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Datasheet for the decision of 16 September 2008

Case Number: T 1234/06 - 3.4.02

Application Number: 97118944.4

Publication Number: 0840095

IPC: G01D 5/16

Language of the proceedings: EN

Title of invention:
Magnetic encoder

Patentee:
Mitutoyo Corporation

Opponent:
TESA SA

Headword:
-

Relevant legal provisions:
EPC Art. 56, 123(2)

Keyword:
-

Decisions cited:
-

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 1234/06 **-** 3.4.02

D E C I S I O N
of the Technical Board of Appeal 3.4.02
of 16 September 2008

Appellant: (Patent Proprietor)
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Decision under appeal:
Decision of the Opposition Division of the European Patent Office posted 9 June 2006 revoking European patent No. 0840095 pursuant to Article 102(1) EPC.

Composition of the Board:

Chairman: A. Klein
Members: F. Maaswinkel
M. J. Vogel

Summary of Facts and Submissions

I. European patent No. 0 840 095 (based on application No. 97118944.4) was revoked by the decision of the opposition division dated 9 June 2006. In its opinion, whereas the objections under Art. 100(c) and 123(2) EPC raised by the opponent were not persuasive, the subject-matter of claim 1 of the main and 1st auxiliary requests did not involve an inventive step having regard, inter alia, to the disclosures of the following documents:

D2: US-A-5 036 319

D3: JP-A-1 212 213

D5: "Bridge Circuits Marrying Gain and Balance", Application Note 43, Linear Technology, June 1990

D6: "Dual Micropower Comparator LTC1040", Linear Technology, Linear Databook 1990

D7: EP-A-0 479 525

D10: US-A-5 386 642

D12: "magnetoresistiver Sensor mit großen Einbautoleranzen zur inkrementalen und absoluten Längenmessung", F. Dettmann et al, published 1995

D13: "Messung mechanischer Größen mit magnetoresistiven Sensoren", F. Dettmann et al, Feingerätetechnik, Berlin, 38 (1989) 2

D16: EP-A-0 112 463ß

D17: US-A-5 047 716

D19: EP-A-0 554 518

D22: JP-A-60 218 027 and translation in English (D22')

D26: P. Horowitz, W. Hill "The art of electronics", 2nd ed., Cambridge University press 1989, pp. 140-144.

Furthermore the opposition division found that claim 1 according to the 2nd auxiliary request filed with the

letter of 18 April 2006 was objectionable under Art. 84 EPC. The 3rd auxiliary request filed during the oral proceedings was not admitted under Art. 114(2) EPC.

II. On 28 July 2006 the patent proprietor filed an appeal against this decision and paid the appeal fee on the same day. In the statement setting out the grounds of appeal received on 18 October 2006 the appellant requested that the decision of the opposition division be set aside and that the patent be maintained on the basis of the set of claims of the main request or auxiliary requests 1 to 3 filed therewith or, as a further auxiliary request, that oral proceedings be arranged.

III. In its reply received on 19 February 2007 the respondent requested that the appeal be dismissed and also, as auxiliary request, oral proceedings.

IV. In a summons pursuant to Rule 115(1) EPC sent on 25 April 2008 the board invited the parties to oral proceedings.

V. In a further letter received on 3 July 2008 the respondent made reference to document D29 (JP-A-6 147 920) and its translation into English and argued that this document, although it was late filed, should be considered because it anticipated the subject-matter of claim 1 of the main and first auxiliary request.

VI. In response the appellant filed with a letter received on 14 August 2008 amended main and first to fourth auxiliary requests.

VII. In a subsequent letter received on 11 September 2008 the respondent filed further observations.

VIII. Oral proceedings were held on 16 September 2008. During the oral proceedings the appellant requested that the decision under appeal be set aside and the patent be maintained on the basis of the main request or one of the auxiliary requests 1 to 3, all filed on August 14, 2008, or on the basis of the fourth auxiliary request filed during the oral proceedings.

IX. The respondent requested that the appeal be dismissed.

X. The wording of claim 1 of the appellant's main request reads as follows (the numbering of features "1)" to "8)" is not part of the claims, but has been introduced for easier reference in the following Reasons):

"A magnetic encoder, comprising:

1) a first member (1) having N pole portions and S pole portions alternately arranged at a predetermined pitch;

2) a second member (2) disposed opposite to said first member (1) so as to be relatively movable to said first member (1);

3) at least four magneto resistance devices (Mal, Mbl, Ma2, Mb2) so arranged on said second member (2) as to output signals with phases that differ by 90° each corresponding to the pitch of the magnetic poles of said first member (1);

4) a displacement detecting circuit (30) for obtaining the difference between output signals with phases that differ by 180° each output from

the magneto resistance devices to output two sine wave signals with phases that differ by 90° each, the amplitudes of the two sine wave signals being varied corresponding to the relative movement of said first member (1) and said second member (2),

5) said displacement detecting circuit (30) being driven by a DC power supply (VDD);

6) a signal processing circuit (4) for generating two square wave signals based on the two sine wave signals obtained by said displacement detecting circuit (30)

6a) and comprising a pair of sample hold circuits (41a, 41b) for sampling and holding the two-phase sine wave signals obtained from said displacement detecting circuit (30) by said first clock CK1;

7) a counter (5) for counting the two square wave signals obtained by said signal processing circuit (4) to obtain relative position of said first member (1) and said second member (2); and

8) a switch circuit (34) for intermittently turning on/off the output of the DC power supply (VDD) to said displacement detecting circuit (30) corresponding to a first clock (CK1) having a predetermined frequency".

The wording of claim 1 of the first auxiliary request is as claim 1 of the main request except for feature 6a) which reads as follows:

"6a) and comprising a pair of sample hold circuits (41a, 41b) for sampling and holding the two-phase sine wave signals obtained from said displacement detecting circuit (30) by the first clock (CK1); and

an interpolation circuit (81) for interpolating output signals of the sample hold circuits (41a, 4lb) to obtain the two-phase square wave signals;"

The wording of claim 1 of the second auxiliary request is as claim 1 of the main request except for feature 6a) which reads as follows:

"6a) and comprising a pair of sample hold circuits (41a, 4lb) for sampling and holding the two-phase sine wave signals obtained from said displacement detecting circuit (30) by said first clock CK1; and

a circuit (42a, 42b, 81) intermittently activated by a second clock CK2 with a phase delayed from the phase of the first clock CK1;"

The wording of claim 1 of the third auxiliary request is as claim 1 of the main request except for feature 6a) which reads as follows:

"6a) and comprising a pair of sample hold circuits (4la, 41b) for sampling and holding the two-phase sine wave signals obtained from said displacement detecting circuit (30) by the first clock (CK1); and

an interpolation circuit (81) for interpolating output signals of the sample hold circuits (4la, 41b) to obtain the two-phase square wave signals, the interpolation circuit (81) being intermittently activated by a second clock (CK2) with a phase delayed from the phase of the first clock (CK1). [*sic*]"

The wording of claim 1 of the fourth auxiliary request is as claim 1 of the main request except for features 6a), 7) and 8) which read as follows:

"6a) and comprising a pair of sample hold circuits (41a, 4lb) for sampling and holding the two-phase sine wave signals obtained from said displacement detecting circuit (30) by a first clock (CK1) having a predetermined frequency;
a pair of comparators (42a, 42b), intermittently activated by a second clock (CK2) with a phase delayed from the phase of the first clock (CK1), for comparing output signals of the sample hold circuits (4la, 41b) with a constant reference voltage to obtain binary data; and
a pair of flip-flops (43a, 43b) for receiving the binary data from the comparators (42a, 42b) to output the two-phase square wave signals;

7) a counter (5) for counting the two square wave signals obtained by said signal processing circuit (4) to obtain relative position of said first member (1) and said second member (2); and

8) a switch circuit (34) for intermittently turning on/off the output of the DC power supply (VDD) to said displacement detecting circuit (30) corresponding to the first clock (CK1)."

Claims 2 to 10 of this request are dependent claims.

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

With regard to the requirements prohibiting added subject-matter (Art. 123(2) and (3) EPC) the opposition division had correctly decided that these were fulfilled by the prior main request, which concerned claim 1 of the patent as granted. From the overall disclosure it is clear that by the expression that "the magnetoresistance devices are arranged on the second member so as to output phases that differ by 90°" it is the spatial arrangement which is responsible for the intended output signal phase. In respect of the reference of the respondent to the spatial arrangement in Figure 2, it is noted that the original patent application disclosed further spatial alternatives of the magnetoresistance member arrangement, for instance in Figure 18. Claim 1 of the present main request additionally includes the first feature of claim 4 as granted, namely that "the signal processing circuit (41) has a pair of sample hold circuits (41a, 41b) for sampling and holding the two-phase sine wave signals obtained from said displacement detecting circuit (30) by said first clock CK1". Since these features are incorporated from claim 4 as granted there is no issue under Article 123(2) or (3) EPC. This also applies to the further requests, which similarly include features of granted claims 4 and/or 5. The pair of sample hold circuits now recited in the claims of the new requests prevents the two sine wave signals obtained by the displacement detecting circuit from varying when the switch circuit is turned off. None of the cited documents, in particular the late filed document D29, teach or suggest such sample hold circuits in an encoder circuit with intermittent power. Therefore the provision of sample hold circuits is an important aspect of the invention. As is illustrated in Figure 5, the provision of sample hold circuits enables a more accurate analysis

of the sinusoidal waves from the encoder. It is admitted that this feature had been defined together with further features in dependent claims 4 and 5 of the patent as granted. Yet, although the respondent has objected that the inclusion of this feature in the independent claim would be contrary to the provisions of Art. 123(2) EPC, it is the understanding of the appellant and also confirmed by the relevant Case Law, that such a feature may be included in the independent claim without the further elements of previous dependent claims if it follows from the original disclosure that these elements are not so linked that they can only be claimed in combination. In the present case, dependent claims 4 and 5 defined different solutions, both relying on the presence of sample hold circuits which are clocked together with the bridge circuit. This feature is therefore an independent feature, not linked to the further features of these claims 4 and 5. Hence, it is the opinion of the appellant that the present claim 1 does not involve an undue generalization and that the claim should not be objectionable under Art. 123(2) EPC. The independent claims according to the auxiliary requests define the further features from claims 4 and 5, and should therefore equally satisfy the provisions of Art. 123(2) EPC.

With respect to the issue of inventive step, the subject-matter of claim 1 according to the main request differs in the following aspects from the cited prior art:-

Document D22’ discloses a rather simple design encoder comprising only two magnetoresistance devices (see, for example, Figure 6, reference numerals 4 and 5) and not comprising a bridge circuit. Furthermore, as is

shown in the signal shapes SA and SB in Figure 5, the output signals of these magnetoresistance elements are not sinusoidal but are binary pulses, and there is no sample hold circuit, instead the signals are directly input to flip-flops. Since the circuit disclosed in D22' does not include a bridge circuit, there would not be an incentive to the skilled person to combine this disclosure with D5, which is only concerned with bridge circuits. It is added that in the encoder circuit according to the patent sinusoidal signals are used for accuracy because they allow a more accurate conversion to square waves, as is illustrated in Figure 5. This should be compared to Figure 5 of D22', which just shows simple binary pulses SA and SB.

Document D29 describes a magnetic encoder with a magnetoresistance element that comprises a bridge circuit with eight components R1 to R8 (as shown in Figure 4) to generate two outputs having an electrical phase difference of 90°, in contrast to the presence patent which requires only four magnetoresistance devices. Furthermore the circuit of D29 requires a frequency multiplier 4 to generate the output signals. Since this document is also silent on the use of sample hold circuits, it cannot anticipate or suggest the invention as defined in the main request.

In the decision under appeal the opposition division had also considered document D2 as the closest prior art. As acknowledged in the introductory part of the patent specification, D2 discloses a magnetic encoder including a multipolar magnetic body having a row of alternate North and South poles of equal widths and a magnetoresistance element disposed in confrontation to the multipolar magnetic body. This element comprises at least one A phase magnetoresistance

element member and at least one B phase magnetoresistance element member disposed in juxtaposition. Each of these members has a group of series connected linear conductors arranged side-by-side into a comb-like shape. According to D2, this arrangement provides overlapping signals that form a rectangular or trapezoidal output signal so to avoid the shortcomings of only a single magnetoresistance element. The superposition of a multitude of output signals requires, however, a continuous operation of the circuit, so that the person of ordinary skill will reject the idea of supplying power to the circuit of D2 only intermittently and would not combine this disclosure with that of document D5. In contrast to D2, the intermittent power supply in the present patent is optimally adapted to the underlying measurement principle, namely the sampling of sinusoidal waves and holding the sampled values for further processing. It is added that in any case document D5, for instance in the embodiment of Fig. 21 or 23, incorporates a complex sampled output bridge conditioner using pulsed excitation and thus involves an expensive, high precision circuitry which appears to be more suitable for laboratory equipment than for cheap, hand-held magnetic encoder devices. Therefore it is the opinion of the appellant, that the subject-matter of claim 1 according to the main request involves an inventive step.

With respect to the auxiliary requests, the combination of sample hold circuits with an interpolation circuit (81) as now recited in the new first and third auxiliary requests is even less apparent from the cited documents and provides increased accuracy in an encoder with sampling intermittently supplying power.

The feature now recited in the new second and fourth requests, namely using a second clock CK2 to intermittently activate further circuits in the signal processing unit (the displacement detecting circuit being operated by the first clock CK1) is equally absent in all of the cited documents. Claim 1 of the new second and fourth auxiliary request specifies that the encoder is operated such that both the displacement detecting means 30 and further circuits (the comparators 41) are intermittently operated under the control of two different clocks CK1 and CK2, respectively. Thus the components with the highest power consumption circuit are affected and the overall power in the encoder circuit is reduced to a minimum. However, other circuits with low consumption, e.g. the flip-flops 43, are not operated intermittently. As described in [0036] of the patent specification, the intermittent operation of the comparators results in their output signals becoming sometimes unstable. The provision of e.g. flip-flops 43, which are not intermittently operated, as in claim 1 according to the fourth auxiliary request, assures that the output signals OUTA and OUTB are nevertheless stable. This aspect of the invention, namely to apply the intermittent power to selected parts of the circuit is not mentioned in any of the numerous documents cited in the opposition proceedings. Use of different, phase-offset clocks for power supply to different components, adds to the stability of the circuit.

VII. The arguments of the respondent may be summarised as follows.

Objection under Art. 123(2) EPC arises against claim 1 of the patent as granted since this claim includes the expression "at least four magnetoresistance devices so arranged on said second member as to output signals with phases that differ by 90°" which replaces the expression in originally filed claim 1 "at least four magnetoresistance devices with phases that differ from by 90°". The original patent application solely disclosed a spatial arrangement of the magnetoresistance resulting in a phase difference of 90° (see figure 2 and col. 7, l. 40 - 44). The patent as granted now covers the case of magnetoresistance devices of which the spatial dephasing on the second member is arbitrary subject to the condition that the output signals have a phase difference of 90°. Therefore the original application did not provide a basis at all for extending the protection to magnetoresistance devices with different dephasing: for instance, the granted patent could be understood to cover the case of magnetoresistance members which are freely arranged but include a barberpole structure, see D13, Fig. 1 and p. 1, right hand column, first paragraph. This rebuts the argument of the opposition division that a magnetoresistance device with a spatial pitch not equal to 90° would only be theoretically possible and that such an arrangement would need a further electrical network of components in order that the output signals would have a phase difference of 90°. It is concluded that because the arrangement shown in D13 is now covered by claim 1 of the granted patent this claim extends beyond the application as filed (Art. 123(2) EPC). Since the objectionable expression is included in the independent claim according to all requests, none of the requests is allowable. Against claim 1 of the main

request and the first and second auxiliary requests there are still further objections under Art. 123(2) EPC:

Claim 1 of the main request now includes an additional feature concerning a pair of sample hold circuits. This feature stems from claim 4 of the granted patent, but has been included as an arbitrary, isolated feature, since, according to that claim 4, the signal processing circuit not only includes a pair of sample hold circuits, but in addition a pair of comparators and a pair of flip-flops. Furthermore, in the original patent application the features from claim 4 were always disclosed in combination, see Figures 3 and 7 and the corresponding description (paragraphs [0030] and [0042] of the patent specification). The combination of all these features has the aim of providing a circuit capable of outputting a square wave signal with a binary value exactly determined at the transition pulses of the clock CK1, which aim is not obtained by the sample hold circuits alone, which is furthermore a feature not providing a complete technical solution to any identifiable problem in the patent application. Therefore introducing this feature in isolation in claim 1 of the main request is not allowable under Art. 123(2) EPC.

For similar reasons claim 1 according to the first auxiliary request is not allowable, because this claim only differs from claim 1 of the main request in that an interpolation circuit is employed to obtain two-phase square signals, which is one of the features from claim 5 as granted. However this claim 5 also requires the presence of a second clock CK2 for intermittently activating this interpolation circuit. Also the original

application does not provide support for an embodiment including an interpolation circuit without being activated by the second clock.

Claim 1 according to the second auxiliary request differs from claim 1 according to the main request in the inclusion of a circuit intermittently activated by a second clock CK2 with a phase delayed with respect to the phase of the first clock. In claim 1 of this request this circuit is not specified, and it could therefore be any kind of circuit. However, the original application and the patent only teach that comparators (42a, 42b) and flip-flops (43a, 43b) or, alternatively, an interpolation circuit (81) can be activated in this way. There is no support whatsoever in the original application documents that this circuit could be any other circuit. Therefore the amendment clearly is contrary to the provisions of Art. 123(2) EPC.

With respect to patentability, irrespective of the objections under Art.123(2) EPC against the claims of all requests their subject-matter does not involve an inventive step (Art. 52(1) and 56 EPC) for the following reasons:

As set out in point 6.3.2 of the Decision, document D22' discloses a magnetic encoder with the features 1), 2), 4) to 6) and 7) and 8) of claim 1 according to the main request. The subject-matter of this claim differs from the magnetic encoder disclosed in D22' in that it comprises, instead of two, at least four magnetoresistance devices (feature 3) of the claim) and in the presence of a pair of sample hold circuits (feature 6a)). The choice of four magnetoresistance

members allows improving the sensitivity of the device and the use of sample hold circuits in this context of encoder devices is nothing but an ordinary step well known in this technical field. For instance, document D5, addressing bridge circuits and their advantages in measuring equipment, shows in Figure 23 a bridge signal conditioner comprising a four element pulsed-excited strain gauge bridge and a sample-hold stage for giving a continuous DC output. Furthermore document D2 illustrates that magnetoresistance encoders comprising a bridge circuit are well known. The appellant's allegation that the trapezoidal waveform signals from the encoder disclosed in D2 would discourage the skilled person to apply a pulsed power supply is simply unproven, and upon reading this document one cannot see any reason for such an incompatibility. Rather document D5 does not put any restriction to the type of signals which can be treated in the circuits disclosed in this document. In this context it is pointed out, that the shape of the output signals of a typical magnetic encoder is just a function of the arrangement of the magnetoresistance members and their interconnection, which signal may therefore have a sinusoidal shape, as in the opposed patent or also shown, e.g. in document D16, or trapezoidal, as in D2, or other shapes. In any case the choice of a sinusoidal signal shape is very common (D16) and it has not been shown that this well known choice would be particular advantageous. Finally it is pointed out that according to the patent, see Figure 10 and [0047], an arrangement with sample hold circuits does not offer a particular advantage, since in the embodiment of Figure 10 these are not employed. Therefore the subject-matter of claim 1 according to the main request follows in an obvious way from the

combination of the teachings of document D22' and D5. Similarly this subject-matter is obvious in view of the teachings of documents D29, which shows all features of claim 1 with the exception of the feature 6a (sample-hold circuit) and D5, which also discloses the use of a sample hold circuit in a measuring bridge circuit for providing a continuous output.

Claim 1 according to the first auxiliary request includes an additional feature relating to an interpolation circuit. As is also recognised in the patent, see [0044], "various interpolation systems are known", and the inclusion of an interpolation circuit to improve the number of interpolated signal levels is therefore a step the skilled person would consider as a matter of routine. In this respect reference is made to, for instance, document D10, column 10, lines 25 – 33, disclosing a magnetoresistance encoder generating two signals with phases that differ by 90° and with an interpolating circuit with exactly the same purpose as in the opposed patent, namely to improve the measurement accuracy and resolution. Such interpolation circuits are further disclosed in document D12 (last paragraph) and in D19 (col. 3, lines 24 - 32). Therefore the subject-matter of this claim is trivial in view of the prior art.

Claim 1 of the second auxiliary request differs from claim 1 of the main request by the addition of a circuit intermittently activated by a second clock CK2 with a phase delayed from that of the first clock. The activation of a circuit by a phase delay is known from document D5, Figure 20, which shows a circuit in which the voltages applied to the strain gauge bridge and the comparator A1 are both pulsed. In this case, whereas the

voltage is directly applied to comparator A1 ("sample command"), it is phase delayed by circuit LT1054 and the 100μF capacitor before its transmission to the measurement bridge. Therefore the skilled person would, by including the circuit from Figure 20 in D5 in the encoder of, for instance, document D22', directly obtain a circuit as defined in claim 1 of the second auxiliary request with the same advantages in terms of reduced power consumption.

Claim 1 of the third auxiliary request differs from claim 1 according to the first auxiliary request by the additional feature that the interpolation circuit is intermittently activated by a second clock CK2. As already pointed out, the inclusion of an interpolation circuit in this context is as a matter of course, as illustrated by document D10 and as acknowledged in the patent itself. The claim merely indicates that the voltage supply of the interpolation circuit is interrupted if the magnetoresistance elements are not powered and there is no signal to interpolate. This step, to interrupt the voltage supply of a circuit if this is not used, is completely trivial, in particular in a portable device. Document D5, for instance, suggests to cut, with a delay, the power of a circuit (a comparator) at the output of a measurement bridge circuit if this bridge is not powered, see the circuit in Figure 20. If the skilled person would consider including an interpolator for improving the resolution at the output of the bridge circuit he would be led to supply this interpolator in the same manner as the comparators and with the same signal in order to obtain the same advantages and reduce the power consumption of the circuit. In fact, there would be no reason to

continuously supply electrical power to the interpolation circuit, instead of intermittently activate it with the available pulsed power signal of this circuit of D5.

Claim 1 according to the fourth auxiliary request includes additionally compared to claim 1 of the main request the features relating to a pair of comparators intermittently activated by a second clock and a pair of flip-flops. As such, the skilled electronics designer is very well familiar with these elements and would therefore routinely include them in a measurement circuit. Actually, in a very similar context document D7 discloses a signal processing circuit at the output of a measuring bridge including a pair of sample-hold circuits 10, a comparator circuit 4 and flip-flops (implicit in the counter circuit 4 and memory 5). Even if D7 does not discloses further details of the pulsed power supply to the comparator circuit, the skilled person would only have to consult document D5 for direct information of pulsed driven comparator circuits. In any case the presence of two clocks, wherein the second clock is delayed in phase, is known from document D22': the circuit shown in Figure 6 includes a first clock (CLK GEN 80') and a second clock (CLK1', the signal of the multivibrator 81) for driving the flip-flops. Finally document D5, Figure 23, discloses that the signal "D" at the sample-hold circuit (switch S1) is phase delayed to the pulse applied to the measurement (strain gauge) bridge (signal "B"), the reason for this being to ensure glitch free operation by preventing capacitor C1 from updating until amplifier A1 has settled (page 43-22, left hand column, lines 5 – 7). Therefore this claim defines nothing but obvious

electronic components which the skilled person routinely includes in this kind of measurement circuits.

Reasons for the Decision

1. The appeal is admissible.

2. *Admissibility of late filed documents and requests*

With its letter of 3 July 2008 the respondent for the first time in the opposition and appeal procedures filed, inter alia, document D29 and an English translation thereof, which it indicated had just been brought to its knowledge and was novelty destroying for at least the main and the first auxiliary requests of the appellant.

The Appellant on 14 August 2008 then filed amended main and first to fourth auxiliary requests, and requested that the documents filed late by the respondent not be admitted into the procedure.

Five days before the oral proceedings, the respondent again filed a new citation and requested that the amended requests presented by the appellant with its letter of 14 August 2008, the late filing of which amounted to abuse of the procedure, not be admitted.

Finally, during the oral procedure of 16 September 2008, the appellant filed an amended fourth auxiliary request.

In the above circumstances, considering in particular that both parties had filed late submissions, that document D29 appeared both to be sufficiently relevant

against the requests of the appellant and easy to understand, that the amendment brought to the latter requests could be considered as an adequate reaction to the filing of document D29, which moreover did not confront the respondent or the board with any unexpected or difficult situation, the board considered it equitable to admit both document D29 and the amended requests of the appellant into the procedure. The remaining late filed citations of the respondent were of no relevance in the discussion at the oral proceedings or for the following decision.

3. *Article 123(2) EPC*

3.1 *Claim 1 of appellant's main request*

3.1.1 During the oral proceedings the respondent repeated its objection under Article 123(2) EPC with respect to the expression in claim 1 as originally filed "at least four magnetoresistance devices with phases that differ from by 90°" which in claim 1 of the main request had been amended to "at least four magnetoresistance devices so arranged on said second member as to output signals with phases that differ by 90°". According to the respondent, under reference to Figure 2 and col. 7, lines 40 - 44 of the published patent application, the original patent application solely disclosed a spatial arrangement of the magnetoresistance resulting in a phase difference of 90°, whereas the patent now also covered the case of magnetoresistance devices of which the spatial dephasing on the second member is arbitrary subject to the condition that the output signals have a phase difference of 90°. Therefore the protection was

extended to magnetoresistance devices with different dephasing.

3.1.2 The board does not concur with the respondent concerning the interpretation of the objected expression in claim 1 of the main request. To the understanding of the board, the expression "(at least four magnetoresistance devices) so arranged on said second member as to output signals with phases that differ by 90° each…" quite clearly defines that it is the arrangement, and therefore: spatial positioning, of the magnetoresistance members on the second member which is responsible for the output signals differing by 90° each. This is also unambiguous from the patent specification, see [0027], "The MR devices Ma1, Mb1, Ma2, and Mb2 are arranged at pitches of (λ/4) in contrast to the magnetizing pitches λ of the first member 1. In other words, the pitches of the MR devices Ma1, Mb1, Ma2, and Mb2 differ from by 90° each". This passage is identical to the corresponding passage in the original patent application referred to by the respondent.

3.1.3 It is noted that at the oral proceedings the respondent motivated its objection that the original patent application did not provide a basis for extending the protection to magnetoresistance devices with different dephasing. A similar objection had already been forwarded by the respondent in the written procedure, cf. its letter of 7 April 2006, point 1.2.3 "Ce n'est que dans le cas particulier où les deux paires de signaux revendiquées coincident que la protection correspond au contenu de la demande initiale" (emphasis added). Irrespective of the fact, that, to the board's

understanding, claim 1 of the main request does not present a new teaching or instruction how the dephasing of the magnetoresistance devices is obtained, the issue of "extending the protection" does not relate to Article 123(2) EPC, but rather Article 123(3) EPC, which defines that the European patent may not be amended in such a way as to extend the protection thereof and which obviously would not be of any relevance here since the same amendment had already been brought to claim 1 as granted. The question to be considered here is merely whether the patent according to the main request contains subject-matter which extends beyond the content of the application as filed. Since the corresponding passages of the published patent application, col. 7, lines 31 - 48 and para. [0027] of the patent specification are identical and claim 1 (feature 3) specifies that the magnetoresistance devices have to be arranged, i.e. positioned, in such a way that the correct dephasing of the output signals is obtained, the skilled person is not presented with any new teaching or information. Therefore this objection under Article 123(2) EPC is not persuasive.

3.1.4 Claim 1 according to the main request includes the additional feature 6a) that the encoder comprises a pair of sample hold circuits for sampling and holding the two-phase sine wave signals. The appellant has argued that the new feature is one of the features defined in dependent claim 4 of the patent as granted and, addressing a different embodiment, one of the features of claim 5 of the patent as granted. According to the appellant, the fact that this feature relating to the sample hold circuits is included in different

embodiments is supportive for the conclusion that this is an independent feature, not linked to further features. In the opinion of the respondent it is not admissible to introduce the feature concerning the sample hold circuits in isolation, because in the original patent application this feature had only be presented in combination with the further features of claim 4 (addressing the embodiments in Figures 3 and 7) and claim 5 (embodiment of Figure 8).

3.1.5 Addressing the original application as published, a first location of the presence of sample hold circuits is in the Chapter "Summary of Invention", col. 3, line 50 - col. 4, line 17. In this passage, the sample hold circuits are part of the signal processing circuit, together with a pair of comparators, a pair of flip-flops and a second clock. According to col. 4, lines 16 and 17, by including these components in the circuit a power reduction is obtained and simultaneously the problem of instability of the output signal is solved. It is noted that these components are claimed in combination in claim 4 as originally filed. In further locations they also appear in combination in the embodiments of Figure 3 (see col. 7, line 48 to col. 8, line 45; and the data processing in Figures 4 and 5) and of Figure 7 (col. 10, line 53 - col. 11, line 12). In another embodiment summarised in col. 4, lines 18 - 31, defined in claim 5, and disclosed in more detail in Figure 8 and the corresponding description (col. 11, lines 13 - 32) the circuit includes a pair of sample hold circuits in combination with an interpolation circuit, which is activated by a second clock. Finally, and in contrast to these embodiments, according to the invention it is apparently not necessary to provide

sample hold circuits when the displacement circuit is intermittently driven (col. 4, lines 32 - 35).

3.1.6 Therefore the teaching of the original patent application as filed with respect to sample hold circuits can be summarised as follows:
i) A pair of sample hold circuits is not an essential part of the invention (col. 4, lines 32 - 35);
ii) In the embodiments of the invention in which sample hold circuits are included, these are present with the other components defined in claim 4, respectively claim 5.

3.1.7 The board concludes, that the application as originally filed does not provide a fair basis for a disclosure of a pair of sample hold circuits to be included in a magnetic encoder as defined in claim 1 as granted, because, apparently, without the further simultaneous components defined in claim 4, respectively claim 5, they are apparently not necessary (col. 4, lines 32 - 35) and therefore they would not solve a technical problem, rather they are disclosed to only result in a complete solution as part of the combined features of these claims.

3.1.8 Therefore the amendment of including feature 6a) in claim 1 according to the main request is objectionable under Article 123(2) EPC.

3.2 *Auxiliary Requests*

3.2.1 Claim 1 according to the first auxiliary defines, in addition to the sample hold circuits in claim 1 of the main request, an interpolation circuit for

interpolating output signals of the sample hold circuits. This is one of the features defined in claim 5 as originally filed and shown in the embodiment of Figure 8. However, according to claim 5 and shown in Figure 8, the interpolation circuit is intermittently activated by a second clock CK2 and the original patent application does not disclose the case of an encoder device with a pair of sample hold circuits and an interpolation circuit without this second clock. Therefore this claim is not admissible under Article 123(2) EPC.

3.2.2 Claim 1 according to the second auxiliary request defines, in addition to the sample hold circuits in claim 1 of the main request, a "circuit intermittently activated by a second clock with a phase delayed from the first clock". The board concurs with the respondent that there is no basis in the original application documents for an inclusion in the magnetic encoder of a not specified circuit, or that such a circuit could be any kind of circuit other than the one actually disclosed, namely an interpolation circuit. Therefore the claim falls under Article 123(2) EPC.

3.2.3 The independent claims of the third and fourth auxiliary requests are combinations of claim 1 and claim 5, respectively claim 4, of the patent as granted. It is noted that the respondent, apart from its objection under Article 123(2) EPC against claim 1 of the main request which the board does not share, did not raise any further objections with respect to admissibility under this Article. The board also finds that the independent claims of these requests are not objectionable under Article 123(2) EPC.

4. *Auxiliary requests 3 and 4 - Patentability*

4.1 *Novelty*

During the appeal proceedings, novelty of the subject-matter of the claims of these requests was not in dispute between the parties.

4.2 *Auxiliary request 3 - inventive step*

4.2.1 *Closest prior art*

At the oral proceedings the appellant, referring to the documents D2 and D22, argued for the first time that unlike the magnetic encoder defined in claim 1, the magnetoresistance devices employed in the encoders disclosed in these documents did not output sine wave signals: according to the appellant, the output signals of the magnetoresistance elements in the encoder disclosed in D22' were not sinusoidal but binary pulses; and the arrangement in the encoder of D2 provided overlapping signals in a trapezoidal shape. The circuit in document D29 included a frequency multiplier 4 to generate the required rectangular output signal. Furthermore, according to the appellant, in the encoder circuit of the opposed patent sinusoidal signals were used for accuracy because these allowed a more accurate conversion to square waves.

4.2.2 The board observes, that feature 4) of claim 1 according to the third (as well as that of the fourth) auxiliary request defines that the magnetoresistance devices output two sine waves with phases that differ 90° each and that according to feature 6) two square

wave signals are generated based on the two sine waves. The board concurs with the appellant that documents D2 (at least the part disclosing its invention), D22' and D29 do not disclose that the output signals of the magnetoresistance devices are sinusoidal.

4.2.3 However, having regard to the general prior art in the field of magnetoresistance encoder devices, it appears that a sinusoidal output signal shape with two signals at 90 phase difference is common for such encoders: indeed already the general prior art acknowledged in paragraphs [0003] and [0008] of the patent specification discloses encoders with output sine waves with phases that differ by 90°. The respondent referred to document D16 as a further example for an encoder with a sinusoidal shape output signal. Finally, also the encoders referred to as prior art in document D2 have signals with a shape similar to sinusoidal (Figure 10). In this respect the board follows the argument of the respondent that the precise shape of the output signal of the magnetoresistance elements depends on the arrangement of the members and their interconnection, this being illustrated in document D2, wherein by a proper arrangement a trapezoidal shape can be obtained.

4.2.4 The board therefore considers the prior art magnetoresistance device acknowledged in the Chapter "Prior Art", in particular paragraphs [0002] and [0003] of the patent specification as the closest prior art. As mentioned by the respondent, document D16 equally discloses such an encoder as "prior art" (see Figures 1 - 5 and the corresponding description). The features labelled 1) to 6) as well as feature 7) of claim 1

according to the third (as well as claim 1 of the fourth request) are features common to these types of encoders, which had not been disputed by the parties. Therefore the subject-matter of claim 1 according to the third auxiliary request differs from this prior art encoder in the following features:

6a) a pair of sample hold circuits (4la, 41b) for sampling and holding the two-phase sine wave signals obtained from said displacement detecting circuit (30) by the first clock (CK1); and

an interpolation circuit (81) for interpolating output signals of the sample hold circuits (4la, 41b) to obtain the two-phase square wave signals, the interpolation circuit (81) being intermittently activated by a second clock (CK2) with a phase delayed from the phase of the first clock (CK1);

8) a switch circuit (34) for intermittently turning on/off the output of the DC power supply (VDD) to said displacement detecting circuit (30) corresponding to a first clock (CK1) having a predetermined frequency.

4.2.5 These features address different, not necessarily interrelated, technical problems. Therefore for the analysis for their contribution towards inventive step they should be addressed separately. With respect to feature 8) the objective technical problem may be seen in the one as formulated in the decision under appeal, namely "how to provide a magnetic encoder with reduced power consumption". Furthermore feature 6a) defining the interpolation circuit may be considered to solve the issue of improving the accuracy of the output signals.

4.2.6 The problem of reduction of power consumption in magnetic encoders is well known in this technical field, see for instance document D22', paragraph [0006]. In paragraphs [00016] and [0017] of D22' it is disclosed that the power consumption of the device may be reduced by applying a pulsed power supply. Also document D29 discloses that the power consumption of a magnetic encoder can be reduced by applying intermittent driving (see Abstract). For inclusion of the concept of intermittent driving in a prior art magnetic encoder comprising a magnetoresistance bridge circuit the skilled person would therefore consult electronics literature dealing with the problem of bridge circuits with low power consumption. He would find a solution for this problem in the publication D5 "Bridge Circuits". In particular Figure 20 and the corresponding description show a circuit with a strobed power bridge drive. Figure 21 discloses a further possibility, wherein the strobing is applied in a clocked frequency, for keeping the average power consumption down. Therefore the skilled person would be motivated by this teaching of document D5 to include in the prior art bridge-circuit a switch circuit with the above feature 8).

4.2.7 With respect to feature 6a) the respondent has argued that the inclusion of sample hold circuits is, according to the patent itself, an optional measure, therefore this does not contribute to inventive step; and that the inclusion of interpolation circuits in measurement devices, and in particular in magnetic encoders, is common practice, in this context referring to documents D10, D12 and D19. Furthermore, according

to the respondent, the patent specification (paragraph [0044]) acknowledges that these systems are well known. It would therefore be a routine measure for the skilled person to add such an interpolation stage in the signal processing circuit. In this context the respondent referred again to document D5, Figure 20, in which circuit the measurement bridge is activated with a time or phase delay. According to the respondent, it is obvious that an interpolation circuit, if included in this circuit, must also be activated with this time delay.

4.2.8 The board shares the opinion of the respondent that, since the inclusion of interpolation stages in magnetic encoder devices is well known, the skilled person would consider to include such an interpolation stage in the prior art bridge-type magnetic encoder, modified with an intermittent power supply as shown in Figure 20 of document D5. Since the additional features of claim 1 according to the third auxiliary request appear not to be interrelated in solving the same technical problem, the combination of teachings of several technical documents in the field of magnetic encoder devices and electrical bridge circuits in solving the different technical problems appears obvious. For this reason the subject-matter of claim 1 of this request does not involve an inventive step.

4.3 *Auxiliary request 4 - inventive step*

4.3.1 As discussed in the context of the third auxiliary request in Section 4.2.4, the prior art magnetoresistance device acknowledged in the Chapter "Prior Art" of the patent specification is considered

as the closest prior art. Claim 1 according to the fourth auxiliary request differs from the prior art device in the features:-

6a) a pair of sample hold circuits (41a, 4lb) for sampling and holding the two-phase sine wave signals obtained from said displacement detecting circuit (30) by a first clock (CK1) having a predetermined frequency;

a pair of comparators (42a, 42b), intermittently activated by a second clock (CK2) with a phase delayed from the phase of the first clock (CK1), for comparing output signals of the sample hold circuits (4la, 41b) with a constant reference voltage to obtain binary data; and

a pair of flip-flops (43a, 43b) for receiving the binary data from the comparators (42a, 42b) to output the two-phase square wave signals;

8) a switch circuit (34) for intermittently turning on/off the output of the DC power supply (VDD) to said displacement detecting circuit (30) corresponding to the first clock (CK1).

4.3.2 Feature 8) addresses again the problem of reducing the power consumption, and for similar reasons as discussed before the board is of the opinion that the skilled person would be aware of this problem and its solution in the field of magnetic encoder devices and for measurement bridge circuits.

4.3.3 Feature 6a) includes the components of the circuits shown in Figures 3 and 7 of the patent specification for the signal processing shown in Figures 4 and 5. Since the switch circuit intermittently turns on/off the power to the displacement detecting circuit the

relevant signals are only available as sampled values. The technical problem addressed by feature 6a) may therefore be seen as providing a suitable signal processing circuit for sampled signal values.

4.3.4 In support of its objection to lack of inventive step the respondent has referred document D7. According to the respondent, this document discloses a signal processing circuit for a magnetic encoder including a sample hold circuit, a comparator circuit and (implicit) flip-flops. For the feature of the pulsed power supply to the comparator circuit the skilled person would find the necessary information in document D5. Furthermore the activation of a comparator by a second clock with a phase delayed of the first clock was known in this kind of circuits, see for instance document D22' and see the circuit shown in Figure 23 of document D5.

4.3.5 The board is not convinced by the arguments of the respondent: document D7 discloses a resolver apparatus for measuring the absolute position of a rotating body, the apparatus having a rotor (1) and stator coils (12a, 12b). The rotor has a single-phase exciting coil (11) which is intermittently excited by pulses of an excitation circuit (2), see Figure 2a. The signals of the two detection coils have a phase differing from each other by 90° (Figure 2b, respectively 2c). These signals are processed in a sample hold circuit (4) and converted into rectangular wave signals Va and Vb (Figure 2d, respectively Figure 2e). This document indeed discloses that the excitation of the excitation circuit by a pulse signal is advantageous, because the power consumption is very low as compared to conventional excitation using sine wave signals (col. 7,

lines 26 - 45). However, according to D7, the excitation circuit, the sample hold circuit, the comparator and counter and the memory are normally energised by an external DC power supply (see col. 6, lines 38 - 41). Contrary to the statement by the appellant that "D7 does not disclose further details of the pulsed power supply to the comparator circuit" suggesting that there would be a pulsed supply, the board observes that in D7 there is no suggestion or indication whatsoever for a pulsed power supply to the further electronics, see the above passage in col. 6 of D7. Therefore, even if the skilled person would have contemplated including the signal processing units shown in Figure 1 of document D7 in a prior art magnetoresistance encoder with intermittent pulse excitation, such a device would still not include the feature that the comparators are intermittently activated by a second clock with a phase delayed from the phase of the first clock. The further references by the respondent to documents D22' and D5 would not provide the skilled person with useful information, because these documents, in particular Figure 6 in D22' and Figure 23 in D5, do not disclose a comparator, and even less a comparator activated by a second clock with a phase delayed from the phase of the first clock.

4.3.6 As shown in Figure 5 and disclosed in paragraph [0034] of the patent specification, if the second clock CK2 is in the "H" state the bias circuit is activated, which in its turn activates the comparators. These compare, after this delay, the sample value "INAS" of the signal "INA" with the reference voltage Vref and output the binary data "DA" (similar for the signal "INB"). According to the patent specification, see paragraph

[0036], because of the intermittent operation of the comparators these may sometimes produce unstable output signals. For this reason the circuit includes the flip-flops, which are always on state (col. 9, line 18). Therefore the flip-flops, holding the binary data DA and DB, output the two-phase square signals OUTA and OUTB and do not become unstable. Hence it appears that the combination of the components in feature 6a) results in obtaining stable binary output data of the sampled signal provided by the intermittently driven magnetoresistance bridge circuit of the encoder defined in claim 1 according to the fourth auxiliary request.

4.3.7 Since neither the above mentioned technical problem nor the claimed solution are defined or suggested in the available documents the board concludes that the subject-matter of claim 1 according to this request involves an inventive step. Claims 2 to 10 according to this request are dependent claims and therefore similarly involve an inventive step.

4.3.8 At the oral proceedings the description of the patent specification has been adapted to the new set of claims.

5. Accordingly, taking into consideration the amendments made to the patent, the patent and the invention to which it relates meet the requirements of the Convention. The patent as so amended can therefore be maintained (Article 101(3) EPC).

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to maintain the patent on the basis of the following documents:

   - claims: 1 - 10, filed as fourth auxiliary request during the oral proceedings;
   - description columns 1 - 16 with two inserts for col. 3 and 4 respectively, filed during the oral proceedings;
   - drawings, figures 1 - 9, 12 - 23B as granted, figures 10 and 11 being deleted.

The Registrar: The Chairman:

M. Kiehl A. G. Klein