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D E C I S I O N
of 5 July 1994

Case Number: T 0946/90 - 3.2.4

Application Number: 84113075.0

Publication Number: 0142101

IPC: F02D 41/04

Language of the proceedings: EN

Title of invention:
Automotive engine control system capable of detecting specific engine operating conditions and projecting subsequent engine operating patterns

Applicant:
Nissan Motor Co., Ltd.

Opponent:
-

Headword:
-

Relevant legal norms:
EPC Art. 56

Keyword:
"Inventive step (yes) - after amendment"

Decisions cited:
-

Catchword:

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0946/90 - 3.2.4

D E C I S I O N
of the Technical Board of Appeal 3.2.4
of 5 July 1994

Appellant: Nissan Motor Co., Ltd.
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Decision under appeal: **Decision of the Examining Division of the European Patent Office dispatched on 24 July 1990 refusing European patent application No. 84 113 075.0 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: C.A.J. Andries
Members: H.A. Berger
J.P.B. Seitz

Summary of Facts and Submissions

I. The Appellant (Applicant) lodged an appeal, received on 4 October 1990, against the decision of the Examining Division, dispatched on 24 July 1990, refusing the application No. 84 113 075.0, published under the publication No. 0 142 101. The fee for appeal was paid on 4 October 1990. The statement setting out the grounds of appeal was received on 3 December 1990.

II. The Examining Division held that the application did not meet the requirements of Articles 52(1) and 54 EPC, having regard to the following prior art document:

(D1) US-A-4 373 501.

The Examining Division was of the opinion that the subject-matter of Claim 1 and/or Claim 15 was not new vis-a-vis the state of the art described in document D1 and that the subject-matter of Claims 2 to 14 and 16 to 19 did not contain any additional features which involved an inventive step having regard to the following additional prior art documents:

(D2) "Motronic" (first edition; 1/83; Robert Bosch GmbH, Stuttgart; pages 20, 29, 32)
(D3) JP-A-56/107 929.

During examination also document

(D4) GB-A-2 102 165

was cited.

III. In an interview and in a communication, the Board drew attention to lack of clarity. Oral proceedings were held on 5 July 1994 during which the Appellant filed new application documents including new claims.

IV. Claim 1 reads as follows:

"An engine control system for an internal combustion engine comprising:

a) means (31,26,230,220,240,260) for monitoring a plurality of preselected engine operating parameters and producing first signals indicative thereof;

b) means (3100) for receiving and processing first signals to derive actual engine operation data, comparing these derived actual engine operation data with various preset data in a ROM (1420) to judge whether the engine operation data match with one of the various preset data, and for sampling the first signals at given intervals for each predetermined period of time if the engine operation data match with one of the preset data so as to derive a variation pattern of engine operating parameters referred to as actual engine operation pattern data (3101, AOPD);

c) means (3200) for monitoring operating state indicative signals of engine accessories (260) and engine-driven components (242) and for selecting and outputting one of preset model behaviour pattern data (EOIP, 3201) referred to as an engine operation influencing parameter based on said engine operating parameters upon occurrence of a

signal indicating a change of the operating state of one of the engine accessories (260) and engine-driven components (242);

d) means (3300) for receiving the actual engine operation pattern data (3101, AOPD) and the preset model behaviour pattern data (EOIP, 3201) both based on the same engine operating parameter and for synthesizing them into a predicted engine operating parameter variation data (3301, OPVD);

e) means (3400) for receiving all of the first signals for determining in which specific unsteady operation condition the engine falls, and for outputting an actual engine operation condition data (AEOCD, 3401) indicative of this unsteady operation condition;

f) means (3500), having a plurality of pattern memory blocks as a pattern memory (1440) and responsive to the actual engine operation condition data (AEOCD, 3401) for receiving and recording the actual engine operation pattern data (AOPD, 3101) in the pattern memory (1440) whose addresses correspond to the actual engine operation condition data (AEOCD, 3401) so that the actual operation pattern data (AOPD) are arrayed in terms of actual engine operating condition data (AEOCD, 3401), the data corresponding to the actual operation pattern data (AOPD) arrayed in terms of the actual engine operating condition data (AEOCD) being referred to as set engine operation pattern data (SEOPD, 3501);

g) means (3600) for receiving the read set engine operation pattern data (SEOPD, 3501) and said engine operating parameter variation data (OPVD, 3301) for projecting possible future engine

operation patterns by reading out the set engine operation pattern data (SEOPD) corresponding to or most closely corresponding to the operating parameter variation data (OPVD, 3301), the data projected by said means (3600) being referred to as projected engine operation pattern data (PEOPD, 3601); and

h) means (3700) for performing control and fail-safe operations for the engine, said means (3700) receiving the projected engine operation pattern data (PEOPD, 3601) to correct various engine control signals."

V. The Appellant argued that the subject-matter of the application was now sufficiently clear for a person skilled in the art (Article 84 EPC). With regard to feature b) of Claim 1, which was thoroughly discussed during the oral proceedings, the Appellant drew attention in particular to page 32 of the description and to Figure 8 of the drawings. He also stated that the amendments in the application satisfied Article 123(2) EPC.

Furthermore, he was of the opinion that the subject-matter of Claim 1 was new with regard to the prior art documents and involved an inventive step since none of the documents D1 to D4 described or gave any hint towards comparing actual engine operation data with preset data to find out if further pattern data are to be sampled in order to store them when unsteady operation conditions are determined, as stated in Claim 1 of the application. He also argued that none of the prior art documents disclosed means for synthesizing preset pattern data of engine accessories and

engine-driven components with actual engine operation pattern data and means for comparing them with renewably stored pattern data.

VI. The Appellant requests that the decision under appeal be set aside and a patent be granted on the basis of the following documents, all filed during the oral proceedings on 5 July 1994:

Claims 1 to 7; description, pages 1 to 39; drawings, sheets 1/10 to 10/10.

Reasons for the Decision

1. The appeal is admissible.

2. *Admissibility of the Amendments (Article 123(2) EPC)*

2.1 Claim 1

New Claim 1 is restricted mainly to the embodiment of originally filed Figure 9 (Figure 3 in the actual documents).

The features of Claim 1 are disclosed in the originally filed application as follows:

Feature a): page 4, lines 20 to 24;

Feature b): "means (3100) for receiving and processing first signals to derive actual engine operation data": Fig.9; page 41, lines 11 to 18, and page 49, lines 11 to 18, (the expression "actual engine operation data" is based on the expression "actual engine operating condition" stated on page 49, line 18);

"comparing these derived actual engine operation data with various preset data in a ROM (1420)": page 49, lines 18 to 20;

"to judge whether the engine operation data match with one of the various preset data": page 49, lines 22 to 24;

"for sampling the first signals at given intervals for each predetermined period of time if the engine operation data match with one of the preset data so as to derive a variation pattern of engine operating parameters": page 49, lines 22 to 27; page 41, lines 18 to 30;

Feature c) (means 3200): page 4, lines 8 to 14; page 42, lines 25 to 33 and page 50, line 7 to page 51, line 3;

Feature d) (means 3300): the paragraph bridging pages 42 and 43;

Feature e) (means 3400): the paragraph bridging pages 41 and 42 and Fig.9;

Feature f) (means 3500): the paragraph bridging pages 43 and 44;

Feature g) (means 3600): page 44, lines 5 to 19;

Feature h) (means 3700): page 44, lines 20 to 27.

2.2 Claims 2 to 7

The features of Claims 2 to 7 are disclosed in the originally filed application as follows:

Claim 2: page 50, line 7 to page 51, line 3;

Claim 3: page 51, lines 4 to 19;

Claim 4: paragraph bridging pages 51 and 52;

Claim 5: page 52, lines 7 to 16 and Fig. 9 (in which the connection with actual operation pattern date AOPD, 3101 is shown);

Claim 6: page 52, lines 16 to 35;

Claim 7: page 53, lines 18 to 36.

2.3 Description

The description has been amended to take into account the relevant state of the art (document D1) and has been adapted to the new claims. Parts of the description comprising cancelled embodiments have been deleted and obvious errors have been corrected.

2.4 Drawings

Drawings which showed excised embodiments have been deleted and obvious errors have been corrected.

2.5 The application documents therefore do not contravene Article 123(2) EPC.

3. *Clarity*

The Board is of the opinion that the application in its present version satisfies Article 84 EPC.

4. *Novelty*

None of the prior art documents D1 to D4 discloses means for monitoring operating state indicative signals of engine accessories and engine-driven components and for selecting and outputting one of the preset model behaviour pattern data upon occurrence of a signal indicating a change of the operating state of one of the engine accessories and engine-driven components. The engine control system of Claim 1 therefore is novel vis-a-vis the disclosures of these prior art documents.

5. *Closest State of the Art*

5.1 The Board agrees with the Appellant to consider document D1 as the closest state of the art.

5.2 Document D1 describes a method and a device for controlling the air fuel ratio for an internal combustion engine having an air supply passage by regulating the air flow through an auxiliary air supply passage (Figure 2: 47), so that the auxiliary air supply can be controlled to counteract a predicted transient.

When a transient is detected, that is, that a minimum value of the rate of change of load has taken place, at a specific engine speed, the air flow control provided by the air bypass system is changed by a certain amount represented by a table value. This change is then decreased with time to a new value, anticipating the next transient, depending on the steady state value of engine speed and load.

Both the amount of instantaneous air flow change and the time constant associated with its decay are obtained from adaptively updated tables of engine speed and the rate of change of load, or similar engine transient

tracking parameters. Depending on the sign of the rate of change of load, the value in the table represents an opening of the valve for decelerations and a closing of the valve for accelerations. The tables are updated on the basis of statistical results taking into account an exhaust gas oxygen sensor signal.

5.3 Document D2 describes an electronic fuel control system with means for calculating the basic amount of injection fuel with the signal of engine load which is determined by the signals of air flow and engine speed; and for influencing the basic amount of fuel by correction factors depending on operating conditions. The control system detects acceleration from the difference of the load signals and initiates the injection of additional fuel if acceleration is detected. This control system also calculates ignition timing. There are no means described for updating stored data in the memory.

5.4 Document D3 describes a method of controlling the amount of fuel and ignition timing during transient operations of an internal combustion engine. According to this known method the operating condition at the time of actual fuel injection is predicted by extrapolation from the past data, that is to say an amount of air which would be taken into the combustion chamber at the time of actual fuel injection and an engine revolution at that time are predicted for calculation of the amount of fuel supply and for deriving ignition timing, thereby ensuring that the fuel supply quantity and ignition timing can always be controlled to an optimum. The amount of calculated injection fuel is thereby used to obtain an optimum ignition timing signal from a data map set in the read only memory that is prepared for correlating the engine speed to the amount of injection fuel to define the optimum ignition timing signal.

5.5 Document D4 describes a method of controlling the combustion sequence in internal combustion engines, wherein the optimum values of the combustion characteristics are determined as functions of the crankshaft angle and are stored in an electronic control unit. The actual combustion characteristic in the combustion chamber is continually measured and compared with the set values stored in the control unit and the deviations between the actual and set values are rectified by intervening into the formation of the mixture and/or the ignition system of the internal combustion engine. For each operating phase of the performance characteristics, from the idling speed to the maximum output, the optimum set value curves are recorded and stored in the electronic control unit. The stored optimum values are experimentally determined.

The purpose of this known method is to increase the efficiency of the internal combustion engines and to reduce the harmful exhaust emissions by eliminating cyclic variations in the combustion sequence. However, means for updating stored data in the memories during engine operation are also not described.

5.6 Therefore, document D1, which discloses updatable tables, can be taken as the starting point when considering inventive step.

6. *Problem and Solution*

6.1 Problem

Starting from the most relevant prior art document D1 the objective problem of the application may be to further improve the control accuracy of an engine control system and to reduce the response time at engine transient operation conditions.

6.2 Solution

By the means for sampling signals of engine operating parameters and storing them in a pattern memory when an unsteady operating condition is determined, the data memory can be updated to the actual standard of the engine. The means for selecting and outputting one of preset model behaviour pattern data upon occurrence of a signal indicating a change of the operating state of one of the engine accessories or engine-driven components, reduce the response time to the change of load resulting from that change of the operating state of the engine accessories or engine-driven components. The time necessary for detecting the actual load change by measuring the actual engine parameters is avoided by the means for synthesizing the model data with the actual engine operation pattern data to form predicted engine operating pattern data which are then used to influence future engine behaviour.

7. *Inventive Step*

7.1 None of the prior art documents D1 to D4 gives any suggestion towards providing means for monitoring operating state indicative signals of engine accessories or engine-driven components and for selecting and outputting preset model behaviour pattern data upon occurrence of a signal indicating a change of the operating state of one of the engine accessories or engine-driven components, and towards providing means for receiving the actual engine operation pattern data and the preset model behaviour pattern data for synthesizing them into predicted engine operating parameter data.

7.2 Document D1 describes a control system in which the next transient is anticipated depending on the steady state value of engine speed and load for shutting off the auxiliary air passage when the engine is in a heavy cruise mode thereby creating the ability to turn on additional air when needed. The auxiliary air passage is closed or partly closed when the engine is in the idle mode or steady state operation. The influence of engine driven components could only be taken into account indirectly by the engine speed and load signals.

Although the exhaust gas oxygen sensor signal is sampled at predetermined intervals and is statistically analyzed during a given time period (see column 6, lines 52 to 57), neither sampling of signals for each predetermined period of time to derive a pattern of engine parameters initiated when a particular engine operation condition is determined, nor recording the actual engine operation pattern data in pattern memories whose addresses correspond to the actual engine operation condition, is described in document D1. According to document D1 the values of two tables (56, 57) are incremented or decremented producing a richer or leaner average, based on a statistical result.

7.3 Documents D2 to D4 do not describe memories which are updated during engine operation. Therefore, the cited documents do not lead the skilled person to store actual engine operation pattern data of engine operating parameters in a memory when an unsteady operating condition is determined for comparing these stored pattern data with predicted engine operation pattern data based on the influence of engine-driven components.

7.4 The subject-matter as set forth in Claim 1 therefore involves an inventive step within the meaning of Article 56 EPC.

8. The subject-matter as set forth in Claim 1 is therefore patentable within the meaning of Article 52 EPC, so that a patent may be granted based on Claim 1, dependent Claims 2 to 7, which concern preferred embodiments of the system according to Claim 1, the modified description and the drawings.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to grant a European patent in the version as defined in above point VI.

The Registrar: The Chairman:

N. Maslin C. Andries