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Bezeichnung der Erfindung: Method and system for engine control
Title of invention:
Titre de l'invention :

Klassifikation / Classification / Classement : F02D 37/02

ENTSCHEIDUNG / DECISION
vom / of / du 29 August 1990

Anmelder / Applicant / Demandeur :

Patentinhaber / Proprietor of the patent /
Titulaire du brevet : HITACHI Ltd

Einsprechender / Opponent / Opposant : Robert BOSCH GmbH

Stichwort / Headword / Référence :

EPÜ / EPC / CBE Article 56

Schlagwort / Keyword / Mot clé : "Inventive step (no)"

Leitsatz / Headnote / Sommaire

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Case Number : T 145/89 - 3.5.2

D E C I S I O N
of the Technical Board of Appeal 3.5.2
of 29 August 1990

Appellant : (Proprietor of the patent)
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Respondent : (Opponent)
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Representative :

Decision under appeal : Decision of the Opposition Division of the European Patent Office dated 27 December 1988 revoking European patent No. 0 017 933 pursuant to Article 102(1) EPC.

Composition of the Board :

Chairman : E. Persson
Members : W. Riewald
A. Hagenbucher

Summary of Facts and Submissions

I. European patent No. 0 017 933 incorporating six method claims and six apparatus claims was granted to the Appellant on 13 August 1986 in response to European patent application No. 80 101 959.7, filed on 11 April 1980 and claiming priority of 13 April 1979 of an application in Japan.

II. A notice of opposition was filed on 12 May 1987 by the Respondent requesting revocation of the patent on the ground of lack of inventive step. In support of his request he referred to the following prior art documents:

D1: US-A-4 130 095;
D2: DE-A-2 817 594;
D3: Proceedings of the IEEE, Vol. 66, No. 2, February 1978, pages 142-150; "Evolving microprocessors which better meet the needs of automotive electronics".

After the opposition period the Opponent cited

D4: US-A-4 084 240,

which, however, was regarded as not relevant and, therefore, not introduced by the Opposition Division into the proceedings.

III. After considering the Grounds for Opposition and having heard the parties in oral proceedings of 15 December 1988,the Opposition Division revoked the patent laying down the reasons for the revocation in a written decision dated 27 December 1988.

IV. On 1 March 1989, the Appellant lodged an appeal against the decision, having paid the appeal fee on 23 February 1989. A Statement of Grounds was filed on 5 May 1989.

During the appeal proceedings, the Respondent made, with letter of 21 November 1989, additional reference to a document US-A-4 070 908, which was not introduced into the proceedings in application of Article 114(2) EPC.

In contrast to the Opposition Division, however, the Board considered the document D4, cited above, to be relevant.

Furthermore, the Board, in application of Article 114(1) EPC, introduced into the proceedings the document

D5: JP-A-53 105 639,

which was cited by the Respondent in a letter of 20 December 1989 and considered to be very relevant by the Board.

V. In a communication accompanying summons for oral proceedings, the Rapporteur drew the parties' attention to the fact that nearly all of the features of the method Claim 1 and the essential features of the system Claim 7 appeared to be known from D5. Furthermore, a number of deficiencies as to clarity of the dependent claims were indicated. The provisional opinion of the Rapporteur was that neither the independent Claims 1 and 7 nor the dependent claims appeared to comprise inventive subject-matter.

VI. At oral proceedings held on 29 August 1990, the Appellant filed a new set of 10 claims and declared that these claims were essentially directed to overcome the formal objections to the dependent claims, that he, however, maintained the independent Claims 1 and 5 (= former

Claim 7) with the exception of the reference sign "$\Delta\sigma$" for the feature "memory correction data" being incorporated in addition to the reference sign QA_1 presently following that feature.

After discussion of the matter the Appellant requested that the decision under appeal be set aside and that the patent be maintained on the basis of Claims 1-10 as filed in the oral proceedings (main request) or on the basis of these claims with the reference signs (QA_1 and $\Delta\sigma$) in Claim 1 being deleted (auxiliary request).

The Respondent requested that the appeal be dismissed.

VII. Claim 1 according to the main request reads as follows:

"Method for controlling a combustion engine in which an engine control signal is generated on the basis of a signal detected each moment from at least one sensor;

producing at least one sensor output value (detection signal) by at least one sensor detecting the engine operating condition (Figure 9; 172);

controlling the operating conditions of said engine in accordance with said engine control signal;

c h a r a c t e r i z e d by the following steps:

(a) storing at least at the time of delivery in an electrically alterable non-volatile memory correction data (QA_1,$\Delta\sigma$) for correcting the detection signal produced from said at least one sensor (24 or 72) in a manner to maintain the engine in a proper operating condition;

(b) electrically correcting at least one said sensor output value by said correction data;

(c) producing an engine control signal on the basis of at least one said electrically corrected sensor output value (Figure 9; 176; 178; 180); and

(d) controlling the operating condition of said engine in accordance with said engine control signal."

Claim 1 according to the auxiliary request is only distinguished therefrom by the deletion of the reference signs "(QA_1,$\Delta\Theta$)".

VIII. In the oral proceedings, essentially two topics were discussed:

- The allowability of adding the reference sign " " in Claim 1.

- The question whether the subject-matter of Claim 1 involves an inventive step.

IX. The Appellant's submissions can be summarised as follows:

The Opposition Division's decision is objected to because it only relies on a prior art describing methods for correcting control signals, whereas the application deals with a method for correcting sensor signals. Reference is made to Figure 9 of the application which shows that the sensor signal is corrected at 174 before it is used for searching a look-up table at 176 for generating a control signal.

In contrast to this, D1 discloses a method according to which the values of a look-up table are updated in response to a feedback circuit detecting the oxygen

concentration in the exhaust gas, with the result that the control signals generated in the look-up table are corrected and not the sensor signals at the input of the look-up table.

Document D3 discloses on page 147, left-hand column, lines 14 to 27 the reprogramming of microprocessor engine controller modules at the time of delivery for adapting the modules to the identity of the automobile or, e.g. at the dealer, in order to account for drifting engine characteristics due to wear and tear and vehicle age. Instructions are altered and not sensor signals.

The method for engine control disclosed in document D5 by one of the co-inventors of the present patent provides for a zero adjustment of a sensor (e.g. detecting the opening degree of the throttle valve) by storing the corresponding offset amount "at the time of power being thrown in" (i.e. the time of actuation of the ignition key) in a RAM (i.e. a volatile memory). In contrast to the present invention, there is no long-term calibration of the sensor by storing the offset value in a non-volatile memory at the time of delivery. In addition to this known simple offset-correction, the present invention is devised for an arbitrary correction of the sensor output in its whole measuring range (e.g. linearisation of the characteristic).

Thus, three steps taken by the inventor are discernible:

- The choice of the sensor output as the value to be corrected.

- The acquisition of correction values by calibration.

- The storing of the correction values in a non-volatile memory.

It should be noted that the scope of the claim is aimed at any form of sensor calibration in connection with the control of combustion engines. Thus, the references QA_1 and $\Delta\Theta$ for the memory correction data are only to be understood as examples, $\Delta\Theta$ standing for correction of an adjustment error of the crank angle sensor (72 in Figure 1).

X. The Respondent's submissions can be summarised as follows:

Claim 1 as granted specifies that the data stored in the non-volatile memory are correction data for correcting detected sensor signals. The detected flow rate of the intake air under the stationary state of the engine is taken as an example by the reference sign QA_1. However, the reference sign $\Delta\Theta$, now added in the newly filed Claim 1, is a correction value added to the calculated ignition advance angle Q_{IGN3} according to step 182 in the flowchart of Figure 9. This is regarded as the correction of a control signal and not of a sensor signal. The adding of the reference sign is, therefore, considered to broaden the scope of Claim 1 and thus to contravene Article 123(3) EPC.

In contrast to the Appellant's submissions, the Opponent can only derive from the present patent a teaching providing a sensor offset-compensation, as in principle known from document D5, and not an adjustment of the whole characteristic. D5 is, therefore, to be taken as the closest prior art. The offset detection is effected in this prior art "at the time of power thrown in" in advance of the subsequent operation. In the Opponent's opinion, this statement is largely equivalent to the corresponding wording of Claim 1 "at least at the time of delivery"

because also the patent description refers in column 2, line 30 onwards to the principle of a correction of the sensor output values before controlling the engine.

Furthermore, it has to be taken into account that document D3 discloses the general principle to accommodate a microprocessor for engine control to the specific requirements of an automobile at the time of the identification of the automobile, i.e. at the time of its delivery, or at the dealer's, e.g. to account for drifting engine characteristics due to wear and tear and vehicle age (D3, page 147, left-hand column, lines 14 to 27). The necessity to provide a calibration at the diverse inputs is mentioned on page 146 of D3 in the fourth paragraph.

The Opponent takes, therefore, the view that the claimed method lacks an inventive step in view of the two documents D3 and D5.

Reasons for the Decision

1. The appeal is admissible.

2. Allowability of the amendments to the claims.

2.1 In the oral proceedings, the question arose whether the reference sign $\Delta\Theta$ in feature (a) of the characterising portion of Claim 1 can be regarded as a memory correction data for correcting the detection signal produced from a sensor in accordance with the wording in section (a) of the characterising portion of Claim 1.

According to Figure 9 of the patent, the "ignition advance angle" Q_{IGN3} is computed in dependence on the engine speed (N), the amount of the intake air flow (QA) and the engine

temperature (TW). It is clear that the control of the thus calculated ignition advance angle requires a detection of the crank position. The measure for the crank position is a count of crank position pulses CPP sensed by crank position sensor 68, the count being regularly restarted by pulses CRP at predetermined crank angles which are sensed by a crank angle sensor 72 (see description, column 4, lines 11 to 25 and the detailed description in connection with Figure 7A to 7F).

The correction value $\Delta\Theta$, introduced at step 182 of the engine control (Figure 9), was determined beforehand under an idling state of the engine in order to compensate for any improper timing of the ignition in the idling state caused by an incorrect generation of an output from the crank angle sensor 72 (column 9, line 49 to column 10, line 15). This amounts to a correction value $\Delta\Theta$ that serves as a correction datum for correcting the detection signal produced from the (crank angle and crank position) sensors 72 and 68 in a manner to maintain the engine in a proper operating condition.

Consequently, the incorporation of the reference sign $\Delta\Theta$ in Claim 1 refers to an embodiment which is well within the claimed scope of protection and thus does not contravene Article 123(3) EPC.

2.2 Since the patent cannot be maintained on the basis of the wording of Claim 1 according to the Appellant's main and auxiliary request, as set out in the following, there is no need for a further consideration of the other claims in respect of the allowability of the amendments.

The Board has, however, noted that at least the second independent Claim 5 (= granted Claim 7) has not been altered.

3. A method for controlling a combustion engine with the precharacterising features and most of the characterising features of Claim 1 is known from document D5:

An engine control signal is generated on the basis of detected signals; cf. the throttle sensor 7, which may, according to the text, also be replaced by a manifold vacuum sensor or an air flowmeter, and crank angle sensor 5 and crank position sensor 4 in the same arrangement as in the present patent.

From the excerpt of the detailed description of D5 in English translation, provided by the Opponent, can further be derived:

At "the time of power being thrown in" a correction datum (in the form of an offset amount of the throttle sensor 7 from its true zero position) for correcting the detection signal produced from the sensor is stored in a memory 23 (random access memory). The engine control signal (ignition timing advancing control) is produced on the basis of the electrically corrected throttle sensor output value, in order to control in accordance therewith the operating condition of the engine.

According to this prior art, the memory is a random access memory which may be regarded as a volatile memory which receives its correction data to be stored each time anew at the time of power being thrown in.

The method of Claim 1 differs therefrom only by the feature that the correction data are stored in the memory (at least) at the time of delivery instead of at every time of power being thrown in. This requires a non-volatile memory in order to avoid the loss of stored data when the power is cut off.

4. The said modification of the method known from D5 must, however, be considered as obvious in view of the further prior art known in the technical field of combustion engine control.

Document D3, dealing in a general form with the evolution of microprocessors for automotive electronics, suggests at page 147, left-hand column, lines 14 to 19 that engine controller modules may be preprogrammed to a standard test pattern by the introduction of an appropriate sequence of instruction words in the microcomputer, in order to adapt the controller to the identity of a particular automobile. This is, of course, carried out at the time of delivery. Further reprogramming may be necessary at the dealer's to account for drifting engine characteristics due to wear and tear and vehicle age (lines 20 to 27, loc.cit.). Page 146 of D3, left-hand column, fourth paragraph, mentions explicitly the requirement to calibrate diverse input functions, which includes input signals of sensors.

Document D4 discloses details about the use of a programmable read only memory circuit in order to tailor a basic program for the control of a particular engine.

It is in the nature of sensors used in the control of combustion engines that they do not change their characteristics so frequently that a recalibration is really necessary at each new start of the engine. The skilled person, with the knowledge of documents D3 or D4, will, therefore, readily envisage to accommodate the sensor characteristics at greater intervals, i.e. at the time of delivery and at a later time only when some drifting of the characteristics must be expected. Such a solution requires, of course, the replacement of the volatile memory (RAM) of D5 by a non-volatile memory which

maintains its stored data when the engine is stopped, but must be alterable for the said accommodation at greater intervals.

The Appellant's argument that the method of D5 only allows for a simple offset-correction whereas the claimed method is devised for an arbitrary correction of the sensor output in its whole measuring range cannot be accepted. Also the present patent discloses the determination of a correction value for the air flow rate QA detection only at a single point of the sensor characteristic, viz. with the actual air flow rate being zero when the engine is stationary (see step 152 in Figure 8 and description, column 11, line 52 to column 12, line 19). This single correction value is then used in the program for the engine control as an additive to any of the detected air flow rates (Figure 9, step 174 and description, column 12, lines 30 to 38). This amounts to the same principle of offset-correction as depicted in Figure 3 of document D5. The situation is similar with the correction value for the crank position detection which is determined only for a single point of the engine characteristic as indicated in the description at column 10, lines 1 to 6. There is no disclosure of details in the present patent how to provide contingently different correction values for different operating points of a sensor characteristic.

5. It follows from the foregoing considerations that the subject-matter of Claim 1 is novel but lacks the necessary inventive step in the sense of Article 56 EPC.

Since reference signs shall not be construed as limiting the claim (Rule 29(7) EPC), the finding of obviousness is independent of the existence of the reference signs "(QA_1,$A\Theta$)" in Claim 1 according to the main request.

6. Claim 1 according to the main request as well as according to the auxiliary request (reference signs QA_1 and △ ⊖ deleted), can, therefore, not be allowed.

Since the Appellant requests to maintain the patent with this Claim 1, the appeal has to be dismissed, and the question of a contingent maintenance of the patent on the basis of the second independent Claim 5 or of one of the dependent claims is not at issue. The Board states, however, that the proceedings in the present case have clearly shown that the patent documents as a whole do not appear to contain patentable subject-matter.

Order

For these reasons, it is decided that:

The appeal is dismissed.

The Registrar: **The Chairman:**

M. Kiehl **E. Persson**