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D E C I S I O N
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:
–

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	Beschwerdekammern	Boards of Appeal	Chambres de recours

Case Number: T 0159/01 - 3.2.1

D E C I S I O N
of the Technical Board of Appeal 3.2.1
of 16 July 2002

Appellant: EATON CORPORATION
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Representative: Patentanwälte
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Respondent: WABCO GmbH & Co. OHG
(Opponent)   Am Lindener Hafen 21
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Representative: Schrödter, Manfred
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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_i) as a
        function of the expression:

$$(T_1 - T_i) \div ((A_1 - A_i) *C)$$

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 … 0;

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

time t_i is less than a reference time (REF_{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 district
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

$$GCW = (T_1 - T_2) \div ((A_1 - A_2) \times C)$$

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

$$GCW = (M_{Ax} - M_{Ax1}) \div (f(\dot{S}_x) - f(\dot{S}_{x1}))$$

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

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