BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

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File No.: T 0302/91 - 3.2.4

Application No.: 88 107 960.2

Publication No.: 0 291 953

Classification: F02D 41/18

Title of invention: System for measuring amount of air introduced into combustion chamber of internal combustion engine with avoiding influence of temperature dependent air density variation and pulsatile air flow

D E C I S I O N
of 15 March 1994

Applicant: Nissan Motor Co. LTD.

Proprietor of the patent:

Opponent:

Headword:

EPC: Art. 56

Keyword: "Inventive step (yes)"

Headnote
Catchwords

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0302/91 - 3.2.4

D E C I S I O N
of the Technical Board of Appeal 3.2.4
of 15 March 1994

Appellant: Nissan Motor Co. LTD.
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Decision under appeal: **Decision of the Examining Division 2.3.01.101 of the European Patent Office despatched on 28 November 1990 refusing European patent application No. 88 107 960.2 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: C.A.J. Andries
Members: P.R. Alting van Geusau
J.-P.B. Seitz

Summary of Facts and Submissions

I. European patent application No. 88 107 960.2 was filed on 18 May 1988 and published on 23 November 1988.

II. Following the communication of 17 January 1990 in which the Examining Division raised objections with respect to clarity and lack of inventive step of the claimed subject-matter, with its decision despatched 28 November 1990 the application was refused on the ground of lack of inventive step of the subject-matter of Claims 1 to 7 as filed on 2 August 1990, in view of the disclosures of:

D1: Proceedings of the XXI Fisita Congress, Belgrade, 2 to 6 June 1986, paper 865078, pages 3.125 to 3.131; G. Härtel et al.: "Entwicklung eines neuen elektronischen Gemischbildungsystems", and

D2: Proceedings of the XXI Fisita Congress, Belgrade, 2 to 6 June 1986, paper 865016, pages 1.111 to 1.118; H.S. Braun et al.: "Antriebsmanagement-Intelligente Triebwerkssteuerung der Zukunft".

III. An appeal was lodged against this decision on 4 February 1991 with payment of the appeal fee on the same day. The Statement of Grounds of Appeal was filed on 8 April 1991.

IV. With its communication dated 12 May 1993 the Board raised a number of questions as regards clarity and support of the claimed subject-matter and, in view of the defects in this respect, requested the Appellant to file new clarified claims and an adapted description.

V. After an interview being held on 11 November 1993 the Appellant filed amended application documents.

He requested grant of a patent on the basis of new Claims 1 to 4, amended description pages 1, 2 and 5 to 27 filed with letter of 1 March 1994, description pages 3 and 4 filed with letter of 31 March 1994 and figure sheet 2/15 filed with letter of 1 March 1994, together with the figure sheets 1/15 and 3/15 to 15/15 as originally filed.

Some small corrections in Claim 1 were agreed upon over the telephone on 30 March 1994. In the characterising part of Claim 1, on line 3, "II" and "K"" were amended to read "2" and "K2", respectively. On line 12 "and" was deleted and on line 13 "basic" was inserted between "said" and "intake".

Claim 1 of the current set of claims reads as follows:

"A system for detecting intake air flow amount in an internal combustion engine, comprising:

first means (20) for monitoring an engine revolution speed to produce an engine speed indicative first signal (N);

second means (19) for monitoring a throttle angle position to produce a throttle angle indicative second signal (A) representing a path area of an intake air passage (18), and

third means (25) for deriving a basic intake air flow amount (Q_{Ho}) from the first signal (N) and the second signal (A);

an engine coolant temperature sensor (21) for producing an engine coolant temperature indicative signal (Tw);

an intake air temperature sensor (22) for producing an intake air temperature indicative third signal (TA) as an intake air density affecting parameter, and

means (25) for deriving an air density dependent first correction value(KTAO) for correcting said basic intake air flow amount (Q_{Ho}) on the basis of said third signal (TA);

characterised by

means (25) for deriving on the basis of said first and second signal values and values stored in a memory (Figure 2), a delay time based correction coefficient (K2), which is a coefficient depending upon lag of time of introduction of intake air into said engine cylinder from a position of said throttle valve (15) to said engine cylinder and for correcting said basic intake air flow amount (Q_{Ho}) on the basis of said delay time based correction coefficient (K2),

said means (25) further deriving an air density dependent second correction value (KTATW) based on said engine coolant temperature indicative signal value (Tw), for correcting said basic intake air flow amount (Q_{Ho}) also on the basis of said second correction value (KTATW)."

VI. In support of his request the Appellant submitted the following arguments:

The Examining Division considered that, in addition to the precharacterising features, D1 also discloses that the engine coolant temperature is used for correcting

the air flow amount determined on the basis of engine speed and throttle opening.

However, in D1 the engine coolant temperature is used only for determining the amount of fuel when cranking the engine and during the warming-up operating period. That is, during the normal operating conditions of the engine, the engine coolant temperature has no influence when determining the amount of fuel and consequently the engine coolant temperature is not considered when determining the intake air flow amount.

The subject-matter claimed is thus distinguished from the closest prior art disclosed in D1 by the characterising features of the present Claim 1 and even when combining the disclosures of D1 with those of D2, showing a delay function for determining the air flow amount, the subject-matter of Claim 1 is not obvious because none of the references suggests using the engine coolant temperature as a further air density affecting parameter at any time during the operation of the engine.

Reasons for the decision

1. The appeal complies with the requirements of Articles 106 to 108 and Rule 64 EPC. It is admissible.

2. *Amendments*

2.1 Claim 1 is based on the subject-matter of the originally filed Claims 15 to 21 and contains clarifications as to the means for deriving a basic intake air flow amount (Q_{Ho}) (see the originally filed page 13, last line, to page 14, line 15), the manner in which the delay time

based correction coefficient (K2) is derived (see the originally filed page 15, lines 6 to 16) and that it is the basic intake air flow amount which is corrected also with respect to the coolant temperature and delay time of introduction of air past the throttle valve into the engine cylinder (see the relations (7), (2) and the relation on page 15, line 24).

Claims 2 to 4 are based on the subject-matter of the original Claims 22, 23 and 27, respectively.

No objections with respect to clarity and support (Article 84 EPC) and added subject-matter (Article 123 (2) EPC) arise against the new claims.

2.2 The single independent Claim 1 is satisfactorily related to the closest prior art and therefore in this respect the requirements of Rule 29(1) EPC are fulfilled.

2.3 The amendments to the description concern adaptations to the now claimed subject-matter, the discussion of the most relevant prior art in accordance with Rule 27(1)(b) EPC and the correction of a number of small clerical errors. These amendments meet the requirements of the EPC also.

3. *Novelty*

3.1 Novelty of the subject-matter of Claim 1 can be concluded because, as was also submitted by the Appellant, none of the cited documents discloses a system for detecting the intake air flow amount in an internal combustion engine in which means are provided for correcting a calculated basic intake air flow amount, based on the engine speed and throttle angle position, with respect to the engine coolant temperature in order to permanently take into account the influence

of the engine coolant temperature on the density of the intake air.

3.2 In the contested decision the Examining Division was of the opinion that in addition to the precharacterising features of Claim 1, document D1 should be considered to disclose exactly such a correction because of the correction factor Ki used in the calculation of the fuel injection amount Ti (see Figure 9 of D1) and the fact that this correction factor comprised further coefficients based on the engine coolant temperature (see page 3.129, "Nachstart" and Warmlaufkennfeld").

However, these correction factors, being basic fuel injection amount correction factors, must be compared with the engine driving condition correction coefficient (COEF) referred to in the present application (see page 18, line 31 to page 19, line 9).

The engine coolant temperature dependent correction value (KTATW) in accordance with Claim 1 of the present application differs from such a known correction factor in that it is used permanently to correct the calculated basic intake air volume. The corrected intake air volume is then used to calculate the basic fuel injection amount (see the relation (2) on page 18) and the latter is corrected, if necessary, with engine driving condition correction coefficients such as a cold engine enrichment factor or an acceleration enrichment factor or engine start-up factors (see page 18, line 32 to page 19, line 2).

In the calculation of the fuel injection amount Ti (see Figure 9 of D1) there is a parameter F_T which is said to take into account the influence of the temperature on the air density. However, it becomes clear from D1 as a whole (cf. Figure 5, system "Indirekte Erfassung mit

α/n-System"; Figure 10), that it is the air temperature which is meant as the air density influencing parameter, so that neither an explicit nor an implicit indication can be found in D1 that the permanent influence on the air density of the engine coolant temperature in the region up to the cylinder inlet area has to be taken into account.

The engine coolant temperature dependent correction factor of the present application is therefore, in fact, an additional and qualitatively different correction factor when compared to the driving condition factors known from the prior art disclosed in D1.

4. *Inventive step*

4.1 The closest prior art is disclosed in document D1. In Figure 5 on page 3.127 an intake air flow amount detecting system is shown in which the engine revolution speed and the throttle angle is used to determine a basic intake air flow amount and apparently a correction based on the sensed air temperature is carried out ("Indirekte Erfassung mit α/n-System"). From the fact that the system also obviously includes a cold enrichment correction, based on the engine coolant temperature, the combination of precharacterising features of Claim 1 of the present application can be derived from this system.

4.2 This prior art system, being an indirect measuring system, does not take into account the variation of the air density caused downstream of the air temperature sensor (see Figure 10 of D1) due to heating between the throttle valve location and the respective cylinder inlet openings by the engine inlet duct, which temperature is dependent on the engine coolant temperature, so that the calculation of the exact fuel

injection amount cannot be satisfactorily precise as that required nowadays.

The system in accordance with Claim 1 of the present application takes these further air density affecting parameters into account in order to determine more precisely the air flow amount and consequently the fuel injection amount, for optimal functioning of the engine under all conditions.

4.3 The problem to be solved by the features of Claim 1 of the present application is therefore the provision of an intake air amount detecting system which can provide intake air amount data as precise as that required in today's high precision engine control systems in order to optimise the engine performance and anti pollution engine control (see page 3, third paragraph, and page 27, lines 20 to 26 of the present patent application).

4.4 Although, D2 already teaches the incorporation of a delay function, when determining the exact air flow amount, essentially in accordance with the first characterising features of Claim 1 of the present application, neither D1 nor D2 or any of the documents cited in the search report discloses or gives an incentive to take permanently the coolant temperature into account when determining the correct intake air flow amount.

4.5 Indeed, although GB-A-2 142 166 (page 4, lines 53 to 57 and lines 83 to 111), EP-A-0 155 663 (page 5, lines 1 to 7), EP-A-0 185 552 (column 9, lines 51 to 66) and US-A-4 625 690 (column 5, lines 21 to 29) disclose that the coolant temperature is detected and used for determining the fuel injection amount, no teaching whatsoever is derivable from these documents that the

coolant temperature signal is used for anything else than for the correction of the fuel injection amount in the manner as disclosed in D1, thus as an engine driving condition correction coefficient such as the term COEF in the relation (3) of the present application.

It can further be concluded from the discussion of JP-Y-60-39465 cited in the description of the present application that, as regards the provision of a coolant temperature signal for correcting the calculated intake air flow amount, this document does not disclose anything more than the above-cited prior art.

4.6 Summarising, the Board therefore comes to the conclusion that the subject-matter of Claim 1 of the present application cannot be derived in an obvious manner from the cited prior art and accordingly involves an inventive step (Article 56 EPC). This claim, together with dependent Claims 2 to 6 and the amended description and drawings form a suitable basis for grant of a patent.

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 patent in the version as set out in above section V (second and third paragraphs).

The Registrar: The Chairman:

N. Maslin C. Andries