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**Datasheet for the decision
of 7 April 2011**

Case Number: T 2038/08 - 3.4.02

Application Number: 00931861.9

Publication Number: 1196742

IPC: G01D5/20, G01B7/02

Language of the proceedings: EN

Title of invention:

METHOD AND DEVICE FOR POSITION DETECTION

Applicant:

VOLVO LASTVAGNAR AB

Relevant legal provisions:

EPC 1973 Art. 84

Keyword:

Clarity (yes)



Case Number: T 2038/08 - 3.4.02

D E C I S I O N
of the Technical Board of Appeal 3.4.02
of 7 April 2011

Appellant: VOLVO LASTVAGNAR AB
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Decision under appeal: **Decision of the Examining Division of the
European Patent Office posted 21 April 2008
refusing European patent application No.
00931861.9 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman: A. G. Klein
Members: F. J. Narganes-Quijano
B. Müller

Summary of Facts and Submissions

I. The appellant (applicant) lodged an appeal against the decision of the examining division refusing European patent application No. 00931861.9 based on the International application No. PCT/SE00/00983 (published with the International Publication No. WO 00/71977).

In the decision under appeal the examining division held that the subject-matter defined in independent claims 1 and 8 of the claim request then on file was not clear (Article 84 EPC 1973).

II. With the statement setting out the grounds of appeal the appellant filed sets of claims amended according to a main and a series of auxiliary requests and requested that the decision under appeal be set aside and a patent be granted.

III. In a telephone consultation the rapporteur drew the attention of the appellant to some deficiencies in the claims and the description. The results of the telephone consultation were dispatched with a communication dated 22 December 2010 together with attached sheets showing, by way of example only, amendments to pages 1, 2, 4 and 10 of the description of the application and amendments to the set of claims of the main request resulting in an amended set of claims 1 to 6.

With its letter dated 1 March 2011 the appellant expressed its agreement to the amendments shown in the amended application documents attached to the aforementioned communication and confirmed its request for the grant of a patent.

IV. Independent claims 1 and 6 amended according to the present request of the appellant read as follows:

"1. A method for substantially temperature-independent detection of the position of a moving element (9) by means of an inductive position sensor (1) comprising a coil (5) and a core (4) movable within the coil, the position of said core in relation to the coil (5) being dependent on the position of said element (9), whereby a measurement of the inductance of said coil (5), corresponding to the core (4) position, is detected by connecting a voltage to said coil (5) and measuring the time period in which a current (i) through the coil (5) is changed between two predetermined levels, comprising the following steps:

feeding a regularly alternating voltage (20) to the coil (5);

measuring the current (21) flowing through the coil (5);

measuring the period of time (t_1) needed for said current (i) to change from a first predetermined level (i_1) to a second predetermined level (i_2), which predetermined levels (i_1, i_2) are close to zero on opposite sides of a zero current level so that a low temperature dependency and an accurate measured value of time (t_1) is reached, and

determining a measurement of the core (4) position through measuring said period of time (t_1)."

"6. A device for substantially temperature-independent detection of the position of a moving element (9) comprising an inductive position sensor (1) including a coil (5) and a core (4) movable within the coil, the position of said core in relation to the coil (5) being dependent on the position of said element (9), and

comprising a measuring device (6) for feeding a voltage through the coil (5), for measuring the current (21) through the coil (5) and for measuring the time period between the points in time when the current through the coil (5) passes two predetermined levels, whereby a measurement of the inductance of said coil (5), corresponding to the core (4) position, is derived from said time measurement, said measuring device (6) comprising an amplifier means (12) for feeding a regularly alternating voltage (20) to the coil (5) and arranged to measure the period of time (t_1) needed for said current (21) to change from a first predetermined level (i_1) to a second predetermined level (i_2), which predetermined levels (i_1, i_2) are close to zero on opposite sides of a zero current level so that a low temperature dependency and an accurate measured value of time (t_1) is reached, said period of time (t_1) being used for determining the measurement of the core (4) position."

The request includes dependent claims 2 to 5 all of them referring back to claim 1.

V. The arguments of the appellant in support of its requests are essentially the following:

The invention is based on the concept of detecting the position of the moving element in a substantially temperature-independent manner by selecting the first and the second current levels so that the measurement of time for change of the current between these two levels is as independent of temperature as possible, and the claims define the technical features which are necessary in order to carry out the invention.

The choice of the current levels depends on the operating conditions, the material and design of the detector, the complex magnetic properties of the core and the resistance of the coil, the characteristics of the environment, etc.. It would therefore be difficult, if not impossible, to indicate precise intervals for the current levels. For the skilled person, however, it would be a matter of design to choose, depending on the circumstances, specific current levels to achieve the claimed effect. The measuring time period should be as long as possible in order to obtain a high resolution and a high accuracy of the measurements, and the skilled person would be able to balance the two aspects so that the measurement can be carried out in a manner which fulfils demands relating to the measurement accuracy and to the temperature independency.

Reasons for the Decision

1. The appeal is admissible.
2. *Amendments*

The application documents have been amended in order to overcome some substantive and formal deficiencies, and the amended application documents meet the formal requirements of the EPC, and in particular those set forth in Article 123(2) EPC. In particular, present independent claims 1 and 6 result from the respective combination of each of independent claims 1 and 8 of the application as published with the features of dependent claim 3 and the disclosure of the third paragraph on page 8 and the first paragraph on page 9 of the description with reference to Figures 2 to 4 of

the application as published, present dependent claims 2 to 5 correspond with dependent claims 4 to 7 as published, the text of the description has been brought into conformity with the invention as defined in the amended claims presently on file (Article 84, second sentence and Rule 27(1)(c) EPC 1973), and the pertinent prior art has been acknowledged in the introductory part of the description (Rule 27(1)(b) EPC).

3. *Clarity*

- 3.1 In its decision the examining division held that the subject-matter of independent claims 1 and 8 then on file was not clear (Article 84 EPC 1973). The objections of lack of clarity raised by the examining division - as far as they are still applicable to the subject-matter of claims 1 and 6 as presently amended - all concern the claimed feature according to which the first and second predetermined current levels "are close to zero on opposite sides of a zero current level so that a low temperature dependency and an accurate measured value of time is reached", and the reasons given by the examining division in support of the objections of lack of clarity were that the mentioned claimed feature constituted the formulation of a result to be achieved and that the claims did not define a solution in terms of the technical features of the invention. More particularly, the examining division held that the claims failed to specify how the current levels are actually selected and how "close to zero" the currents are, and also failed to define the expressions "low temperature dependency" and "accurate measured value of time" and to specify how the effects expressed by these two features are achieved.

3.2 However, in view of the subject-matter defined in the present independent claims and after consideration of the invention disclosed in the description of the application, the Board does not find or, as the case may be, no longer finds convincing the objections raised by the examining division for the following reasons:

3.2.1 The invention as defined in the present claims is primarily directed to the measurement of the position of a moving object by means of a position sensor of the inductive type, i.e. a sensor comprising a coil and a magnetic core coupled to the object and movable within the coil in such a way that the inductance of the coil varies as the core moves, the position of the object being determined according to the inductance of the coil which in turn is determined by feeding an alternating voltage to the coil and measuring the time response of the resulting periodic current flowing through the coil (see disclosure of Figures 1 and 2, together with page 2, first paragraph to page 3, second paragraph, and page 4, lines 4 to 14 of the description of the application).

According to the description of the application, the determination of the position of the object by means of an inductive position sensor of the type under consideration exhibits a substantial temperature dependency (Figures 2 to 4 together with page 1, first paragraph, page 3, two last paragraphs, page 8, last paragraph, and page 9, second paragraph of the description), and the main object of the invention is to solve this problem without resorting to complex equipment and without a significant deterioration of the measurement accuracy (page 3, third paragraph, and page 4, lines 17 to 24). The solution proposed in the

description is based on the realisation that, on the one hand, the dependency of the periodic current with the temperature is such that the instantaneous inductance is relatively uninfluenced by the temperature when the current is relatively small, i.e. close to zero (Figures 2 to 4 together with page 8, lines 14 to 18, and page 9, first paragraph) but that, on the other hand, the measuring time should be as long as possible in order to obtain an accurate measurement (page 8, lines 20 to 24). Accordingly, as emphasized by the appellant in the statement of grounds of appeal (see point V above), the invention resides in carrying out the determination of the inductance and therefore of the core position on the basis of the measurement of the period of time needed for the periodic current to change - not, for instance, along a cycle of the periodic current as in prior art approaches - but only between two predetermined current levels selected closely enough to zero on opposite sides of the zero current level in order to obtain a substantially temperature-independent measurement, but sufficiently far apart from each other in order not to jeopardize the measurement accuracy (page 4, lines 15 to 24, page 7, lines 20 to 25, and page 9, first paragraph of the description together with Figures 2 to 4).

- 3.2.2 Each of claims 1 and 6 defines the determination of the core position on the basis of a measurement of the period of time needed for the current to change between two predetermined levels defined in the claims as being "close to zero on opposite sides of a zero current level so that a low temperature dependency and an accurate measured value of time is reached", and the Board is of the opinion that, in view of the technical nature of the invention, the mentioned claimed feature defines in a sufficiently clear manner the essential

features of the invention disclosed in the description and referred to in point 3.2.1 above. In particular, the Board agrees with the examining division that the claimed feature "so that a low temperature dependency and an accurate measured value time is reached" constitutes a result to be achieved, but each of independent claims 1 and 6 also defines the technical measures required to achieve this result, namely carrying out the detection measurements on the basis of the period of time needed for the current to change between two predetermined levels that are "close to zero on opposite sides of a zero current level", so that in the circumstances of the present case no objection of lack of clarity arises from the mere fact of specifying a result to be achieved.

The Board also notes that independent claims 1 and 6 do not define in quantitative terms how close to zero the predetermined current levels should be in order to achieve the claimed effect. However, as submitted by the appellant (point V above) and acknowledged in the description of the application (page 2, lines 16 and 17, and page 8, last paragraph), the values of the optimum predetermined current levels generally depend on the magnetic properties and the resistance of the coil which in turn depend on the particular design and the specific materials of the inductive position sensor, and in these circumstances a precise quantitative definition of the predetermined current levels is not generally possible - or at least not available in the present case. The Board considers that in these circumstances a functional definition of the values of the predetermined current levels appears appropriate, subject to the corresponding definition being clear as it appears to be the case here. Thus, each of independent claims 1 and 6 requires, on the one

hand, that the predetermined current levels "are close to zero on opposite sides of a zero current level" and, on the other hand, specifies the effect to be achieved by the values of these levels ("a low temperature dependency and an accurate measured value time") and therefore defines in sufficient terms the teaching in the application referred to in point 3.2.1 above that the predetermined currents should be close enough to zero on opposite sides of the zero current to neutralize the influence of the temperature but also sufficiently apart from each other in order not to jeopardize the measurement accuracy. Consequently, the claimed features provide, on the one hand, clear instructions for the skilled person to perform the claimed invention by appropriately selecting in a particular inductive position detector a positive and a negative current level satisfying the claimed conditions and, on the other hand, enough information to allow the skilled person faced with a given inductive position detector device to easily determine whether it meets the claimed requirements by reference to an evaluation of the detection's accuracy and temperature dependency. In addition, the assessment of whether the claimed features are clear also depends on their contribution to distinguishing the claimed subject-matter from the prior art, and in the circumstances of the present case the issue of patentability does not rest only upon the exact value of the current levels (see also point 4 below). The Board is therefore satisfied that the formulation of independent claims 1 and 6 in functional terms constitutes a sufficiently clear definition of the invention within the meaning of Article 84 EPC 1973.

As regards the objection raised by the examining division that the independent claims do not define the

claimed features "low temperature dependency" and "accurate measured value of time" and how to achieve the effects expressed by these features, the Board notes that these two relative terms are to be interpreted in the technical context of the claimed subject-matter and that the question of how low the temperature dependency or how accurate the measured value actually is or should be, is not detrimental to clarity within the meaning of Article 84 EPC 1973. Indeed, the skilled person understands that the degree of temperature dependency and the degree of measurement accuracy run, as explained above, in opposite directions, and that the purpose of the invention is not a quantifiable optimum level of temperature independency and/or of measurement accuracy, but a compromise between these two aspects as also expressed by the claimed requirement that the predetermined levels are "close to zero" and are therefore neither zero (with minimum temperature dependency but a totally inaccurate measurement of the inductance) nor close to the extreme value(s) of the periodic current (with the highest measurement accuracy but also with the highest dependency on temperature).

3.3 Having regard to the above considerations and conclusions, the Board is satisfied that, in view of the technical nature of the claimed invention, the subject-matter defined in independent claims 1 and 6 is sufficiently clear within the meaning of Article 84 EPC 1973.

4. The Board is also satisfied that the application documents amended according to the present request of the appellant and the invention to which they relate meet the remaining requirements of the EPC within the meaning of Article 97(1) EPC. In particular, during the

examination proceedings the examining division expressed no doubts regarding the patentability of the claimed invention, and the Board, after consideration of the prior art on file addressing the problem of the influence of temperature on the detection of the position of an object by means of an inductive position detector, is satisfied that the claimed solution, and in particular the substantially temperature-independent and accurate determination of the position of the object in terms of the time needed for the current to change between two opposite levels close to zero, is neither disclosed nor rendered obvious by the available prior art (Article 52(1) EPC). The Board therefore concludes that the decision under appeal is to be set aside and a patent be granted on the basis of the amended application documents of the present request of the appellant.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the department of first instance with the order to grant a patent on the basis of the following application documents:
 - claims 1 to 6 annexed to the communication dated 22 December 2010,
 - description pages 1, 2, 4 and 10 annexed to the communication dated 22 December 2010 and pages 3 and 5 to 9 of the application as published, and
 - drawing sheets 1/3 to 3/3 of the application as published.

The Registrar:

The Chairman:

M. Kiehl

A. G. Klein