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D E C I S I O N
of 13 January 2006

Case Number: T 1186/04 - 3.2.01

Application Number: 99830536.1

Publication Number: 0989047

IPC: B62D 5/04

Language of the proceedings: EN

Title of invention:
Electronic power steering for electric vehicles

Applicant:
Zapi S.P.A.

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (no)"

Decisions cited:
-

Catchword:
-

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Case Number: T 1186/04 - 3.2.01

D E C I S I O N
of the Technical Board of Appeal 3.2.01
of 13 January 2006

Appellant: Zapi S.P.A.
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 24 February 2004 refusing European application No. 99830536.1 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: J. Osborne
Members: C. Narcisi
G. Weiss

Summary of Facts and Submissions

I. The European patent application Nr. 99830536.1 was refused with the decision of the examining division posted on 24 February 2004. In that decision the examining division found that claim 1 then on file was unclear (Article 84 EPC) and that its subject matter was not new in comparison with the prior art D1 (DE-A-196 25 350) (Article 54 EPC). Against this decision an appeal was filed by the applicant on 5 May 2004 and the appeal fee was paid at the same time.

II. In a communication in preparation of the oral proceedings among other matters the Board raised the question of inventive step.

III. Oral proceedings took place on 13 January 2006. The applicant requested a patent to be granted on the basis of the claims according to the main request or to the auxiliary request, both as filed during the oral proceedings.

Claim 1 according to the main request reads as follows:

"Electronic power steering for electric vehicles such as trucks used for lifting and transporting pallets with an operator on board, comprising:
an asynchronous motor (4) for actuating the movement of a wheel to be steered (5),
an inverter (3) connected to said asynchronous motor(4),
a controller (2) connected to said inverter (3), and
a steering command device (1) connected to said controller (2),

characterized in that said controller (2) is a constant flux controller and said asynchronous motor (4), said controller (2) and said inverter (3) cooperate to provide said asynchronous motor, without obtaining information from said asynchronous motor, with a torque characteristic so as to be of the type with a slight saddle effect having output torques higher than the rated torque in the whole range of working frequencies, and a ratio of a starting torque to a rated torque of greater than 2.5".

Claim 1 according to the auxiliary request reads as follows:

"A method of steering a wheel of a vehicle, comprising: controlling an asynchronous motor, mechanically coupled to said wheel, without receiving positional information from said asynchronous motor on the basis of a steering command device, and
maintaining said asynchronous motor in a stable region of the torque characteristic of said asynchronous motor for a range of working frequencies, said torque characteristic having a ratio of a starting torque to a rated torque of greater than 2.5."

IV. The appellant's arguments may be summarized as follows:

The subject matter of claim 1 according to the main request is disclosed in the originally filed application, the feature relating to the motor starting torque to rated torque ratio being in particular derivable from the motor torque vs. slip frequency characteristic curve shown in fig.1 having a rotor resistance equal to 0.05 Ohm. Further, as illustrated

in said figure, the choice of starting to rated torque ratio as indicated in claim 1 gives a clear definition of the parameter range in which only a slight saddle effect is to be expected, thus ensuring operation of the motor outside of the region of instability.
Concerning novelty and inventive step the appellant submitted that none of the cited documents shows or suggests an electronic power steering for electric vehicles having the features of claim 1 since in particular none of the available documents discloses or suggests an electronic power steering for electric vehicles having a controller and an inverter operating without obtaining position information from the asynchronous motor. The closest prior art is known from D1 (DE-A-196 25 350) which contains no hint as to how the system's costs and size may be efficiently reduced. Quite to the contrary, in the control system of D1 a position or motor revolution (or speed) sensor such as encoder 34 is necessary for the speed control of the motor to be able to function properly. Conventional constant flux regimes for controlling asynchronous motors in servo actuator applications typically require the use of a position encoder, in the same way as in D1. D3 (US-A-3 775 652) clearly describes an example of a speed control for an electric motor not including a speed sensor or position sensor and similar types of open loop controls are generally known, but the skilled person would not consider this older prior art since more recent prior art shows that electrically controlled servo actuators, for efficiency reasons, generally rely upon the use of a speed or position sensor. Thus the skilled person, starting from closest prior art D1, would not envisage a combination with D3 which lies outside the main stream of recent technical

development. The invention has its basis in the realisation that the power requirement of the steering motor is only a small proportion of the total for the vehicle, thereby opening the way to use a less efficient steering operating system where a costly speed or position sensor is dispensed with. The same arguments apply equally to the subject matter of claim 1 according to the auxiliary request.

Reasons for the Decision

1. The appeal is admissible since it meets the requirements of Articles 106 to 108 EPC in conjunction with Rules 1(1) and 64 EPC.

2. The Board is satisfied that the subject matter of claim 1 according to the main request meets the requirements of Article 123(2) EPC since it includes amendments of originally filed claim 1 relating to the type of control, to its components and the mentioned torque ratio which are supported by figures 1 and 2 as well as column 1, lines 22-33 and column 2, lines 9-20,34-41 of the published patent application.

3. The subject matter of claim 1 according to the main request is new over the cited prior art, given that the closest prior art D1 discloses a closed loop control with an incremental encoder 34 providing the control with information on actual speed and rotation angle of the motor (column 5, lines 36-45), whereas such a position sensor is explicitly excluded by claim 1. D3 does not relate to an electronic power steering for electric vehicles. Moreover the Board considers claim 1

to satisfy the requirements of Article 84 EPC in respect of clarity. It follows that following amendment to the claim the grounds on which the impugned decision were based are no longer valid. In accordance with the appellant's request to grant a patent and as indicated in the communication of the Board, the Board has proceeded to consider inventive step.

4. D1, acknowledged by the appellant as closest prior art, discloses an electronic power steering device with an inverter 38 connected to the asynchronous motor, a controller 30,40 connected to said inverter and a steering command device 12 connected to said controller.

Therefore, as results from the characterizing portion of claim 1 and already mentioned above, the fundamental difference to D1 resides in that the electronic power steering of the present invention uses a constant flux controller without obtaining information from a position or velocity sensor, and in that in the operating frequency range the torque characteristic has only a slight saddle effect and a ratio of starting torque to rated torque greater than 2.5.

It is noted that the torque characteristic according to present claim 1, as emphasized by the applicant during the oral proceedings (see also published patent application column 2, lines 9-20; fig.1), minimises the influence of the unstable region in the operating frequency range and so avoids the need for the closed loop control employing the expensive encoder. Hence, the objective problem underlying the invention can be considered as consisting in providing a simplified electronic power steering control having lower costs

and smaller dimensions, while nevertheless obviously maintaining the operating frequency range in a stable region of the torque characteristic.

5. For the appreciation of inventive step the relevant question is whether the skilled person, in view of the above stated objective problem of the invention, would arrive at the claimed subject matter starting from closest prior art D1.

In the first place the realisation of the cost of the speed encoder is not new, as is demonstrated for instance by D3, where the expense of a speed sensor ("tachometer") is recognized (column 1, lines 20-25).

Further, it is acknowledged in the description of the application that it was well known how to influence the torque characteristic of an asynchronous motor (published patent application, column 2, lines 21-33) to obtain an operating frequency region without instabilities or having at most only a slight saddle effect with a starting torque being greater than the rated torque (published patent application, column 2, lines 11-20), and thereby minimise or indeed eliminate the region of instability.

Moreover, as acknowledged by the appellant, open-loop control systems for asynchronous motors including a constant-flux controller and an inverter for changing the frequency of the supply are conventional and are known from handbooks. D3 provides a further example of a speed control for electric motors with an open-loop system dispensing with a speed or position sensor and using supply voltage and current feedback.

Thus, the skilled person wishing to avoid the cost of the incremental encoder of D1 would consider these known and conventional, alternative control systems and adapt the torque characteristic in the known way in order to avoid the instability which would be inherent in such a less efficient control system. The acceptance of technical disadvantages in order to achieve economic gains does not involve inventive activity.

The appellant argues that inventive merit is present in the realisation that the power requirement of the servo actuator motor is a small portion of the total and that a less efficient motor control would be an acceptable penalty. The Board cannot accept this argument since the activity described by the appellant falls within the scope of normal analysis by the skilled person.

For the reasons mentioned above the subject matter of claim 1 cannot be considered as involving an inventive step (Article 56 EPC).

6. The subject matter of claim 1 according to the auxiliary request relates to the method of steering the wheel of a vehicle by means of an electronic power control including features already explicitly indicated in claim 1 of the main request, or obviously implicitly assumed therein, such as for instance the achievement of a stable control in the working frequency range. Consequently, for the same reasons as given above, the subject matter of claim 1 of the auxiliary request does not involve an inventive step.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

A. Vottner J. Osborne