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D E C I S I O N
of 19 May 2005

Case Number: T 0647/03 - 3.2.1

Application Number: 95921599.7

Publication Number: 0762957

IPC: B60K 6/12

Language of the proceedings: EN

Title of invention:
Hybrid powertrain vehicle

Patentee:
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Opponent:
Spandern, Uwe

Headword:
-

Relevant legal provisions:
EPC Art. 56, 69(1), 123(2)

Keyword:
"Inventive step (yes)"
"Claims - interpretation"
"Amendments - added subject-matter (no)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0647/03 - 3.2.1

D E C I S I O N
of the Technical Board of Appeal 3.2.1
of 19 May 2005

Appellant: (Opponent)
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Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office posted 3 April 2003 concerning maintenance of European patent No. 0762957 in amended form.**

Composition of the Board:

Chairman: S. Crane
Members: J. Osborne
S. U. Hoffmann

Summary of Facts and Submissions

I. The appeal is directed against the decision posted 3 April 2003 according to which the Opposition Division found that, account being taken of the amendments made by the patent proprietor during the opposition proceedings, European patent No. 0 762 957 and the invention to which it relates were found to meet the requirements of the EPC.

II. The opposition was directed against claims 1, 6, 7 and 8 only and was based on the opposition grounds of Article 100(a) (inventive step) and 100(c) EPC.

III. The following prior art was cited during the opposition procedure:

D1: JP-A-59-204402 (translation into English)

D2: JP-A-62-110535 (translation into English).

IV. Independent claims 1 and 7 approved by the Opposition Division read:

"1. A hybrid powertrain vehicle comprising:
a vehicle frame;
drive wheels (5) rotatably mounted on said vehicle frame;
a primary engine, mounted on said vehicle frame, for providing engine power by rotation of an output shaft;
power storage means (6), mounted on said vehicle frame, for storing and releasing power generated by said primary engine;

first drive train means (2, 3, 9, 4) for transmitting said engine power to said drive wheels, said first drive train means including a transmission (3) having adjustable speed input and output;
reversible means (7) for selectively, while driven by said rotation of said engine in a first mode, transmitting said engine power to said power storage means or, operating as a motor in a second mode, transmitting stored power from said power storage means to said first drive train;
second drive train means (30), in parallel with at least a portion of said first drive train means, connecting said reversible means to said first drive train means, for, in said second mode, transmitting said stored power to said first drivetrain means in addition to said engine power and for, in said first mode, transmitting said rotation of said engine to said reversible means for transfer of a portion of said engine power to said power storage means simultaneously with transfer of the remainder of said engine power to said drive wheels;
vehicle speed sensor means (12) for sensing vehicle speed;
stored power sensor means (16) for sensing a quantity of power stored within said power storage means;
power demand sensing means (14) for sensing power demanded of the vehicle by a driver;
comparing means (42) for comparing said sensed quantity of stored power with a predetermined minimum amount of stored power and generating a demand signal upon determination that said sensed quantity is below said predetermined amount;
power output determining means (44) for determining an additional increment of power in accordance with said

demand signal and for determining an engine output power as a sum of the sensed power demand and the additional increment of power;
engine speed control means (24) for controlling speed of said rotation of said output shaft by changing the input speed of said transmission responsive to a transmission signal;
engine speed determining means (46) for determining an engine speed of optimum efficiency in accordance with said determined engine output power and said sensed vehicle speed and for outputting the transmission signal, indicative of the determined engine speed, to said engine speed control means;
engine load control means (26) for controlling said engine power by controlling fuel feed to said primary engine responsive to said transmission signal; and
mode control means (20) for converting operation of said reversible means between said first and second modes responsive to the demand signal."

"7. A method for controlling a vehicle equipped with the hybrid powertrain propulsion system including drive wheels (5), reversible drive means (7), a primary engine (1) for rotatable driving said drive wheels and said reversible drive means simultaneously in parallel, power storage means (6) for storing engine power generated by said primary engine, a transmission (3) having adjustable speed input and speed output and engine speed control means (24) for changing the input speed of said transmission, said method comprising:
sensing vehicle speed;
sensing a quantity of power stored within the power storage means;
sensing power demanded of the vehicle by a driver;

feeding power from the power storage means, through the reversible drive means, utilizing the reversible drive means as a motor for driving said drive wheels responsive to a signal indicating a demanded power above that output by the primary engine, simultaneously and in addition to transfer of power from the primary engine to the drive wheels;
simultaneously (1) transmitting a portion of the output power of the primary engine into said power storage means, using said reversible drive means, responsive to a sensed quantity of stored power lower than a predetermined value and (2) transmitting the remainder of the output power of the primary engine to the drive wheels;
comparing the sensed quantity of stored power with a predetermined minimum value and generating a demand signal upon determining that the sensed quantity of stored power is below the predetermined low value;
determining an additional output power in accordance with the demand signal and determining an engine output power as the sum of the sensed power demand and the additional output power;
controlling the rotary speed of the primary engine by changing the input speed of the transmission responsive to a transmission signal; and
determining an engine speed of optimum efficiency in accordance with the determined engine output power and the sensed vehicle speed and outputting the transmission signal in accordance with the determined engine speed."

The other opposed claims 6 and 8 remain as granted and contain all features of claims 1 and 7 respectively.

V. The essential basis of the Opposition Division's decision in respect of the opposition ground according to Article 100(a) EPC was that the features relating to simultaneous supply of power to drive the vehicle from both the primary engine and the power storage means were not obvious in the light of the cited prior art.

VI. Upon appeal the following additional prior art was cited:

D3: DE-C-42 17 668.

VII. During oral proceedings held 19 May 2005 the appellant requested that the decision be set aside and that the patent be revoked. The respondent requested that the appeal be dismissed.

VIII. The appellant's submissions may be summarised as follows:

Claim 1 is a product claim and defines second drive train means as being "in parallel with" at least a portion of the first drive train means. The wording "in parallel with" exists in the claim in the context of associated constructional terms "portion" and "connecting" and is followed by wording defining the function of the second drive train means. The skilled person therefore would understand "in parallel with" as being a constructional feature defining a spatial arrangement of the second drive train means parallel to at least part of the first drive train means. However, there was no original disclosure of such an arrangement.

In respect of inventive step D3 forms the closest prior art, relating to a hybrid powertrain vehicle having an internal combustion engine and a power storage means together with a pump/motor, the engine and pump/motor being operable to transfer power in all of the ways presently claimed. D3 relates to operation of the engine together with a manual gearbox whereby the engine is provided with fuel to result in optimum efficiency for the engine's speed. Power in excess of that required to drive the vehicle is used to charge the power storage means. In the final paragraph of D3 it is stated that the control system may be extended to operate an automatic transmission whereby if the storage means is discharged a lower gear ratio would be chosen.

D2 relates to a control system for an engine together with a continuously variable transmission (CVT) for operating the engine at optimum efficiency and which would be an obvious choice for use when putting into effect the teaching of the final paragraph of D3. The control system operates by determining the power demanded of the engine and using this in turn to determine the desired engine speed and the corresponding gear ratio. In view of the statement in D3 that the gear ratio should be changed in order to accommodate the additional load of charging the storage means it would be obvious to include that additional load in the power demand determined by D2. The resulting control system would correspond to that as defined in claim 1. The same reasoning applies correspondingly to claim 7.

IX. The respondent replied essentially as follows:

It is correct that the original disclosure is only of functional parallelism. The claims are not to be read in isolation and in the light of the description it is clear that the expression "in parallel with" refers to a functional arrangement. This functional definition in claim 1 reinforces those which follow it.

It would not be obvious for the skilled person to combine the teachings of D3 and D2 because the latter contains no mention of the difference between power output and power requirement with which D3 is concerned. Moreover, even if the teachings of the documents were to be combined, there still would be no determination of an increment for power storage; D3 supplies for storage whichever amount of power is available. Furthermore, there would be no means for determining an engine speed of optimum efficiency in accordance with a determined engine output power because D3 concerns itself only with a manual transmission.

Reasons for the Decision

1. The patent relates to a hybrid powertrain in which a primary engine may provide power to drive a vehicle. Internal combustion engines suffer from being able to operate at optimum efficiency only within limited operating conditions. By employing a reversible means (e.g. motor/pump) to selectively transmit power to and withdraw power from a storage means it is possible to restrict the range of conditions under which an internal combustion engine operates, allowing increased

operation at optimum efficiency. In the vehicle according to the present patent the engine supplies mechanical power to the vehicle wheels along a first drive train and the reversible means supplies power along a second drive train.

Addition of subject-matter (Article 100(c) EPC)

2. This objection relates to the wording in claim 1 specifying that the second drive train means are "in parallel with" at least a portion of the first drive train means. The Board is in agreement with the parties that the original disclosure does not include a constructional arrangement in which any parts of the two drive trains are spatially arranged in parallel. The matter to be determined is only whether the objected wording in the claim defines a functional or a constructional feature.

2.1 The appellant's arguments are based in part on its belief that claim 1 would be read in isolation when determining the extent of protection to be conferred. Such a belief cannot form the basis of a valid objection in accordance with Article 100(c) EPC, however, since Article 69(1) EPC requires that in determining the extent of protection to be conferred the description and drawings shall be used to interpret the claims. Further consideration of the appellant's objection therefore is based on the wording of the claim when interpreted in the context of the description and drawings of the patent specification.

2.2 The description contains four embodiments of a hybrid powertrain, in all of which the engine is coupled to

the first drive train means comprising a drive shaft. Since in each of these embodiments some power is transmitted directly to the wheels by the first drive train and some power is converted by a motor/pump they all relate to what is classed as a "parallel system" (column 2, line 53 to column 3, line 6). However, this aspect is already defined in claim 1 by the wording "transfer of portion of said engine power to said power storage means simultaneously with transfer of the remainder of said engine power to said drive wheels".

2.3 In each of the embodiments the motor/pump when acting as a motor drives an output shaft which is connected to the drive shaft of the first drive train. Downstream of the connection the components of the two drive trains are common. However, when the engine and motor simultaneously supply power to drive the vehicle, power flows "in parallel" along the portions of the respective drive trains upstream of the connection (column 8, lines 39 to 49). The Board is satisfied that it is this arrangement, the original disclosure of which is not contested by the appellant, which is defined by the objected wording in claim 1 upon its proper interpretation.

2.4 On the basis of the foregoing the Board concludes that the appellant's objection in accordance with Article 100(c) EPC is not valid.

Inventive step (Article 100(a) EPC)

3. D3 was first cited by the appellant in the grounds of appeal and the respondent argued that it was not relevant and should be disregarded (Article 114(2) EPC).

During opposition the closest prior art had been considered to be disclosed by D1. The Opposition Division correctly stated in its decision that the powertrain according to D1 does not provide for operation in the presently claimed second mode of transmitting both stored energy and energy supplied directly from the engine and it was the absence of this feature which essentially formed the basis for the positive conclusion on inventive step. The powertrain according to D3, on the other hand, does provide for such operation and the Board therefore admits D3 into the procedure.

4. It is not disputed between the parties that most of the features of claim 1 are known from D3 and/or D2. There is, however, dispute as to:

- whether it would be obvious for the skilled person to combine D2 with D3; and, if so

- whether the following feature of claim 1 would be the obvious result of such a combination:

"power output determining means for determining an additional increment of power in accordance with the demand signal and for determining an engine output power as a sum of the sensed power demand and the additional increment of power."

5. The aim according to D3 is to ensure that an internal combustion engine as part of a hybrid powertrain including a manual gearbox runs at optimum efficiency. When the system operates to supply engine power both to propel the vehicle and for generating electricity for

storage in a battery, for a given gear ratio and vehicle speed the engine is supplied with the amount of fuel to cause it to operate at its optimum efficiency, thereby producing more power than is necessary to propel the vehicle. The differential between the engine power output and the power required to propel the vehicle is the amount of power supplied for storage. In the final paragraph of the description it is furthermore stated that in a vehicle equipped with an automatic gearbox the selection of the gear ratio can be incorporated into the control arrangement whereby if the battery is discharged a lower gear ratio will be chosen in order to accommodate the additional load of driving the generator.

6. D2 relates to a control system for an internal combustion engine propelling a vehicle through a CVT. The system determines a desired engine power output based on measured accelerator pedal position and measured vehicle speed, i.e. it determines the power necessary to propel the vehicle. From the determined power output it determines the engine speed at which optimum efficiency would be achieved. The system then selects a gear ratio which, at the given vehicle speed, will provide the desired engine speed and supplies fuel to the engine to provide the determined power.

7. The appellant takes the view that the final paragraph of D3 relating to the incorporation of automatic gearbox control in the system according to D3 would be an incentive to the skilled person to include the control system according to D2. Furthermore, in the resulting system and in the event of a discharged battery the power demand determined by the D2 control

system would be increased by the amount of the extra load due to the generator, as specified in D3. The appellant concludes that the system would be summating the power demand determined according to D2 ("sensed power demand") and the additional load of the generator ("additional increment of power") to determine a desired engine output, as defined in present claim 1.

7.1 The fundamental teaching of D3 in respect of the supply of power from the engine both to propel the vehicle and for storage is that the power supplied for storage is an indeterminate amount resulting from the differential between the output of the engine when operating at optimum efficiency for a given engine speed and the power necessary to propel the vehicle. The final paragraph of D3 is an additional teaching which, whilst it is left open how it might be put into practice by the skilled person is nevertheless implicitly supplementary to and consistent with the basic teaching of D3. When putting that additional teaching into practice the skilled person therefore would retain the feature that the amount of power to be supplied for storage would be determined by the differential between the output of the engine when operating at optimum efficiency for a given engine speed and the power necessary to propel the vehicle. In the event of a discharged battery the selection of a lower gear ratio would provide a higher engine speed, permitting a larger power differential for storage. However, in accordance with the basic teaching of D3 the power differential would remain an indeterminate amount. It follows that, even if the skilled person were to combine D3 and D2, the presently claimed feature of power output determining means for determining an

additional increment of power in accordance with a power storage demand signal and for determining an engine output power as a sum of the sensed power demand and the additional increment of power would still be absent.

7.2 There is furthermore the question of whether the skilled person would combine the teachings of D3 and D2. Common to both is the operation of an engine at optimum efficiency. However, as already discussed above, D3 relates to a hybrid powertrain which in the one mode produces an excess of engine power over that necessary to propel the vehicle. D2, on the other hand, aims to match engine power to that necessary to propel the vehicle. As a result, the engine output power determined according to D2 and employed for selecting the gear ratio differs from that which is produced by an engine employing the control system according to D3. Since the differential is indeterminate it follows that the control systems according to D3 and D2 are incompatible and the skilled person would not be able to combine them without the exercise of inventive activity.

7.3 The Board concludes from the foregoing that the subject-matter of present claim 1 does not result in an obvious manner from the prior art D3 and D2 and therefore involves an inventive step (Article 56 EPC). The same conclusion applies to the corresponding method claim 7 and to claims 6 and 8 which include all features of claims 1, 7 respectively.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

A. Vottner S. Crane