BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

A		B		C	X

File Number: T 760/90 - 3.4.2

Application No.: 84 108 111.0

Publication No.: 0 133 229

Title of invention: Wheel balancer two plane calibration apparatus and method

Classification: G01M 1/00

D E C I S I O N
of 24 November 1992

Applicant: FMC CORPORATION

Opponent: Hofmann Werkstatt-Technik GmbH

Headword:

EPC Article 84, 56

Keyword: "Main and first auxiliary requests: Clarity (no)" - "Second auxiliary request: Inventive step (yes)"

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number : T 760/90 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 24 November 1992

Appellant : (Opponent)
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Decision under appeal :
Interlocutory decision of the Opposition Division of the European Patent Office dated 30 May 1990, posted on 25 July 1990, concerning maintenance of European patent No. 0 133 229 in amended form.

Composition of the Board :

Chairman : E. Turrini
Members : W.W.G. Hofmann
L.C. Mancini

Summary of Facts and Submissions

I. European patent No. 0 133 229 was granted on 2 November 1988 on the basis of European patent application No. 84 108 111.0. The granted patent concerns a wheel balancer two plane calibration apparatus and method and contains 13 claims.

II. The patent was opposed by Hofmann Werkstatt-Technik GmbH (Opponent and Appellant). The opposition was filed against the patent as a whole and based on Article 100(a) EPC. Following documents were, inter alia, cited by the Opponent:

(D1) K. Federn, Auswuchttechnik, Vol. 1, Allgemeine Grundlagen, Meßverfahren und Richtlinien, Springer-Verlag, 1977, pages 39 to 43, 92, 113, 137, 156, 157, 172 to 180, 265 to 267, and

(D4) Hofmann Info Nr. 9, August 1977, G. Himmler, Rechnergestütztes Betriebsauswuchten.

III. By interlocutory decision the Opposition Division maintained the patent in amended form.

IV. The Opponent (Appellant) lodged an appeal against this decision. In the Statement of Grounds of Appeal the following document was, inter alia, cited:

(D2) US-A-4 285 240.

V. In accordance with requests submitted by the Appellant and the Respondent (Proprietor of the patent), the Board issued a summons to oral proceedings, together with a communication pursuant to Article 11(2) of the Rules of Procedure of the Boards of Appeal.

VI. At the oral proceedings, the Appellant requested that the decision under appeal be set aside and that the European patent be revoked.

The Respondent requested that the appeal be dismissed and that the patent be maintained on the basis of the following documents:

main request:
- Claims 1 to 11, as filed at the oral proceedings,
- description and drawings of the granted patent,

first auxiliary request:
- Claims 1 to 10, as filed at the oral proceedings,
- description and drawings of the granted patent,

second auxiliary request:
- Claims 1 to 3, as filed at the oral proceedings,
- description and drawings of the granted patent.

VII. Independent apparatus **Claim 1** according to the Respondent's **main request** reads as follows:

"Apparatus for calibrating a balancing machine for dynamically balancing objects rotatable on a shaft (11) thereon, comprising:

- fixture means (Fig. 1) for mounting a known mass (W1, W2) at a known radial position and at two different axial positions (Z_1, Z_2) on the shaft (11);

- a pair of force sensors (18, 19) spaced along (Z_0, Z_3) and coupled to said shaft (11) for detecting forces (F_{C1}, F_{C2}) caused by mass unbalance mounted on the shaft when it is rotating;

- means coupled to said force sensors (18, 19) for measuring the mass unbalance during calibration spins;

- means for effecting a first calibration spin with said known mass (W1) in said first axial position (Z_1) and for effecting a second calibration spin with said known mass (W2) in said second axial position (Z_2);

- means for processing the measured mass unbalance obtained as outputs (E) during said calibration spins to determine (equ. 16) correction factors (K) from said measured outputs (E), from said known calibration forces (F) and from apparent sensor positions (a', d') to compensate for existing non-linearity,

wherein the outputs obtained from said shaft spins approximate the actual non-linear curve (21, 22) by straight lines (F'_L, F'_R) whose intersections with the zero output axis (E=0) represent said apparent sensor positions (a', d');

said correction factors (K) being used to correct (equ. 17) the measured results from an unknown balance force.".

Independent method **Claim 4** according to the Respondent's **main request** reads as follows:

"Method for calibrating a balancing machine for dynamically balancing vehicle wheel assemblies rotatable on a shaft (11) thereon, comprising the steps of:

- mounting a fixture with a known mass (W1, W2) to said shaft (11) at a known radial position and at at least two different axial positions (Z_1, Z_2);

- rotating said fixture and determining balance forces (F_{C1}, F_{C2}) by a pair of force sensors (18, 19) coupled to and spaced along (Z_0, Z_3) said shaft;

- measuring the mass unbalance during a first calibration spin with said known mass (W1) in said first axial position (Z_1) and during at least a second calibration spin with said known mass (W2) in said second axial position (Z_2);

- processing the measured mass unbalance obtained as outputs (E) during said calibration spins to determine (equ. 16) correction factors (K) from said measured outputs (E), from said known calibration forces (F) and from apparent sensor positions (a', d') to compensate for existing non-linearity,

wherein the outputs obtained from said plurality of shaft spins approximate the actual non-linear curve (21, 22) by straight lines (F'_L, F'_R) whose intersections with the zero output axis (E=0) represent said apparent sensor positions (a', d');

said correction factors (K) being used to correct (equ. 17) the measured results from an unknown balance force.".

Independent apparatus **Claim 1** according to the Respondent's **first auxiliary request** reads as follows:

"Apparatus for calibrating a balancing machine for dynamically balancing automobile wheel assemblies rotatable on a shaft (11) thereon comprising

a fixture for mounting a known mass (W1) at a known radial position and at a first known axial position (Z_1) on the shaft, and for mounting a known mass (W2) at a known

radial position and at a second known axial position (Z_2) on the shaft (11),

a pair of force sensors (18, 19) spaced along (Z_0, Z_3) and coupled to the shaft (11) for detecting forces (F_{C1}, F_{C2}) caused by mass unbalance mounted on the shaft (11) when it is rotating,

means coupled to said sensor means (18, 19) for computing the mass unbalance during a first calibration spin with said known mass (W1) in said first axial position (Z_1) and during a second calibration spin with said known mass (W2) in said second axial position (Z_2) and for computing (equations 10, 11) an apparent axial separation (a') between the sensors and apparent axial positions (Z_0', Z_3', d') of the sensors utilizing the outputs from the first and second shaft spins, whereby correction factors (K in equation 16) for a specific sensor means (18, 19) is obtainable from a comparison (equations 12 to 15), and magnitude and phase information (equation 17) with reduced non-linear error content is detectable relative to unbalance mass in machine shaft mounted automobile wheel assemblies at predetermined axially located planes (P_1, P_2).".

Independent method **Claim 4** according to the Respondent's **first auxiliary request** reads as follows:

"Method for calibrating a balancing machine for dynamically balancing automobile wheel assemblies rotatable on a shaft (11) thereon comprising

mounting a known mass (W1) at a known radial position and at a first known axial position (Z_1) on the shaft,

mounting a known mass (W2) at a known radial position and at a second known axial position (Z_2) on the shaft (11),

detecting force (F_L, F_R) by a pair of sensors (18, 19) spaced along (Z_0, Z_3) and coupled to the shaft (11) for detecting forces (F_{C1}, F_{C2}) caused by mass unbalance mounted on the shaft (11) when it is rotating,

computing the mass unbalance during a first calibration spin with said known mass (W1) in said first axial position (Z_1) and during a second calibration spin with said known mass (W2) in said second axial position (Z_2) and computing (equations 10, 11) an apparent axial separation (a') between the sensors and apparent axial positions (Z_0', Z_3', d') of the sensors utilizing the outputs from the first and second shaft spins, whereby correction factors (K in equation 16) for a specific sensor means (18, 19) is obtainable from a comparison (equations 12 to 15), and magnitude and phase information (equation 17) with reduced non-linear error content is detectable relative to unbalance mass in machine shaft mounted automobile wheel assemblies at predetermined axially located planes (P_1, P_2).".

Independent method **Claim 1** according to the Respondent's **second auxiliary request** reads as follows:

"A method of calibrating a dynamic mass unbalance detection machine having a shaft rotatably driven about a spin axis and a pair of force sensors providing outputs indicative of force resulting from unbalance loads during shaft rotations and being axially spaced along and mechanically coupled to the shaft, wherein the outputs are electrically coupled to a computer, comprising the steps of

mounting a known mass on the shaft at a known radius from the spin axis and in a plurality of successive known axially spaced mass unbalance calibration planes,

spinning the shaft a plurality of times, once for each of the axially spaced calibration planes,

storing data indicative of the force sensor outputs from each calibration plane spin, and

computing the relationships between unbalance force and data indicative thereof as a function of axial shaft position using the data indicative of the force sensor outputs from the plurality of spins, whereby such computed relationships may be used to provide calibration data to reduce the error content in detected unbalance in predetermined mass unbalance correction planes.".

VIII. In support of his requests the Appellant essentially argued as follows:

As to the claims according to the main and first auxiliary requests, they are considered as lacking clarity in view of the fact that they contain features, like "to compensate for existing non-linearity" or "reduced non-linear error content", which are obscure. A non-linearity is mentioned but not at all defined. Moreover, it would be wrong to try to define an unknown non-linear curve by means of only two points. The claims do not give all the information necessary for the performance of the invention.

As to the claims of the second auxiliary request, they refer to a method of determining a non-linear curve by means of a plurality of tests. Considering that the person skilled in the art should have knowledge of the occurrence

of non-linearities, as proved by D4, it appears to be obvious, although no specific document could be cited, to apply a method, which should be already known in technics in general, to the specific field of balancing technology.

IX. The Respondent contested the Appellant's view and submitted essentially the following counter-arguments:

As to clarity of the claims according to the main and first auxiliary requests, the invention as claimed is clearly defined and, notwithstanding a certain generalisation, supported by the description. In particular, the claims contain all the features essential to the performance of the invention.

It is clear that, in the context of the invention, linearity has to be understood to mean that each sensor measuring signal can be represented as a straight line as a function of the axial position z or as a function of the unbalance effective at one location. Moreover, calibration constants or correction factors K are understood to be the ratio between the input signal of the force sensor and the electrical output signal of the force sensor. In an overall linear system these calibrating constants are assumed to be constant. The way in which the correction factors are obtained is given in equations (16), whereas equations (17) indicate how these factors are then used.

The claims address the true invention in an adequate manner and it would not be justified to restrict them by inserting further features, for instance the equations (16) and (17), as suggested by the Board in the communication dated 30 June 1992.

As to the second auxiliary request, Appellant's arguments are not convincing. An indication of the presence of an inventive step simply derives from the fact that no document could be cited against the claims. Indeed, if the claimed method is really so obvious, then it should have been already disclosed or at least suggested in a document in the relevant field of balancing technology.

Reasons for the Decision

1. The appeal complies with Articles 106 to 108 and Rule 64 EPC and is, therefore, admissible.

2. Main request

2.1 Claim 1 pertains to an apparatus for calibrating a balancing machine for dynamically balancing objects rotatable on a shaft. This apparatus comprises, inter alia, "means for processing the measured mass unbalance obtained as outputs (E) during said calibration spins to determine (equ. 16) correction factors (K) from said measured outputs (E), from said known calibration forces (F) and from apparent sensor positions (a', d') to compensate for existing non-linearity".

The expression "equ. 16" is put between parentheses and thus - even under Rule 29(7) EPC - cannot be construed as limiting or defining the subject-matter of the claim. Moreover, this expression cannot even be considered as an allowable reference sign within the meaning of Rule 29(7) EPC since it does not relate to the drawings. It is, therefore, to be ignored when assessing clarity of definitions as required in Claim 1. The correction factors (K) are thus not clearly defined in the claim as such. Indeed, the statement alone, that these factors depend on the measured outputs (E), the known calibration forces (F)

and apparent sensor positions (a', d'), is not sufficient for a clear definition. There is a boundless number of possibilities how one could come from these parameters to the correction factors.

These factors are said to be used "to correct (equ. 17) the measured results from an unknown balance force". Ignoring the expression "(equ. 17)" for the reason mentioned above, the claim also fails to indicate how the correction should be performed.

The claim, furthermore, mentions the presence of a "non-linearity" to be compensated, without indicating which function, as a matter of fact, is meant. For the same reason, the feature that "the actual non-linear curve" is approximated by straight lines is obscure. The reference numbers put between parentheses cannot provide a definition of the curve.

2.2 The Respondent has argued, in effect, that Claim 1 is intelligible, if read in the light of the description. This argument, however, is not convincing, because amended claims should themselves be clear in the sense of Article 84 EPC, without the help of the description.

It should be noted that, at the oral proceedings, the Respondent submitted the amended claims according to the main and first auxiliary requests in order to meet the objections regarding inventive step raised against the granted Claim 1 in the communication of the Board dated 30 June 1992. It is thus apparent that a clear and complete definition of the new features in the claim itself would have been essential.

2.3 Therefore, in view of the foregoing and considering that, even though Article 84 EPC does not constitute a ground for opposition according to Article 100 EPC, the provisions of Article 84 must nevertheless be satisfied in opposition proceedings in view of Article 102(3) EPC if the granted patent has been amended, present Claim 1 of the main request is not allowable, because its subject-matter lacks clarity.

The wording of the independent method Claim 4 is similar to that of Claim 1 and, therefore, gives rise to the same objections.

3. First auxiliary request

3.1 Similar arguments as those mentioned with regard to Claim 1 of the main request are valid for Claim 1 according to the first auxiliary request, in particular with reference to the definition and use of the correction factors. A further source of unclarity is, moreover, the fact that an apparent axial separation between the sensors and apparent axial positions of the sensors are mentioned but not defined, so that their meaning is obscure. The same applies to the expression "reduced non-linear error content".

3.2 Therefore, Claim 1 is not allowable, since it lacks clarity in the sense of Article 84 EPC. The same is true for the independent method Claim 4, the wording of which corresponds to that of Claim 1.

4. Second auxiliary request

4.1 The wording of Claim 1 according to the second auxiliary request exactly corresponds to that of Claim 10 of the patent as granted.

4.2 The Appellant agrees that none of the documents cited during opposition proceedings is relevant with respect to novelty and inventive step of the subject-matter of this claim. Thus, novelty of the subject-matter of Claim 1 is not in question. The Appellant argues that, once it has been recognized that the actual dependence of the sensor outputs from the axial position of the calibration force is not linear, it should be obvious to a skilled person to try to reconstruct this non-linear dependence by means of a plurality of tests, this approach being usual in technics.

As to the non-linear dependence, the Respondent himself agrees in his letters of 10 April 1991 (see page 12, penultimate paragraph) and of 10 July 1992 (see page 5, last paragraph), that the skilled worker could have some knowledge about the occurrence of non-linearities. This view is also shared by the Board and is supported by the prior art, in particular D4 (see page 6, last paragraph).

However, even though the idea of calibrating non-linear dependences by means of a plurality of test measurements does not appear to be unusual in technics in general, neither general knowledge nor prior art provides a hint as regards the possibility of applying this idea to the particular field of balancing technology. Indeed, known calibration methods for hard-bearing balancing machines normally resort to the smallest absolutely necessary number of runs, for instance a zero run with no load and a test run with a known calibration weight (see D2, column 2, lines 58 to 68) or two test runs (see D1, page 137, last line of first paragraph).

4.3 For these reasons, the subject-matter of Claim 1 according to the second auxiliary request involves an inventive step in the sense of Article 56 EPC. Claim 1 is thus allowable (Article 52(1) EPC).

Dependent Claims 2 and 3 refer to particular embodiments of the invention as defined in Claim 1 and are, therefore, likewise allowable.

4.4 Since according to the second auxiliary request the claims of the patent have been limited substantially, the remainder of the patent specification will have to be adapted. Having regard to the extent of the amendments required, the Board, before reaching its final decision, did not insist upon the Respondent filing a complete set of documents for each of his requests, but under these circumstances deemed it appropriate to make use of the power conferred upon it under Article 111(1) EPC to remit the case to the Opposition Division for further prosecution.

Order

For these reasons, it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the Opposition Division with the order to maintain the patent on the basis of the following text:

   - Claims 1 to 3 according to the second auxiliary request,
   - description and drawings to be adapted to these claims.

The Registrar: **The Chairman:**

P. Martorana E. Turrini