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D E C I S I O N
of 13 July 1995

Case Number: T 0768/93 - 3.2.4

Application Number: 86107882.2

Publication Number: 0206091

IPC: F02D 41/16

Language of the proceedings: EN

Title of invention:
Method for control of idle rotations of internal combustion engines

Patentee:
HONDA GIKEN KOGYO KABUSHIKI KAISHA

Opponent:
Robert Bosch GmbH

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step - yes"

Decisions cited:
-

Catchword:
-

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Case Number: T 0768/93 - 3.2.4

D E C I S I O N
of the Technical Board of Appeal 3.2.4
of 13 July 1995

Appellant: (Opponent)
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Representative: -

Respondent: (Proprietor of the patent)
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Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office dated 16 June 1993 and dispatched to the parties on 28 June 1993 concerning maintenance of European patent No. 0 206 091 in amended form.**

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 (Opponent) lodged an appeal, received on 28 August 1993, against the interlocutory decision of the Opposition Division, dispatched on 28 June 1993. The appeal fee was also paid on 28 August 1993. The statement setting out the grounds of appeal was received on 3 November 1993.

II. In response to a communication of the Board the Respondent (Proprietor of the patent) filed with a letter dated 21 June 1995 a new main request and two auxiliary requests.

The wording of Claim 1 of the main request with the correction of the reference sign (IV) to (V) is as follows:

"A method for the control of the idling rotational speed of an internal combustion engine provided with a control valve (30) adapted to control the amount of inlet air to said internal combustion engine during an idling operation thereof by allowing the degree of opening of said control valve (30) to be controlled proportionately to the value of a control valve command (lcmd) obtained on the basis of the sum of a feedback control term (lfb) and an addition correction term (lat) conforming to the load of an automatic transmission, characterized by said automatic transmission including a torque converter, and by obtaining said addition correction term (lat) as a continuously variable function of a parameter representing the operating state of said torque converter wherein said parameter is the vehicle speed (V) which is a function of the rotational speed of an output member of said torque converter."

III. Oral proceedings were held on 13 July 1995.

IV. The Appellant argues that the most relevant prior art document is document D1 (DE-A-3 020 494) which already deals with the problem of a stable engine adjustment (see page 12, last paragraph) and with the correction of the opening rate of an air bypass valve in order to attain an optimal air amount in accordance with a change of engine load (page 13, lines 15 to 21). In particular, formula I on page 62 discloses a way to determine the control signal (ISC_{DN}) for the air valve, taking into account a correction coefficient relating to the automatic gear (ISC_{AT}) and a correction coefficient (ISC_{CL}) relating to the closed loop control. Although, according to the description of document D1, the bypass valve is only controlled by the open loop control mode during unstable engine conditions, formula I concerns open and closed loop control, which becomes clear from Figure 19 and the description on page 62, from line 12 onwards. The closed loop control system is in operation during small changes of parameters. It is true that details of the correction coefficient (ISC_{AT}) relating to the automatic gear are not described in document D1, however from page 67, last paragraph, it becomes clear that no correction coefficients are necessary at higher vehicle speed. This implies that there is a correction coefficient at low vehicle speed. Therefore, it would be obvious that the correction coefficient (ISC_{AT}) relating to the automatic gear takes into account vehicle speed. This would be supported by Figure 12 of document D1 which shows the influence of vehicle speed on the correction coefficients.

In the oral proceedings the Appellant explained the method known from document D1 and that of Claim 1 of the main request by means of drawings and came to the conclusion that the only difference between the methods

was the additional correction term being obtained as a continuously variable function of the engine speed. However, this differing feature would be obvious for the skilled person because of the enormous improvement of computer technology which allowed a much faster and more accurate processing of functions at the date of the application of the impugned patent than at the filing date of the prior art document D1. The skilled person therefore would use this improved computer technology to improve the engine control system and would take into account the variable engine speed when determining the correction factor, instead of the step like variation known from document D1.

The Appellant is of the opinion that the method defined by Claim 1 of the main request does not involve an inventive step with regard to the teaching of document D1.

V. The Respondent argues that it is clear that the wording "function of a parameter representing the operating state of said torque converter wherein said parameter is the vehicle speed" used in Claim 1 of the main request, implies that the automatic gear is in its D-range position and that therefore the vehicle is connected with the engine. The continuously variable function relating to the vehicle speed is disclosed in Figure 5 and the corresponding part of the description. A specific value of the speed at which the correction coefficient (Lat) becomes zero is not mentioned in the patent but the invention deals with a method of controlling the idling rotational speed, i.e. when the throttle valve is substantially closed and the engine speed is in the particular idling speed range (column 1, lines 51 to 54 of the patent). In this operation condition the vehicle either is in the stop position or is travelling in the creep state or in the state of

engine brake. As is clear from the description and from the feedback control term lfb defined in Claim 1, the method of controlling the idling rotational speed is related all the time to a closed loop control which is influenced by a correction term (lat) from an outside parameter (vehicle speed).

The Respondent also considers document D1 as the most relevant prior art document. There is, however, an essential difference with regard to the invention, since document D1 nowhere gives a hint for obtaining an additional correction term as a continuously variable function of the vehicle speed. Figure 12 of document D1 would concern the open loop operation mode and would only lead to a step like variation of the correction term. The Respondent explained on the basis of the correction values shown in Figure 12 of document D1 the influence of the vehicle speed thereon.

The Respondent further argues that according to the invention, it is not the brake which is measured and taken into account for a step like increase of the correction value in order to take into account braking during idling, but it is a continuously variable function of the vehicle speed which is used. The change of the vehicle speed indicates acceleration and deceleration of the vehicle.

The Respondent also stated during the oral proceedings that the reference sign (IV) in Claim 1 of the main request should be (V).

VI. Requests

The Appellant requests that the decision under appeal be set aside and the patent be revoked.

The Respondent requests that the decision under appeal be set aside and that a patent be maintained on the basis of:

1. The main request as filed with letter dated 21 June 1995, with the correction of the reference sign (IV) to the reference sign (V) in Claim 1;

2. Auxiliary requests 1 and 2 as filed with letter dated 21 June 1995.

Reasons for the Decision

1. The appeal is admissible.

2. *Amendments*

2.1 Claim 1 (main request)

Claim 1 of the main request differs from the granted Claim 1 only by the term "continuously variable" which was added between the words "a" and "function of a parameter" in the characterizing portion of the Claim 1 and by the correction of the reference sign (IV) to (V).

The feature concerning "a variable function of a parameter ... wherein said parameter is the vehicle speed" is disclosed in originally filed and published Figure 5 and the corresponding part of the description

(originally filed application page 13, line 7 to 26, and granted description column 6, line 49 to column 7, line 13).

This additional feature restricts the protection conferred.

2.2 Dependent claims (main request)

According to the main request Claims 5, 8 and 9 of the granted patent are deleted and Claims 6 and 7 of the granted version are renumbered. In the new Claim 5 the term "the prescribed" is altered to "a prescribed" and in the new Claim 6 a comma is inserted after the term "Claim 5".

2.3 Description and drawings (main request)

The description is adapted to the new Claim 1. The part of the description (column 9, line 16 to column 15, line 13), as well as Figures 8 to 14 concerning the second embodiment of the invention, which no longer corresponds with the new Claim 1, are cancelled.

2.4 The amended version of the patent according to the Respondent's main request does not contravene Article 123 EPC, which was not disputed by the Appellant.

3. *Novelty (main request)*

The Board ascertained during examination that the method of Claim 1 is novel with regard to the cited prior art. Novelty was not disputed by the Appellant during the appeal.

4. *Closest state of the art (main request)*

4.1 The Appellant and the Respondent consider document D1 as the most relevant prior art document. During the oral proceedings only this document was discussed. The Board therefore also takes this document as the starting point in assessing inventive step.

4.2 Document D1 discloses a method of controlling the rotational speed (including idling) of an internal combustion engine. It is indicated therein that either open loop control or closed loop control is used. It can therefore be accepted that under certain conditions a closed loop control with the possibility of correction will be used. The engine described in document D1 is provided with a control valve (50) adapted to control the amount of inlet air to said internal combustion engine during an idling operation by allowing the degree of opening of said control valve (50) to be controlled proportionately to the value of a control valve command (ISC_{DN}) obtained on the basis of the sum of a basic control term (ISC_{TW}: "Grundsteuerwert"), which is related to the engine temperature, and a number of correction factors ("Korrekturwert") relating to the automatic transmission (ISC_{AT}), to motor acceleration and deceleration (ISC_{TR} and ISC_{AS}) and to the feedback control (ISC_{CL}) (see page 62, formula I).

4.3 Document D1 teaches the automatic switching between a closed loop (feedback) and an open loop control. The whole disclosure of document D1 clearly points to the fact that a closed loop control is only used under stable engine rotation conditions. In particular during starting of a vehicle or during deceleration the closed loop control is switched to the open loop control (see page 11, first paragraph and page 13, lines 7 to 18). Although in the control method of document D1 vehicle

speed is taken into account (see Figure 12, step 386; and Figure 21, step 722), there is no indication of obtaining an additional correction term as a continuously variable function of the vehicle speed parameter. The flow chart of Figure 12, which discloses a program for determining correction values during and after engine start (see page 41, last paragraph) and which considers vehicle speed (flow chart step 386), discloses a step like increase of the control output by a high constant value (i.e. 21) at low vehicle speed operation (below 4 km/h) and by a small constant value (i.e. 3) at high vehicle speed operation (≥ 4 km/h). The flow chart downstream of step 366 concerns the open loop control (see page 44, lines 16 to 18).

5. *Problem and solution (main request)*

5.1 Problem

With regard to the state of the art known from document D1 the objective problem of the invention is to provide a simplified method for controlling the engine speed during idling of an internal combustion engine without heavily dropping the engine speed or inducing the engine stall when the magnitude of automatic transmission (AT) load is suddenly increased, particularly, when the automatic transmission is in its D-mode during braking.

5.2 Solution

The additional correction term as a continuously variable function of the vehicle speed not only takes into account the value of the vehicle speed as such but also indicates acceleration or deceleration because of this variable function of the speed.

6. *Inventive step (main request)*

6.1 Although document D1 can be interpreted as disclosing the features of the preamble of Claim 1 of the main request, the main feature of this known method is the switching from the open loop control at engine transient conditions, such as engine acceleration and deceleration, to the closed loop control at engine steady state condition, when the throttle valve is in its closed position (see page 13, lines 7 to 21, and page 46, line 32 to page 47, line 26) and vice versa. This method therefore is based on an open loop system and on a closed loop system and one of the results of the problem concerning a stable engine operation (see page 12, last paragraph) is the smooth and stepless switching between the two systems (see for instance page 15, lines 3 to 7).

6.2 The present patent however only deals with a closed loop control for idling in which an addition correction term is added to the feed back control term, which is the basic control term (see column 2, lines 4 to 10), and influences thereby the closed loop control during idling. Switching between a closed loop system and an open loop system is not described and is not part of this invention.

According to the Board, a control system switching during idling in accordance with the engine conditions between an open loop control system and a closed loop control system (cf. document D1) is different from a closed loop control system working all the time during idling. Modifying the first system in such a manner that the second system is created can only result from considerations based on an ex-post facto analysis, particularly since firstly there is in the cited documents no indication which leads to such a

modification, and secondly such a modification would clearly negate the teaching of document D1 (page 13, lines 7 to 11; page 12, lines 5 to 15).

6.3 It is true that formula I on page 62 of document D1 takes into account several correction values, and that one of these correction values relates to the automatic transmission (ISC_{AT}). However, the teaching of this formula is incomplete if formula I is considered to be used in a closed control loop. The determination of this correction value relating to the automatic transmission (AT) and taking into account vehicle speed is only explained in document D1 with regard to an open loop system (flow chart in Figure 12; page 44, lines 16 to 18), and only proposes a step like increase (21) with regard to a low vehicle speed and a step like increase (3) with regard to a high vehicle speed. Therefore, no information is given in the disclosure of document D1 with respect to correction values relating to automatic transmission for closed loop control systems.

Furthermore, the basic control term for determining the value of the control valve command is, according to formula I of document D1, the control term (ISC_{TW}: Grundsteuerwert) depending on the engine temperature, and not the feed back control term as stated in the method of the impugned patent. The feed back term (ISC_{-}) of formula I is only a correction term in addition to other correction terms including the correction terms (ISC_{AT}) for automatic transmission (AT) and for engine acceleration and deceleration (ISC_{TR} and ISC_{AS}). Furthermore, it should be emphasized that according to document D1 this correction factor ISC_{CL} is not taken into consideration (because it is zero) if the current engine speed is greater than the target engine speed

($N_{PPM} > N_{SET}$; page 65, lines 26 to page 66, line 3; Figure 17: $\Delta N \rightarrow (+)$; page 60, lines 11 to 15, and page 62, lines 23 to 28).

Since usually the basic control term is the leading control term for determining the value of the valve command, the replacement of this basic control term by a term, which is used only as a correction term and which even disappears completely when ΔN is positive, necessitates modification of the system. Moreover, a correction term of an open loop system normally cannot be used without adaptation in a closed loop system. There is no hint given in document D1 for such modifications.

6.4 In his argumentation the Appellant drew attention to page 67, last paragraph, of document D1 and maintained that therein a hint is given to consider vehicle speed in the determination of the valve command.

It becomes clear from the disclosure of document D1 that the operating state of the automatic transmission (see for instance flow charts of Figures 14 and 15, step 504) and therewith the operating state of the usually used torque converter and also the presence of a low vehicle speed (step 506) is taken into account for determining the open or closed loop control.

The cited part of page 67 however describes that at vehicle acceleration an increase of the effective pulse width is carried out in the open loop control in order to attain a rapid increase of engine air. This rapid increase of engine air however is not necessary at high vehicle speed since there is no danger of engine starving.

This paragraph therefore only confirms the overall content of document D1, namely that at low vehicle speed a change to the open loop control is necessary when the vehicle is accelerated or decelerated. This again leads to the proposal of Figure 12 which discloses a step like increase of the control output by a constant value in the open loop version. The values of increase of the control output shown in Figure 12 however do not depend on the vehicle speed but on the operation state of the automatic transmission (step 376) effecting an increase by a constant value 3 (step 390) in its drive position, and depend on the operating state of the air conditioning unit (steps 378 and 384) effecting an increase by a constant value 18 (see step 380) in its on position. The constant value 21 selected by the vehicle speed below 4 km/h, therefore results from the constant value 3 for the automatic transmission in its drive position and the constant value 18 of the air condition in its on position. The presence of a certain threshold vehicle speed (4 km/h) only avoids (steps 386 and 390) a superfluous increase of the control value, since at a vehicle speed greater that 4 km/h there is no danger of engine stalling. Therefore, it cannot be derived from Figure 12 to obtain the correction term as a continuously variable function of the vehicle speed.

6.5 The Appellant argued that the use of a continuously variable function of the vehicle speed would have been obvious at the application date of the present patent because of the high standard of the computer technology at this date compared with the computer standard at the application date of document D1.

This is not convincing since, as explained in section 6.4 above, the vehicle speed only has the effect that the control output is not superfluously increased by a constant value according to the flow chart of Figure 12

(3 instead of 21) and it has no direct influence on the value of the correction term, which is instead influenced by the automatic transmission and/or the air conditioning unit. Furthermore, without any concrete indication towards the use of a continuously variable function of the engine speed for obtaining the correction term, the argument that the highly developed computer technology is in particular used in this respect, can be considered only as the result of an ex-post facto analysis.

6.6 The Board also took into account document JP-A-60/73026 (D3) as a relevant document, which was cited in the granted patent as the most relevant document, and came to the conclusion that this document also cannot lead to the method of Claim 1 of the main request.

6.7 The method of Claim 1 of the main request therefore is considered to involve an inventive step.

7. In view of the above, the patent in suit can be maintained on the basis of the documents of the Respondent's main request.

8. Therefore, there is no need to examine the Respondent's subsidiary requests.

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 maintain the patent in the following version:

   Claims: 1 to 6 as filed with the letter dated 21 June 1995 (main request), with the correction of the reference sign (IV) to (V) in Claim 1.

   Description: Columns 1, 2, 5 to 8 as granted; columns 3, 4, 9 and 15 as filed with the letter dated 21 June 1995 (main request).

   Drawings: Figures 1 to 7 as granted.

The Registrar: The Chairman:

N. Maslin C. Andries