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Datasheet for the decision of 26 January 2010

Case Number: T 1590/07 - 3.4.02

Application Number: 04781012.2

Publication Number: 1671078

IPC: G01B 5/00

Language of the proceedings: EN

Title of invention:
Method for improving measurement accuracy of a portable coordinate measurement machine

Applicant:
FARO TECHNOLOGIES INC.

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 84

Relevant legal provisions (EPC 1973):
-

Keyword:
"Clarity support: no"

Decisions cited:
-

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 1590/07 - 3.4.02

D E C I S I O N
of the Technical Board of Appeal 3.4.02
of 26 January 2010

Appellant: FARO TECHNOLOGIES INC.
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 12 April 2007 refusing European application No. 04781012.2 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: A. G. Klein
Members: F. Maaswinkel
C. Rennie-Smith

Summary of Facts and Submissions

I. The appellant (applicant) lodged an appeal, received on 20 June 2007, against the decision of the examining division, dispatched on 12 April 2007, refusing the European patent application No. 04781012.2. The fee for the appeal was paid on 20 June 2007. The statement setting out the grounds of appeal was received on 22 August 2007.

In its decision, the examining division held that the independent claims then on file lacked clarity (Article 84 EPC) and that the subject-matter of some of the dependent claims was not disclosed in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art (Article 83 EPC).

II. With the statement of grounds of appeal the appellant filed new sets of claims according to a main and a subsidiary request and amended description pages and requested that a patent be granted with the following documents:

Claims:
main request: 1 - 82 filed with the letter of 22 August 2007;
subsidiary request: 1 - 82 filed with the letter of 22 August 2007;
Description:
pages 1, 2, 6 to 22, 24, 25, 27 to 29, 31, 32 and 34 to 36 as published;
pages 3, 5, 23, 26, 30 and 33 filed with the letter of 21 March 2007;
(*main request*) pages 4 and 4a filed with the letter of

22 August 2007;
(*subsidiary request*) pages 4 and 4a filed with the letter of 22 August 2007;
Drawings: sheets 1/50 - 50/50 as published.

Furthermore the appellant filed an auxiliary request for oral proceedings.

III. In a Communication pursuant to Article 15(1) RPBA accompanying a summons to oral proceedings the board expressed its preliminary opinion that the subject-matter of claim 1 of the requests appeared to be objectionable under Article 84 EPC.

IV. Oral proceedings took place on 26 January 2010. At the oral proceedings the appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of either the main request or the subsidiary request filed with the statement of grounds of appeal. The board gave its decision at the end of the oral proceedings.

V. The wording of claim 1 of the main request reads as follows:

" A method for improving the measurement accuracy of a portable coordinate measurement machine (CMM) which measures the position of an object in a selected volume, the CMM including:

a manually positionable articulated arm having opposed first and second ends, said arm including at least five rotary joints such that said articulated arm has at least five degrees of freedom,

a measurement probe attached to a first end of said articulated arm,

an electronic circuit which receives the position signals from transducers in said arm and which provides a digital coordinate corresponding to the position of the probe in a selected volume,

wherein, at least one of said rotary joints includes:

a periodic pattern of a measurable characteristic,

at least two read heads spaced from and in communication with said pattern, said pattern and said at least two read heads being positioned within said joint so as to be rotatable with respect to each other,

the method comprising:

using said at least two read heads to sense an error in the angular measurement of at least one transducer associated with a joint, said error being caused by deformation of a portion of said articulated arm when said arm is placed under a load,

correcting said error in the angular measurement".

The wording of claim 42 of the main request reads as follows:

" A portable coordinate measurement machine (CMM) which measures the position of an object in a selected volume, the CMM including:

a manually positionable articulated arm having opposed first and second ends, said arm including at least five rotary joints such that said articulated arm has at least five degrees of freedom,

a measurement probe attached to a first end of said articulated arm,

an electronic circuit which receives the position signals from transducers in said arm and which provides a digital coordinate corresponding to the position of the probe in a selected volume,

wherein at least one of said rotary joints includes a periodic pattern of a measurable characteristic, and at least two read heads spaced from and in communication with said pattern, said pattern and said at least two read heads being positioned within said joint so as to be rotatable with respect to each other, and said at least two read heads sensing an error in the angular measurement of at least one transducer associated with a joint, said error being caused by deformation of a portion of said articulated arm when said arm is placed under a load,

the CMM further including means for correcting said error in the angular measurement ".

Claims 2 to 41 and 43 to 82 of this request are dependent claims.

Independent claim 1 of the subsidiary request differs from claim 1 of the main request in that the last feature "…correcting said error in the angular measurement" reads "…decreasing said error in the angular measurement" (*emphasis added*). Independent claim 42 of the subsidiary request differs from claim 42 of the main request in that the last feature "…the CMM further including means for correcting said error in the angular measurement" reads "…the CMM further including means for decreasing said error in the angular measurement" (*emphasis added*).

Claims 2 to 41 and 43 to 82 of the subsidiary request are dependent claims.

VI. The arguments of the appellant may be summarised as follows.

Amended claim 1 of the main request corresponds to the combination of claims 1 and 4 of the set of claims of the decision under appeal, therefore the amendment does not extend beyond the content of the application as filed. Similarly claim 42 of the main request is a combination of former claims 43 and 46. New description pages 4 and 4a are filed in order to bring the description into conformity with new claims 1 and 42. In the decision to refuse the European patent application it was objected that former claims 1 and 43 are not clear. Furthermore the dependent claims would be objectionable since the person skilled in the art could not carry out the invention because the difference between the readings of two read heads was not sufficient for correcting a deformation induced error. In this respect the applicant agrees with the fact that the difference between the readings of two read heads is not sufficient for completely correcting a deformation induced error. Indeed, the expression "the inaccuracies of the rotational transducers are corrected for using at least two read heads" on page 19, lines 29 - 30 of the published patent application does not mean that the inaccuracies are completely corrected but means that the inaccuracies are partially corrected (see page 17, lines 20 - 21). However, the readings of the two read heads allow correcting one component of deformation (that being perpendicular to a line joining the two read heads). This can be concluded from the

passage on page 22, lines 10 to 12 which discloses "*In the case of the two read head arrangement, the angular measurement is derived from the average of the two read heads. The force of deformation can then be obtained by measuring the difference between the two read head readings*" (emphasis added). This component of deformation is by far the main component of deformation that affects angular measurement error. Hence, while the readings of the two read heads do not correct for all the error caused by deformation, from a practical standpoint the readings of the two read heads correct enough of the error caused by deformation as to provide an improved angular measurement. Consequently, the error is certainly substantially smaller as a result of using the two read heads than without using the two read heads. Thus, the method defined in claim 1 is clear and not contradictory to the described invention. Further, the invention defined in claim 1 is sufficiently disclosed that it can be carried out by the skilled person. This similarly applies to the apparatus defined in claim 42.

Claims 1 and 42 of the subsidiary request substantially correspond to a combination of former claims 1 and 4; and claims 43 and 46, respectively. In these claims only the term "correcting" has been replaced with the term "decreasing" which might be more appropriate. Such amendment does not extend beyond the content of the application as filed since the term "decreasing" is directly and unambiguously derivable from the application as filed for a person skilled in the art. Indeed, as disclosed above, the term "the inaccuracies of the rotational transducers are corrected for using at least two read heads" on page 19, lines 29-30 of the

published patent application does not mean that the inaccuracies are completely corrected but means that the inaccuracies are partially corrected. Consequently, the readings of the two read heads decrease the error caused by deformation so as to provide an improved angular measurement.

Reasons for the Decision

1. The appeal is admissible.

2. *Main request*

2.1 *Amendments*

According to the appellant in the grounds of appeal of 22 August 2007, amended claim 1 corresponds to the combination of former claims 1 and 4, this former claim 1 combining the features of original claims 1 and 4. Thus present claim 1 combines the features of original claims 1, 4 and 5. Similarly present apparatus claim 42 appears to combine the features of original claims 44, 47 and 48. Therefore these amendments should not be objectionable under Article 123(2) EPC.

2.2 *Article 84 EPC*

2.2.1 It appears, however, that the independent claims do not meet the requirements of Article 84 EPC for the following reasons:

2.2.2 In point 1 of the Grounds for the Decision, the examining division has objected that in order to be

able to correct an error in an angular measurement caused by a deformation it is indispensable that its amount and direction are known and that the only solution for determining the amount and direction of deformation disclosed in the present patent application is by using the information provided by the sensors S1 - S5. In the absence of such feature the independent claims were neither consistent with nor sufficiently supported by the description.

2.2.3 The appellant admits that determining the difference between the two read heads is not sufficient for completely correcting a deformation induced error, referring to the passage in page 19, lines 29-30 "*the inaccuracies of the rotational transducers are corrected for using at least two read heads*" and page 17, lines 20 and 21 " *Thus, the use of two read heads and the resultant error cancellation will result in a less error prone and more accurate encoder measurement*" which, according to the appellant, would disclose that the inaccuracies are partially corrected.

2.2.4 However, the issue to be decided here is whether the statement in independent method claim 1 - and the similar statement in independent apparatus claim 42 - directed to "using said at least two read heads to sense an error in the angular measurement of at least one transducer associated with a joint, said error being caused by deformation of a portion of said articulated arm when said arm is placed under load, correcting said error in the angular measurement" is clear and adequately supported by the description, as is required by Article 84 EPC.

2.2.5 Few passages only of the description are dedicated to correction of angular measurements using two read heads, and to accounting for deformations:

- Lines 15 to 27 on page 17 (paragraph [0100]) explain that angle measurement of an encoder is affected by disk run out or radial motion due to applied load but that cancellation effects arise when two read heads are positioned at 180° from each other, averaging of which allows for a final immune angle measurement. This embodiment, according to which cancellation of errors due to several causes not limited to deformation from applied load directly results from a particular arrangement of the two read heads at 180° from each other and from averaging of the measurement signals, is not considered to provide any support for the independent claims, which do not call for any particular arrangement of the read heads and also require the "sensing" of a specific error as caused by deformation of a portion of the articulated arm placed under load, which is different from averaging the signals from the two read heads.

- Paragraph [0106] bridging pages 19 and 20 is specifically dedicated to the correction of inaccuracies in a rotational transducer, the primary cause of which is stated to be non-circularity of the motion of the periodic pattern due to a number of phenomena including assembly imperfection and external deformations (see lines 22 to 28). The description then indicates that as an alternative to the embodiment of the invention discussed with respect to Figures 17 to 21 in which correction results from the use of two read heads mounted at 180° apart from each other (this is

the embodiment referred to above in relation to paragraph [0100]) another embodiment is disclosed with reference to Figures 41 to 43 wherein the possible error derived from deformations and/or assembly imperfections is corrected using a combination of at least one read head with one or more additional sensors. Since this second embodiment requires the use of sensors to correct an error in which the effect of deformation and assembly imperfections is aggregated, it cannot either adequately support the wording of the independent claims which on the one hand requires specific sensing and correction of the deformation-caused error and on the other does not define any additional sensor.

- Finally paragraph [0110] bridging pages 21 and 22 and the following paragraph [0111] relate to the concept of measuring the external force of deformation on a given joint using either the additional sensors of the embodiment disclosed with reference to Figures 41 to 43 (this is the second embodiment referred to above in relation to paragraph [0106]) or the two or more read heads of the embodiment referred to above in relation to paragraph [0100]. In respect of the latter alternative, the appellant's argumentation at the oral proceedings in support of the independent claims mainly relied upon the single phrase stating that "The force of deformation can then be obtained by measuring the difference between the two read head readings" (see lines 11 and 12 on page 22). The board cannot however endorse this view: this single sentence explicitly refers to a quite specific means of accounting for errors due to deformation, which consists in (directly) sensing a deformation force by measuring the difference

between the two read head readings. In the absence from the description of any further example or way of "using" said two read heads to sense an error caused by deformation within the generic meaning of the independent claims - other than by measuring the difference between the two readings - these claims are not considered to be supported by the description, in contravention of the requirement of Article 84 EPC.

2.2.6 Moreover, whilst it is clear from the description that a difference in the signals from the two read heads may reflect an imbalance in the rotary detectors which might be caused inter alia by external deformation, or non-circularity of the motion of the periodic pattern, due to assembly imperfection or disk run out, or by a combination of several such effects, the independent claims apparently relate the signals from the read heads only to such errors as are caused by deformation of an articulated arm under load. To that extent the claims do not appear to be consistent with the description, as also required by Article 84 EPC.

3. *Subsidiary request*

The statement in the independent claims of the main request objected to above under Article 84 EPC appears as well in the independent claims of the auxiliary request, which therefore fail for the same reason.

4. Since the independent claims of either request do not meet the requirements of Article 84 EPC, the appeal is not allowable.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

M. Kiehl A. G. Klein