DECISION
of 16 July 2002

Case Number: T 0159/01 - 3.2.1
Application Number: 95300633.5
Publication Number: 0666435
IPC: F16H 59/52

Language of the proceedings: EN

Title of invention:
Method/system to determine gross combinaion weight of vehicles

Patentee:
EATON CORPORATION

Opponent:
WABCO GmbH & Co. OHG

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (no)"

Decisions cited:
-

Catchword:
-
Case Number: T 0159/01 - 3.2.1

DECISION
of the Technical Board of Appeal 3.2.1
of 16 July 2002

Appellant: EATON CORPORATION
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Decision under appeal: Decision of the Opposition Division of the European Patent Office posted 11 December 2000 revoking European patent No. 0 666 435 pursuant to Article 102(1) EPC.

Composition of the Board:
Chairman: S. Crane
Members: F. Proels
          H. Preglau
Summary of Facts and Submissions

I. European patent No. 0 666 435 was granted on 14 October 1998 on the basis of European patent application No. 95 300 633.5.

Claim 1 of the granted patent reads as follows:

"A control method for determining vehicular gross combined weight (GCW) in a vehicle having at least a partially automated transmission system, including a fuel-controlled engine, a multiple-speed change-gear transmission having a plurality of known gear ratios, an input shaft drivingly connectable to the engine and an output shaft drivingly connectable to vehicular drivewheels, first sensor means for providing an input signal indicative of drive torque to the drivewheels, second sensor means for providing an input signal indicative of vehicular acceleration and a controller for receiving said input signals and processing same according to predetermined logic rules to issue command output signals to system actuators, said method including;

determining a value indicative of current drivewheel torque (T);

determining a value indicative of current vehicle acceleration (A); and

characterized by: determining only immediately after an upshift into a target gear ratio, a value indicative of current vehicular gross combined weight (GCW) as a function of the expression:
\[
(T_1 - T_i) \div ((A_1 - A_i) \times C)
\]

where:

\( i \) = an integer greater than 1.

\( T_1 \) = a value indicative of wheel torque at time \( t_1 \)
selected at a time immediately prior to engagement of the target gear ratio;

\( T_1 = 0; \)

\( T_i \) = a value indicative of wheel torque at time \( t_i \)

\( A_1 \) = a value indicative of vehicle acceleration at time \( t_1 \)
selected at a time immediately prior to engagement of the target gear ratio;

\( A_i \) = a value indicative of vehicle acceleration at time \( t_i \);

\( C \) = constant related to gear ratio, drivetrain characteristics and gravity; and

\( t_1 \) is less than a reference time \( (\text{REF} \_\text{TIME}) \) after time \( t_1. \)

II. The granted patent was opposed by the present respondents on the grounds that its subject-matter lacked novelty and/or inventive step (Article 100(a) EPC). Among the prior art documents relied upon was EP A-0 111 636 (D1).

With its decision posted on 11 December 2000 the Opposition Division revoked the patent. The reason
given for the decision was that the subject-matter of claim 1 lacked inventive step with respect to document D1 and the common general knowledge of the person skilled in the art.

III. A notice of appeal against this decision was filed on 31 January 2001 and the fee for appeal paid at the same time.

The statement of grounds of appeal was received on 12 April 2001.

IV. Oral proceedings before the Board were held on 16 July 2002.

The appellants (proprietors of the patent) requested that the decision under appeal be set aside and the patent maintained as granted.

Their arguments in support of this request can be summarised as follows:

Both the claimed invention and the method of document D1 determined the gross combined weight (GCW) of a vehicle by comparing drive torque and vehicle acceleration at two closely spaced points in time. The basic principle involved was therefore similar. The teaching of this prior art document did not however lead in practice to accurate results and the appellants had had the insight that the reason for this lay in the variable deceleration of the vehicle when in a drive-free condition with an open clutch, due to the condition of the transmission (eg oil temperature, gear ratio engaged). To eliminate this the invention proposed locating the first time point for the
determination of vehicle acceleration immediately prior to engagement of the target gear ratio, ie when the transmission would be in neutral and its braking effect minimal. The invention therefore represented a distinct improvement over the teaching of document D1 and there was nothing in the prior art which pointed the skilled person in this direction.

The respondents requested dismissal of the appeal and argued substantially as follows:

It was self-evident in the system of document D1 that the establishment of a drive-free condition by opening the clutch would normally be associated with a gear change. Since the document taught that the time interval between the two measurements should be kept as short as possible it was obvious to make the first measurement immediately prior to engagement of the target gear. A restriction to making the calculation of the GCW only on an upshift followed from elementary considerations.

Reasons for the Decision

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

2. As explained in the introductory description of the patent specification it is known in the context of various vehicle control systems to utilize the current GCW of the vehicle as control parameter. One example is a control system for an at least partially automated transmission which upon sensing the selection of an
upshift will only initiate this if it is feasible and acceptable, ie if the available engine torque applied to the drivewheels in the target ratio is sufficient to provide at least a minimum vehicle acceleration. The aim of the invention is to provide a method for determining the current GCW of the vehicle on the basis of information already existing in the control system for the automated transmission, without requiring additional sensors or other hardware.

Starting from basic principles the formula

\[ GCW = \frac{\left( T_1 - T_2 \right)}{\left( A_1 - A_2 \right) \times C} \]

is developed, whereby

- \( T_i \) = wheel torque at time \( t_i \)
- \( A_i \) = vehicle acceleration at time \( t_i \)
- \( C \) = a constant.

This formula holds if the times \( t_1 \) and \( t_2 \) are relatively close together (within seconds).

In order to improve the accuracy of the calculation the invention proposes increasing the value of the term \( (T_1 - T_2) \) by performing the determination at a time when \( T_1 = 0 \), ie with the clutch open, and more particularly at a time immediately prior to engagement of the target gear ratio during an upshift.

Document D1 is also concerned with the determination of the current GCW of a vehicle, in particular for use in
the control of an automated multi-speed transmission. Starting from the same basic principles as those considered in the contested patent, document D1 also arrives at a formula for GCW which is generally equivalent to that found in the patent, namely

\[
GCW = \frac{(M_{Ax} - M_{Ax1})}{f(\dot{S}_x) - f(\dot{S}_{x1})}
\]

Where:

- \(M_{Ax}\) = engine torque at time \(t_x\)
- \(M_{Ax1}\) = engine torque at time \(t_{x1}\)
- \(f(\dot{S}_x)\) = function of vehicle acceleration at time \(t_x\)
- \(f(\dot{S}_{x1})\) = function of vehicle acceleration at time \(t_{x1}\)

This formula holds if the time interval between \(t_x\) and \(t_{x1}\) is relatively short, see page 3, lines 1 to 5. According to page 3, lines 6 to 12, for a useful determination of the GCW the difference in the values of the engine torque at the two measurement times should be significant. This can be achieved by making the first value equal to zero, which has the further advantage that only one value need be determined. In the next paragraph it is then said that the drive-free condition can be obtained by opening the clutch. Another possibility is to control the drive to the vehicle that there is no acceleration or deceleration.

Having regard to the above it is plainly evident that the general concept underlying the claimed invention is known from document D1. In the statement of grounds of appeal the appellants sought to draw a distinction
between the fact that according to claim 1 of the patent the GCW is calculated by reference to wheel torque whereas in the prior art it is calculated by reference to engine torque. In view of the fact however that according to the patent specification the wheel torque is also preferably derived from the engine torque, in particular by consideration of the gear ratio, this line of argument was not pursued at the oral proceedings. It is clear to the person skilled in the art that to be workable the method proposed in document D1 must also take the gear ratio into account to derive the wheel torque from the engine torque, since it is the former rather than the latter which determines the acceleration of the vehicle.

At the oral proceedings the appellants concentrated instead on the time $t_1$ at which the first vehicle acceleration $A_1$ is measured (the drive torque is not measured at this time, as in document D1 it is assumed to be zero). In their view when document D1 proposed making the first measurement with the clutch open this was not in connection with a change in gear ratio. The gears of the transmission would therefore still be engaged and the transmission would exert a considerable braking force on the vehicle. Since this braking force could vary within wide limits as a result of the oil temperature and gear ratio engaged it introduced an uncertainty factor into the determination of the GCW. This was eliminated by the claimed invention in that the time point $t_1$ was set to be immediately prior to engagement of the target gear ratio during an upshift. This ensured that the transmission would be in neutral so that its braking effect on the vehicle would be negligible. Furthermore by restricting the determination to when an upshift was made the value of
the drive torque at the second measurement point after the change of gear would be more reliable than it would be with a downshift.

The above interpretation of document D1 is however not a realistic one when proper account is taken of the context. Although other possibilities are indeed mentioned in this document, it is clear from page 4, lines 17 to 35, that in the preferred embodiment the determination of GCW is associated with a change in gear ratio. Given the general considerations involved it is thus implicit that the first measurement point \( t_x \) for vehicle acceleration ("\( t_1 \)" in the terms of present claim 1) is before the engagement of the target gear ratio and the second measure point \( t_{x1} \) ("\( t_i \)" in the terms of the claims) shortly after the engagement of that gear ratio. Moreover, considering the need to keep \( t_x \) and \( t_{x1} \) as close together as is compatible with obtaining different values for vehicle acceleration it is obvious to place \( t_x \) "immediately prior" to engagement of the target ratio as stated in present claim 1 since there will be little change in vehicle speed in the time period when the transmission is in neutral.

As for the requirement of claim 1 that the GCW is determined only after an upshift, the Board can see nothing going beyond the normal competence of the person skilled in the art. After an upshift the engine will be delivering power to accelerate the vehicle and the engine torque can thus be more accurately and readily determined than when the engine is in overdrive (acting as a brake) after a downshift. It is therefore obvious to restrict the GCW determination to those gear changes which will give the most accurate results.
Having regard to the above the Board has therefore come to the conclusion that the subject-matter of granted claim 1 lacks inventive step (Article 56 EPC).

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:  

The Chairman:

S. Fabiani  

S. Crane