BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

A		B		C	X

File Number: T 615/91 - 3.2.1

Application No.: 83 104 918.4

Publication No.: 0 096 758

Title of invention: Control system and method for a power delivery system having a continuously variable ratio transmission

Classification: B60K 41/12

D E C I S I O N
of 31 March 1993

Proprietor of the patent: Aisin Seiki Kabushiki Kaisha

Opponent: Zahnradfabrik Friedrichshafen AG

Headword:

EPC Articles 54, 56

Keyword: "Novelty (yes)"
"Inventive step (yes)"

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number : T 615/91 - 3.2.1

D E C I S I O N
of the Technical Board of Appeal 3.2.1
of 31 March 1993

Appellant : (Proprietor of the patent)
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Decision under appeal :
Decision of the Opposition Division of the European Patent Office dated 7 May 1991, with written grounds posted on 28 May 1991 revoking European patent No. 0 096 758 pursuant to Article 102(1) EPC.

Composition of the Board :

Chairman : F. Gumbel
Members : P. Alting van Geusau
J.-C. de Preter

Summary of Facts and Submissions

I. European patent No. 0 096 758 was granted on 26 April 1989 on the basis of European patent application No. 83 104 918.4 filed on 18 May 1983.

II. With notice of opposition filed on 26 January 1990 the Respondent (Opponent) requested revocation of the patent for the reason of non-compliance with the provisions of Article 100(a) EPC.

In respect of an alleged lack of novelty and inventive step the opposition was supported by

D1: Automobiltechnische Zeitschrift ATZ 69 (1967) 5, pages 156 to 162.

III. By decision given at oral proceedings held on 7 May 1991, with written grounds posted on 28 May 1991, the Opposition Division revoked the patent.

The Opposition Division held that in addition to the precharacterising features also the characterising features of independent Claims 1 and 6 as granted could be derived from D1, in particular when interpreting Figure 2 and taking into account the text of page 157, column 2, lines 7 to 12. Therefore the subject-matter of Claims 1 and 6 as granted was not considered to be novel.

IV. An appeal was lodged against this decision on 5 August 1991, with payment of the appeal fee on the same day. The Statement of Grounds of Appeal was filed on 7 October 1991.

With the Statement of Grounds of Appeal new Claims 1 and 6 amended to comprise clarifications of the characterising

features thereof, as well as amended columns 3a and 3b of the description were filed .

The Appellant requested maintenance of the patent in a restricted version as defined by the new Claims 1 and 6 together with Claims 2 to 5 and 7 to 10 as granted and with an amended specification comprising columns 1, 2, 4 and 5 of the published patent specification and the new columns 3a and 3b together with Figures 1 to 4 of the published patent specification.

The independent Claims 1 and 6 (after correction of some reference signs) read as follows:

"1. A method of controlling the operation of a power delivery system comprising a prime mover (100) having a fuel delivery means (102) for delivering a variable quantity of fuel thereto, a continuously variable drive ratio transmission (200) coupled to said prime mover (100) for delivering power from said prime mover (100) to an output shaft (108), and a command means (104) for determining a desired power delivery system performance, characterized in that said fuel delivery means (102) and said continuously variable drive ratio transmission (200) are controlled separately from and independently of each other, the transmission ratio of said continuously variable drive ratio transmission (200) being directly controlled strictly as a function of the command means (104) position and of a torque difference between the load torque on said output shaft (108) and the output torque of said prime mover (100), only said command means (104) position and said torque difference being sensed for controlling said continuously variable drive ration transmission (200), said fuel delivery means (102) being controlled without taking into account the command means (104) position only dependent on a measured speed (N_E) of said prime mover in

accordance with a predetermined fuel function defining a desired fuel requirement for said prime mover (100).

6. A control system for controlling the operation of a power delivery system comprising a prime mover (100) having a fuel delivery means (102) for delivering a variable quantity of fuel thereto, a continuously variable drive ratio transmission (200) coupled to said prime mover (100) for delivering power from said prime mover (100) to an output shaft (108), and a command means (104) for determining a desired power delivery system performance, characterized in that said control system is adapted to control said fuel delivery means (102) and said continuously variable drive ratio transmission (200) separately from and independently of each other, the transmission ratio of said continuously variable drive ratio transmission (200) being directly controlled strictly as a function of said command means (104) position and of a torque difference between the load torque on said output shaft (108) and the output torque of said prime mover (100), only said command means (104) position and said torque difference being sensed for controlling said continuously variable drive ratio transmission (200), and that said control system comprises an engine controller (110) for controlling said fuel delivery means (102) without taking into account the command means (104) position only dependent on a measured speed (N_E) of said prime mover in accordance with a predetermined fuel function defining a desired fuel requirement for said prime mover (100)."

V. In a communication the Board expressed the provisional opinion that the amendments proposed to the claims and the description appeared to meet the requirements of the EPC. However clarifications were requested as to how the CVT control of the invention was carried out because the

description and claims did not appear to be sufficiently clear in this respect.

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

In accordance with the subject-matter of the new claims no other operational signals than those from the accelerator pedal and from the torque ramp are used or required to control the transmission ratio of the transmission. However, there is no simple direct dependence of the position of the movable portion of the driven sheave on the command means position, rather an increasing force is exerted on the movable portion as the command means (accelerator pedal) is depressed.

The axial position of the movable portion of the driver sheave is determined by means of a conventional spring loaded torque ramp. This torque ramp creates an axial force acting on the movable portion which force depends on the difference between the load torque and the engine output torque. Therefore the forces applied to the input and output side of the transmission determine the transmission ratio of the transmission.

Examples of such transmissions are known from

New Fan Drive Design for VAV applications by Robert O. Huff, published in 1981, by Reliance Electric, Cleveland, Ohio, U.S.A. and

A study of Snowmobile Drive Systems by Henri Kotesmana Prosad, Society of Automotive Engineers, Inc., 1973.

In the prior art disclosed in D1, considered to be pertinent by the Opposition Division in particular in view of picture 2 thereof, the desired power delivery system performance factor is set by means of the command means. In accordance with a predetermined function a specific desired speed of the engine and at the same time a specific desired output torque of the engine are assigned to a desired power delivery system performance factor k. The desired speed is compared with the actual speed of the engine and the difference between both speeds is calculated. This difference is used to adjust the fuel delivery system.

It would be clear that in this prior art system the fuel delivery means is controlled not only dependent on the measured engine speed but also dependent on the system performance factor k. Such a control is principally different from the control of the present patent in which the fuel delivery means is controlled in dependence of the measured speed only.

The unsatisfying operations of the system of D1 during transient conditions is discussed in the present patent (column 2, lines 24 to 40) and the system disclosed in the patent has overcome this deficiency.

The further characterising features of the new Claims 1 and 6 are also neither known nor obvious from D1. The known engine and transmission control of D1 overlap to some extent, therefore both controls are not separate and independent from each other as required in the patent in suit.

Thus, taking into account the state of the art disclosed in D1, an inventive step was required to provide the control method of the new Claim 1.

The new independent apparatus Claim 6 discloses the necessary means for performing the method defined in the new Claim 1 and therefore the subject-matter of this claim must be considered patentable too.

VII. The Respondent did not file any requests. In his response to the Statement of Grounds of Appeal he submitted that the control system as claimed takes account of only a very limited operation area of an engine and would therefore be unserviceable in practice.

In view of the Appellant's submissions, by which the scope of the claimed subject-matter is clarified the Respondent submitted that he did not any longer feel restricted in his own further technical developments.

Reasons for the decision

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

2. Amendments

2.1 The current Claims 1 and 6 include all features of the granted Claims 1 and 6, respectively. The granted Claims 1 and 6 are essentially based on the Claims 1 and 6 as originally filed and the embodiment of the invention disclosed with respect to Figures 1 to 4. When compared to the granted Claims 1 and 6 the current claims contain further clarifications with respect to the meaning of "directly controlled" which further features are supported by column 5, lines 13 to 17, and lines 37 to 39, of the published patent specification corresponding to page 8, lines 24 to 28, and page 9, lines 6 and 7, of the application document as filed. There is also a

clarification of what is meant by controlling the fuel delivery means "only" dependent on a measured speed of the prime mover which additional features are supported by column 5, lines 18 to 21 and 37 to 40, of the published patent specification corresponding to page 8, lines 28 to 31, and page 9, lines 6 to 8, of the application documents as filed.

The dependent Claims 2 to 5 and 7 to 10 correspond to granted and originally filed Claims 2 to 5 and 7 to 10.

Therefore Claims 1 to 10 do not give rise to objections under Article 123(2) and (3) EPC.

2.2 By the new columns 3a and 3b the specification is amended to the effect that also the document D1 is mentioned as state of the art.

In this respect no objections arise under the requirements of the EPC either.

2.3 According to the independent Claims 1 and 6 the transmission ratio of the continuously variable drive ratio transmission is directly controlled strictly as a function of the command means position and of a torque difference between the load torque on the output shaft and the output torque of the prime mover. In view of the arguments and of the documents presented by the Appellant with letter of 16 March 1992 (see point VI above) the Board is satisfied that the skilled person would not have any difficulties in interpreting this part of the claim when relating the claim to the single embodiment of the invention disclosed in the description and drawings.

In particular because of the dependence of the transmission ratio on both the torque difference and command means position he would immediately understand that an increasing axial force is exerted on the movable portion of the driven sheaves as the command means is depressed rather than that a simple direct dependence of the position of this movable portion on the command means position exists, and that the balance of forces exerted on the driven and driver sheaves determines the transmission ratio of the transmission.

The new independent claims therefore also meet the requirement of clarity (Article 84 EPC).

3. Novelty

3.1 The Opposition Division considered the disclosure of D1 to be novelty destroying for the subject-matter of the granted Claims 1 and 6, in particular in view of the control shown in Figure 2 ("Bild 2").

In the control system of D1 control is carried out on the basis of a wanted engine speed ("Soll-Drehzahlgeber") and a predetermined torque requirement ("Soll-Moment-Geber"). When such a control system is used with a continuously variable transmission such as a hydrostatic power drive shown in Figure 12 of D1, the engine speed is set by means of the accelerator pedal to a required value ("Soll-Drehzahl") and the required torque value (Getrieb-Soll-Lastmoment) is also determined by this pedal.

However, such a control does not include any of the characterising features of the present independent Claims 1 and 6. In D1 clearly the control of the fuel delivery means and transmission is linked and thus these parts are not separately and independently controlled as required by the new Claims 1 and 6. The transmission ratio of D1 is

controlled to provide a desired transmission output torque (see also paragraph 3.3.2 on page 158) which is adjusted essentially on the basis of a wanted torque value (Getriebe-Soll-Lastmoment) and a measured torque value (Getriebe-Lastmoment) rather than exclusively on the basis of the accelerator pedal position and a sensed torque difference between the engine output shaft and load torque of the transmission such as defined in the new independent Claims 1 and 6.

Furthermore, no means for controlling the fuel delivery means exclusively on the basis of the measured speed of the prime mover (engine) are disclosed in D1 but rather a wanted speed of the engine is the control factor.

3.2 The further prior art acknowledged in the patent in suit, DE-A-2 811 574 (D2), US-A-4 152 947 (D3) and US-A-4 091 690 (D4) concern systems in which the transmission ratio is controlled together with the engine and consequently do not disclose any of the characterising features of the independent Claims 1 and 6 under consideration either.

3.3 In view of the above considerations with respect to the relevant prior art, none of the available documents discloses more than the precharacterising features of the independent Claims 1 and 6. Therefore the subject-matter of these claims is novel within the meaning of Article 54 EPC.

4. Inventive step

4.1 For the purpose of meeting the requirement of Rule 29.1 EPC, the independent Claims 1 and 6 are related in their precharacterising portion to the prior art disclosed in D2.

The characterising features of the independent Claims 1 and 6 have the effect that engine operation can readily be maintained along a predetermined ideal operating line by providing for totally independent engine and transmission control. Throttle position, and consequently engine output torque, is a function of the engine speed only and that function may be any desired relationship, for example the ideal operating line for minimum fuel consumption, the ideal line for low emissions or a compromise ideal operating line for low fuel consumption and low emissions.

The accelerator pedal and loads on the transmission determine the transmission ratio and thus also, as a result, the engine speed but in this respect there is no direct control of the engine speed as a function of the accelerator pedal.

The objective problem to be solved by the subject-matter of the claim can therefore be seen in a further development of the prior art control disclosed in D2 such that maintaining the engine operation on a predetermined ideal operating line is simplified.

4.2 As follows from the preceding paragraphs concerning novelty, none of the documents of the available prior art discloses a fully independent control of engine and variable drive ratio transmission. Moreover, in the Board's opinion none of these documents can be considered to contain an incentive to provide such independent control in a power delivery system of the type as defined in the precharacterising portion of the amended Claims 1 and 6 of the patent in suit.

In document D1, page 157, column 2, lines 7 to 12 it is stated that the transmission is controlled by a control **program** which is independent from the engine and as is immediately apparent from the further disclosures of D1, in

particular the control circuit shown in "Bild 2", an independent control program for the transmission does not mean that the transmission is controlled independently from the engine because clearly the accelerator pedal directly controls both the engine and the transmission.

In D2 the engine and transmission are also directly controlled on the basis of the accelerator pedal position using specific engine and transmission data (blocks 13 and 12 respectively). Indeed D2 concerns a system by which the engine-drive-unit may be controlled to follow a minimum fuel consumption line, which is also intended by the claimed control of the patent in suit. Nevertheless because the engine is directly controlled by the accelerator pedal, before reaching a steady state, deviations from this wanted line cannot be avoided. In contrast hereto, by providing independent control of the engine and the transmission in the manner as claimed in the patent in suit, no deviation from the predetermined fuel function can occur.

4.3 The Respondent submitted that such control would be unserviceable in practice. However, in the Board's view, this largely depends on the use of the drive system for a particular purpose and no technically founded reason can be seen for considering that no practical purpose exists for the claimed control.

4.4 Summarising, in the Board's judgment, the proposed solution defined in the independent Claims 1 and 6 to the technical problem underlying the patent in suit is not only new but also inventive and therefore these claims as well as their dependent claims relating to particular embodiments of the invention in accordance with Rule 29(3) EPC, can form the basis for maintenance of the patent (Article 52(1) EPC).

5. The description and drawings are in agreement with the actual wording and scope of the claims. Hence these documents are also suitable for maintenance of the patent in amended form.

6. Thus taking into account the amendments made by the Appellant, the patent and the invention to which it relates meet the requirements of the EPC and the patent as amended may be maintained in this form (Article 102(3) EPC).

Order

For these reasons, it is decided that:

1. The contested decision is set aside.

2. The case is remitted to the first instance with the order to maintain the patent with Claims 1 and 6 filed on 7 October 1991 together with Claims 2 to 5 and 7 to 10 as granted and with the amended description comprising columns 1, 2, 4 and 5 of the published patent specification and columns 3a and 3b filed on 7 October 1991 and the drawings as granted.

The Registrar: The Chairman:

S. Fabiani F. Gumbel