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Datasheet for the decision of 28 January 2021

Case Number: T 0651/16 - 3.4.02

Application Number: 08775757.1

Publication Number: 2162701

IPC: G01B21/04

Language of the proceedings: EN

Title of invention:
APPARATUS AND METHOD FOR CALIBRATING A SCANNING HEAD

Applicant:
Renishaw PLC

Headword:

Relevant legal provisions:
EPC Art. 54(1)
EPÜ Art. 56

Keyword:
Novelty - after amendment - (yes)
Inventive step - after amendment - (yes)

Decisions cited:

Catchword:

Europäisches Patentamt
European Patent Office
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Beschwerdekammern

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Case Number: T 0651/16 - 3.4.02

D E C I S I O N
of Technical Board of Appeal 3.4.02
of 28 January 2021

Appellant: (Applicant)	Renishaw PLC New Mills Wotton-Under-Edge Gloucestershire GL12 8JR (GB)
Representative:	Dunn, Paul Edward Renishaw plc Patent Department New Mills Wotton-under-Edge, Glos. GL12 8JR (GB)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 22 October 2015 refusing European patent application No. 08775757.1 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	R. Bekkering
Members:	H. von Gronau
	B. Müller

Summary of Facts and Submissions

I. The applicant's appeal is directed against the decision of the examining division to refuse European patent application No. 08775757.1. The examining division refused the application on the grounds that the subject-matter of the independent claim 1 of the main request and the then first auxiliary request was not novel over document

D1: WO 2005/028996 A.

II. The examining division also cited the following documents:

D2: US 2003/0069709 A1
D3: US 4 888 877 A
D4: EP 0 438 095 A .

III. With the statement setting out the grounds of appeal, the appellant requested that the application be allowed based on the claims of the main request submitted to the examining division, or if the board was minded to refuse the main request, that a patent be granted based on the claims of first to fifth auxiliary requests filed with the grounds of appeal. In the event that the board was minded to refuse the main request, oral proceedings were requested.

IV. In a communication pursuant to Article 15(1) RPBA 2007 the board expressed its provisional opinion that inter alia the subject-matter of claim 1 of the main request was not new, and that the claims of all requests lacked clarity.

V. With a letter dated 13 February 2020 the appellant filed claims according to a main request and first to third auxiliary requests. The main request substantially corresponded to the first auxiliary request submitted with the grounds of appeal, the first auxiliary request substantially corresponded to the "previously submitted" second auxiliary request, and the second and third auxiliary requests were new requests. The previous requests were withdrawn on condition that the new requests were admitted into the appeal proceedings.

VI. Oral proceedings took place on 28 January 2021. During the oral proceedings the requests on file were discussed. The appellant then filed a fourth and a fifth auxiliary request and finally withdrew all requests but the last-filed fifth auxiliary request labelled "Time: 16:20 CET". The appellant confirmed its final request as follows:

The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of the sole request comprising the claims 1 to 10 filed as fifth auxiliary claim request, labelled "Time: 16:20 CET", description pages 1 to 12 and 14 to 25 filed during the oral proceedings and labelled "Time:16:20 CET", and originally filed drawing sheets 1/8 to 8/8.

At the end of the oral proceedings the chairman announced the board's decision.

VII. Claim 1 of the sole request reads as follows:

"A method of calibrating a measurement scale in a scanning head (16) using a calibration sphere (80), the method comprising the steps of;

(i) rotating a surface sensing device (28) mounted on the scanning head (16) about an axis (Al,A2) of the scanning head to move the surface sensing device (28) into a plurality of different angular orientations relative to the calibration sphere (80), the scanning head (16) comprising a measurement scale that provides a measure of an angular orientation of the scanning head about the axis (Al,A2);
(ii) measuring, with the surface sensing device (28), a plurality of points on the calibration sphere (80) at each of the different angular orientations of step (i);
(iii) determining multiple measurements of a radius or sphere centre of the calibration sphere, each measurement of the radius or sphere centre determined from the plurality of points measured at a different one of the different angular orientations;
steps (ii) and (iii) carried out for multiple different positions of the scanning head (16) around the calibration sphere (80); and
(iv) creating an error map or function relating measurements from the measurement scale of the scanning head (16) to angular orientations of the scanning head (16) about the axis (Al,A2), to correct for errors associated with the measurement scale, from variations in the radius or sphere centre as a function of angular orientation of the scanning head about the axis (Al,A2)."

Independent method claim 7 reads as follows:

"A method of calibrating a measurement scale in a scanning head (16) using a calibration artefact (40;60), the calibration artefact (40;60) comprises an array of features (46;66) arranged in a circle about a central axis, the method comprising the steps of:

(i) aligning the scanning head (16) with the central axis;
(ii) rotating a surface sensing device (28) mounted on the scanning head (16) about an axis (Al,A2) of the scanning head to move the surface sensing device (28) into a plurality of different angular orientations relative to the calibration artefact (40;60), the surface sensing device (28) aligned with a different one of the features (46;66) at each of the different angular orientations, the scanning head (16) comprising a measurement scale that provides a measure of an angular orientation of the scanning head about the axis (Al,A2);
(iii) at each of the different angular orientations of step (i), measuring with the surface sensing device (28) a plurality of points on the corresponding one of the features with which the surface sensing device (28) is aligned;
(iv) determining a measured position of each feature (46;66) from the plurality of points measured on the feature (46;66); and
(v) creating an error map or function relating measurements from the measurement scale of the scanning head (16) to angular orientations of the scanning head (16) about the axis (Al,A2), to correct for errors associated with the measurement scale, from variations in the measured position of each feature (46;66) from a known calibrated position of the feature (46;66)."

Reasons for the Decision

1. The appeal is admissible.

2. Sole request - amendments (Article 123(2) EPC)

2.1 Claim 1 is based on originally filed claims 1 and 14 and further includes features from the embodiment described with reference to Figures 9 and 10, where the calibration artefact is a single sphere and the radius or sphere center is determined with measurements from a plurality of positions of the scanning head with corresponding angular orientations (see originally filed description, page 23, second and third paragraph). The error map or function relating measurements from the measurement scale of the scanning head to angular orientations of the scanning head about the corresponding axis is then created from variations in the radius or sphere center position as a function of angular orientation of the scanning head about the axis (see paragraph bridging pages 23 and 24).

2.2 Claim 7 is based on originally filed claim 17 and further includes features from the embodiment described with reference to Figures 3 and 4, where the calibration artefact comprises an array of features arranged in a circle about a central axis. In this method the scanning head is aligned with the central axis and it is rotated with the surface sensing device about an axis to move the surface sensing device into a plurality of different angular orientations to align it with a different one of the features (see description, page 15, penultimate and last paragraphs). At each of the different angular orientations a plurality of points on the corresponding feature are measured to determine a measured position of each feature from the plurality of points measured on the feature (see page 16, first paragraph to page 18, first paragraph). The error map or function relating measurements from the measurement scale of the scanning head to angular

orientations of the scanning head about the relevant axis is created from variations in the measured position of each feature from a known calibrated position of the feature (see page 18, second paragraph).

2.3 The dependent claims are also disclosed in the application as filed (see in particular originally filed claims 9, 13 and 15).

2.4 The board therefore comes to the conclusion that the application meets the requirements of Article 123(2) EPC.

3. Sole request - clarity (Article 84 EPC)

3.1 The clarity issues raised by the board (see point IV above) have been addressed in the present claims. It is now sufficiently clear how the plurality of points on the sphere are measured with the surface sensing device at each angular orientation. Furthermore the claims define clearly that the error map or function is created by relating measurements from the measurement scale of the scanning head to angular orientations of the scanning head about the respective axis to correct for errors associated with the measurement scale from variations in the dimension (radius or sphere center in claim 1 or feature position in claim 7) as a function of angular orientation of the scanning head about the axis.

3.2 The board is therefore satisfied that the claims define clearly the invention.

4. Sole request - novelty and inventive step (Article 54(1) and 56 EPC).

4.1 Document D1 is considered to be the closest prior art document. It discloses a method of calibrating a scanning head 16 using a calibration artefact 100 (see Figures 1 and 8), the method comprising the steps of;
(i) rotating a probe mounted on the scanning head about an axis of the scanning head to move the probe 18 into a plurality of different angular orientations relative to the calibration artefact, the scanning head comprising a measurement scale that provides a measure of an angular orientation of the scanning head about the axis (A1, A2);
(ii) measuring, with the probe, a plurality of points on the calibration artefact at each of the different angular orientations of step (i);
(iii) determining the dimension and position of the calibration artefact by multiple measurements of the artefact from the plurality of points measured at a different one of the different angular orientations; and
(iv) creating an error map or function from a difference in the measured positions to positions on the artefact (see page 18, second paragraph to page 19, third paragraph).

4.2 However, document D1 does not disclose or suggest measuring with a plurality of points a radius or sphere center of a calibration sphere from different angular orientations or features of a calibration artefact at different angular orientations that allows to create an error map or function relating measurements from the measurement scale of the scanning head to angular orientations of the scanning head.
Such method steps are not suggested either by the other prior art documents on file.

4.3 Document D2 discloses correcting errors in the position of the probe and probe ball size by repeatedly measuring points on a reference sphere surface and calculating the center of the reference sphere with an assumed transformation matrix. However, document D2 does not suggest performing the measurements at different angular orientations of the scanning head and correcting for errors associated with the measurement scale.

4.4 Document D3 discloses a method of compensating travel errors of the anti-friction bearings of the articulating head and/or indexing errors of the angle encoders. To determine these travel errors, a base plate 53 (Figure 8) is substituted for plate 51 of Figure 7. Base plate 53 is clamped to the chucking receptacle of the articulating head. Plate 53 has four balls 55a-d, fixedly mounted at equal angular spacing. The center points of the balls are then measured for a very large number of angular positions about axis A, and, from these measurements, deviations in travel are determined for the cycle of rotation about axis A, and/or deviations in angular position for the encoder are determined for the cycle of rotation about axis A. However, document D3 does not suggest using a calibration sphere or an array of features arranged in a circle about a central axis that are measured with the sensing probe at different angular orientations. Therefore document D3 does not suggest the claimed method.

4.5 Document D4 discloses a procedure that makes it possible to correct the change in position of the scanner head as a result of deflection under its own weight as quickly and easily as possible, without time-consuming calibration procedures for the required

angular positions. It does not suggest creating an error map or function to correct for errors associated with the measurement scale.

4.6 The subject-matter of independent claims 1 and 7 is therefore new and involves an inventive step.

4.7 Claims 2 to 6 and 8 to 10 are dependent from claims 1 and 7 respectively and therefore also meet the requirements of novelty and inventive step.

4.8 The board concludes that the claimed invention meets the novelty and inventive step requirements (Article 54(1) and 56 EPC).

5. The description has been adapted to the invention defined in the amended claims and the relevant prior art documents are cited in the description (Rule 42(1) EPC).

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 in the following version:

Claims: nos. 1 to 10 filed as the fifth auxiliary claim request during the oral proceedings of 28 January 2021 labelled "Time: 16:20 CET".

Description: pages 1 to 12 and 14 to 25 filed during the oral proceedings of 28 January 2021 labelled "Time: 16:20 CET".

Drawings: sheets 1/8 to 8/8 as originally filed.

The Registrar: The Chairman:

L. Gabor R. Bekkering

Decision electronically authenticated