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D E C I S I O N
of 19 November 1996

Case Number: T 0418/95 - 3.2.1

Application Number: 90307055.5

Publication Number: 0410584

IPC: B60K 28/16, F02D 41/10

Language of the proceedings: EN

Title of invention:
Vehicle traction control method with fuel control

Patentee:
GENERAL MOTORS CORPORATION

Opponent:
Siemens AG

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step - yes"

Decisions cited:
-

Catchword:
-

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Case Number: T 0418/95 - 3.2.1

D E C I S I O N
of the Technical Board of Appeal 3.2.1
of 19 November 1996

Appellant: (Proprietor of the patent)
GENERAL MOTORS CORPORATION
General Motors Building
3044 West Grand Boulevard
US - Detroit, Michigan 48202 (US)

Representative:
Denton, Michael John
Patent Section
1st Floor
Gideon House
28 Chapel Street
Luton
GB - Bedfordshire LU1 2SE (GB)

Respondent: (Opponent)
Siemens AG
Postbach 22 16 34
DE - 80506 München (DE)

Decision under appeal: **Decision of the Opposition Division of the European Patent Office posted 22 March 1995 revoking European patent No. 0 410 584 pursuant to Article 102(1) EPC.**

Composition of the Board:

Chairman: F. A. Gumbel
Members: P. Alting Van Geusau
G. Davies

Summary of Facts and Submissions

I. The mention of the grant of European patent No. 0 410 584 in respect of European patent application No. 90 307 055.5, filed on 28 June 1990, and claiming priority from US application 385321 filed on 25 July 1989 in the United States of America, was published on 21 April 1993.

Claim 1 of the patent reads as follows:

"1. A method of traction control for a vehicle having wheels driven by an engine (10) having a number of cylinders into which air is drawn and a respective fuel injector (INJ1-INJ8) for each cylinder for delivering fuel to the cylinder that is mixed with air drawn into the cylinder to establish a scheduled air/fuel ratio of the mixture in the cylinder, the method comprising the steps of: sensing (20) an excessive acceleration spin condition of the driven wheels; and disabling (18, Figure 2) injection of fuel from selected fuel injectors to withhold fuel from their respective cylinders to reduce engine torque output driving the wheels when an excessive acceleration spin condition is sensed so as to allow recovery from the excessive acceleration spin condition, the remaining fuel injectors being enabled to deliver fuel to their respective cylinders to establish the scheduled air/fuel ratio therein; characterised by setting a value of the scheduled air/fuel ratio by (A) determining a normal run air/fuel ratio (92) and (B) increasing the determined normal run air/fuel ratio (94-110) when injection of fuel from selected fuel injectors is disabled so that

the air/fuel ratio of the mixture in the cylinders corresponding to the enabled fuel injectors is leaned out from the normal run air/fuel ratio when fuel is being withheld from the remaining cylinders."

II. Notice of opposition was filed on 21 January 1994 on the grounds of Article 100 (a) EPC. In respect of an alleged lack of inventive step the opposition was supported by the documents

D1: US-A-4 432 430 and
D2: DE-A-3 042 852.

III. By a decision which was given at the end of oral proceedings held on 10 March 1995 and issued in writing on 22 March 1995 the Opposition Division revoked the patent.

The Opposition Division was of the opinion that, starting from the prior art disclosed in D1, the teaching of D2 enabled the skilled person to arrive in an obvious manner at a method of traction control in accordance with claim 1 of the patent in suit.

IV. On 25 April 1995 a notice of appeal was lodged against that decision together with payment of the appeal fee. With the statement of grounds of appeal, which was filed on 30 June 1995, the appellant (proprietor of the patent) filed three sets of new claims in accordance with appendices 1 to 3.

V. In a communication issued in preparation of oral proceedings, requested by both parties, the Board expressed the provisional opinion that, taking into account the problems arising from the addition of a catalytic converter to an engine under traction control as disclosed in D1, the skilled person might appear to arrive in an obvious manner at a method of

traction control for a vehicle in which the air/fuel ratio of the active cylinders is increased in response to a sensed temperature rise in the converter.

However, in accordance with claim 1 of the patent in suit, the control for increase of the air/fuel ratio is in response to the disabling of selected fuel injectors and thus in advance rather than in a feedback manner as known from D2. Therefore one of the main issues to be discussed at the oral proceedings would be the question whether and for what reason the skilled person would have contemplated further development of the system disclosed in D1, if adapted in accordance with D2, in the manner as claimed in the patent in suit.

VI. Oral proceedings were held on 19 November 1996.

The appellant requested that the decision under appeal be set aside and that the patent be maintained as granted (main request) or on the basis of one of the new sets of claims according to the appendices 1, 2 and 3 submitted together with the statement of grounds of appeal (auxiliary requests 1 to 3).

The respondent requested that the appeal be dismissed.

VII. In support of its requests the appellant essentially relied upon the following submissions:

A skilled person would not have combined the teachings of documents D1 and D2 since these belonged to unrelated technical fields which were too remote from each other and encompassed specific technical problems not dealt with in practice by the same skilled person. This was evidenced by the fact that

D2 was published before the original filing date of D1 and nevertheless the inventors of D1 did not make use of the information provided by D2. Since potential overheating of the catalytic converter apparently was not recognised as a problem in D1, this clearly indicated that the present invention was not an obvious combination of the methods known from D1 and D2.

But even when combining the teachings of D1 and D2, the traction control expert, who should be considered to be the competent skilled person in the present case, would not arrive at the system claimed. The combination of the systems disclosed in D1 and D2 would lead to a traction control system which disabled one or more fuel injectors on detecting the need for traction control and thereafter increased the air/fuel ratio when the temperature of the catalytic converter subsequently exceeded a predetermined threshold level. Such a system would not adequately protect the catalytic converter because the temperature of the catalytic converter would have already risen and continued to rise after the initial increase in the air/fuel ratio.

The present patent actually went a step further and provided improved protection. It did not allow a temperature increase to occur since, on detection of the disabling of one or more fuel injectors, the air/fuel ratio was immediately increased. Monitoring the catalytic converter temperature was not required and no potentially damaging temperature rise would occur. Since, neither D1 nor D2 gave any suggestion for such further development of protection of the catalytic converter as such, let alone when used in a traction control system, the subject-matter of the patent was based on an inventive activity.

VIII. The respondent (opponent) disputed the appellant's view and its arguments may be summarised as follows:

Although the traction control system disclosed in D1 did not comprise a catalytic converter, such equipment was generally applied in motor cars before the priority date of the present patent and, if a catalytic converter was added to the system known from D1, the skilled person would be faced with the problem that the converter would overheat, when unfuelling one or more cylinders.

D2 concerned a known engine control system for full- or split-engine mode operation in which the air/fuel ratio was increased in case an increase in the temperature of the catalytic converter was sensed, when the engine operated in the split-engine mode, i.e. when fuel-injection to some cylinders was disabled. In view of the fact that, in the present case, the competent skilled person was the control specialist for catalytic converters, this person would turn to D2 when looking for a solution to the problem he was confronted with when adding a catalytic converter to the system disclosed in D1. Considering that D2 essentially taught the principle of an increase of the air/fuel ratio to avoid converter overheating, and that the skilled person was immediately aware of the relation between the number of unfueled cylinders and the necessary air/fuel ratio increase, such skilled person would be led to choose the amount of air/fuel ratio increase as a function of the number of unfueled cylinders. Both alternatives, a control based on the result achieved (feedback control) and one based on an observed change of process parameters (feed-forward) were well known to the control engineer and would be applied by him in accordance with the prevailing circumstances. Hence, no inventive activity was

involved in changing from the feedback control disclosed in D2, which was based on the catalytic converter temperature, to a forward control based on the disabling of a number of cylinders. The method of claim 1 therefore lacked an inventive step as had been correctly recognised by the Opposition Division when deciding to revoke the patent.

Reasons for the Decision

1. The appeal is admissible.

MAIN REQUEST

2. *Novelty*

Novelty of the subject-matter of claim 1 of the patent clearly follows from the fact that none of the available prior art documents discloses a traction control method for a vehicle by disabling fuel injection of cylinders of a multi-cylinder engine in which method the air/fuel ratio of the mixture for enabled fuel injected cylinders is increased so as to lean out the normal run air/fuel ratio for those cylinders in response to disabling of the fuel injectors.

Novelty was in fact not in dispute in the proceedings.

3. *Inventive step*

3.1 There is agreement between the parties and the Board that D1, cited in the description of the patent, represents the closest prior art document from which the invention departs.

This document discloses a traction control method for a motor vehicle with a multi-cylinder engine having fuel injection. Wheel spin control is achieved by disabling injection of fuel from selected fuel injectors in proportion to the wheel slippage sensed. The disabling of fuel injection of these cylinders reduces engine torque output to limit acceleration spin.

The traction control method defined in the precharacterising portion of claim 1 is based on this known method.

3.2 In the known method disclosed in D1, the cylinders, for which fuel injection is disabled, take in air during their intake strokes, which air is discharged during the exhaust stroke into the exhaust manifold. This fresh air is mixed with the combustion gases from the operating cylinders and is discharged into the exhaust system.

A problem arises when a catalytic converter, commonly utilized to minimize the amounts of certain exhaust gas components, is used in the arrangement known from D1.

Namely, when the engine torque output is reduced by withholding fuel from one or more cylinders, the extra air discharged into the exhaust system from the disabled cylinders, combined with the combustion by-products of the operating cylinders, creates a condition in which the catalytic converter may be heated to excessive levels by the combustion processes of the by-products, such excessive heating giving rise to damage of the converter. This may be the case in particular when the engine is operated in the power enrichment mode.

Starting from the known traction control method disclosed in D1, it is therefore the object of the present patent to provide measures of protecting the catalytic converter (see column 1, line 58 to column 2, line 4 of the patent in suit).

3.3 This object is generally solved by the method defined in claim 1 of the patent in suit, that is by increasing, during active traction control, the air/fuel ratio of the mixture of the enabled cylinders when injection of fuel from selected fuel injectors is disabled, thus directly in response to the disabling of the selected fuel injectors.

In this manner the mixture for the fuelled cylinders is leaned out in response to the disabling of selected injectors and thereby the amounts of hydrocarbons and carbon monoxide discharged into the exhaust system from the fuelled cylinders are reduced and, consequently, the amounts available for reaction with the excessive amount of oxygen delivered to the exhaust system from the unfuelled cylinders are also reduced.

3.4 In the present case, the competent skilled person is the combustion engine control expert who is well acquainted with fuel injection control incorporating a catalytic converter and a lambda sensor and such person knows of the risks unburned fuel components provide for the catalytic converter.

When adapting the system disclosed in D1 to incorporate a catalytic converter, the competent skilled person is fully aware of the necessity to adapt the engine control so as to avoid converter overload.

3.5 When looking for a solution to the problem of catalytic converter overheating, in the Board's opinion, such skilled person would turn to D2 because this document also deals with the problem of catalytic converter overheating due to fresh air being discharged into the exhaust system, together with unburned components of the enabled cylinders.

In general terms, D2 teaches (see also the abstract of the corresponding US-A-4 484 548) that overload of the catalytic converter can be avoided by leaning out the air/fuel ratio in response to an increase in the sensed temperature of the converter.

However, in accordance with the method defined in Claim 1 of the patent in suit, leaning out the air/fuel ratio is controlled in immediate response to the disabling of fuel injectors and thus air-fuel ratio is compensated in advance rather than in a feedback manner based on the increase of the catalytic converter temperature.

3.6 It is to be noted that there is no direct lead to such a system of control in the available prior art. The respondent was of the opinion that, given the fact that the skilled person is aware of the principles of feed-forward and feed-back control, it would be an obvious measure to replace the control based on the converter temperature by a control based on the disabled selected fuel injectors, since clearly this was nothing more than the selection of an immediately available alternative not leading to any surprising technical effects.

In this respect, it has to be noted that the control circuit for leaning out the air/fuel ratio in response to an increase in the temperature of the catalytic converter as shown in D2, is an emergency

circuit in case of malfunctioning of one or more of the control valves placed in the exhaust and inlet tracts of the engine so that normally the disabled cylinders do not discharge fresh air but exhaust gas that is recirculated.

Therefore, when taking into account the teachings of D2, the skilled person did not have any reason to alter the control method as such but rather would be led by D2 to avoid any discharge of fresh air into the exhaust system, thus he would be led in a totally different direction as compared with the solution claimed in the present patent.

Furthermore, there is no identifiable reason to suppose that the skilled person would have sought a solution leaving the principle of feedback control proposed in D2, since by appropriate selection of the first and second predetermined reference temperatures at which leaning out of the air/fuel ratio begins and is further increased, this solution would give proper protection of the catalytic converter, which was also emphasised by the respondent itself during the oral proceedings.

Although the appellant submitted that the traction control in accordance with claim 1 works faster, because it provides feed-forward control and is easier and cheaper to realise technically since it does not rely on temperature measurements, such advantages achieved by the method of claim 1 are not directly linked to apparent deficiencies of the solution as suggested by D2 to the underlying problem of the patent, which is the protection of the

could not derive any incentive for further development from directly derivable deficiencies of the solution derivable from D2 to the underlying problem of the patent.

3.7 The respondent also argued that the skilled person would immediately recognise that the number of disabled fuel injectors was a measure of the amount of fresh air introduced into the exhaust system and that therefore the number of disabled fuel injectors was an obvious indicator for a basis of air/fuel ratio increase control.

However, in view of the problem to be solved by the patent, which focuses on the protection of the catalytic converter, the skilled person was led by D2 to the measure of increase of the air-fuel ratio when cylinders of the engine were disabled in context with the solution proposed in this document. Considering the direct link of this specific solution to the temperature measurement of the catalytic converter, in the Board's opinion, it is only with hindsight that it could be maintained that the skilled person would immediately envisage a principally different control method involving omission of the temperature sensing of the catalytic converter.

3.8 The Board therefore concludes that the subject-matter of claim 1 according to the appellant's main request cannot be derived in an obvious manner from the cited prior art and accordingly involves an inventive step (Article 56 EPC). Consequently, this claim, together with dependent claims 2 to 4, relating to particular embodiments of the invention in accordance with Rule 29 (3) EPC, are acceptable.

The patent can therefore be maintained unamended.

AUXILIARY REQUESTS

4. Since the appellant's main request is accepted there is no need to consider the auxiliary requests.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is maintained as granted.

The Registrar: The Chairman:

S. Fabiani F. Gumbel

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