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D E C I S I O N
of 31 January 2003

Case Number: T 1166/00 - 3.2.1

Application Number: 96300090.6

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IPC: B60K 41/02

Language of the proceedings: EN

Title of invention:

Vehicle engine fuel control during start-up

Applicant:

EATON CORPORATION

Opponent:

-

Headword:

-

Relevant legal provisions:

EPC Art. 54, 56

Keyword:

"Novelty (yes)"

"Inventive step (yes)"

Decisions cited:

-

Catchword:

-



Case Number: T 1166/00 - 3.2.1

D E C I S I O N
of the Technical Board of Appeal 3.2.1
of 31 January 2003

Appellant: EATON CORPORATION
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Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 3 July 2000
refusing European patent application
No. 96 300 090.6 pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: S. Crane
Members: J. Osborne
G. E. Weiss

Summary of Facts and Submissions

- I. The appeal is directed against the decision of the Examining Division to refuse application No. 96 300 090.6 (EP-A-0 720 929).
- II. The following prior art was cited in the search report:
- D1 US-A-5 316 116
- D2 DE-A-32 43 485
- D3 US-A-4 874 070
- D4 US-A-4 873 637
- D5 DE-A-34 21 387
- D6 DE-A-33 34 724.
- III. In the decision the Examining Division held that the subject-matter of independent claims 1, 6 lacked novelty and was furthermore of the opinion that the subject-matter of the dependent claims lacked inventive step, all with respect to D1.
- IV. The appellant requests that the impugned decision be set aside and that a patent be granted on the basis of claims 1 to 8 filed with a letter of 21 November 2002. Independent claims 1, 5 read as follows, wherein to indicate the essential amendments in comparison with the corresponding claims as originally filed additional text is indicated in italics:

"1. A control method for controlling engine fueling during vehicle launch conditions of a vehicle equipped with an automated multi-speed mechanical transmission system (12), a fuel-controlled engine (14), a fuel controller (14A) for controlling fueling of the engine, a master friction clutch (16) drivingly interposed between the transmission and the engine, a non-manually controlled clutch actuator (36) for controlling engagement and disengagement of the master clutch, a manually positioned throttle control (30), a throttle control position sensor for providing input signals (THL) indicative of throttle control position, and a control unit (44) for receiving input signals including said input signal indicative of throttle control position and for processing same in accordance with predetermined logic rules to issue command output signals to system actuators including said fuel controller and said clutch actuator, said logic rules including rules for sensing operation in a vehicle launch condition including controlling engagement of said master clutch and controlling fueling of said engine to a calculated fueling value (F_{CALC}), regardless of the fueling level (T_{REQ}) corresponding to throttle control position (THL), said method comprising the steps of:

- (1) determining a reference level of engine flywheel torque (REF) deemed to be non-damaging to the vehicle driveline and satisfactory to the vehicle operator for low-speed operations;
- (2) sensing for vehicle launch conditions; and
- (3) during vehicle launch conditions, if the fueling level requested by throttle control position is less than or equal to that corresponding to the reference level, causing fueling of the engine to be as requested by throttle control position, and if the fueling level

requested by throttle *control* position exceeds *that* corresponding to the reference level, causing fueling of the engine to be the calculated fueling value, wherein the calculated fueling value is less than or equal to that corresponding to the reference level."

"5. A machine for controlling engine fueling during vehicle launch conditions of a vehicle equipped with an automated multi-speed mechanical transmission system (12) comprising a fuel-controlled engine (14), a fuel controller (14A) for controlling fueling of the engine, a master friction clutch (16) drivingly interposed between the transmission and the engine, a non-manually controlled clutch actuator (36) for controlling engagement and disengagement of the master clutch, a manually positioned throttle *control* (30) and a throttle *control* position sensor (28) for providing input signals (THL) indicative of throttle *control* position, said machine comprising:

input signal receiving means for receiving input signals including input signals indicative of throttle *control* position;

data processing means (44) processing said input signals according to predetermined logic rules to issue command output signals to system actuators including said fuel controller and said clutch actuator, said logic rules including rules for:

- (1) sensing operation in a vehicle launch condition including controlling engagement of said master clutch;
- (2) controlling fueling of said engine to a calculated fueling value (F_{CALC}), regardless of the fueling level (T_{REQ}) corresponding to throttle *control* position (THL);
- (3) determining a reference level of engine flywheel torque (REF) deemed to be non-damaging to the vehicle driveline and satisfactory to the vehicle operator for

low-speed operations; and
(4) during vehicle launch conditions, if the fueling level requested by throttle control position is less than or equal to that corresponding to the reference level, causing fueling of the engine to be as requested by throttle control position, and if the fueling level requested by throttle control position exceeds the reference level, causing fueling of the engine to be the calculated fueling value, wherein the calculated fueling value is less than or equal to that corresponding to the reference level; and
output signal generating means for issuing said command signals to said actuators."

Claims 2 to 4 and 6 to 8 are dependent on claims 1 and 5 respectively.

V. In reasoning that the subject-matter of claim 1 lacked novelty with respect to D1 the Examining Division argued essentially as follows:

D1 discloses a method for controlling engine fuelling during vehicle launch operations of a vehicle having the apparatus features contained in claim 1. Moreover the predetermined logic rules in accordance with which the control unit processes input signals include rules for controlling fuelling of the engine to a calculated fuelling level (60% PEDAL), regardless of the fuelling level (PEDAL) corresponding to the throttle control position. In particular, the steps of the method comprise determining a reference level of engine flywheel torque (25%) deemed to be non-damaging to the vehicle driveline and satisfactory to the operator for low-speed operations. It argued that, in order to limit the transmitted engine torque, the control of D1 limits

the engine speed during clutch slippage, thereby explicitly disclosing that high torques in the driveline result from engine overspeed before the clutch is fully applied, subsequent abrupt engagement of the clutch allowing the kinetic energy at the flywheel to be converted into excessive torque in the driveline.

Reasons for the decision

Amendments

1. The essential amendments to the subject-matter of the independent claims in comparison with the versions as originally filed and the basis therefore in the application as originally filed are as follows:
 - the replacement of the term "throttle" by "throttle control" is based on the disclosure of page 2, lines 22 to 25 in combination with original claims 2, 3 from which it is clearly derivable that the term "throttle" relates to the control, such as the pedal, operated by the driver, as opposed to the device which actually controls fuel flow (compare the term "fuel controller" in claims 1, 5);
 - the correspondence between a fuelling level and a given level of flywheel torque ("fueling level ... corresponding to the reference level") is based on the disclosure of page 7, lines 11 to 15;
 - the additional condition of equality of the fuelling levels requested by the throttle control position and corresponding to the reference level

respectively ("or equal to") was originally disclosed in claims 5, 10;

- the definition of the calculated fuelling value in terms of the reference level ("the calculated fuelling value is less than or equal to that corresponding to the reference level") was implicitly disclosed in original claim 5 in its dependence from claim 2 because the former would be without meaning if the throttle position referred to therein were not that corresponding to the reference level.

1.1 It follows from that above that the amendments do not contravene the provisions of Article 123 (2) EPC.

Novelty

2. D1 discloses a method for controlling engine fuelling during vehicle launch conditions for a vehicle having all of the constructional features specified in claim 1. The logic rules include rules for sensing for operation in a vehicle launch condition (column 6, line 67 to column 7, line 25; Figure 4), controlling engagement of the master clutch (Figure 3) and controlling fuelling of the engine to a calculated fuelling value (with the throttle filter in "launch" state - see column 7, lines 26 to 41).

2.1 Figure 7 illustrates the operation of the system in response to a step change of throttle control position to 100%. The fuelling value is controlled to increase at a predetermined rate until it reaches 60% of that requested by the throttle control position (column 8, lines 3 to 6). At time X the fuelling level is

increased at a predetermined rate to correspond to that requested by the throttle control position at the time that clutch engagement is completed (column 8, lines 8 to 17). Figure 8 illustrates the operation of the system in response to a constant rate of change in throttle control position until it reaches 100%. Whilst the throttle control ("pedal") is below a reference level of 25% of maximum the fuelling value ("control signal") is set to correspond to that of the throttle control position (column 2, lines 59 to 61; column 8, lines 18 to 23). When the throttle control position exceeds the reference level the fuelling value is controlled to not exceed 60% of that requested by the throttle control position and it is maintained at the 25% of maximum until the throttle control position has risen sufficiently that 60% of the requested value exceeds 25% of the maximum (Figure 8, time W; column 8, lines 23 to 26). Thereafter the fuelling value increases again to remain at the 60% value (Figure 8, from time W to time X). From time X control of the fuelling value corresponds to Figure 7.

- 2.2 Present claim 1 specifies two conditions for the relationship between the fuelling level requested by the throttle control position and the fuelling level of the engine. The first condition is that if the fuelling level requested by throttle control position is less than or equal to that corresponding to the reference level, the fuelling of the engine is caused to be as requested by the throttle control position. This condition is disclosed in D1 as illustrated by the section of Figure 8 in which the control signal line follows the pedal signal line until the 25% reference value is reached. The second condition is that if the fuelling level requested by the throttle control

position exceeds that corresponding to the reference level the fuelling of the engine is caused to be at a calculated value which is less than or equal to that corresponding to the reference level, regardless of the fuelling level corresponding to the throttle control position. This second condition is not disclosed by D1 as can be seen from both Figure 7, where the value of the control signal rises at a predetermined rate to a level dependent on the throttle control position (60%), and Figure 8, where between times W and X the control signal has an increasing value greater than the 25% reference value. Also, the plateau in the value of the control signal at 25% in Figure 8 occurs only because the pedal signal continues to rise relatively slowly and therefore the fuelling level is not at the reference level "regardless of the fueling level corresponding to the throttle control position" as specified by present claim 1.

2.3 The problem which is addressed by D1 is that an engine and an automatically operated friction clutch exhibit different transient responses to a change of throttle control position (column 1, line 65 to column 2, line 2). The solution offered aims to provide a system which limits engine output torque in order to avoid the engine speed increasing excessively before the clutch engages and so is concerned with the period before full engagement of the clutch (column 2, lines 9 to 11 and column 8, lines 31 to 37). Before the clutch engages fully the maximum torque which can be transmitted to the driveline is determined primarily not by the fuelling level but by the degree and rate of engagement of the clutch. Once the clutch is fully engaged the driveline will be subjected to the engine flywheel torque multiplied by the ratio of the engaged gear and

it is evident that the highest level of driving torque to which the driveline can be subjected by an automated system such as that of D1 in which the maximum rate of engagement of the clutch is controlled will occur during the launch condition from the combination of the lowest gear and a fully engaged clutch. In a vehicle having such a system and an engine producing sufficient driving torque to propel the vehicle in high gears there is the risk that the multiplication of the flywheel torque by the lowest gear ratio could exceed the desirable torque capacity of the driveline. The concept of the reference level according to present claim 1 ensures that the driveline will not be subjected to a damaging level of torque during the launch condition whilst ensuring that the vehicle operator is satisfied with the response to changes in throttle control position during, for instance, low-speed manoeuvring. It follows that the reference value according to D1 does not represent a level of engine flywheel torque "deemed to be non-damaging to the vehicle driveline and satisfactory to the vehicle operator for low-speed operations" within the meaning of present claim 1.

2.4 The Board therefore finds that the subject-matter of present claim 1 differs from the disclosure of D1 by the following:

- determining a reference level of engine flywheel torque deemed to be non-damaging to the vehicle driveline and satisfactory to the vehicle operator for low-speed operations; and
- if the fuelling level requested by throttle control position exceeds that corresponding to the

reference level, causing fuelling of the engine to be less than or equal to that corresponding to the reference level, regardless of the fuelling level corresponding to the throttle position.

3. D2 discloses a linear relationship between the throttle control position and the fuelling level. D3 and D4 disclose systems wherein the fuelling of the engine is regulated to cause the engine speed to increase in a predetermined way to a value corresponding to the throttle control position during clutch engagement and thereafter to cause it to correspond to the throttle control position. D5 concerns only those aspects of a system which are relevant for allowing low-speed manoeuvring with a slipping clutch. D6 discloses a fixed relationship between throttle control position and engine speed, particularly for use during low speed manoeuvring.
4. On the basis of the foregoing reasoning the Board comes to the conclusion that the subject-matter of present claim 1 is novel (Article 54(2) EPC). The subject-matter of claim 5 is an apparatus which has a control unit which performs the method steps defined in claim 1 and so is similarly novel with respect to the cited prior art.

Inventive step

5. The closest prior art is considered to be that disclosed by D1 and the method according to present claim 1 differs therefrom by the steps set out under 2.4 above. As explained above the teaching of D1 relates to the phase of clutch engagement. Once the clutch is fully engaged the fuelling level is equal to

that requested by the throttle control position, as can be seen from the final portions of the graphs of Figures 7, 8 in which the control signal becomes equal to the pedal signal. This would provide optimum response of the engine to changes in throttle control position. However, if the skilled person were to combine the system of D1 with a vehicle having an engine which produces sufficient torque for propelling the vehicle in a satisfactory manner using the highest gears the multiplication of that torque through the lowest gear would require a higher torque capacity of the driveline than may be desirable.

- 5.1 No cited prior art document relates to the problem of subjecting the driveline to excessive torque during launch conditions. It would be normal for the skilled person to design the driveline in order to cope with the maximum torque to which it could be subjected in normal use, i.e. in the lowest gear. In the opinion of the Board, to establish a design capacity below that maximum and to restrict the output of the engine during launch conditions to a level which nevertheless the vehicle operator would find satisfactory for low-speed operations is not obvious for the skilled person. The subject-matter of claim 1 therefore involves an inventive step (Article 56 EPC). Similar reasoning applies to claim 5.

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 on the basis of the following documents:

Description: pages 1, 1a, 3, 4, 6 received 12 June 2002 with a letter of 6 June 2002, pages 2, 5, 7 received 29 November 2002 with a letter of 21 November 2002.

Claims: 1 to 8 received 29 November 2002 with a letter of 21 November 2002.

Drawings: Figures 1, 1a, 2, 3 as published.

The Registrar:

The Chairman:

S. Fabiani

S. Crane