BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS | BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE | CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

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File Number: T 0633/91 - 3.4.2

Application No.: 84 305 094.9

Publication No.: 0 157 034

Title of invention: Detector head

Classification: G01D 5/245

D E C I S I O N
of 4 May 1993

Applicant: Sony Magnescale Incorporation

Headword:

EPC Art. 56

Keyword: "Inventive step: after amendment, yes"

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number : T 0633/91 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 4 May 1993

Appellant : Sony Magnescale Incorporation
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Decision under appeal : **Decision of the Examining Division of the European Patent Office dated 13 February 1991 refusing European patent application No. 84 305 094.9 pursuant to Article 97(1) EPC.**

Composition of the Board :

Chairman : E. Turrini
Members : M. Chomentowski
M.V.E. Lewenton

Summary of Facts and Submissions

I. European patent application No. 84 305 094.9 (publication No. 0 157 034) was refused on the grounds that the subject-matter of the submitted Claim 1 lacked an inventive step having regard to

D2 = US-A-3 427 463 and
D1 = GB-A-2 034 053.

II. The Appellant (Applicant) filed an appeal against this decision. He requested that the decision under appeal be set aside and that a patent be granted on the basis of new claims, with amended pages of the description.

III. In a first official communication, the Appellant was informed by the Board of Appeal that the main claims appeared to lack clarity and that their subject-matter appeared to lack an inventive step having regard to either D2 or D1.

IV. The Appellant filed new claims and amended pages of description and sheets of drawings and requested oral proceedings auxiliarily.

V. In the communication annexed to the summons to oral proceedings, the Appellant was informed that the subject-matter of the main claim appeared to lack an inventive step having respect to either D1 or D2.

VI. During the oral proceedings of 4 May 1993, the Appellant submitted new claims 1 to 7 and requested that a patent be granted on this basis with description and drawings to be adapted.

VII. Claim 1 reads as follows:

"1. A detector head for use in detecting dimensions of an object being measured, comprising; (read ":")

a plurality of sensor means (2; 3) for use in conjunction with a scale (1, 11) having a predetermined pitch, each of said sensor means (2; 3) producing an electrical signal having a relative phase-difference therebetween determined in accordance with the pitch of the scale (1, 11) and together indicating the dimensions of the object with greater resolution than would be possible from any one of said sensor means (2;3);
each of said sensor means (2; 3) comprising conversion means (2; 3; 13) for producing one of said electrical signals and a plurality of constituent elements (N_1, S_1, N'_1; 21) arranged in a pattern (Q, R, S, T);
said pattern (Q, R, S, T) being formed of at least two blocks (a, b, c, d) of the constituent elements (N_1, S_1, N'_1; 21), each of said at least two blocks (a, b, c, d) producing an intermediate signal of equal amplitude including higher harmonic components cancellable by combination of signals and characterized by having the blocks relatively positioned to produce a relative phase-difference corresponding to one sixth of the effective pitch of the scale (1, 11), wherein the intermediate signals from said at least two blocks (a, b, c, d) of constituent elements (N_1, S_1, N'_1; 21) are combined within the respective sensor means (2; 3) to cancel the third-order harmonic components such that said one of said electrical signals produced by the respective conversion means (2; 3; 13) is free from the third order harmonic components."

Claims 2 to 7 are dependent claims.

VIII. The Appellant submitted the following arguments in support of his request.

The necessary electrical interpolation of the signal output of a detector in order to realize a high precision measurement is rendered difficult when said signal is distorted and not sinusoidal; with triangular or trapezoidal shaped detector output with respect to mechanical displacement, the major part of the distortion can be attributed to the third harmonic components. An object of the present invention is to provide a detector head in which the deleterious harmonic waves of the third order which can cause distortions in the scaling detector signals or the output waves with respect to the displacement of the transducer are removed from the output. Admittedly, D2 comes part-way in recognizing the problem which the present invention intends to overcome. However, for solving this problem D2 only suggests to achieve successful interpolation by obtaining signals of purely sine or cosine shape and provides a device with the sole intent of producing a signal which is of such shape; indeed, D2 discloses eliminating the third order harmonic of the signal and, arguably, by choosing appropriate space to bar ratios in the emitter screen and receiver screen, which can be displaced with respect to each other, the third order harmonics is eliminated within the sensor itself; however, D2 only suggests that in order to eliminate harmonics, these are electrically processed as shown in Fig. 2, and does not disclose a single sensor formed of two blocks each producing a signal of equal amplitude and having a relative phase difference therebetween; D2 fails to recognize that two light signals from different gratings may be eliminated during the optical stage by having the blocks relatively positioned to produce a relative phase-difference corresponding to one sixth of the effective pitch of the

scale, this being done prior to producing an electrical output signal. D1 does not recognize the problem to be solved by the present invention and also only proposes electrical processing by which signals of different phase may be mixed, and is thus less relevant. Therefore, since the subject-matter of present Claim 1 is not suggested by the prior art, it involves an inventive step.

Reasons for the Decision

1. The appeal is admissible.

2. The amendments

2.1 Present Claim 1 is based in particular on a combination of original Claim 1 and original dependent Claim 2, which discloses the feature that it is the third-order harmonic components of the resultant sum signal which is cancelled. The further feature that the intermediate signal produced by the blocks within the sensor means are of equal amplitude and have a relative phase-difference corresponding to one sixth of the pitch of the scale, is based on embodiments of the description and drawings as originally filed (see in particular page 5, second paragraph; page 12, penultimate paragraph to page 13, first paragraph; Fig. 5(C), 6(A), 9(A) to 9(C), 10 to 13, 20; page 20, second paragraph and Fig. 19; Fig. 23(A)), the other originally disclosed embodiments showing ranges of values of relative phase-difference which comprise said specific value thereof.

The Board is satisfied that the present Claim 1 considered independently correctly defines the matter for which protection is sought and which can comprise in

particular either a magnetic-type device or an optical-type device.

3. Novelty

3.1 A detector head for use in detecting dimensions of an object being measured comprising all the features of present Claim 1 is not known from the prior art and, therefore, the subject-matter of Claim 1 is novel in the sense of Article 54 EPC.

4. The closest state of the art

4.1 A detector head for use in detecting dimensions of an object being measured, is known from D2 (see column 1, lines 38 to 41; column 1, lines 65 to 72; column 2, line 60 to column 3, line 42; Fig. 1 and 2); this detector head is an **optical-type device** and comprises:

a plurality of sensor means, i.e. the 4 sensor means (3a, 5a, 6a), (3b, 5b, 6b), (3c, 5c, 6c) and (3d, 5d, 6d), for use in conjunction with a scale (2) having a predetermined pitch, each of said sensor means (3a, 5a, 6a; 3b, 5b, 6b; 3c, 5c, 6c; 3d, 5d, 6d) producing an electrical signal having a relative phase-difference therebetween determined in accordance with the pitch between screen bars (2') of the scale (2) and together indicating the dimensions of the object;

each of said sensor means (3a, 5a, 6a; 3b, 5b, 6b; 3c, 5c, 6c; 3d, 5d, 6d) comprises conversion means (6a; 6b; 6c; 6d) for producing one of said electrical signals and a plurality of constituent elements (3'; 3''; 3'''; 3'''') arranged in a respective pattern, i.e. the respective patterns (3a), (3b), (3c) and (3d);

moreover, each of said patterns can be divided and thus is formed of at least two blocks of constituent elements, for instance two blocks of constituent elements (3') formed by dividing the pattern (3a); each of said at least two blocks, for instance the two blocks in the pattern (3a), produce, i.e. transmit, an intermediate optical signal of equal amplitude including higher order harmonic components cancellable by combination of signals.

This particular example of D2 showing patterns formed of blocks of constituent elements is accompanied by the most detailed explanations.

4.2 However, contrary to the presently claimed detector head, the relative phase-difference between the electrical signals produced by the sensor means (3a, 5a, 6a; 3b, 5b, 6b; 3c, 5c, 6c; 3d, 5d, 6d) of the detector head known from D2 is not derivable as corresponding to one sixth of the effective pitch of the scale (2); moreover, the intermediate signals from said at least two blocks of for instance the pattern (3a) of constituent elements are **not** combined within the respective sensor means, but **a subtracting circuit external to the sensors** is used for eliminating harmonics. It is also to be noted that by means of the double scanning system described with reference to Fig.1 and the subtraction circuit arrangement of Fig.2, i.e. with 4 patterns (3a, 3b, 3c, 3d), it is possible to eliminate the direct-current component and the **harmonics** of even order (n = 2, 4, 6 and so forth) from the signal output, but there is no derivable indication about the elimination of the third harmonic components.

4.3 Indeed, other harmonics can be eliminated by a suitable construction of the emitter screen (2) and/or the

receiver screen system (3) of the detector head of D2 (see column 3, lines 43 to 69; Fig. 3); for instance the third harmonic and the fifth harmonics and their integral multiples can be eliminated from the derived signal voltage wave. However, this is done by a selection of the space to bar relations, i.e. of the respective locations of the individual constituent elements (3', 3'', 3''', 3'''') within the patterns and also of the constituent elements (2') within the scale (2), and not by the location of the blocks within the patterns (3a, 3b, 3c, 3d) with respect to each other. Also in this form there is no indication that the elimination of the third harmonic is effected within the sensor and not by using the subtracting electrical circuit of Fig. 2. It is to be noted that the indications in D2 (see column 2, lines 67 to 71) that only two, and not four, patterns are required in one form of the method, do not provide any further information about the arrangement of the blocks within the patterns or the specific means for eliminating the third harmonic components.

4.4 It is furthermore to be noted that in another aspect of the device known from D2 (see column 3, line 60 to column 4, line 3; Fig. 4) it is also possible to eliminate additional harmonics and their integral multiples, but this is not done by selecting particular locations of the blocks but by a somewhat inclined arrangement of the receiver screen (3) with respect to the emitter screen (2), and this owing to the "moiré" effect. Concerning a further example known from D2 (see column 4, lines 4 to 65; Fig. 5) whereby it is possible to eliminate all harmonics above a certain order, it is to be noted that this is done by pupillary influence, for instance by interposing a diaphragm (13) having a properly proportioned aperture between focusing lenses

having particular focal lengths, and not by the location of the blocks with respect to each other in the patterns.

4.5 Therefore, no indication is derivable that in the device of D2 (see the title), which is for eliminating harmonics, it is the arrangement of the blocks in the patterns which should be specifically selected for this purpose and in particular for eliminating the third harmonic within the sensors.

5. Problems of the prior art and solution therefor

5.1 As credibly submitted by the Appellant, the necessary electrical interpolation of the signal output by the detector in order to realize a high precision measurement is rendered difficult when said output signal is distorted and not sinusoidal; with triangular or trapezoidal shaped detector output with respect to mechanical displacement, in optical or capacitance types of systems, which contain harmonic components, it can be seen that the major part of the distortion can be attributed to the third harmonic components. Accordingly, it is an object of the invention to provide a detector head in which deleterious harmonic waves are removed from the output, specifically, harmonic waves of the third order which can cause distortions in the scaling detector signals or the output waves with respect to the displacement of the transducer.

6. Inventive step

6.1 As admitted by the Appellant, D2 (see column 1, lines 50 to 64) comes part-way in recognizing the problem which the present invention intends to overcome, i.e. that the previous somewhat crude scanning systems produce a signal which is not cosine or sine shaped but which has many

superimposed harmonics, i.e. the signal is more or less in the form of direct current having ripples of superimposed harmonics, which have an adverse effect on further interpolation.

6.2 However, as credibly argued by the Appellant, for solving this problem D2 (see column 1, lines 58 to 72) only suggests to achieve successful interpolation by obtaining signals of purely sine or cosine shape and provides a device with the intent of producing a desirable signal comprising combining scanning signals through an electric subtraction circuit.

6.3 A detector head for use in detecting dimensions of an object being measured, i.e. a magnetoresistive displacement sensor and signal processing circuit therefor, is known from D1 (see the title; page 2, lines 18 to 33; see also page 4, lines 30 to 57; Fig. 4) and comprises:

a plurality of sensor means (44, 44') for use in conjunction with a scale (24) having a predetermined pitch (lambda), each of said sensor means (44, 44') producing an electrical signal having a relative phase-difference therebetween determined in accordance with the pitch (lambda) of the scale (24) and together indicating the dimensions of the object;

each of said sensor means (44, 44') comprises conversion means for producing one of said electrical signals and a plurality of constituent elements (28, 28', 28'', 28''') arranged in a pattern (44, 44'); it is to be noted that each of said patterns (44, 44') can be formed of at least two blocks of the constituent elements (28, 28', 28'', 28'''), each of said at least two blocks (48, 48') (or

the two blocks (48'', 48''')) producing an intermediate signal of equal amplitude.

6.4 However, as credibly argued by the Appellant, the purpose of the device of D1 (see page 4, lines 52 to 53; see also page 5, lines 59 to 63) is to produce a predetermined number of zero crossings, in particular for increasing the accuracy of measurement, and not to eliminate harmonics of a predetermined order and thus D1 does not recognize the problem to be solved by the present invention. Although in D1 the relative phase difference between the sensors can be selected as a part of the pitch of the scale, whereby for instance in another form of the detector head of D1 (see page 5, lines 54 to 64; Fig. 10) parts of said detector head are spaced and have a relative phase-difference corresponding to one sixth of the pitch of the scale, there is no indication in D1 that this arrangement, which is for six zero crossings of said pitch, could result in cancelling the third-order harmonic components such that said one of said electrical signals produced by the respective conversion means is free from the third order harmonic components as required in present Claim 1. Moreover, D1 (see page 3, lines 3 and 4; pages 6, lines 29 and 30; Fig. 14) only proposes electrical processing by which signals of different phases may be mixed.

Therefore, D1 is relevant neither as the starting prior art document nor for a combination with D2.

6.5 The other prior art documents are less relevant.

6.6 Therefore, the subject-matter of present Claim 1 involves an inventive step in the sense of Article 56 EPC.

7. Thus, a patent may be granted after subsequent adaptation of the description and drawings (Art. 97(2) EPC).

Order

For these reasons, it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the Examining Division with the order to grant a patent on the basis of Claims 1 to 7 filed during the oral proceedings of 4 May 1993 and description and drawings to be adapted.

The Registrar: The Chairman:

P. Martorana E. Turrini