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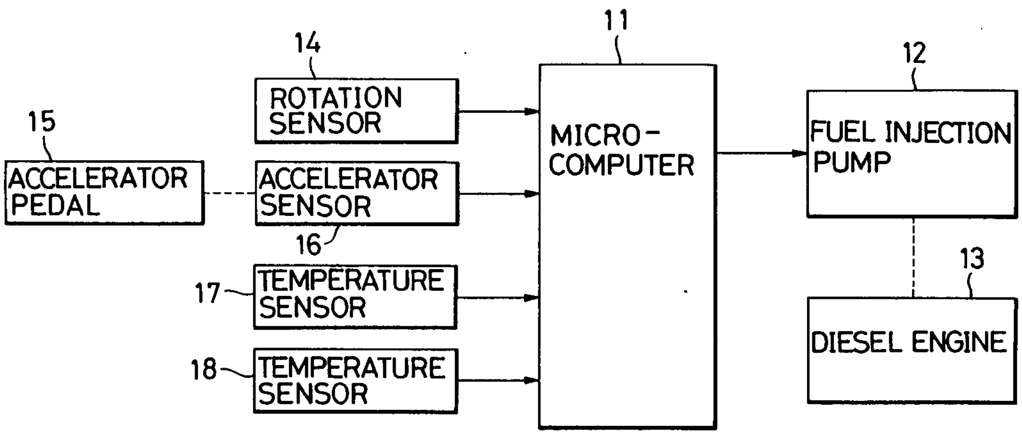
(54) Fuel supply control device for internal combustion engine of vehicle.

(57) When the amount of pressing-down of an accelerator pedal (15) is abruptly changed, the amount of supply of fuel to an internal combustion engine (13) is restrained. When a change (ΔQ_I) of a primary target amount (Q_I) of supply of fuel corresponding to the amount of pressing-down of the accelerator pedal exceeds a predetermined threshold value (α_0, α_1), a secondary target amount (Q_D), which is restrained in change, is calculated. The secondary target amount (Q_D) is determined such that it is changed by a change amount (K_1, K_2, $K_3 \cdot Q_{Dn-1}$) corresponding to its own amount.

Fig.1



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BACKGROUND OF THE INVENTION

This invention relates to a fuel supply control device for an internal combustion engine of a vehicle.

Generally speaking, in a fuel supply control device for an internal combustion engine of a vehicle, the amount of supply of fuel is determined in accordance with the amount of pressing-down of an accelerator pedal and the speed of rotation of an internal combustion engine. This control device has the following shortcomings. For example, when the accelerator pedal is abruptly pressed down in an idling condition, the amount of supply of fuel is abruptly increased from a level of very small amount. As a result, surging is generated during the abrupt increase of engine speed and/or black smoke is generated. On the contrary, when the accelerator pedal is abruptly released, the engine brake works excessively. As a result, the vehicle speed is abruptly decreased.

In a control device disclosed in Japanese Patent Publication No. 51664/84, when a reducing amount (amount reduced per unit time) of a target amount of supply of fuel is not less than a predetermined limit value, the target amount of supply of fuel is reduced by a reducing amount coincident with this limit value. In this control device, since the limit value is constant, the engine brake does not work well when the limit value is comparatively small, but the engine brake works excessively when the limit value is comparatively large.

In the control device disclosed in Japanese Patent Publication No. 61013/91, when the change of the amount of pressing-down of the accelerator pedal per unit time exceeds a predetermined limit value, the amount of pressing-down is corrected such that it is changed by a change amount coincident with the limit value, and the amount of supply of fuel is controlled in accordance with such corrected amount of pressing-down. In this control device, it is not apparent how the change of the amount of supply of fuel is finally restrained. If it is presumed that the amount of supply of fuel is linear to the amount of pressing-down of the accelerator pedal, this control device has the following shortcomings. That is, when the amount of supply of fuel is increased, if the limit value of the amount of pressing-down of the accelerator pedal is large, the restraining effect of change becomes weak. As a result, the above generation of surging and black smoke can not be prevented completely. On the contrary, if the limit value is small, the generation of surging and black smoke can be prevented but the acceleration performance of the vehicle is jeopardized. When the amount of supply of fuel is reduced, those shortcomings as had by the Japanese Patent Publication No. 51664/84 are arisen.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a fuel supply control device for an internal combustion engine of a vehicle which is capable of carefully carrying out a change retaining procedure of the amount of supply of fuel in accordance characteristic of the internal combustion engine.

According to the present invention, there is provided a fuel supply control device for an internal combustion engine of a vehicle comprising:

(a) first calculation means for calculating a primary target amount (Q_I) of supply of fuel to an internal combustion engine in accordance with information including an amount of pressing-down of an accelerator (15) and speed of rotation of the internal combustion engine (13);

(b) change amount judgment means (205, 217) for judging whether or not a change (ΔQ_I) of the primary target amount per unit time is larger than a predetermined threshold value (α_0, α_1);

(c) second calculation means (207, 208, 213, 214, 219, 223) including change restraint means (208, 213, 214, 219, 223) for carrying out a change restraining procedure for obtaining a secondary target amount (Q_D) when a result of judgment made by the change amount judgment means is affirmative, the secondary target amount being more restrained in change than the primary target amount, and target amount coincidence means (207) for obtaining a secondary target amount (Q_D) coincident with the primary target amount when the result of judgment made by the change amount judgment means is negative; and

(d) fuel supply means (12) for supplying fuel to the internal combustion engine (13) in accordance with the secondary target amount,

CHARACTERIZED in that the change restraint means (208, 213, 214, 219, 223) includes means (213, 214, 223) for changing the secondary target amount (Q_D) by a change amount (K_1, K_2, $K_3 \cdot Q_{Dn-1}$) corresponding to the secondary target amount (Q_D).

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing a general construction of a fuel supply control device according to the present invention for an internal combustion engine of a vehicle;

Fig. 2 is a flow chart showing a routine for controlling a fuel injection;

Fig. 3 is a flow chart showing the detail of a subroutine for calculating a secondary target amount of Fig. 2;

Fig. 4 is a graph showing a primary target amount and a secondary target amount of fuel injection when an accelerator pedal is abruptly pressed down;

Fig. 5 is likewise a graph showing a primary target amount and a secondary target amount of fuel injection when an accelerator pedal is abruptly released;

Fig. 6 is a graph, similar to Fig. 4, but showing a modified example; and

Fig. 7 is a graph, similar to Fig. 5, but showing a further modified example.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention will be described hereinafter with reference to the accompanying drawings.

As shown in Fig. 1, a fuel supply control device for a diesel engine includes a microcomputer 11. A signal representative of rotation of an output shaft of a diesel engine 13 or rotation of a cam shaft of a fuel injection pump 12 connected to this output shaft is inputted into the microcomputer 11 from a rotation sensor 14. Also, a signal representative of an amount of pressing-down of an accelerator pedal 15 is inputted into the microcomputer 11 from an accelerator sensor 16. Furthermore, signals representative respectively of the temperature of fuel and the temperature of cooling water for engine are also inputted into the microcomputer 11 from temperature sensors 17 and 18. The microcomputer 11 calculates the speed of rotation of the engine 13 in accordance with the signal from the rotation sensor 14, further calculates target fuel injection amounts required from time to time in accordance with the rotation speed, the amount of pressing-down of the accelerator pedal, the temperature of fuel, and the temperature of cooling water of engine, and then controls an actuator (not shown) of the fuel injection pump 12 so that fuel is injected by the target fuel injection amounts. The fuel injected from the fuel injection pump 12 is supplied to the diesel engine 13.

The microcomputer 11 exercises the routine of Fig. 2 for controlling fuel injection. The routine of Fig. 2 is executed at predetermined intervals of time (for example, 10msec.).

First, in Subroutine 100, a primary target amount Q_I of injection of the fuel is calculated in accordance with the speed of rotation of the engine 13 and the amount of pressing-down of the accelerator pedal 15. In the next Subroutine 101, a secondary target amount Q_D is calculated in accordance with the primary target amount Q_I. In the next Subroutine 102, a maximum fuel injection amount Q_F corresponding to the speed of rotation of the engine 13 is calculated. In the next Subroutine 103, the secondary target amount Q_D is corrected. That is, in the case of $Q_D < Q_F$, the secondary target amount Q_D is not corrected, and in the case of $Q_D \geqq Q_F$, the secondary target amount Q_D is brought into a value which is in agreement with the maximum fuel injection amount Q_F. In the next Subroutine 104, the secondary target amount Q_D is corrected in accordance with the temperature of fuel, the temperature of cooling water of the engine 13, etc. In the next Subroutine 105, a target position of the actuator of the fuel injection pump 12 corresponding to the corrected secondary target amount Q_D is calculated, and a control signal relating to this target position is outputted to a drive circuit for the actuator. By doing so, the corrected secondary target amount of fuel is injected to the diesel engine 13 from the fuel injection pump 12.

A calculation of the secondary target amount Q_D will be roughly described with reference to Figs. 4 and 5. In the case where the accelerator pedal 15 is abruptly pressed down for acceleration, as shown in Fig. 4, the primary target amount Q_I is abruptly increased in response to the amount of pressing-down of the accelerator pedal 15. The secondary target amount Q_D is obtained by restraining the change of the primary target amount Q_I. For this change restraining procedure, a predetermined upper limit value Q_{Xmax} and a predetermined reference value Q_{Xth} lower than the upper limit value are set. For example, when the primary target amount Q_I is going to increase abruptly to Q_2 from the injection amount Q_1 in an idly operating condition by pressing down the accelerator pedal 15, the secondary target amount Q_D is subjected to a radical change restraining procedure until the secondary target amount Q_D is brought to the reference value Q_{Xth}. In other words, the secondary target amount Q_D is increased by a small change amount K_1 per unit time between the injection amount Q_1 and the reference value Q_{Xth}. When the secondary target amount Q_D exceeds the reference value Q_{Xth}, it is subjected to a gentle change restraining procedure. In other words, the secondary target amount Q_D is increased by a comparatively large change amount K_2 per unit time. When the secondary target amount Q_D reaches the upper limit value Q_{Xmax}, the secondary target amount Q_D is increased up to the primary target amount Q_I or Q_2 at a dash.

As described above, when the amount of injection of the fuel is lower than the reference value Q_{Xth}, it is subjected to the change restraining procedure by the small change amount K_1 and therefore, the generation of black smoke and surging can be positively prevented. On the contrary, when the amount of injection of the fuel exceeds the reference value Q_{Xth}, it is subjected to the change restraining procedure by the comparatively large amount K_2 and therefore, the acceleration performance can be prevented from being lowered. At this time, even if the amount of injection of the fuel is subjected to the gentle change restraining procedure, the generation of black smoke and surging can be prevented. The reason is that in the area where the amount of injection of the fuel is large, even if the amount of injection of the fuel is abruptly increased, the amount of generation of black smoke becomes less and a possibility of generation of surging becomes small. When the amount of injection of the fuel exceeds the predetermined upper value Q_{Xmax}, the amount of injection of the fuel is increased at a dash and therefore, a satisfactory acceleration performance can be obtained.

On the other hand, when the accelerator pedal 15 is abruptly released for speed reduction, as shown in Fig. 5, the primary target amount Q_I is abruptly reduced in response to the amount of pressing-down of the accelerator pedal. The secondary target amount Q_D can be obtained by restraining the change of the primary target amount Q_I. For this change restraining procedure, a predetermined upper limit value Q_{Ymax} and a predetermined lower limit value Q_{Ymin} are set. For example, reference is made to a case where the primary target amount Q_I is reduced to Q_4 (smaller than the lower limit value Q_{Ymin}) from Q_3 (larger than the upper limit value Q_{Ymax}). The change restraining procedure is not carried out until the primary target amount Q_I is brought to the upper limit value Q_{Ymax}. When the primary target amount Q_I goes below Q_{Ymax}, the change restraining procedure is carried out. In this change restraining procedure, the change restraining procedure becomes gradually more radical as the secondary target amount Q_D is reduced. In other words, the change amount per unit time becomes gradually smaller as the secondary target amount Q_D is reduced. When the amount of injection of the fuel becomes smaller than the lower limit value Q_{Ymin}, the change restraining procedure is not carried out, and the secondary target amount Q_D is brought into agreement with the primary target amount Q_I (namely, the injection amount Q_4).

As described above, since the change restraining procedure is not carried out until the amount of injection of the fuel reaches the upper limit value Q_{Ymax}, a favorable engine brake can be effected. When the amount of injection of the fuel goes below the upper limit value Q_{Ymax}, the change restraining to the amount of injection of the fuel is gentle first and therefore, the engine brake works comparatively favorably. Since the change restraining procedure becomes more radical as the amount of injection of the fuel becomes smaller, a possible shock to the driver caused by abrupt speed reduction can be eased.

Next, the Subroutine 101 for calculating the secondary target amount Q_D will be described in detail with reference to Fig. 3. The reference characters Q_I and Q_D each with a lower suffix "n" represent a primary target amount and a secondary target amount, respectively, which are calculated in this routine, while the reference characters Q_I and Q_D each with a lower suffix "n-1" represent a primary target amount and a secondary target amount, respectively, which are calculated in the preceding routine.

In Step 200, it is judged whether a flag F_0 is set or cleared. If it is judged that the flag F_0 is cleared, the program goes to Step 201 where it is judged whether or not a flag F_1 is set. If the flag F_1 is cleared, the program proceeds to Step 202. The flag F_0 indicates a fact that the increasing target amount is being subjected to a change restraining procedure, while the flag F_1 indicates another fact that the reducing target amount is being subjected to a change restraining procedure.

In Step 202, it is judged whether or not $\Delta Q_I \geqq 0$. Here, $\Delta Q_I = Q_{In} - Q_{In-1}$, and ΔQ_I represents a change of the primary target amount Q_I per unit time. Therefore, when the primary target amount Q_I is remained unchanged or is being increased, the judgment is made in the affirmative in Step 202, and when the primary target amount Q_I is being reduced, the judgment is made in the negative.

Reference is made first to the case where the primary target amount Q_I is being increased. In this case, the judgment is made in the affirmative in Step 202, and the program proceeds to Step 203 where it is judged whether or not the speed of rotation of the engine 13 is equal to or lower than a predetermined rotation speed N_0. If the result of judgment is negative, the flag F_0 is cleared in Step 206, and the secondary target amount Q_{Dn} is brought into agreement with the primary target amount Q_{In}. In other words, the change restraining procedure is not carried out. The reason is that when the rotation speed N of the engine 13 is larger than the rotation speed N_0, black smoke and surging are not generated even if the amount of injection of the fuel is abruptly increased. The rotation speed N_0 is determined through testing.

If the result of judgment is affirmative in Step 203, the program proceeds to Step 204 where it is judged whether or not the primary target amount Q_{In} of this time is smaller than the upper limit value Q_{Xmax}. If the result of judgment is negative, the above Steps 206 and 207 are executed, and the change restraining procedure is not carried out. The reason is that when the fuel injection amount is equal to Q_{Xmax} or more, black smoke and surging are not generated even if the amount of injection of the fuel is abruptly increased. The upper limit value Q_{Xmax} is determined through testing.

If the result of judgment is affirmative in Step 204, the program proceeds to Step 205 where it is judged whether or not the above change amount ΔQ_I is equal to a predetermined threshold value α_0 or more. If the result of judgment is negative (that is, it is judged that the change amount ΔQ_I is smaller than the threshold value α_0), the above Steps 206 and 207 are executed, and the change restraining procedure is not carried out. This threshold value α_0 is determined through testing, too.

When the accelerator pedal 15 is abruptly pressed down under the conditions that the engine speed N is equal to N_0 or less and the primary target amount Q_I is smaller than the upper limit value Q_{Xmax}, the judgment is made in the affirmative in Steps 202, 203, 204 and 205, and therefore, the program proceeds to Step 208 where the secondary target amount Q_{Dn} is calculated in accordance with the following equation.

$$Q_{Dn} = Q_{In-1} + K_1$$

Here, K_1 represents a constant change amount which is determined within a range satisfying $0 < K_1 < \alpha_0$ through testing. As a result of this calculation, the secondary target amount Q_{Dn} becomes a smaller value than the primary target amount Q_{In}. In other words, the change restraining procedure is started.

In the next step 209, it is judged whether or not the secondary target amount Q_{Dn} is equal to the upper limit value Q_{Xmax} or less. In the routine where the above Step 208 is executed, the judgment is of course made in the affirmative. If the result of judgment is affirmative in Step 209, the program proceeds to Step 210 where it is judged whether or not $Q_{Dn} \geqq Q_{In}$ is satisfied. In the routine where the above Step 208 is executed, the judgment is of course made in the negative in Step 210, and the program proceeds to Step 211 where the flag F_0 is set. Then, the program proceeds to the above Subroutine 102 of Fig. 2.

In the Subroutine 101 which is to be executed next, the judgment is made in the affirmative in Step 200, and the program proceeds to Step 212 where it is judged whether or not the secondary target amount Q_{Dn-1} of last time is smaller than the reference value Q_{Xth}. Here, the reference value Q_{Xth} is determined, through testing, taking into consideration the acceleration performance of the engine 13, and the generation of black smoke and surging. If the result of judgment is affirmative in Step 212, the program proceeds to Step 213. In Step 213, the secondary target amount Q_{Dn} of this time is obtained in accordance with the following equation.

$$Q_D = Q_{Dn-1} + K_1$$

The change amount K_1 is the same one as the change amount K_1 in the Step 208. If the result of judgment is negative in Step 212, the program proceeds to Step 214. In Step 214, the secondary target amount Q_{Dn} of this time can be obtained by the following equation.

$$Q_{Dn} = Q_{Dn-1} + K_2$$

Here, K_2 represents a change amount, and $K_1 < K_2 < \alpha_0$ is satisfied.

After the Step 213 or 214 is executed, the above-mentioned judgment of Step 209 or 210 is made. When the secondary target amount Q_{Dn} exceeds the upper limit value Q_{Xmax} during the change retaining procedure, the judgment is made in the negative in Step 209 to finish the change retaining procedure. Then, the flag F_0 is cleared in Step 206, and the secondary target amount Q_{Dn} is increased up to the primary target amount Q_{Dn} at a dash. When the secondary target amount Q_{Dn} reaches the primary target amount Q_{In} during the change retaining procedure, the judgment is made in the affirmative in Step 210 to finish the change retaining procedure, and the steps 206 and 207 are executed.

Next, close reference is made to the case where the amount of injection of the fuel is reduced. In this case, the judgment is made in the negative in Step 202, and the program proceeds to Step 215 where it is judged whether or not the rotation speed N of the engine is equal to the predetermined rotation speed N_1 or less. If the result of judgment is negative, the flag F_1 is cleared in Step 218, and the primary target amount Q_{In} is brought into agreement with the secondary target amount Q_{Dn}. In other words, the change retaining procedure is not carried out. The reason is that when the rotation speed N of the engine 13 is larger than the rotation speed N_1, the abrupt speed reduction of the vehicle caused by engine brake can be avoided even if the amount of injection of the fuel is abruptly reduced. The rotation speed N_1 is determined through testing.

If the result of judgment is affirmative in Step 215, the program proceeds to Step 216 where it is judged whether or not the primary target amount Q_{In} of this time is smaller than the upper limit value Q_{Ymax}. If the result of judgment is negative, the above steps 218 and 207 are executed, and the change retaining procedure is not carried out. The reason is that when the amount of injection of the fuel is equal to Q_{Ymax} or more, the abrupt speed reduction of the vehicle caused by engine brake can be avoided even if the amount of injection of the fuel is abruptly reduced. The upper limit value

Q_{Ymax} is determined through testing.

If the result of judgment is affirmative in Step 216, the program proceeds to Step 217 where it is judged whether or not an absolute value $|\Delta Q_I|$ of the above change amount ΔQ_I is equal to or more than the predetermined threshold α_1. If the result of judgment is negative (that is, it is judged that the absolute value of the change amount ΔQ_I is smaller than the threshold value α_1), the above Steps 218 and 207 are executed and the change retaining procedure is not carried out. This threshold value α_1 is determined through testing, too.

When the accelerator pedal 15 is abruptly released under the conditions that the engine speed N is equal to N_1 or less and the primary target amount Q_I is smaller than the upper limit value Q_{Ymax}, the judgments are made in the affirmative in Steps 215, 216 and 217, and therefore the program proceeds to Step 219 where the secondary target amount Q_{Dn} is calculated in accordance with the following equation.

$$Q_{Dn} = (1-K_3) \cdot Q_{In-1}$$

Here, K_3 represents a constant value satisfying the following expressions.

$$0 < K_3 < 1$$

$$|Q_{In} - Q_{In-1}| = K_3 \cdot Q_{In-1} < \alpha_1$$

The larger the primary target amount is, the larger the change amount $K_3 \cdot Q_{In-1}$ becomes, and the smaller the primary target amount is, the smaller the change amount $K_3 \cdot Q_{In-1}$ becomes. In this way, the change retaining procedure is started.

In the next Step 220, it is judged whether or not the secondary target amount Q_{Dn} of this time is larger than the lower limit value Q_{Ymin}. If the result of judgment is affirmative, the program proceeds to Step 221 where it is judged whether or not $Q_{Dn} \leqq Q_{In}$ is satisfied. If the result of judgment is negative, the flag F_1 indicating that the change retaining is undergoing is set in Step 222.

In Subroutine 101 which is to be executed next, the judgment is made in the affirmative in Step 201 and therefore, the program proceeds to Step 223 where the secondary target amount Q_{Dn} of this time is calculated in accordance with the following equation.

$$Q_{Dn} = (1 - K_3) \cdot Q_{Dn-1}$$

Here, K_3 is the same one as K_3 in the Step 219. As apparent from this equation, the secondary target amount Q_D is reduced each time the Step 223 is executed at the predetermined interval of time, and this reduction amount per predetermined time interval is gradually reduced as the secondary target amount Q_D becomes smaller.

After the Step 223 is executed, the judgments of the above Steps 220 and 221 are made. When the secondary target amount Q_{Dn} goes below the lower limit value Q_{Ymin} during the change retaining procedure, the judgment is made in the negative in Step 220 to finish the change retaining procedure, and the flag F_0 is cleared in Step 218, and the secondary target amount Q_{Dn} is brought down to the primary target amount Q_{In} at a dash in Step 207. When the secondary target amount Q_{Dn} reaches the primary target amount Q_{In} during the change retaining procedure, the judgment is made in the affirmative in Step 221 to finish the change retaining procedure, and then Steps 218 and 207 are executed.

As shown in Fig. 6, in the change retaining procedure during the increase of the amount of injection of the fuel, the secondary target amount Q_D may be calculated such that the change amount per unit time is gradually increased as the secondary target amount Q_D is increased.

As shown in Fig. 7, in the change retaining procedure during the reduction of the amount of injection of the fuel, the predetermined change amount K_3 may be used when the secondary target amount Q_D is more than the reference value Q_{Yth}, and the change amount K_4 may be used when the secondary target amount Q_D is equal to the reference value Q_{Yth} or less. K_4 is smaller than K_3.

The present invention is not limited to the above embodiment, and various modifications can be made without departing from the scope of the claims. For example, the change amount may be determined in accordance with the secondary target amount and the engine speed.

In the case where the amount of injection of the fuel is in a generally linear relation to the amount of pressing-down of the accelerator pedal under the condition that the engine speed is constant, the amount of the pressing-down of the accelerator pedal may be subjected to the change retaining procedure, and the amount of injection of the fuel may be calculated in accordance with this amount of pressing-down of the accelerator pedal subjected to the change restraining procedure. In this case, the detection of the amount of the pressing-down of the accelerator pedal corresponds substantially to the calculation of the primary target amount of injection of the fuel in the above embodiment, the comparison between the the change of the amount of pressing-down of the accelerator pedal and the threshold value corresponds to the comparison between the change of the primary target amount and the threshold value in the above embodiment, and the calculation of the corrected amount of pressing-down of the accelerator pedal including the change retaining procedure of the amount of pressing-down of the accelerator pedal corresponds to the calculation of the secondary target amount in the above embodiment. In this case, the smaller the amount of the pressing-down of the accelerator pedal is, the smaller the change of the amount of pressing-down of the accelerator pedal becomes, and the larger the amount of the pressing-down of the accelerator pedal is, the larger the change of the amount of pressing-down of the accelerator pedal becomes.

The present invention can be likewise applied to, for example, a fuel supply control device for a gasoline engine.

Claims

1. A fuel supply control device for an internal combustion engine of a vehicle comprising:

(a) first calculation means for calculating a primary target amount (Q_I) of supply of fuel to an internal combustion engine in accordance with information including an amount of pressing-down of an accelerator (15) and speed of rotation of the internal combustion engine (13);

(b) change amount judgment means (205, 217) for judging whether or not a change (ΔQ_I) of said primary target amount per unit time is larger than a predetermined threshold value (α_0, α_1,);

(c) second calculation means (207, 208, 213, 214, 219, 223) including change restraint means (208, 213, 214, 219, 223) for carrying out a change restraining procedure for obtaining a secondary target amount (Q_D) when a result of judgment made by said change amount judgment means is affirmative, said secondary target amount being more restrained in change than said primary target amount, and target amount coincidence means (207) for obtaining a secondary target amount (Q_D) coincident with said primary target amount when the result of judgment made by said change amount judgment means is negative; and

(d) fuel supply means (12) for supplying fuel to said internal combustion engine (13) in accordance with said secondary target amount,

CHARACTERIZED in that said change restraint means (208, 213, 214, 219, 223) includes means (213, 214, 223) for changing said secondary target amount (Q_D) by a change amount (K_1, K_2, $K_3 \cdot Q_{Dn-1}$) corresponding to said secondary target amount (Q_D).

2. A fuel supply control device for an internal combustion engine of a vehicle according to claim 1, further comprising target amount judgment means (210, 221) for judging whether or not said secondary target amount (Q_D) subjected to the change restraining procedure reaches said primary target amount (Q_I), said change restraint means (208, 213, 214, 219, 223) starting said change restraining procedure when the result of judgment made by said change amount judgment means (205, 217) is affirmative, and finishing said change restraining procedure when a result of judgment made by said target amount judgment means is affirmative.

3. A fuel supply control device for an internal combustion engine of a vehicle according to claim 1, further comprising rotation speed judgment means (203, 215) for judging whether or not the rotation speed of said internal combustion engine is smaller than an upper limit value (N_0, N_1), said target amount coincidence means (207) of said second calculation means being carried out to obtain said secondary target amount (Q_D) coincident with said primary target amount (Q_I) when a result of judgment made by said rotation speed judgment means is negative.

4. A fuel supply control device for an internal combustion engine of a vehicle according to claim 1, in which said change restraint means (213, 214) increases said secondary target amount (Q_D) by a small change amount when said secondary target amount is small, but by a large change amount when said secondary target amount is large.

5. A fuel supply control device for an internal combustion engine of a vehicle according to claim 4, in which said change restraint means (213, 214) increases said secondary target amount by a predetermined first change amount (K_1) when said secondary target amount is smaller than a predetermined reference value (Q_{Xth}), but by a predetermined second change amount (K_2) which is larger than said first change amount when said secondary target amount is larger than said reference value.

6. A fuel supply control device for an internal combustion engine of a vehicle according to claim 4, in which said change restraint means (213, 214) gradually increases said change amount as said secondary target amount is increased.

7. A fuel supply control device for an internal combustion engine of a vehicle according to claim 4, further comprising upper limit value judgment means (204) for judging whether or not said primary target value (Q_I) is smaller than said upper limit value (Q_{Xmax}), said target amount coincidence means (207) of said second calculation means being carried out irrespective of said change amount of said primary target amount to obtain said second target amount (Q_D) coincident with said primary target amount (Q_I) when a result of judgment made by said upper limit value judgment means is negative.

8. A fuel supply control device for an internal combustion engine of a vehicle according to claim 7, in which when said upper limit judgment means (204) judges that said secondary target amount exceeds said upper limit value (Q_{Xmax}) during the increase of said secondary target amount (Q_D) which is being subjected to said change restraining procedure, said change restraining procedure is finished and said target amount coincidence means (207) of said second calculation means are carried out to obtain a secondary target amount coincident with said primary target amount (Q_I).

9. A fuel supply control device for an internal combustion engine of a vehicle according to claim 1, in which said change restraint means (223) decreases said secondary target amount (Q_D) by a large change amount when said secondary target amount is large, but by a small change amount when said secondary target amount is small.

10. A fuel supply control device for an internal combustion engine of a vehicle according to claim 9, in which said change restraint means decreases said secondary target amount (Q_D) by a predetermined first change amount (K_3) when said secondary target amount is larger than a predetermined reference value (Q_{Yth}), but by a predetermined second change amount (K_4) which is smaller than said first change amount when said secondary target amount is smaller than said reference value.

11. A fuel supply control device for an internal combustion engine of a vehicle according to claim 9, in which said change restraint means (223) gradually decreases said change amount (Q_D) as said secondary target amount is decreased.

12. A fuel supply control device for an internal combustion engine of a vehicle according to claim 9, further comprising upper value judgment means (216) for judging whether or not said primary target amount (Q_I) is smaller than said upper limit value (Q_{Ymax}), said target amount coincidence means (207) of said second calculation means being carried out irrespective of said change (ΔQ_I) of said primary target amount to obtain said second target amount (Q_D) coincident with said primary target amount (Q_I) when a result of judgment made by said upper limit value judgment means is negative.

13. A fuel supply control device for an internal combustion engine of a vehicle according to claim 12, further comprising lower limit value judgment means (220) for judging whether or not said secondary target amount reaches said lower limit value (Q_{Ymax}), restraining procedure being finished and said target value coincidence means (207) of said second calculation means being carried out to obtain said secondary target amount (Q_D) coincident with said primary target amount (Q_I) when said lower limit value judgment means judges that said secondary target amount reaches said lower limit value during the decrease of said secondary target amount (Q_D) which is being subjected to said change restraining procedure.

Fig.1

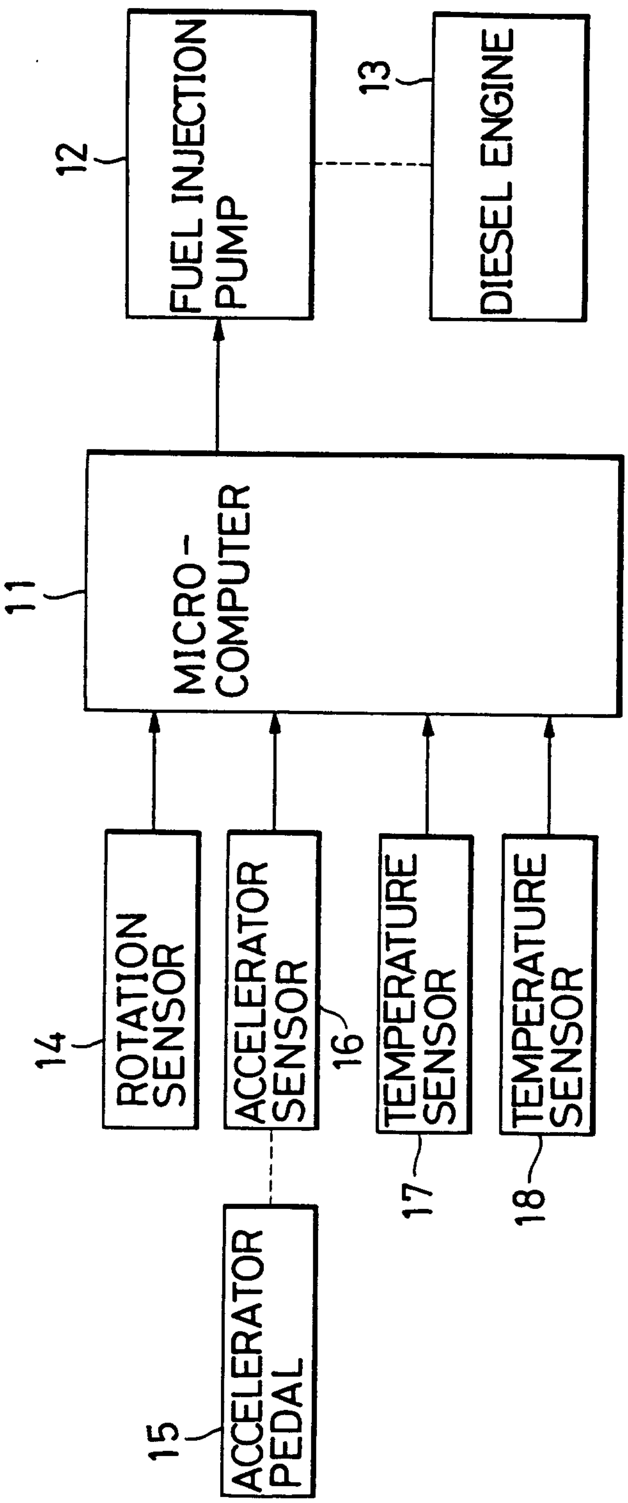
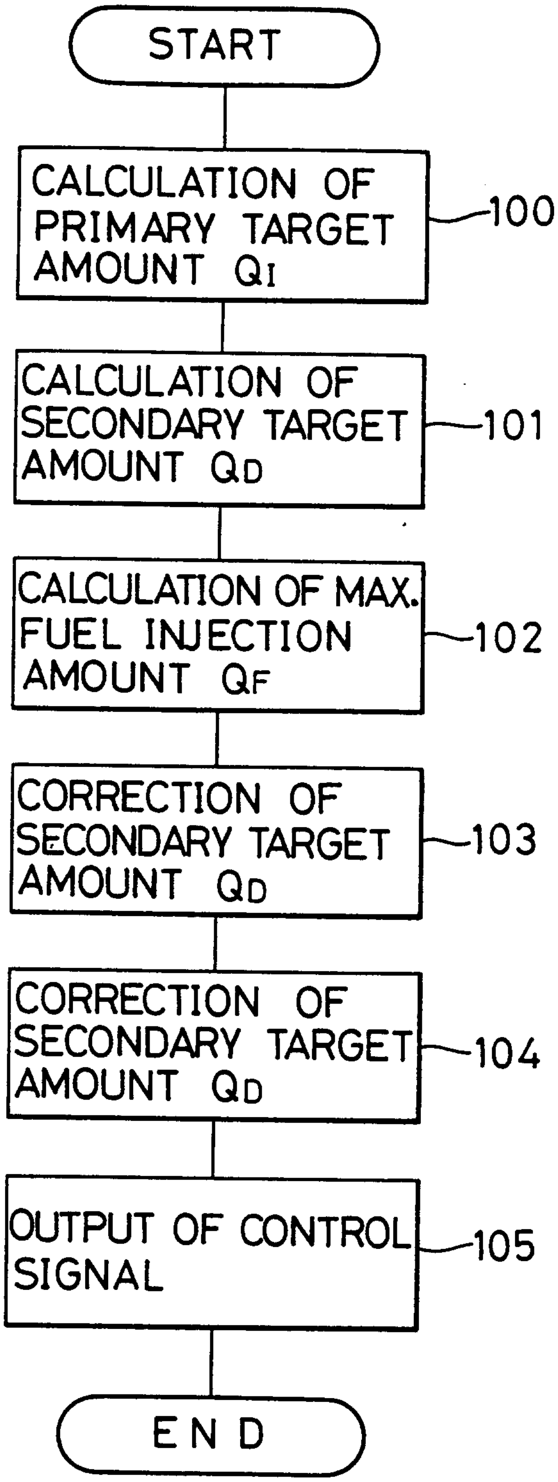

12
FUEL INJECTION PUMP
13
DIESEL ENGINE
11
MICRO-COMPUTER
14
ROTATION SENSOR
16
ACCELERATOR SENSOR
TEMPERATURE SENSOR
17
TEMPERATURE SENSOR
18
15
ACCELERATOR PEDAL

Fig. 2


START
CALCULATION OF PRIMARY TARGET AMOUNT QI
100
CALCULATION OF SECONDARY TARGET AMOUNT QD
101
CALCULATION OF MAX. FUEL INJECTION AMOUNT QF
102
CORRECTION OF SECONDARY TARGET AMOUNT QD
103
CORRECTION OF SECONDARY TARGET AMOUNT QD
104
OUTPUT OF CONTROL SIGNAL
105
END

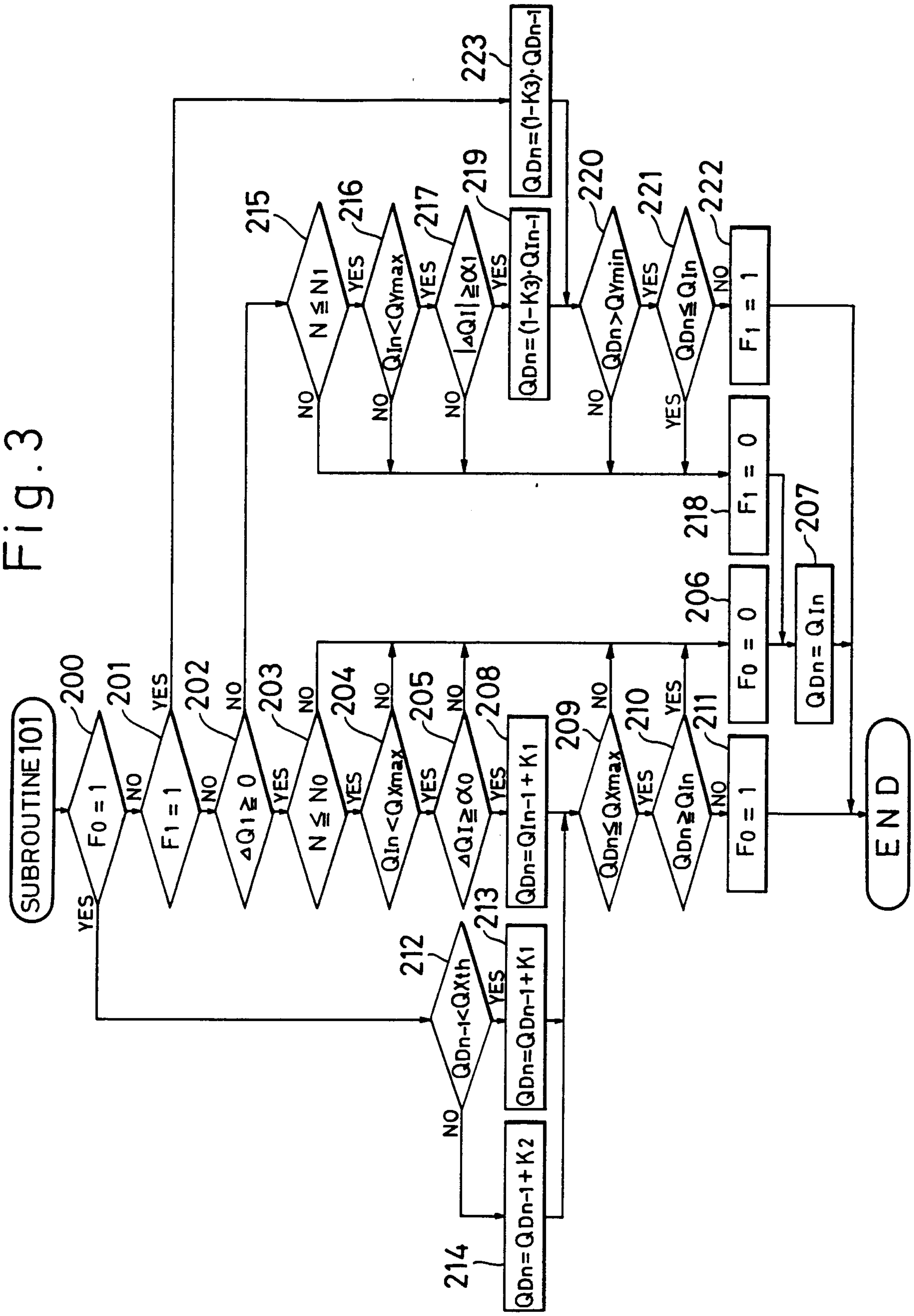

SUBROUTINE 101
200
F0 = 1
201
F1 = 1
202
ΔQI ≧ 0
203
N ≦ N0
204
QIn < QXmax
205
ΔQI ≧ α0
208
QDn = QIn-1 + K1
209
QDn ≦ QXmax
210
QDn ≧ QIn
211
F0 = 1
212
QDn-1 < QXth
213
QDn = QDn-1 + K1
214
QDn = QDn-1 + K2
215
N ≦ N1
216
QIn < QYmax
217
|ΔQI| ≧ α1
219
QDn = (1-K3)·QIn-1
220
QDn > QYmin
221
QDn ≦ QIn
222
F1 = 1
223
QDn = (1-K3)·QDn-1
218
F1 = 0
206
F0 = 0
207
QDn = QIn
END
YES
NO

Fig. 3

Fig. 4

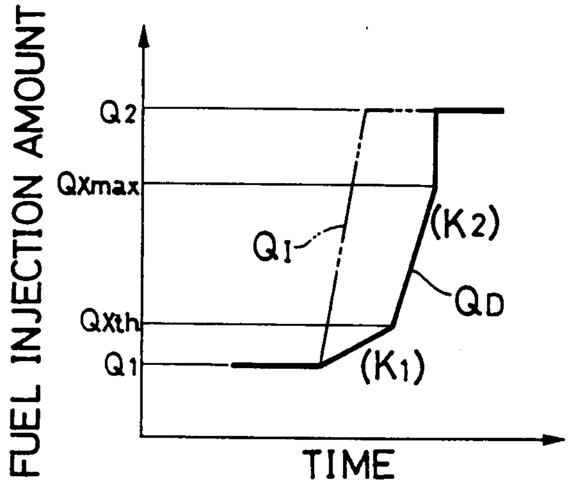


Fig. 5

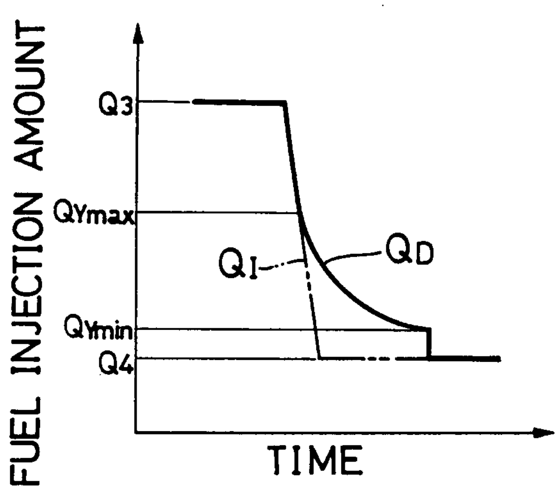


Fig. 6

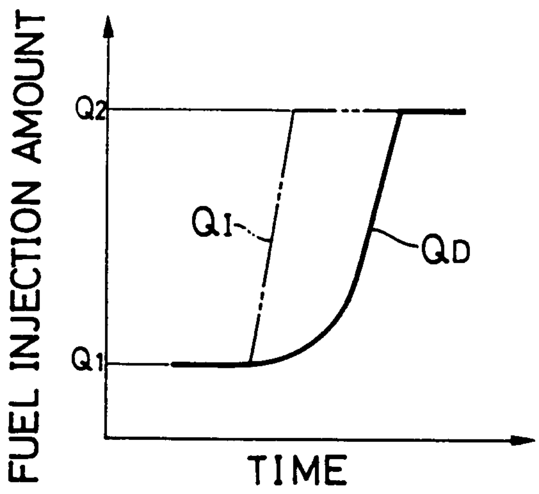
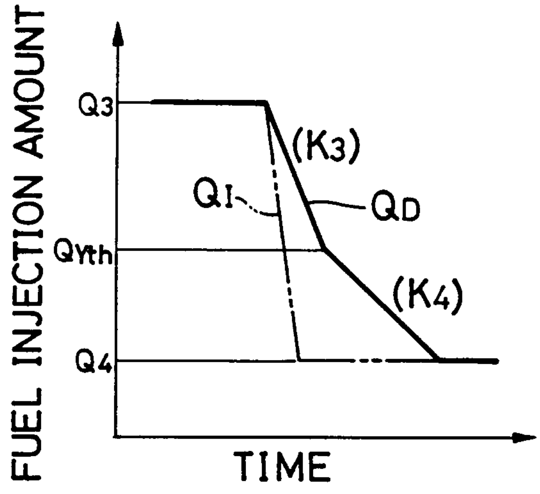


Fig. 7



European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 93301300.5

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	US - A - 4 920 941 (FUKUI et al.) * Abstract; claims; fig. 1,2 * --	1	F 02 D 41/04
A	PATENT ABSTRACTS OF JAPAN, unexamined applications, M field, vol. 14, no. 540, November 29, 1990 THE PATENT OFFICE JAPANESE GOVERNMENT page 38 M 1053 * No. 2-227 528 (FIJI) * --	1	
A	PATENT ABSTRACTS OF JAPAN, unexamined applications, M field, vol. 12, no. 464, December 06, 1988 THE PATENT OFFICE JAPANESE GOVERNMENT page 3 M 771 * No. 63-186 937 (JAPAN) * --	1	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
A	PATENT ABSTRACTS OF JAPAN, unexamined applications, M field, vol. 8, no. 234, October 26, 1984 THE PATENT OFFICE JAPANESE GOVERNMENT page 160 M 334 * No. 59-115 439 (TOYOTA) * ----	1	F 02 D 41/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	10-05-1993	KUTZELNIGG

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
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