposed on the switch pressing member 16 (step 205).

[0026] If the full-opening switch 17 is OFF, the control advances to step 206.

[0027] Next, the throttle valve 4 is opened to the ON-position of the full-opening switch 17, or to, in this example, the position at 68 steps from the idling position in the opening direction (step 206).

[0028] It is then judged whether the full-opening switch 17 is ON at this position or not (step 207).

[0029] If the full-opening switch 17 is OFF, the full-opening switch 17 is adjusted so as to be turned ON, by using the screw disposed on the switch pressing member 16 (step 208). Thereafter, the throttle valve is once closed to a position where the full-opening switch 17 is surely turned OFF irrespective of the hysteresis, or to, for example, a position in the vicinity of the 60th step

(step 209), and !he control returns to step 203 to repeat the process described above.

[0030] If the full-opening switch 17 is ON, the process is ended.

[0031] In the conventional method of adjusting the full-opening switch, as shown in Fig. 15, the switch pressing member 16 is adjusted so that the state of the full-opening switch 17 is changed from OFF to ON when the throttle valve 4 is moved from the position where the valve is moved by 67 steps from the idling position, to the position where the valve is moved by 68 steps. Even when the ON-position of the full-opening switch 17 is correctly adjusted in a step of incorporating the switch into the throttle body, therefore, the ON-position of the full-opening switch 17 may be displaced by wear of the full-opening switch 17 and the gears, and deterioration of parts. In such a case, it is often that the displaced position is erroneously judged as the full-opening position.

[0032] For example, the case as shown in Fig. 16 where the ON-position of the full-opening switch 17 is in the vicinity of the position where the valve is moved by 67 steps from the idling position will be considered. In such a case, even when the ON-position of the full-opening switch 17 is displaced by a very short distance in the closing direction by wear of the full-opening switch 17 or the like, the position which is separated from the original full-opening position by one step in the closing direction is judged as the full-opening position.

[0033] In another case as shown in Fig. 17 where the ON-position of the full-opening switch 17 is in the vicinity of the position where the valve is moved by 68 steps from the idling position, even when the ON-position of the full-opening switch 17 is displaced by a very short distance in the opening direction by wear of the full-opening switch 17 or the like, the position which is separated from the original full-opening position by one step in the opening direction is judged as the full-opening position.

SUMMARY OF INVENTION

[0034] Therefore, it is an object of the invention to provide a position controller and an intake throttle device for an engine in which the occurrence frequency of displacement of the detection of the reference position caused by displacement of the ON-position of a switch due to wear or deterioration of parts or the like can be suppressed to a minimum degree, thereby preventing the control performance from being lowered.

[0035] In order to attain objects, the invention provide with a position controller comprises: a step motor which drives an apparatus; a reference position detection device which detects that the apparatus is located at a reference position and outputs a reference position detection signal; and a control device which, based on the reference position detection signal from the reference position detection device, controls the step motor, thereby controlling a position of the apparatus, when the apparatus is moved and the reference position detection device is to be adjusted, the control device drives the step motor by a minute angle.

[0036] When the position controller set forth is used, the reference position detection device is adjusted while the step motor is driven by a minute angle or by a step moving amount which is smaller than that in normal driving. Therefore, the occurrence frequency of displacement of the detection of the reference position due to deterioration or wear of parts or the like can be suppressed to a minimum degree, thereby preventing the control performance from being lowered.

[0037] Moreover, in the position controller set forth above, the control device drives the step motor by a minute angle in a minute range which is at a substantially center portion of a movement range of the apparatus where the reference position detection device outputs the reference position detection signal during normal driving.

[0038] When the position controller set forth is used, the reference position detection device is adjusted while the step motor is driven by a minute angle in a minute range which is at a substantially center portion of a movement range of the apparatus where the reference position detection device outputs the reference position detection signal during normal driving. Therefore, the occurrence frequency of displacement of the detection of the reference position due to deterioration or wear of parts or the like can be further suppressed to a minimum degree.

[0039] Another asepect of the invention, there is provided with an intake throttle device for an engine and comprising a throttle valve which opens and closes an intake passage of the engine, the position controller described above used as a position controller for the throttle valve.

[0040] When the intake throttle device for an engine set forth above, the reference position detection device is adjusted while the step motor is driven by a minute angle or by a step moving amount which is smaller than that in normal driving. Therefore, the occurrence frequency of displacement of the detection of the reference position due to deterioration or wear of parts or the like can be suppressed to a minimum degree, thereby preventing the control performance from being lowered.

[0041] Furthermore, in the intake throttle device for an engine set forth above, the reference position detection device detects a full-open position of the throttle valve, as the reference position.

[0042] When the intake throttle device for an engine set forth above is used, a general-purpose switch which has a small detection stroke and the production cost of which is low can be used as the reference position detection device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0043]

Fig. 1 is a front section view of an intake throttle device for a diesel engine;
Fig. 2 is a left-side view of Fig. 1;
Fig. 3 is a diagram illustrating moving positions of a throttle valve;
Fig. 4 is a block diagram of a control device;
Fig. 5 is a timing chart showing relationships between an output signal of a full-opening switch and the throttle opening;
Fig. 6 is a diagram illustrating the adjustment process of a reference position detection device in the invention;
Fig. 7 is a diagram illustrating the minute-angle driving method;
Fig. 8 is a diagram illustrating the minute-angle driving method;
Fig. 9 is a view illustrating the minute-angle driving method;
Fig. 10 is a view illustrating the minute-angle driving method;
Fig. 11 is a diagram illustrating the minute-angle driving method;
Fig. 12 is a view illustrating the minute-angle driving method;
Fig. 13 is a flowchart illustrating the adjustment process of a reference position detection device in the invention;
Fig. 14 is a flowchart illustrating the adjustment process of a reference position detection device in the conventional art;
Fig. 15 is a diagram illustrating the adjustment process of a reference position detection device in the conventional art;
Fig. 16 is a diagram illustrating a case where the detection position of the reference position detection device is displaced;
Fig. 17 is a diagram illustrating a case where the detection position of the reference position detection device is displaced; and
Fig. 18 is a characteristic graph showing relationships between the opening degree of a throttle and an intake amount.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0044] Hereinafter, an embodiment of the invention will be described with reference to the accompanying drawings.

[0045] In the invention, as shown in Fig. 6, the amount by which, when one pulse is supplied to the step motor 20 during a normal operation, the step motor 20 and hence the throttle valve 4 are moved (hereinafter, such an amount is referred to as "step movement amount") is finely divided, and the step motor 20 and hence the throttle valve 4 are driven by the minute angle which is obtained as a result of the fine division. In the figure, the step movement amount in a normal operation is divided into seven equal parts. The minute-angle movement is performed by using a step movement amount which is one seventh of the step movement amount in a normal operation. The number of divisions can be arbitrarily set.

[0046] The full-opening switch 17 is adjusted so that the state of the full-opening switch 17 is changed from OFF to ON in an arbitrary minute angle range between the position where the valve is moved by 67 steps from the idling position in the opening direction and that where the valve is moved by 68 steps, or, in the figure, during the period when the valve is moved from the position P where the valve is moved by 67 and 3/7 steps to the position Q where the valve is moved by 67 and 4/7 steps, i.e., in a minute angle range which is substantially center between the position where the valve is moved by 67 steps from the idling position in the opening direction and that where the valve is moved by 68 steps.

[0047] According to this configuration, even when the position where the state of the full-opening switch 17 is changed from OFF to ON is displaced because of occurrence of wear of the full-opening switch 17 and the gears, deterioration of parts, or the like, the possibility that the displacement falls outside the range from the position where the valve is moved by 67 steps from the idling position and that where the valve is moved by 68 steps is small.

[0048] The method of driving the step motor 20 by a minute angle includes the duty driving method, the dual-power source method, the external-resistor method, etc.

[0049] According to the duty driving method, in a two-phase step motor having phase-A and phase-B power sources such as shown in Fig. 7, for example, the phase-A and phase-B power sources are subjected to a duty-control (in which the ratio of the power supply time in a period T, i.e., the duty ratio is controlled) as shown in Fig. 8.

[0050] In the method, as shown in Fig. 9, the step movement amount from the one-phase excitation state of phase A in which the duty ratio of the phase-A power source is 100% and that of the phase-B power source is 0%, to the one-phase excitation state of phase B in which the duty ratio of the phase-A power source is 0% and that of the phase-B power source is 100% is finely divided into minute angular movement amounts by changing the duty ratios of the phase-A and phase-B power sources (for example, A_1% to A_6% and B_1% to B_6%).

[0051] According to the dual-power source method, in a two-phase step motor having phase-A and phase-B power sources such as shown in Fig. 7, for example, the voltages of the phase-A and phase-B power sources are changed.

[0052] In the method, as shown in Fig. 10, the step movement amount from the one-phase excitation state of phase A in which the voltage of the phase-A power source is 12 V and that of the phase-B power source is 0 V, to the one-phase excitation state of phase B in which the voltage of the phase-A power source is 0 V and that of the phase-B power source is 12 V is finely divided into minute angular movement amounts by changing the voltages of the phase-A and phase-B power sources (for example, A_1 V to A_6 V and B_1 V to B_6 V).

[0053] According to the external-resistor method, in a two-phase step motor having external resistors for phase-A and phase-B such as shown in Fig. 11, for example, the values of the external resistors for phase-A and phase-B are changed.

[0054] In the method, as shown in Fig. 12, the step movement amount from the one-phase excitation state of phase A in which the external resistor for phase-A is 0Ω and that of the phase-B power source is ∞Ω, to the one-phase excitation state of phase B in which the external resistor for phase-A is ∞Ω and that of the phase-B power source is 0Ω is finely divided into minute angular movement amounts by changing the external resistors for phase-A and phase-B (for example, A_1 Ω to A_6 Ω and B_1 Ω to B_6 Ω).

[0055] Next, a method of adjusting the full-opening switch in the invention will be described with reference to a flowchart of Fig. 13.

[0056] First, the step motor 20 is controlled and the throttle valve 4 is moved to the idling position (step 101). Thereafter, the adjustment step number is set to zero (step 102).

[0057] Next, the throttle valve 4 is opened to the position at the 67 and 3/7 steps from the idling position in the opening direction (step 103).

[0058] It is then judged whether the full-opening switch 17 is OFF at this position or not (step 104).

[0059] If the full-opening switch 17 is ON, the full-opening switch 17 is adjusted so as to be turned OFF, by using the screw disposed on the switch pressing member 16 (step 105).

[0060] If,the full-opening switch 17 is OFF, the control advances to step 106.

[0061] Next, the throttle valve 4 is opened to the position at 67 and 4/7 steps (step 106).

[0062] It is then judged whether the full-opening switch 17 is ON at this position or not (step 107).

[0063] If the full-opening switch 17 is OFF, the full-opening switch 17 is adjusted so as to be turned ON, by using the screw disposed on the switch pressing member 16 (step 108). Thereafter, the throttle valve is once closed to a position where the full-opening switch 17 is surely turned OFF irrespective of the hysteresis, or to, for example, a position in the vicinity of the 60th step (step 109), and the control returns to step 103 to repeat the process described above.

[0064] If the full-opening switch 17 is ON, the process is ended.

[0065] The process of initializing the motor counter 45 after the full-opening switch 17 is adjusted in this way will be described.

[0066] When the engine is to be started, the initializing process is commenced at the same time when the ignition switch of the engine is turned ON.

[0067] First, it is detected whether the full-opening switch 17 is ON or OFF. If the switch is ON, the valve is once closed until the switch is turned OFF. When the full-opening switch 17 is turned OFF, the throttle valve 4 is moved from this position in the opening direction.

[0068] At the position where the full-opening switch 17 is turned ON, the counted value of the motor counter 45 at this timing is set to zero.

[0069] Next, the step-out judgment of the motor counter 45 during the operation of the engine will be described. The step-out judgment is a judgment on whether the motor is operating without stepping out with respect to the initial value at the ignition-ON operation or not. For example, it is judged whether, when the throttle valve is moved to the full-opening position, the state of the switch is changed from OFF to ON or not. If it is detected as a result of the step-out judgment that the motor is normal, the control is continued as it is. If an abnormality is detected, a process of eliminating the abnormality is performed by, for example, executing again the initialization process.

[0070] The reason why the above-described process is performed in the full-opening state will be described. The relationships between the opening degree of the throttle valve 4 (the throttle opening) and the necessary intake amount of the diesel engine are shown in the characteristic graph of Fig. 18. As shown in Fig. 18, the necessary intake amount (necessary air amount) at a certain number of revolutions of the engine is attained at a valve opening of 50 degrees. Even when the throttle valve 4 is opened or closed in the opening range X in which the opening is not smaller than 50 degrees, i.e., the opening range of 50 to 80 degrees, the intake amount is little changed and the engine is hardly affected. As the number of revolutions of the engine is lower, the necessary intake amount is smaller, and, as the number of revolutions of the engine is higher, the necessary intake amount is larger. Therefore, the opening range X in which, even when the throttle valve 4 is opened or closed, the intake amount is little changed is wider as the number of revolutions of the engine is lower, and narrower as the number of revolutions of the engine is higher. In a range of 70 to 80 degrees within the opening range X, even when the throttle valve 4 is opened or closed, the intake amount is little changed irrespective of the number of revolutions of the engine, and the operation of the engine hardly disturbed. This range is called the high-opening range H.

[0071] During an operation of the engine, when the opening of the throttle valve 4 enters the opening range X in which the necessary intake amount of the diesel engine is satisfied, the step motor 20 is controlled so that the throttle valve 4 is located at the full-opening position in the high-opening range H. When the step-out judgment is performed at this time, even a special movement of the throttle valve which is conducted in the step-out judgment does not impose any effect on the engine. Therefore, the step-out judgment can be conveniently performed. In order to detect that the opening of the throttle valve 4 enters the opening range X in which the necessary intake amount is satisfied, for example, a map of the number of revolutions of the diesel engine, the fuel injection amount, and the opening of the throttle valve is previously prepared, and the judgment is performed on the basis of the map.

[0072] By contrast, when the engine is to be stopped, the step motor 20 is controlled so that the throttle valve 4 is moved from the idling position to the full-close position, and it is then judged whether the engine is stopped or not.

[0073] If the engine is stopped, the throttle valve is moved in the opening direction.

[0074] When the full-opening switch 17 is then turned ON, the power supply to the step motor 20 is stopped.

[0075] In this way, when the engine is to be stopped, the power supply to the step motor 20 is stopped under state where the throttle valve 4 is located in the vicinity of the position where the state of the full-opening switch 17 is changed from ON to OFF or vice versa. When the engine is to be next started, therefore, it is possible to rapidly initialize the motor counter 45.

[0076] As the reference position detection device which detects that the throttle valve is located at the reference position, the full-opening switch which detects that the throttle valve is located at the full-open position is used. According to this configuration, it is not required to use a switch or the like having a special structure which has a large detection stroke and in which, for example, detection is performed while using an intermediate position of the opening and closing strokes of the throttle valve as the reference position. A general-purpose switch which has a small detection stroke and the production cost of which is low can be used as the device.

[0077] In the embodiment, the position where the state of the full-opening switch is changed from OFF to ON is used as the reference position. Alternatively, the position where the state of the full-opening switch is changed from ON to OFF may be used as the reference position. In the alternative, also the adjustment is performed the position where the state of the switch is changed from OFF to ON.

[0078] The reference position detection device is not restricted to a mechanical switch, and various kinds of detection devices such as an optical switch may be used.

[0079] The reference position which is to be detected by the reference position detection device is not restricted to the full-open position. An arbitrary position may be selected as far as it is in the high-opening range H of the throttle valve. In this case, the process of initializing the motor counter is performed in accordance with the selected reference position.

[0080] In the above, the embodiment in which a reference position detection device of an intake throttle device for a diesel engine is adjusted has been described. The invention can be applied to also an intake throttle device for an engine other than a diesel engine, and also the reference position can be suitably changed.

[0081] In the above, the embodiment in which the invention is applied to a position controller for a throttle valve of an intake throttle device has been described. The invention can be applied to also a position controller for various kinds of apparatuses other than a throttle valve.

[0082] As described above, when the position controller set forth in claim 1 is used, the occurrence frequency of displacement of the detection of the reference position due to deterioration or wear of parts or the like can be suppressed to a minimum degree, thereby preventing the control performance from being lowered.

[0083] When the position controller set forth in claim 2 is used, the occurrence frequency of displacement of the detection of the reference position due to deterioration or wear of parts or the like can be further suppressed to a minimum degree.

[0084] When the intake throttle device for an engine set forth in claim 3 is used, the occurrence frequency of displacement of the detection of the reference position due to deterioration or wear of parts or the like can be suppressed to a minimum degree, thereby preventing the control performance from being lowered.

[0085] When the intake throttle device for an engine set forth in claim 4 is used, a general-purpose switch which has a small detection stroke and the production cost of which is low can be used as the reference position detection device.

[0086] A position controller comprising: a step motor (20) which drives an apparatus (4); a reference position detection device (17) which detects that said apparatus (4) is located at a reference position and outputs a reference position detection signal; and a control device (40) which, based on the reference position detection signal from said reference position detection device (17), controls said step motor (20) so as to control a position of said apparatus (4), wherein, when said apparatus (4) is moved and said reference position detection device (17) is to be adjusted, said control device (17) drives said step motor (20) by an angle smaller than the regular angle.

Claims

1. A position controller comprising:

a step motor (20) which drives an apparatus

(4);

a reference position detection device (17) which detects that said apparatus (4) is located at a reference position and outputs a reference position detection signal; and

a control device (40) which, based on the reference position detection signal from said reference position detection device (17), controls said step motor (20) so as to control a position of said apparatus (4), wherein, when said apparatus (4) is moved and said reference position detection device (17) is to be adjusted, said control device (40) drives said step motor (20) by an angle smaller than the regular step angle.

2. The position controller according to claim 1, wherein said control device (40) drives said step motor (20) by an agnel smaller than the regular step angle in a minute range which is at a substantially center portion of a movement range of said apparatus (4) where said reference position detection device (17) outputs the reference position detection signal during normal driving.

3. An intake throttle device for an engine, comprising:

a throttle valve (4) which opens and closes an intake passage (2); and

a position controller for said throttle valve, comprising,

a step motor (20) which drives said throttle valve (4),

a reference position detection device (17) which detects that said throttle valve (4) is located at a reference position and outputs a reference position detection signal; and

a control device (40) which, based on the reference position detection signal from said reference position detection device (17), controls said step motor (20) so as to control a position of said throttle valve (4), wherein, when said throttle valve (4) is moved and said reference position detection device (17) is to be adjusted, said control device (40) drives said step motor (20) by an angle smaller than the regular step angle.

4. The intake throttle device for an engine according to claim 3, wherein said reference position detection device (17) detects a full-open position of said throttle valve (4) as the reference position.

5. The intake throttle device for an engine according to claim 3, wherein said control device (40) drives said step motor (20) by an angle smaller than the regular step angle in a minute range which is at a substantially center portion of a movement range of said throttle valve (4) where said reference position detection device (17) outputs the reference position detection signal during normal driving.

6. The intake throttle device for an engine according to claim 5, wherein said reference position detection device (17) detects a full-open position of said throttle valve (4) as the reference position.

FIG. 1

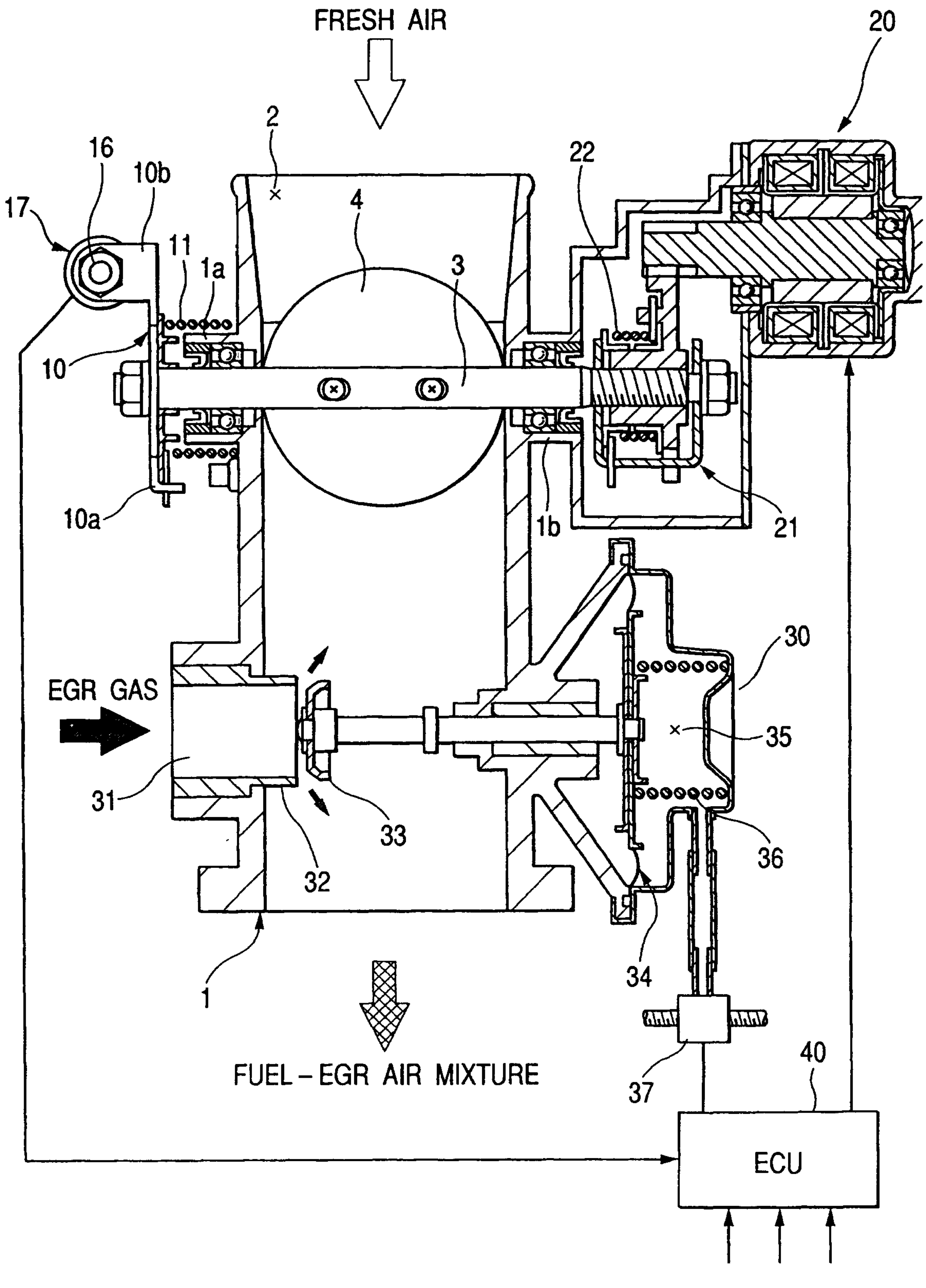

FRESH AIR
20
2
22
16
10b
17
4
11
1a
3
10
10a
1b
21
30
EGR GAS
35
31
33
36
32
34
1
37
40
FUEL-EGR AIR MIXTURE
ECU

FIG. 2

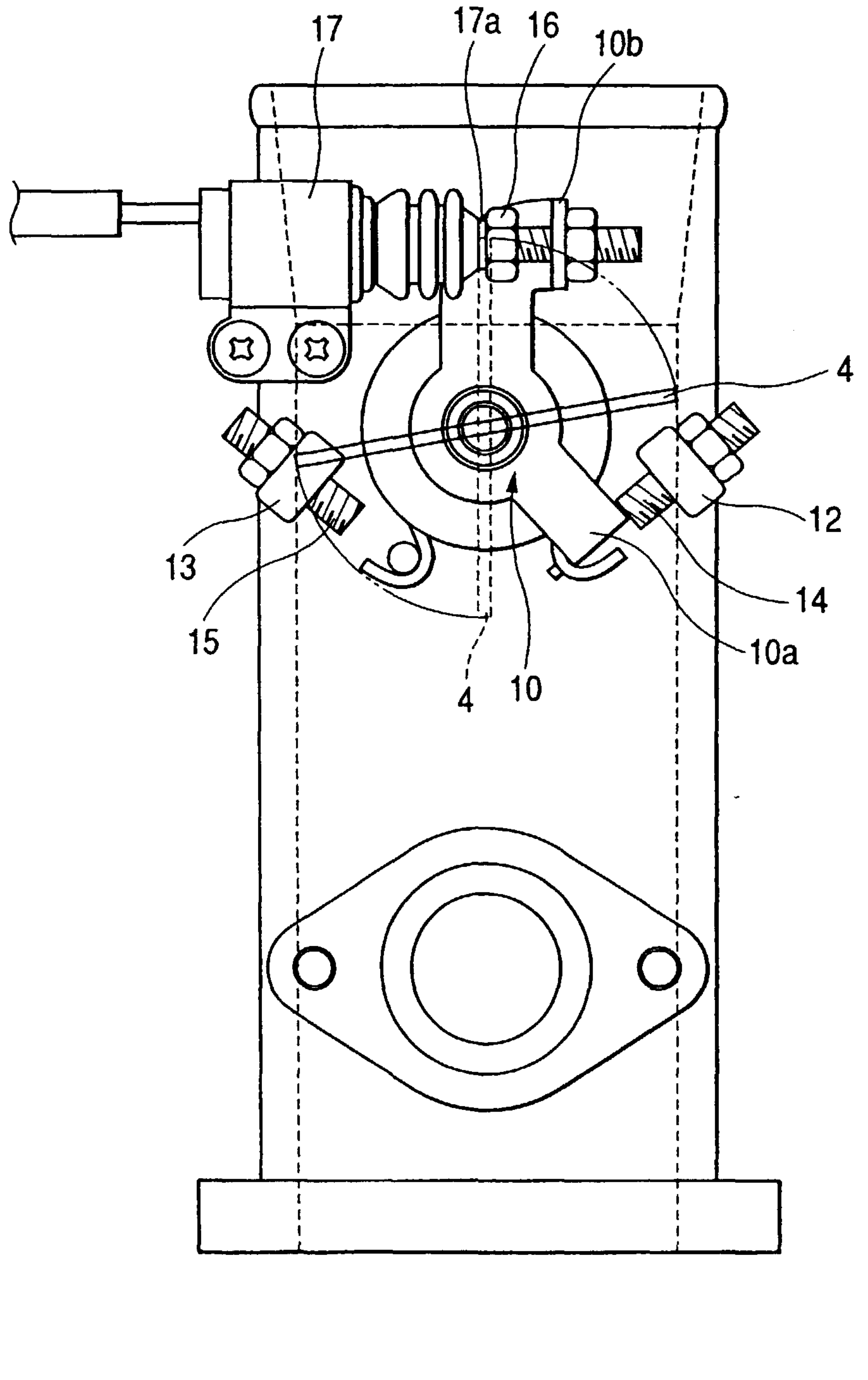


FIG. 3

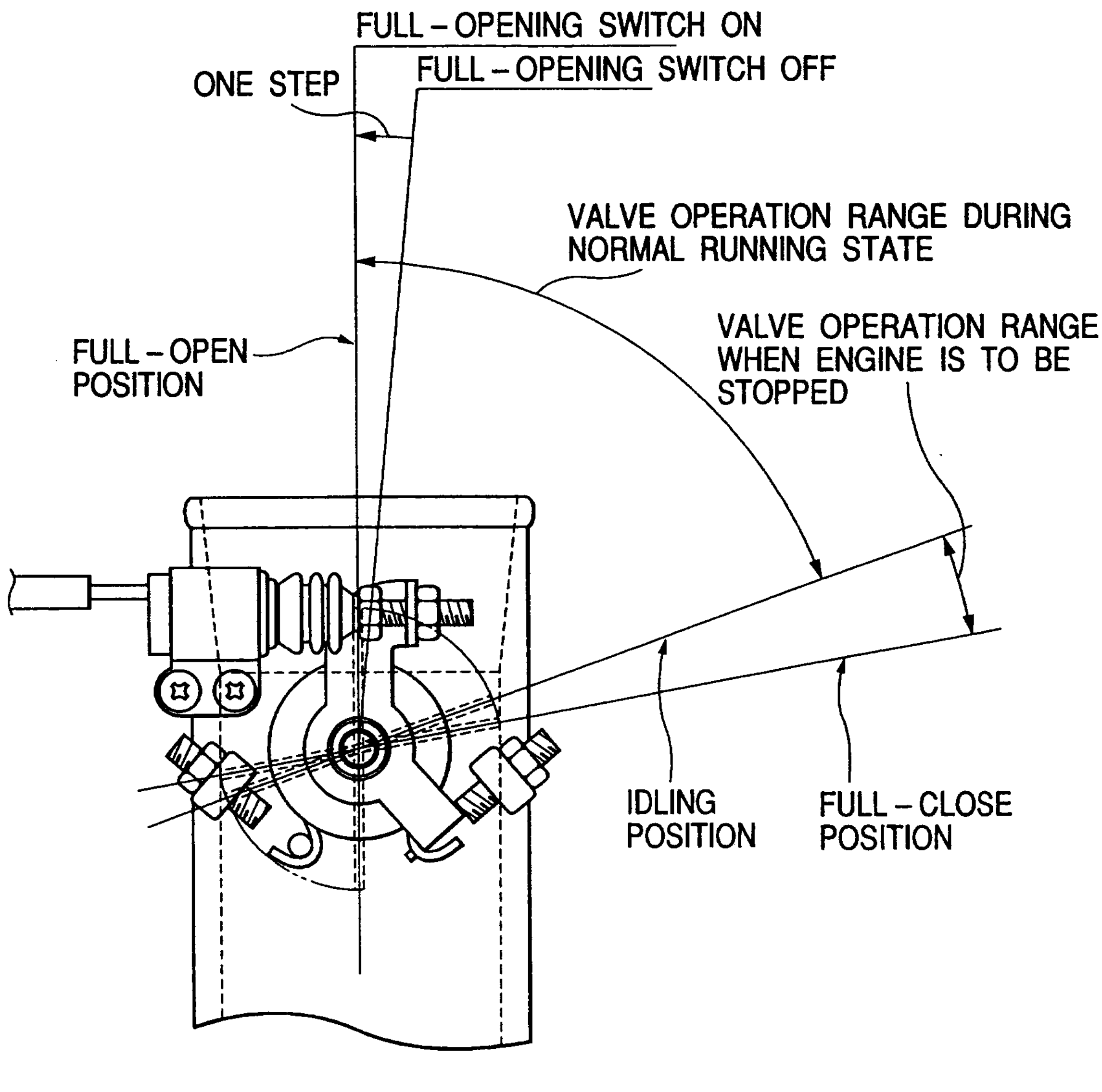

FULL-OPENING SWITCH ON
ONE STEP
FULL-OPENING SWITCH OFF
VALVE OPERATION RANGE DURING NORMAL RUNNING STATE
FULL-OPEN POSITION
VALVE OPERATION RANGE WHEN ENGINE IS TO BE STOPPED
IDLING POSITION
FULL-CLOSE POSITION

FIG. 4

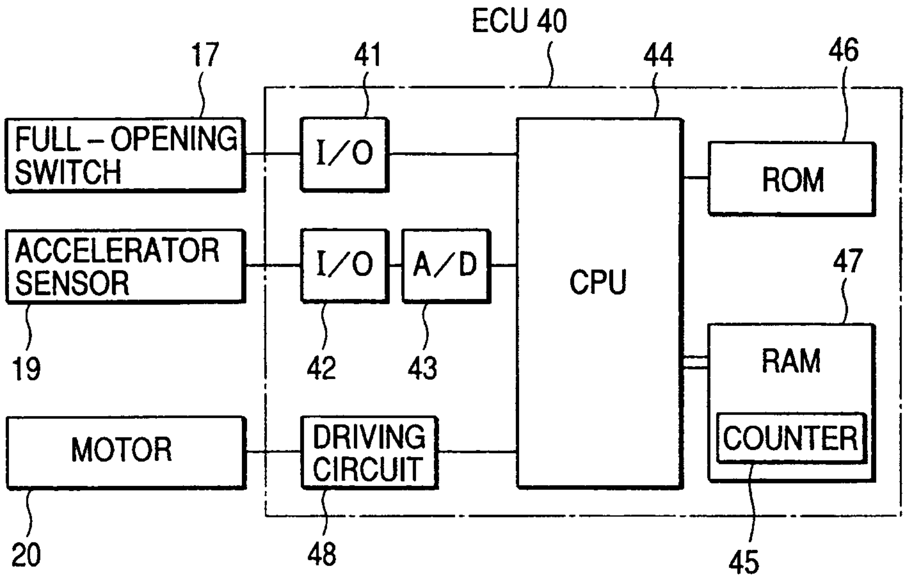

ECU 40
17
41
44
46
FULL-OPENING SWITCH
I/O
ROM
ACCELERATOR SENSOR
I/O
A/D
CPU
47
RAM
19
42
43
MOTOR
DRIVING CIRCUIT
COUNTER
20
48
45

FIG. 5

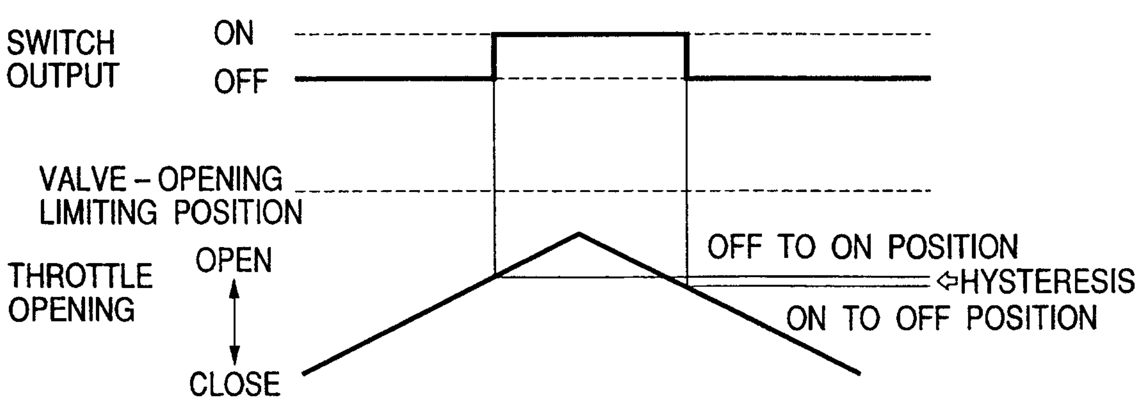

SWITCH OUTPUT
ON
OFF
VALVE-OPENING LIMITING POSITION
THROTTLE OPENING
OPEN
CLOSE
OFF TO ON POSITION
HYSTERESIS
ON TO OFF POSITION

FIG. 6

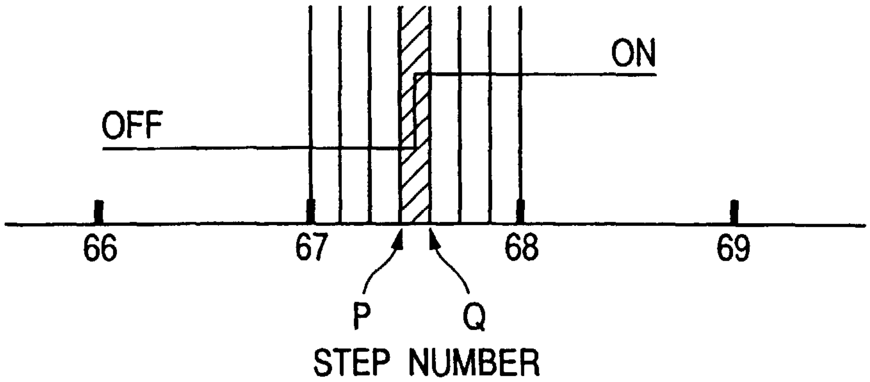


FIG. 7

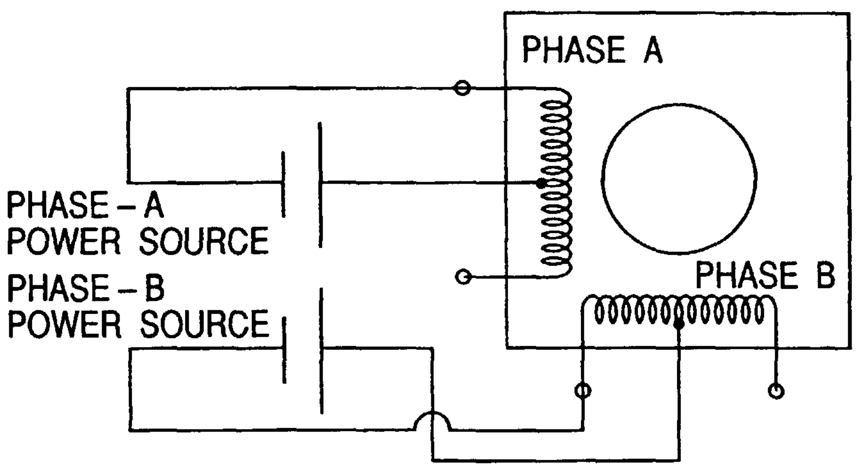


FIG. 8

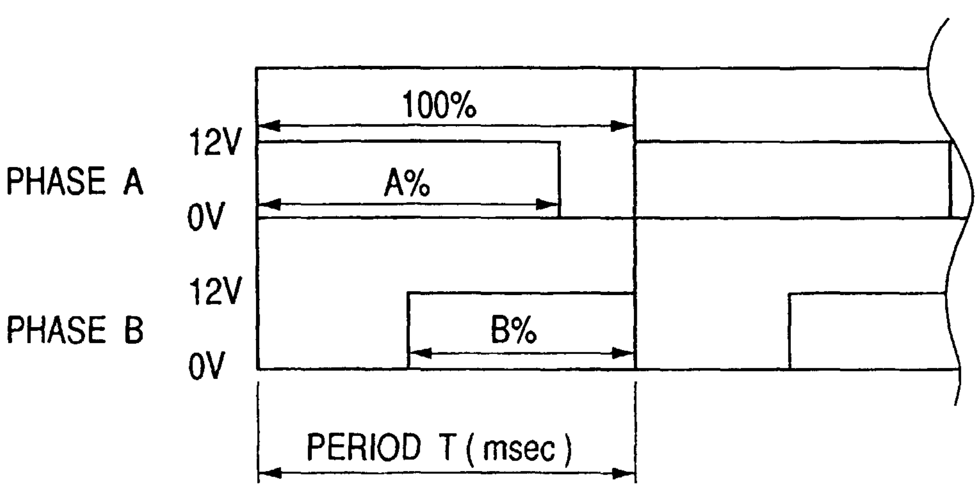


FIG. 9

STEP NUMBER OF MINUTE-ANGLE DRIVING	POWER SUPPLY TIME IN ONE PERIOD	
	PHASE A	PHASE B
0	T	O
1	$T \times A_1\%$	$T \times B_1\%$
∫	∫	∫
6	$T \times A_6\%$	$T \times B_6\%$
7	O	T

FIG. 10

STEP NUMBER OF MINUTE-ANGLE DRIVING	POWER SOURCE	
	VOLTAGE OF PHASE A	VOLTAGE OF PHASE B
0	12V	OV
1	A_1V	B_1V
∫	∫	∫
6	A_6V	B_6V
7	OV	12V

FIG. 11

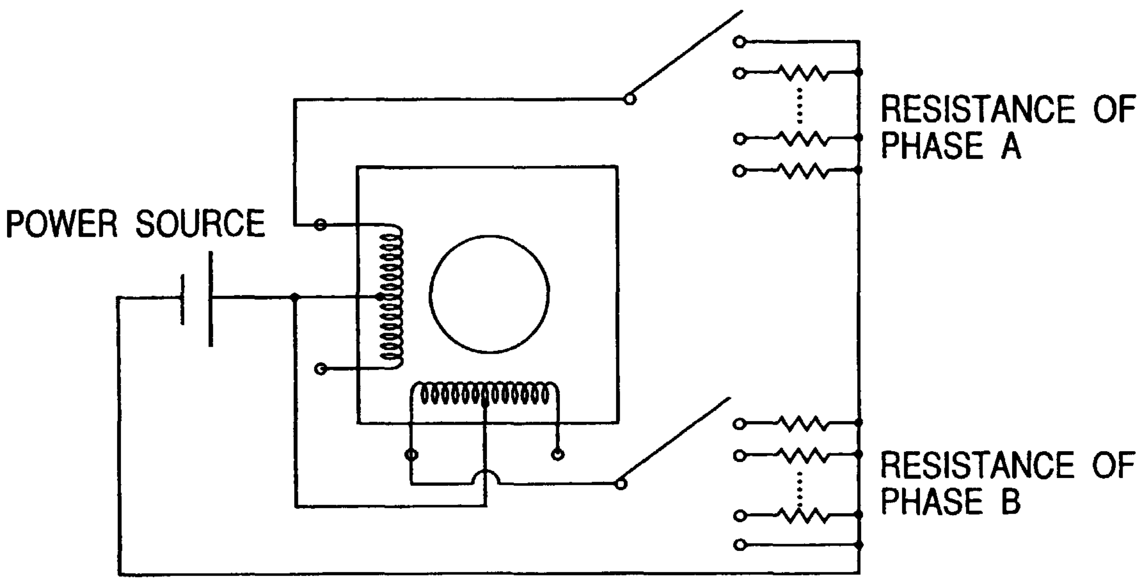


FIG. 12

STEP NUMBER OF MINUTE-ANGLE DRIVING	EXTERNAL RESISTANCE	
	PHASE A	PHASE B
0	0Ω	∞Ω
1	A_1Ω	B_1Ω
∫	∫	∫
6	A_6Ω	B_6Ω
7	∞Ω	0Ω

FIG. 13

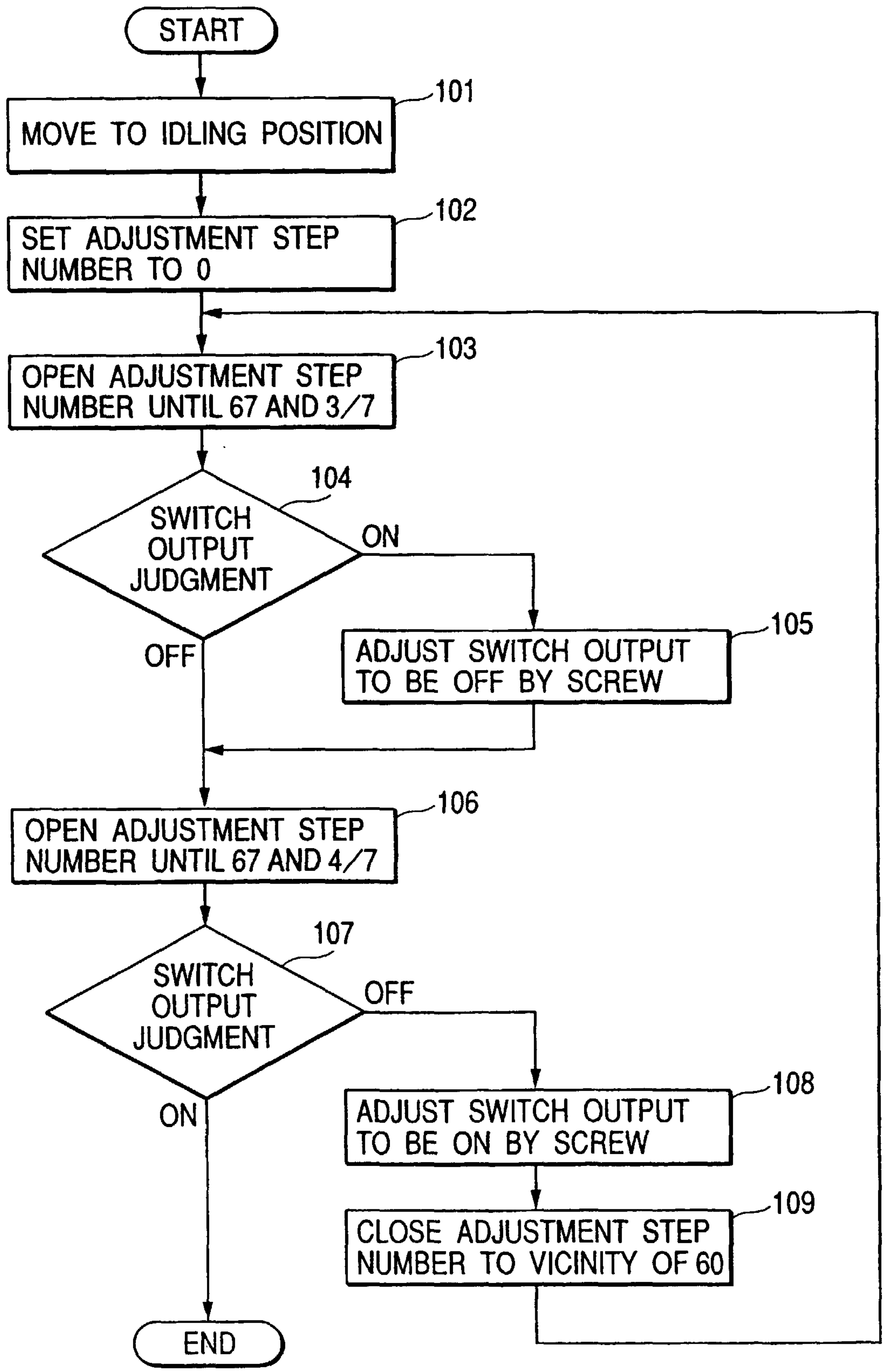

START
MOVE TO IDLING POSITION
101
SET ADJUSTMENT STEP NUMBER TO 0
102
OPEN ADJUSTMENT STEP NUMBER UNTIL 67 AND 3/7
103
SWITCH OUTPUT JUDGMENT
104
ON
OFF
ADJUST SWITCH OUTPUT TO BE OFF BY SCREW
105
OPEN ADJUSTMENT STEP NUMBER UNTIL 67 AND 4/7
106
SWITCH OUTPUT JUDGMENT
107
OFF
ON
ADJUST SWITCH OUTPUT TO BE ON BY SCREW
108
CLOSE ADJUSTMENT STEP NUMBER TO VICINITY OF 60
109
END

FIG. 14

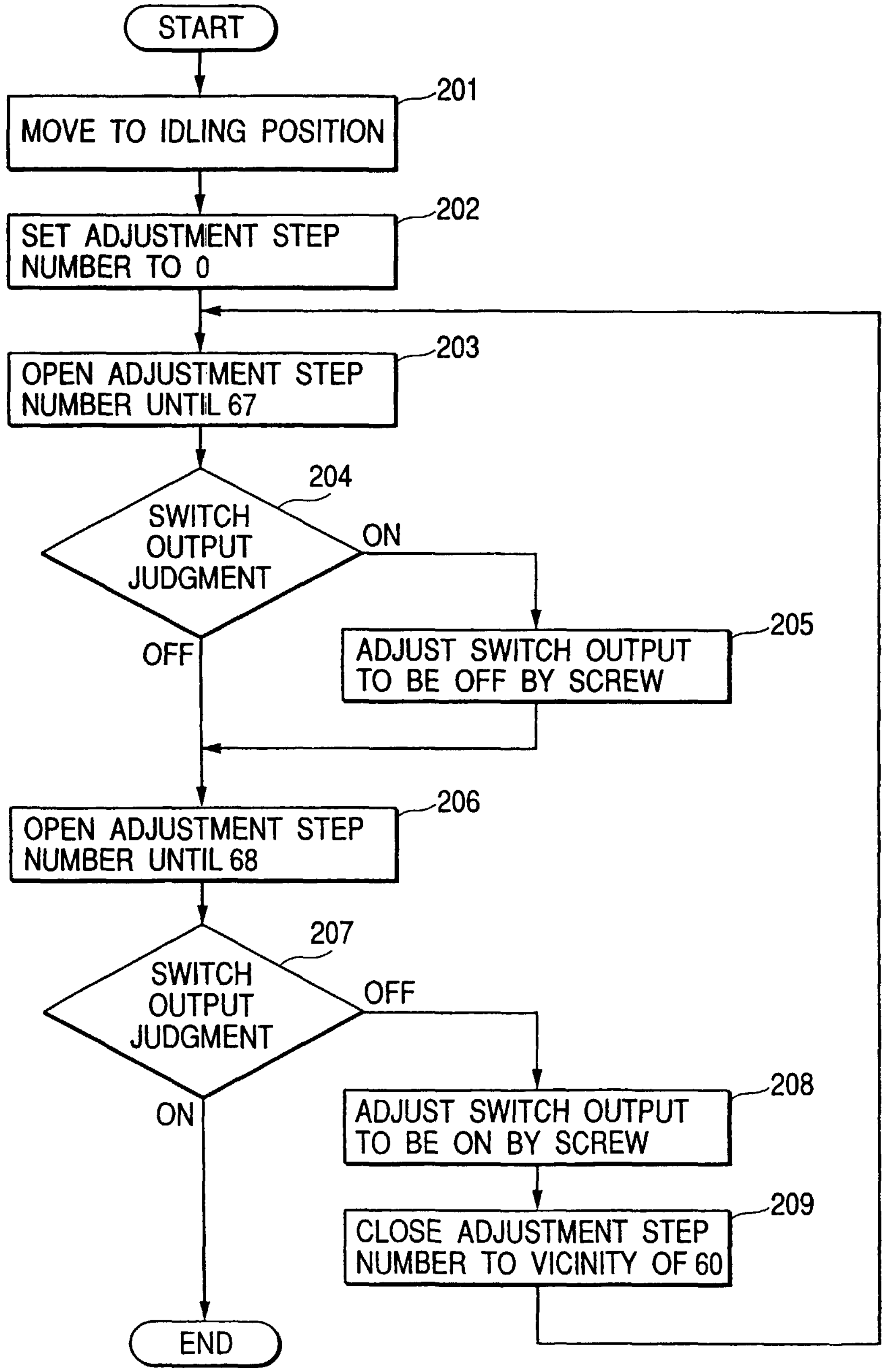

START
MOVE TO IDLING POSITION
201
SET ADJUSTMENT STEP NUMBER TO 0
202
OPEN ADJUSTMENT STEP NUMBER UNTIL 67
203
SWITCH OUTPUT JUDGMENT
204
ON
OFF
ADJUST SWITCH OUTPUT TO BE OFF BY SCREW
205
OPEN ADJUSTMENT STEP NUMBER UNTIL 68
206
SWITCH OUTPUT JUDGMENT
207
OFF
ON
ADJUST SWITCH OUTPUT TO BE ON BY SCREW
208
CLOSE ADJUSTMENT STEP NUMBER TO VICINITY OF 60
209
END

FIG. 15

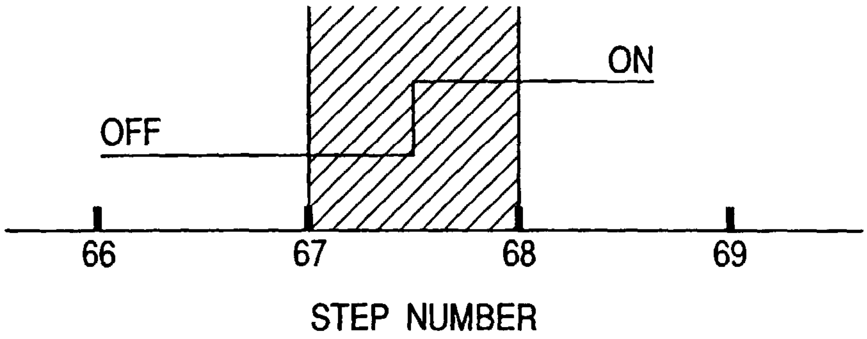


FIG. 16

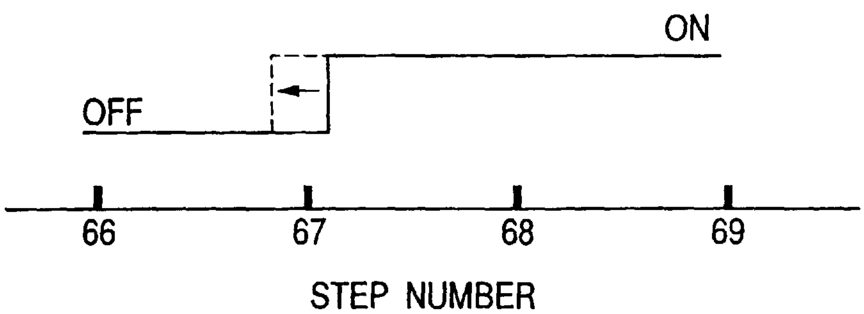


FIG. 17

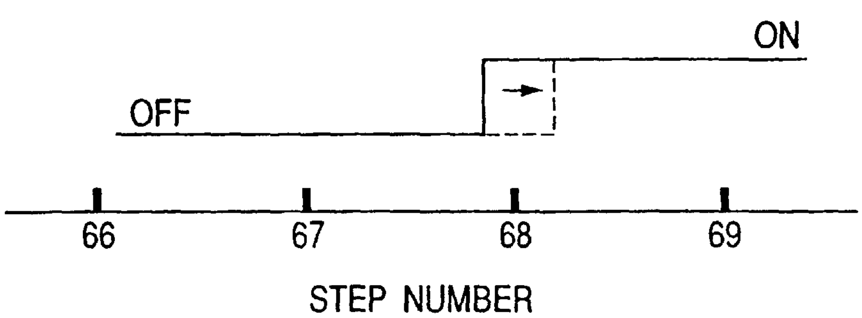
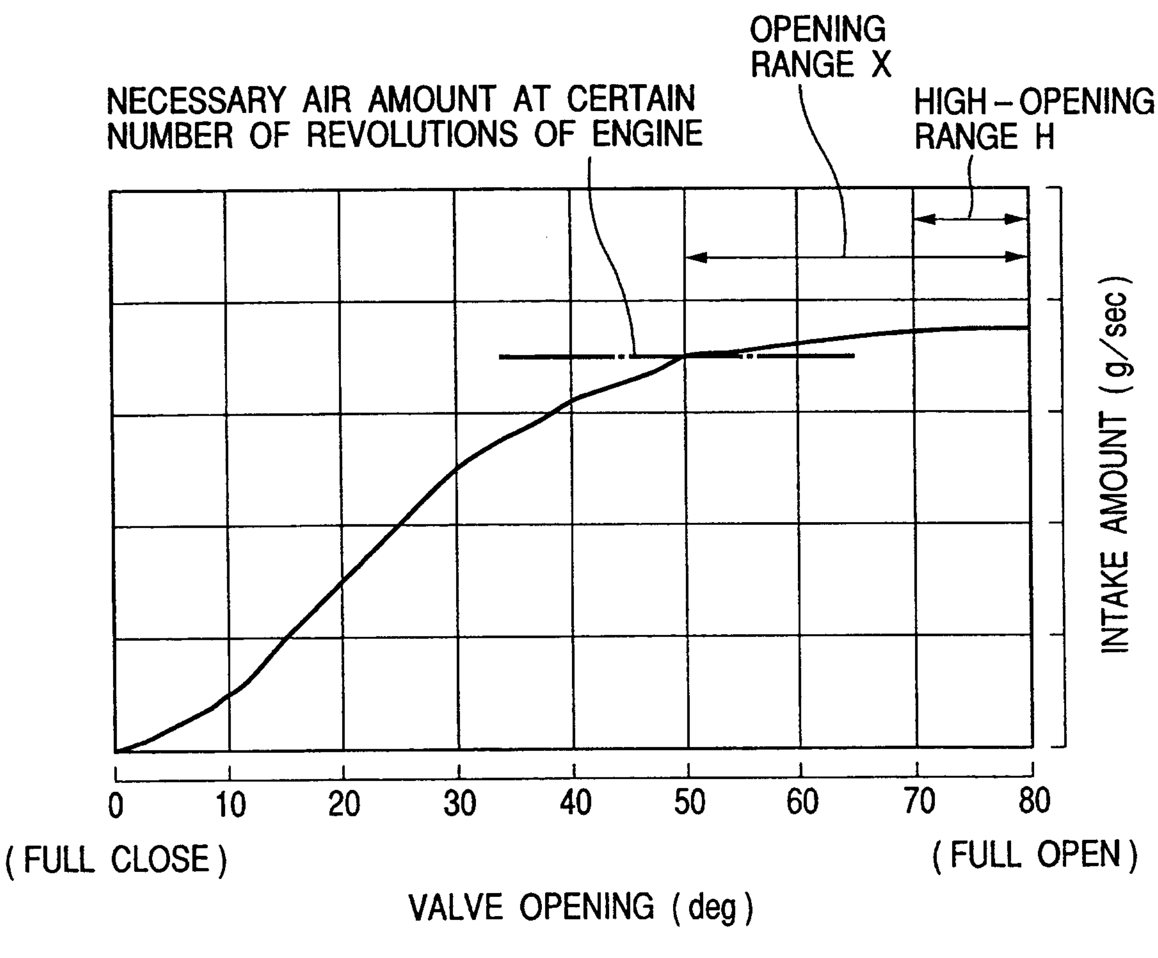


FIG. 18


OPENING
RANGE X
NECESSARY AIR AMOUNT AT CERTAIN
NUMBER OF REVOLUTIONS OF ENGINE
HIGH-OPENING
RANGE H
INTAKE AMOUNT (g/sec)
0
10
20
30
40
50
60
70
80
(FULL CLOSE)
(FULL OPEN)
VALVE OPENING (deg)