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

(11) Publication number: **0 646 710 A1**

(12) **EUROPEAN PATENT APPLICATION**

(21) Application number: **94115402.3**

(22) Date of filing: **29.09.94**

(51) Int. Cl.[6]: **F02D 41/04**, F02D 41/12, F02D 17/02, F02D 37/02

(30) Priority: **30.09.93 IT BO930388**

(43) Date of publication of application: **05.04.95 Bulletin 95/14**

(84) Designated Contracting States: **DE ES FR GB SE**

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(54) **Apparatus for varying the engine torque in particular operating states of an internal combustion engine.**

(57) The apparatus 1 comprises sensors 3 which detect engine parameters, an electronic injection system 4, a block 13 for control, according to stored maps, of the injection system in the state of normal distribution of air/fuel mixture, means 43 and 44, activated in the mixture cut-off state, which compare, for each engine stroke, the value F of the angular position of the throttle of the air intake manifold with a first threshold value MF2 and the value RPM of the number of engine revolutions with a second threshold value MRPM2, and means 53, activated when the value of the position of the throttle is greater than the first threshold value or when the value of the number of engine revolutions is smaller than the second threshold value, which control, for each cylinder of the engine and according to a table, the inflow of the mixture in order to pass, in a predetermined time, from the cut-off state of the mixture to that of normal distribution with a predetermined rate of variation of the engine torque.

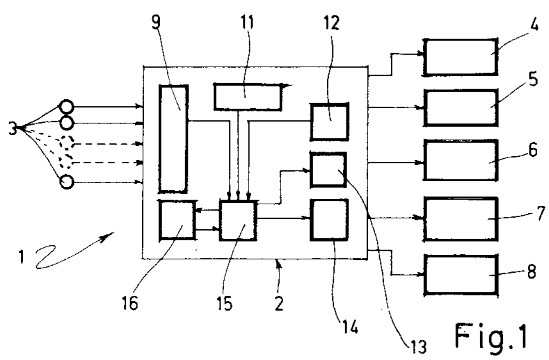

Fig.1

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The present invention relates to an apparatus for varying the engine torque in particular operating states of an endothermic engine of a vehicle. In particular, the apparatus forming the subject of the present invention relates to a strategy of control of the fuel inflow towards the cylinders of the engine in order to pass from a state of normal distribution of the fuel to a fuel cut-off state and vice versa.

As is known, in vehicles, attempts are being made to bring about the fuel cut-off state when useful power is not required of the engine, that is to say when the accelerator pedal is completely released (that is to say when the throttle of the air intake manifold reaches the minimum position) and when at the same time the number of engine revolutions is greater than a predetermined threshold value. From the fuel cut-off state, a return is made to the state of normal distribution of the fuel when the accelerator pedal is pressed (that is to say when the throttle of the air intake manifold moves from the minimum position) or when the number of engine revolutions is smaller than a predetermined threshold value. Present-day apparatuses which allow passing from the state of normal distribution of the fuel to that of fuel cut-off and vice versa provide, in equal measure for all the cylinders of the engine and after a predetermined time or after a predetermined number of engine strokes, for the cut-off (the increase) of 100% of the fuel in one or two stages.

The apparatuses described above comprise a number of disadvantages which manifest themselves in particular in an unpleasantness in driving the vehicle due to abrupt switching from the positive torque state to the negative torque state and vice versa, which abrupt switching causes jumps and kicks of the engine. It is clear that the shaking of the engine does nothing but increase the wear of the various parts of the engine. Moreover, in passing from the fuel cut-off state to the state of normal distribution, the quantity of fuel to be supplied is defined in a single solution, irrespective of the reason (intake throttle angle variation or variation of number of engine revolutions) which is causing the return to the state of normal distribution. It can therefore happen that, on a request for increased power of the engine, the response of the engine falls short of expectations.

The aim of the present invention is that of producing an apparatus for varying the engine torque in particular operating states of an endothermic engine of a vehicle which is free of the disadvantages mentioned, that is to say which reduces the engine shaking in passing from a state of normal distribution of the fuel to a fuel cut-off state and vice versa.

On the basis of the present invention, an apparatus for varying the engine torque in particular operating states of an endothermic engine of a vehicle is produced, of the type comprising:

a plurality of sensors capable of detecting parameters of the engine such as the number of engine revolutions, the engine stroke, the angular position of the throttle of the air intake manifold, the temperature of the cooling fluid of the engine, the temperature of the air taken in, the electric voltage of the battery of the vehicle, and others;

an electronic injection device;

a memory block in which there are stored, for each engine speed, the management maps of said injection device;

a block for control of said injection device in the state of normal distribution of air/fuel mixture;

a block for processing and comparing data, capable of processing the parameters of the engine and of managing said control block;

first means, activated in the air/fuel mixture cut-off state, for comparing, for each engine stroke, the detected value of the angular position of the throttle of the air intake manifold with a first threshold value;

second means, activated in the mixture cut-off state, for comparing, for each engine stroke, the detected value of the number of engine revolutions with a second threshold value;

characterized in that it comprises first means, activated when said value of the angular position of the throttle is greater than said first threshold value or when said value of the number of engine revolutions is smaller than said second threshold value, which control, for each cylinder of the engine and according to a first predetermined table, the inflow of the air/fuel mixture in order to pass, in a predetermined period of time, from the cut-off state of the mixture to the state of normal distribution with a predetermined rate of variation of the engine torque.

For better understanding of the present invention, a preferred embodiment is now described, by way of non-limiting example only, with reference to the attached drawings, in which:

Figure 1 is a block diagram of an apparatus produced according to the dictates of the present invention;

Figures 2 and 3 are operating diagrams of the apparatus in Figure 1;

Figure 4 is a block diagram of an operating flow of a block of the operating diagrams of Figures 2 and 3, and

Figure 5 is a table of coefficients.

In Figure 1, an apparatus for varying the engine torque in particular operating states of an endothermic engine (not illustrated) of a vehicle (not illustrated) is indicated as a whole by 1. In particular, the apparatus 1 brings about the control of the inflow of the air/fuel mixture towards the cylinders (not illustrated) of the engine in order to pass from a state of normal distribution of the air/fuel mixture to an air/fuel mixture cut-off state and vice versa.

The apparatus 1 comprises:

a central electronic unit 2;

a plurality of sensors 3 connected to the central unit 2 and capable of detecting the parameters of the engine such as the number of engine revolutions, the engine stroke, the angular position of the throttle (not illustrated) of the air intake manifold (not illustrated), the temperature of the cooling fluid of the engine, the temperature of the air taken in, the electric voltage of the battery (not illustrated) of the vehicle and others;

an electronic injection device 4 controlled by the central unit 2;

an electronic ignition device 5 controlled by the central unit 2;

a device 6 for control of a fuel pump (not illustrated), this device being managed by the central unit 2;

a device 7 for management of the flow of air taken in by the intake manifold, and

a device 8 mounted on the dashboard (not illustrated) of the vehicle and capable of signalling the cut-off state, and the states of entering and leaving the cut-off state.

With reference to Figure 1, the central unit 2 comprises:

a block 9 for reading of the input quantities signalled by the sensors 3;

a memory block 11, in which the management maps of the devices 4, 5, 6 and 7 for each speed of the engine are stored;

a memory block 12, in which threshold values and values of coefficients which will be described below are stored;

a block 13 for control of the devices 4, 5, 6 and 7 in the state of normal mixture distribution;

a block 14 for control of the devices 4, 5, 6, 7 and 8 in passing from a state of normal distribution to that of mixture cut-off and vice versa;

a block 15 for processing and comparing data and for management of the blocks 13 and 14, and

a counter 16 connected to the block 15.

In use, on the basis of the value of the quantities detected by the sensors 3, the block 15 calculates the engine speed, takes from the block 11 for the calculated speed the management maps of the devices 4, 5, 6 and 7 and, according to the data of said maps, manages the block 13 which then controls the devices 4, 5, 6 and 7.

With reference to Figure 2, an operating cycle of the apparatus 1 is now described, which makes it possible to pass from a state of normal distribution of the air/fuel mixture represented by a block 21 to a mixture cut-off state represented by a block 22. Each engine stroke, that is to say each 180° of the engine shaft, the apparatus passes from the block 21 to a block 23, in which in the block 15 the detected value F of the angular position of the throttle of the air intake manifold is compared with a threshold value MF1 stored in the block 12. In the event that the value F is smaller than or equal to the value MF1, the apparatus passes from the block 23 to a block 24 while, in the opposite case, it returns from the block 23 to the block 21. In the block 24, the detected value RPM of the nubmer of engine revolutions is compared with a threshold value MRPM1 stored in the block 12. In the event that the value RPM is greater than or equal to the value MRPM1, the apparatus passes from the block 24 to a block 25 while, in the opposite case, it returns from the block 24 to the block 21.

In the block 25, a strategy of control of the devices 4, 5, 6, 7 and 8 is carried out by means of the block 14 for the purpose of passing in a predetermined number of engine strokes N to the cut-off state (which state as will be recalled does not allow any inflow of air/fuel mixture to the engine) and for the purpose of signalling to the user, by means of the device 8, the switch-over to the cut-off state. Once the strategy of varying the air/fuel mixture inflow has been defined and carried out, the apparatus passes from the block 25 to a block 26, in which in the block 15 the value F is compared with the threshold value MF1. In the event that the value F is smaller than or equal to the value MF1, the apparatus passes from the block 26 to a block 27 while, in the opposite case, it returns from the block 26 to the block 21. In the block 27, the value RPM is compared with the threshold value MRPM1. In the event that the value RPM is greater than or equal to the value MRPM1, the apparatus passes from the block 27 to the block 22 while, in the opposite case, it returns from the block 27 to the block 21.

In Figure 4, a preferred embodiment of the strategy carried out by the block 25 is illustrated. In said strategy, use is made of a table 28 (Figure 5) of coefficients Ki which is stored in the block 12. The table 28 comprises N boxes, with each of which a value of the coefficient Ki is associated. The block 25 comprises a block 31, in which in the counter 16 a quantity C is given the value 1, the quantity C being relative to the sequence of the boxes of the table 28. From the block 31 the apparatus moves to a block 32, in which the speed of the engine is evaluated and the injection time Tj for this speed is calculated. From the block 32 it moves to a block 33 in which, C being = 1, the coefficient Ki1 is taken from the first box of the table 28. From the block 33 the apparatus moves to a block 34 in which the injection time Tj just calculated is multiplied by the coefficient Ki1 so as to define a new injection time Tji1. In the block 34, an injection of mixture according to the new injection time Tji1 is moreover ordered for the cylinder in its intake stroke. From the block 34 the apparatus moves to a block 35 in which it is decided whether the quantity C is greater than the number N of the boxes of the table 28. In the positive case, the apparatus moves from the block 35 to a block 37 and from this to the block 26 of Figure 2 while, in the opposite case, it passes from the block 35 to a block 36, in which the value of the quantity C of the counter 16 is increased by one unit. From the block 36 it then returns the block 32. In the block 37, the device 8 is activated, which signals, for example by means of a warning light (not illustrated), the switch-over to the mixture cut-off state.

The block 25 makes it possible to calculate cylinder by cylinder an injection time Tji1 following the variation of the engine speed. The values of the coefficients Ki are worked out so as to vary the engine torque, in passing from the state of normal air/fuel mixture distribution to that of cut-off, according to the rate which does not comprise abrupt switching over and therefore shaking of the engine.

Other parameters such as the variation of the advance of the electronic ignition by managing expediently the device 5, the variation of the control of the fuel pump by managing expediently the device 6, and/or the variation of the flow of the air taken in by managing expediently the device 7, can contribute to the working out of the rate of variation of the engine torque in various embodiments. In substance, in addition to the inflow cylinder by cylinder of the mixture, it is possible to vary the combustion times, the total inflow of the fuel and the stoichiometric strength of the mixture.

With reference to Figure 3, an operating cycle of the apparatus 1 is now described, which makes it possible to pass from the mixture cut-off state represented by the block 22 to the state of normal distribution represented the block 21. Each engine stroke, that is to say each 180° of the engine shaft, the apparatus moves from the block 22 to a block 41 in which in the block 15 the value Qa detected by a sensor 3 and relating to the flow of the air along the intake manifold is compared with a threshold value MQa stored in the block 12. In the event that Qa is greater than MQa, the apparatus passes from the block 41 to a block 42 while, in the opposite case, it passes from the block 41 to a block 43.

In the block 43, the detected value F of the angular position of the throttle of the air intake manifold is compared with a minimum threshold value MF2 stored in the block 12. In the event that the value F is smaller than or equal to the value MF2, the apparatus passes from the block 43 to a block 44 while, in the opposite case, it passes from the block 43 to a block 45. In the block 44, the detected value RPM of the number of engine revolutions is compared with a threshold value MRPM2 stored in the block 12. In the event that the value RPM is greater than or equal to the value MRPM2, the apparatus returns from the block 44 to the block 22 while, in the opposite case, it passes from the block 44 to a block 46. In the block 45, the angular variation of the throttle of the manifold in a predetermined time $\delta F/\delta t$ is compared with a threshold value MFt stored in the block 12. In the event that the value $\delta F/\delta t$ is greater than or equal to the value MFt, the apparatus passes from the block 45 to a block 47 while, in the opposite case, it passes from the block 45 to a block 48. In the block 46, the variation of the number of engine revolutions in a predetermined time $\delta RPM/\delta t$ is compared with a threshold value MRPMt stored in the block 12. In the event that the value $\delta RPM/\delta t$ is greater than or equal to the value MRPMt, the apparatus passes from the block 46 to a block 51 while, in the opposite case, it passes from the block 46 to a block 52.

In the block 41, in place of the flow of the air taken in, use can be made of a different quantity which is representative of the behaviour of the air taken in and, for example, use can be made of the parameter relating to the pressure of the air taken in. In any case, the parameter used in the block 41 detects any rapid and undesirable decreases in the engine speed. In the block 43, the angular position of the throttle of the air intake manifold and therefore the angular position of the accelerator pedal is evaluated, which position represents the intention of the user to leave the cut-off state. In the block 45, the speed of the variation of the angular positon of the throttle and in substance the pressure exerted by the user on the accelerator pedal is evaluated. In the block 44, the value of the number of engine revolutions is evaluated and in the block 46, the speed of the variation of the number of engine revolutions is evaluated. The apparatus 1 provides for leaving the cut-off state when there is a variation of the flow of the air taken in (block 41), a variation of the angular position of the throttle (block 43) and a variation of the number of engine revolutions (block 44). The apparatus 1 also detects the manner of variation of the angular position of the throttle (block 45) and of variation of the number of engine revolutions (block 46). In substance, the apparatus 1 provides for five possibilities (blocks 42, 47, 48, 51 and 52) for leaving the cut-off state. In the block 12, five tables similar to the table 28 are stored, each of which relates to a state of leaving the cut-off state. In the blocks 42, 47, 48, 51 and 52, the relevant table is therefore taken from the block 12.

From the blocks 42, 47, 48, 51 and 52, the apparatus passes to a block 53, which is similar to the block 25 of Figures 2 and 4, and from the block 53 to the block 21, which represents the state of normal distribution of the air/fuel mixture. The operating diagram of the block 25 illustrated in Figure 4 can also be assumed as the operating diagram of the block 53. In fact, in the block 53, a strategy of control of the devices 4, 5, 6, 7 and 8 is carried out by means of the block 14 for the purpose of passing in a predetermined number of engine strokes N from the mixture cut-off state to the state of normal distribution and for the purpose of signalling to the user, by means of the device 8, the switch-over to said state of normal distribution of the mixture.

In Figure 4, the components of the block 53 are numbered at the side of the numbering of the components of the block 25 and in brackets. In the strategy carried out by the block 53, use is made of a table (corresponding to the block 52, 47, 48, 51 or 52 through which the block 53 has been reached) of coefficients Ko stored in the block 12. The table comprises N boxes, with each of which a value of the coefficient Ko is associated. The block 53 comprises a block 54, in which in the counter 16 a quantity D is given the value 1, the quantity D being related to the sequence of the boxes of the above-mentioned table. From the block 54 the apparatus passes to a block 55, in which the speed of the engine is evaluated and the injection time Tj for this speed is calculated. From the block 55 it passes to a block 56 in which, D being = 1, the coefficient Ko1 is taken from the first box of the table. From the block 56 the apparatus passes to a block 57, in which the injection time Tj just calculated is multiplied by the coefficient Ko1 so as to define a new injection time Tjo1. In the block 57, an injection of mixture according to the new injection time Tjo1 is moreover ordered for the cylinder in its intake stroke. From the block 57 the apparatus passes to a block 58 in which it is decided whether the quantity D is greater than the number N of the boxes of said table. In the positive case the apparatus passes from the block 58 to a block 62 and from this to the block 21 of Figure 3 while, in the opposite case, it passes from the block 58 to a block 61 in which the value of the quantity D of the counter 16 is increased by one unit. From the block 61 the apparatus then returns to the block 55. In the block 62, the device 8 is activated, which signals, for example by means of a warning light (not illustrated), the switch-over to the state of normal distribution of the mixture.

The block 53 makes it possible therefore, as a function of the type of state of leaving the cut-off state, to calculate cylinder by cylinder an injection time Tjo1 following the variation of the engine speed. The values of the coefficients Ko are worked out so as to vary the engine torque, in passing from the cut-off state to that of normal distribution, according to a rate which does not comprise abrupt switching over and therefore shaking of the engine. Also in the block 53, other parameters such as the variation of the advance of the electronic ignition, the variation of the control of the fuel pump, and/or the variation of the flow of the air taken in, can contribute to the working out of the rate of variation of the engine torque in various embodiments.

From what is described above, the advantages achieved with the realization of the present invention are clear.

In particular, an apparatus is produced, which makes it possible to graduate the variation of the engine torque so as to avoid abrupt shaking of the engine both in entering and in leaving the cut-off state. The manner of control of the inflow of the air/fuel mixture contributes in a particular way to the rate of variation of the engine torque, which manner is worked out for each cylinder and updated for each engine stroke to follow the engine speed. In passing from the cut-off state to that of normal distribution, it is possible to select a rate of variation of the engine torque as a function of the variation of the values of a number of parameters and of the speed of variation of said values. In this way, the intentions of the user are followed with greater promptness.

Finally, it is clear that modifications and variations can be made to said apparatus 1 described and illustrated here, without thereby leaving the protective scope of the present invention.

In particular, the rates of variation of the engine torque both in entering and in leaving the cut-off state and in substance the tables of the coefficients Ki and Ko can be the varied items which are possible both as values of the coefficients Ki and Ko and as the number of boxes. It is therefore possible to adapt the rates of variation of the engine torque in entering and in leaving the cut-off state both to the type of engine installed in the vehicle and to the performance which it is desired to obtain from the engine particularly in leaving the cut-off state.

Claims

1. Apparatus for varying the engine torque in particular operating states of an endothermic engine of a vehicle is produced, of the type comprising:

a plurality of sensors (3) capable of detecting parameters of the engine such as the number of engine revolutions, the engine stroke, the angular position of the throttle of the air intake manifold, the temperature of the cooling fluid of the engine, the temperature of the air taken in, the electric voltage of the battery of the vehicle, and others;

an electronic injection device (4);

a memory block (11) in which there are stored, for each engine speed, the management maps of said injection device (4);

a block (13) for control of said injection device (4) in the state of normal distribution of air/fuel mixture;

a block (15) for processing and comparing data, capable of processing the parameters of the engine and of managing said control block (13);

first means (43), activated in the air/fuel mixture cut-off state, for comparing, for each engine stroke, the detected value (F) of the angular position of the throttle of the air intake manifold with a first threshold value (MF2);

second means (44), activated in the mixture cut-off state, for comparing, for each engine stroke, the detected value (RPM) of the number of engine revolutions with a second threshold value (MRPM2);

characterized in that it comprises first means (53), activated when said value (F) of the angular position of the throttle is greater than said first threshold value (MF2) or when said value (RPM) of the number of engine revolutions is smaller than said second threshold value (MRPM2), which control, for each cylinder of the engine and according to a first predetermined table, the inflow of the air/fuel mixture in order to pass, in a predetermined period of time, from the cut-off state of the mixture to the state of normal distribution with a predetermined rate of variation of the engine torque.

2. Apparatus according to Claim 1, characterized in that it comprises third means (41), activated in the mixture cut-off state, of comparing, for each engine stroke, a detected value (Qa) relating to a parameter of the air taken in along said intake manifold with a third threshold value (MQa), said first means of control (53) being activated when said value (Qa) relating to a parameter of the air taken in along said intake manifold is greater than said third threshold value (MQa).

3. Apparatus according to Claim 1 and/or 2, characterized in that said first table comprises, according to a given sequence, a plurality of first coefficients (Ko), each of predetermined value, said first coefficients (Ko) associated with the set number of engine strokes for passing from the mixture cut-off state to the state of normal distribution of the mixture, and characterized in that said first means of control (53) comprise a block (55) which works out during each engine stroke, on the basis of the parameters of the engine, the engine speed and from this the injection time (Tj) relating to the cylinder in its intake stroke during the engine stroke, and a block (57) which calculates for each engine stroke a new injection time (Tjo1) which is a function of the injection time (Tj) calculated on the basis of the engine speed and of one of said first coefficients (Ko), and which moreover orders, for the cylinder in the intake stroke, an injection of mixture according to the new injection time (Tjo).

4. Apparatus according to Claims 1 to 3, characterized in that it comprises means of detection of the speed ($\delta F/\delta t$ and $\delta RPM/\delta t$) of variation of the detected value (F) of the angular position of the throttle of the air intake manifold and of the detected value (RPM) of the number of engine revolutions and characterized in that it comprises five of said first tables, the first relating to a variation greater than a given fourth threshold value (MFt) of said value (F) of the angular position of the throttle, the second relating to a variation smaller than said fourth threshold value (MFt) of said value (F) of the angular position of the throttle, the third relating to a variation greater than a given fifth threshold value (MRPMt) of said value (RPM) of the number of engine revolutions, the fourth relating to a variation greater than said fifth threshold value (MRPMt) of said value (RPM) of the number of engine revolutions, and the fifth relating to the variation above said third threshold value (MQa) of said value (Qa) corresponding to a parameter of the air taken in along said intake manifold.

5. Apparatus according to Claim 4, characterized in that it comprises means capable, during the switch-over from the mixture cut-off state to that of normal distribution, of varying parameters (pressure and/or flow) of the air taken in.

6. Apparatus according to Claim 4 and/or 5, characterized in that it comprises means capable, during the switch-over from the mixture cut-off state to that of normal distribution, of varying the control of a fuel delivery pump (6).

7. Apparatus according to at least one of Claims 4 to 6, characterized in that it comprises means capable, during the switch-over from the mixture cut-off state to that of normal distribution, of varying the control of an electronic ignition device (5) in order to modify the ignition advance.

8. Apparatus according to at least one of the preceding claims, characterized in that it comprises:

fourth means (23) of comparing, for each engine stroke, the detected value (F) of the angular position of the throttle of the air intake manifold with a sixth threshold value (MF1);

fifth means (24) of comparing, for each engine stroke, the detected value (RPM) of the number of engine revolutions with a seventh threshold value (MRPM1), and

second means (25), activated when said value (F) of the angular position of the throttle is smaller than said sixth threshold value (MF1) and said value (RPM) of the number of engine revolutions is greater than said seventh threshold value (MRPM1), which control, for each cylinder of the engine and according to a predetermined second table (28), the inflow of the air/fuel mixture in order to pass, in a predetermined period of time, from the state of normal distribution of the mixture to that of mixture cut-off with a predetermined rate of variation of the engine torque.

9. Apparatus according to Claim 8, characterized in that it comprises:

sixth means (26) which compare, during the phase of activation of said second means of control (25), said detected value (F) of the angular position of the throttle of the air intake manifold with said sixth threshold value (MF1);

seventh means (27) which compare, during the activation of said second means of control (25), said detected value (RPM) of the number of engine revolutions with said seventh threshold value (MRPM1), and

means capable of restoring the state of normal distribution of the mixture when said value (F) of the angular position of the throttle is greater than said sixth threshold value (MF1) or said value (RPM) of the number of engine revolutions is smaller than said seventh threshold value (MRPM1).

10. Apparatus according to Claim 9, characterized in that said second table (28) comprises, according to a given sequence, a plurality of second coefficients (Ki), each of predetermined value, said second coefficients (Ki) associated with the set number of engine strokes for passing from the state of normal distribution of the mixture to the mixture cut-off state, and characterized in that said second means of control (25) comprise a block (32) which works out during each engine stroke, on the basis of the parameters of the engine, the engine speed and from this the injection time (Tj) relating to the cylinder in the intake stroke during the engine stroke, and a block (34) which calculates for each engine stroke a new injection time (Tji1) which is a function of the injection time (Tj) calculated on the basis of the engine speed and of one of said second coefficients (Ki), and which moreover orders, for the cylinder in the intake stroke, an injection of mixture according to the new injection time (Tji).

11. Apparatus according to Claim 10, characterized in that it comprises means capable, during the switch-over from the state of normal distribution of the mixture to that of mixture cut-off, of varying parameters (pressure and/or flow) of the air taken in.

12. Apparatus according to Claim 10 and/or 11, characterized in that it comprises means capable, during the switch-over from the state of normal distribution of the mixture to that of mixture cut-off, of varying the control of a fuel delivery pump (6).

13. Apparatus according to at least one of Claims 10 to 12, characterized in that it comprises means capable, during the switch-over from the state of normal distribution of the mixture to that of mixture cut-off, of varying the control of an electronic ignition device (5) in order to modify the ignition advance.

14. Apparatus according to the preceding claims, characterized in that it comprises means (8) of signalling to the user the state of air/fuel mixture cut-off.

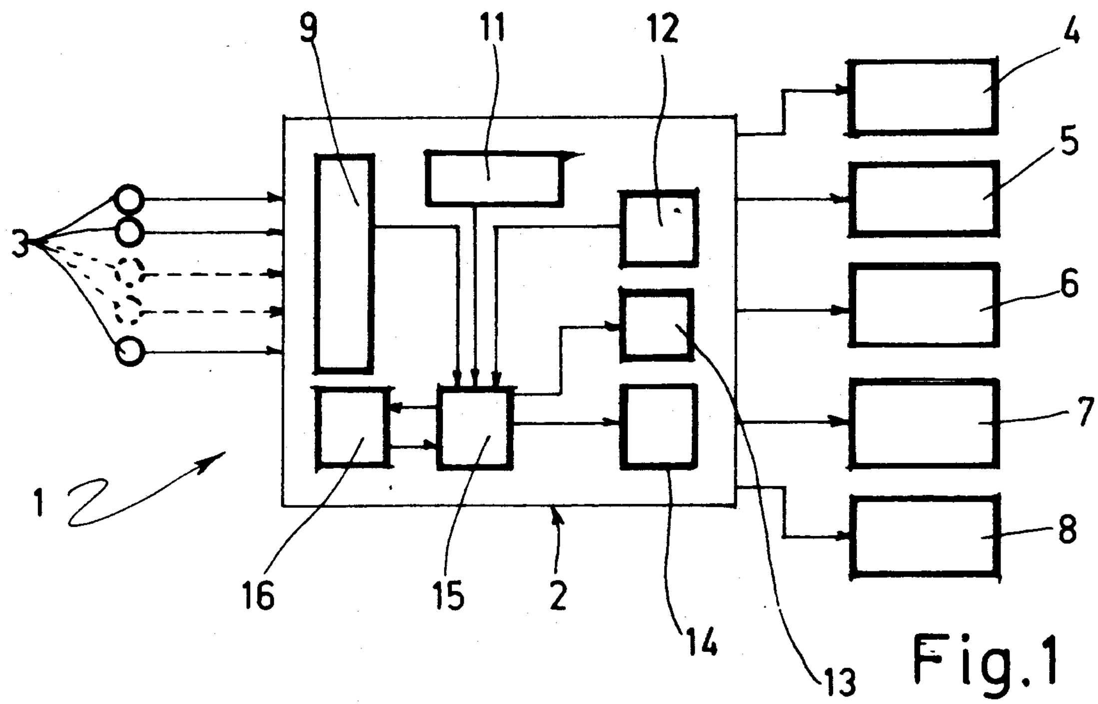


Fig.1

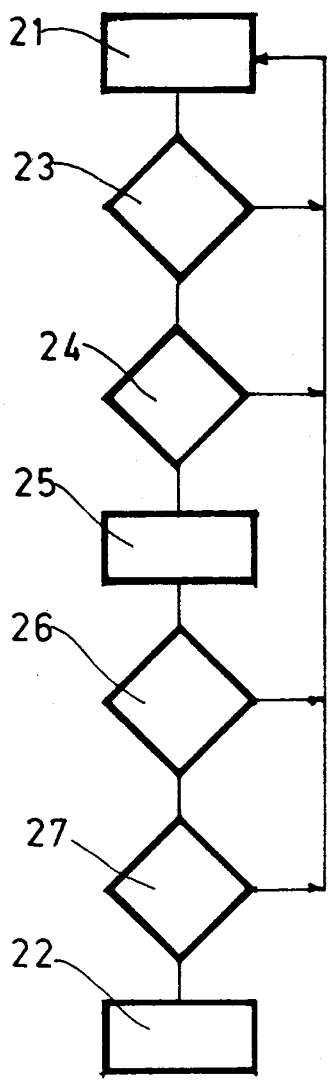
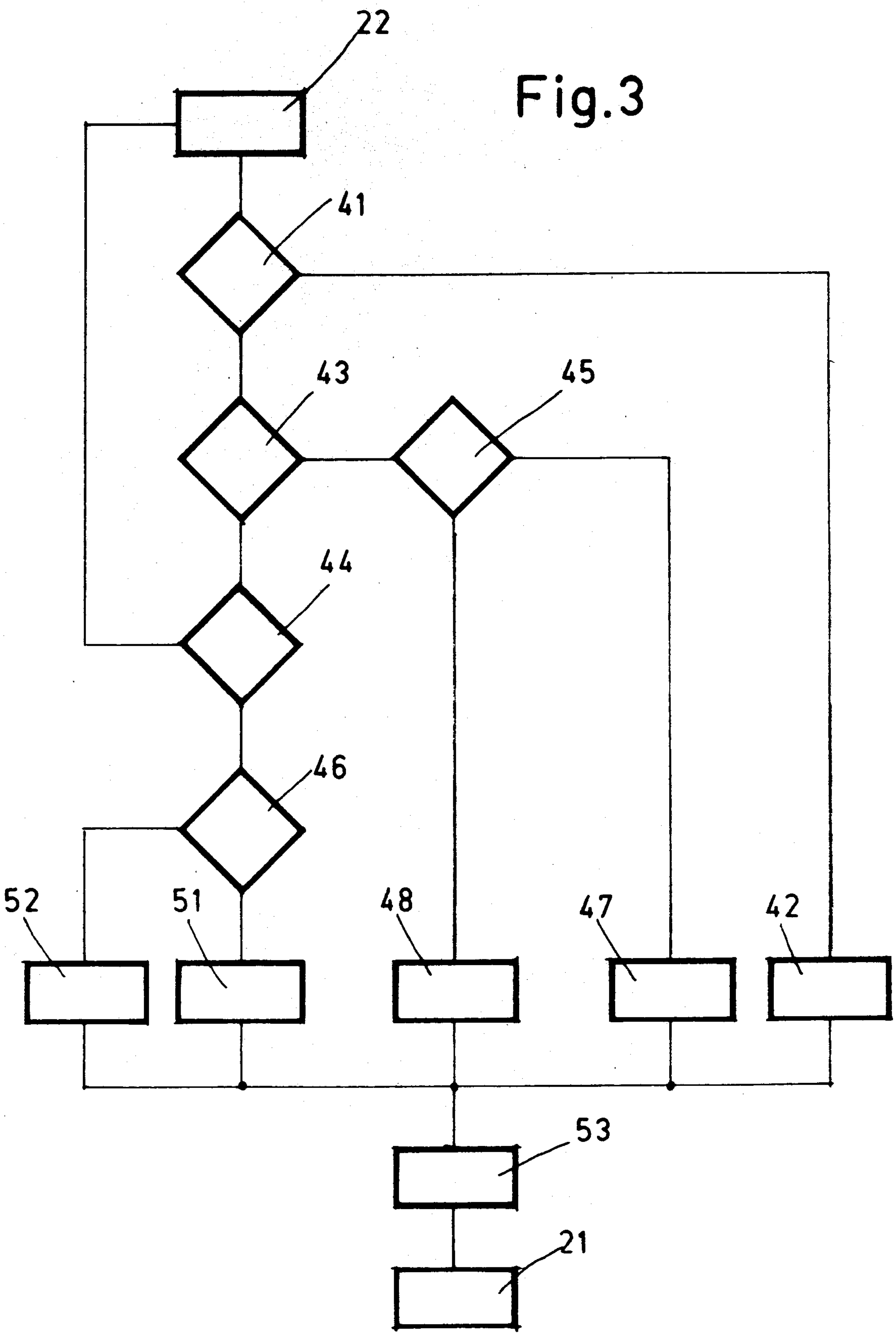
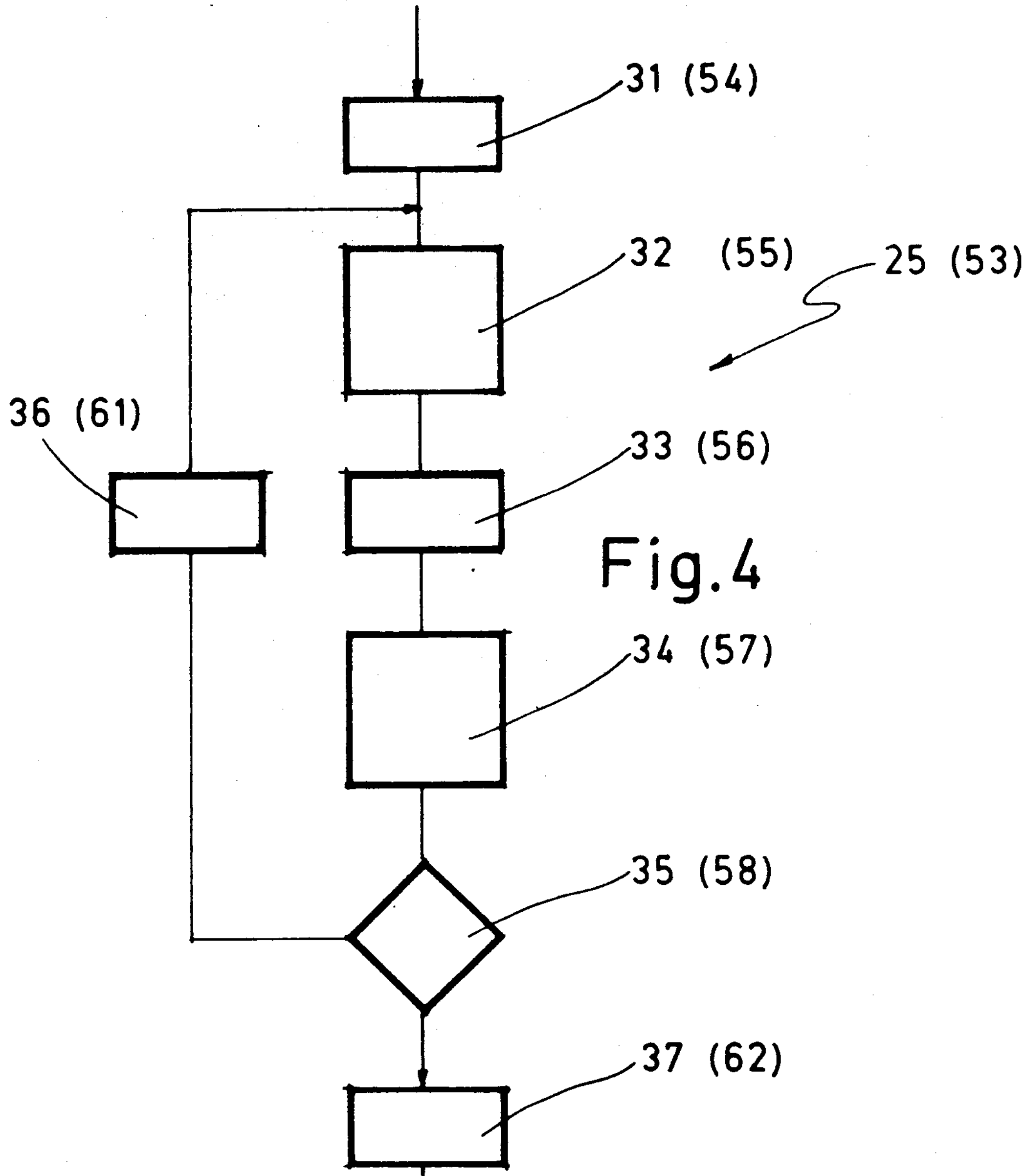


Fig.2

Fig.3

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32 (55)
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36 (61)
33 (56)
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35 (58)
37 (62)

Fig.4

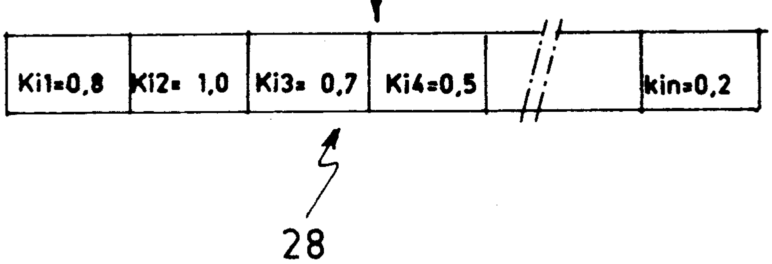
Ki1=0,8
Ki2= 1,0
Ki3= 0,7
Ki4=0,5
kin=0,2
28

Fig.5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 11 5402

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.6)
X A	EP-A-0 501 541 (GENERAL MOTORS CORPORATION) 2 September 1992 * column 1, line 8 - column 3, line 3 * * column 4, line 19 - column 9, line 23 *	1 4	F02D41/04 F02D41/12 F02D17/02 F02D37/02
Y	GB-A-2 138 176 (HONDA GIKEN KOGYO KABUSHIKI KAISHA) 17 October 1984 * page 2, line 104 - page 5, line 97 *	1,3,4,8,9	
Y	FR-A-2 406 080 (NISSAN MOTOR CO.,LTD.) 11 May 1979 * the whole document *	1,3,4,8,9	
A	US-A-4 259 723 (FUJISAWA ET AL) 31 March 1981 * the whole document *	7,13	
A	PATENT ABSTRACTS OF JAPAN vol. 8, no. 124 (M-301) (1561) 9 June 1984 & JP-A-59 028 029 (TOYOTA JIDOSHA KABUSHIKI KAISHA) 14 February 1984 * abstract *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
F02D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	25 January 1995	Moualed, R

CATEGORY OF CITED DOCUMENTS

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