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Datasheet for the decision of 8 January 2008

Case Number: T 0340/06 - 3.4.02

Application Number: 96945659.9

Publication Number: 0885373

IPC: G01B 7/02

Language of the proceedings: EN

Title of invention:
Method for high resolution measurement of a time period

Patentee:
MTS SYSTEMS CORPORATION

Opponent:
ASM Automation Sensorik

Headword:
-

Relevant legal provisions:
EPC Art. 56

Relevant legal provisions (EPC 1973):
-

Keyword:
-

Decisions cited:
-

Catchword:
-

Case Number: T 0340/06 - 3.4.02

D E C I S I O N
of the Technical Board of Appeal 3.4.02
of 8 January 2008

Appellant: (Opponent)
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Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office posted 29 December 2005 concerning maintenance of European patent No. 0885373 in amended form.**

Composition of the Board:

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

Summary of Facts and Submissions

I. The patent proprietor lodged an appeal, received on 8 March 2006, against the interlocutory decision of the opposition division, dispatched on 29 December 2005, on the amended form in which the European patent No. 0 885 373 (application No. 96945659.9) could be maintained. The fee for the appeal was paid on 8 March 2006. The statement setting out the grounds of appeal was received on 8 May 2006.

The opponent likewise lodged an appeal, received on 8 March 2006, against the interlocutory decision of the opposition division. The appeal fee was paid the same day. The statement setting out the grounds of appeal was received on 5 May 2006.

II. The opposition had been filed against the patent as a whole on the basis of Article 100(a) EPC and had been substantiated by the grounds that the subject-matter of the patent was not patentable within the terms of Articles 52(1) and 56 EPC.

The opposition division decided that the subject-mater of the independent claims of the patent as granted did not involve an inventive step but that the patent in amended form according to the proprietor’s auxiliary request met the requirements of the EPC, having regard inter alia to the following documents:

(D1) US-A-4 404 523
(D3) EP-A-0 508 232
(D6a) "TDC 501 Funktionsbeschreibung", prospect by company MSC/Gleichmann dated 1 December 1994;

(D6b)"TDC 501 2001 10000 Solutions in Time", prospect by company MSC/Gleichmann dated 20 October 1994.

III. After its initial request that the decision under appeal be set aside and that the patent be maintained as granted or in amended form on the basis of the auxiliary requests filed before the opposition division, the appellant/proprietor filed with its letter dated 8 December 2007 seven further auxiliary requests with the sole explanation that "...the newly filed auxiliary requests include essentially the combinations of features already claimed in the former auxiliary requests, so that no further explanation of the new features is provided".

In a letter of 10 December 2007 the appellant/ proprietor filed a further auxiliary request 6a stating that "...the newly filed auxiliary request 6a is based on paragraph [0061] of the patent specification (penultimate sentence in connection with the first sentence)".

IV. At the auxiliary requests of both appellants oral proceedings were held on 8 January 2008.

The appellant/patent proprietor requested that the decision under appeal be set aside and that the patent be maintained as granted (main request) or on the basis of one of the auxiliary requests 1 to 5, 6b or 7 filed on 8 December 2007 or auxiliary request 6a filed on 10 December 2007 or on the basis of the claims allowed by the opposition division.

The appellant/opponent requested that the decision under appeal be set aside and that the patent be revoked.

V. The wording of independent claims 1 and 7 as granted, which form the basis of the appellant/ patent proprietor's main request reads as follows:

"1. A method for measuring a time interval corresponding to a position of a magnet associated with a magnetostrictive device, the method comprising the steps of:

a. generating a start pulse from a sensor advanced running period acquisition system (12);

b. transmitting the start pulse to the magnetostrictive device (14);

c. receiving at the sensor advanced running period acquisition system (12) an input signal from the magnetostrictive device (14);

d. comparing said input signal to a threshold voltage to form a stop pulse;

e. storing a coarse count generated by a coarse clock (56) in the megahertz ranges and a fine count generated by a fine clock (58) in the gigahertz ranges at the occurrence of the stop pulse;

f. adding the coarse count and fine count to form a resultant time interval having a resolution of less than about 280 ps; and

g. converting the interval into the position of the magnet associated with the magnetostrictive device (14).

7. An apparatus for measuring time intervals corresponding to a position of a magnet associated with a magnetostrictive device (14) comprising:

a sensor advanced running period acquisition system (12) which includes a microcomputer, and a coarse clock (56) in the megahertz ranges;

a pulse generator connected to said acquisition system (12) and having means responsive to said acquisition system (12) for the magnet via the magnetostrictive device (14) for generating a start pulse (26) and receiving a return pulse from the magnetostrictive device (14) corresponding to the position of the magnet;

a comparator (30) for comparing said return pulse to a threshold value to generate a stop pulse, said comparator (30) connected to said acquisition system and the magnetostrictive device (14);

said microcomputer has a counter to accumulate a coarse count from said coarse clock (56) on initiation of said start pulse, said counter terminating accumulation when said stop pulse is received by said acquisition system (12); and said microcomputer determines a time interval corresponding to the position of the magnet;

characterised in that:

the apparatus additionally comprises a fine clock (58) in the gigahertz ranges; and

said microcomputer adds a fine count, from the fine clock (58) to the accumulated coarse count."

The wording of independent method claim 1 according to the request maintained by the opposition division reads as method claim 1 of the granted patent with the additional features at the end of the claim:

"h. running said sensor advanced running period acquisition system (12) in a continuous measurement mode;
wherein the sensor advanced running period acquisition system (12) includes a control unit (36) which is a state machine programmed for the desired sequence of events as necessary to operate the magnetostrictive device (14); and wherein the coarse clock (56) is a quartz clock."

The independent apparatus claim 6 according to the request maintained by the opposition division has the same preamble as apparatus claim 7 of the granted patent; its characterising portion reads as follows:

" characterised in that:
the apparatus additionally comprises a fine clock (58) in the gigahertz ranges; said microcomputer adds a fine count, from the fine clock (58) to the accumulated coarse count; said acquisition system (12) runs in a continuous mode;

the sensor advanced running period acquisition system (12) includes a control unit (36) which is a state machine programmed for the desired sequence of events as necessary to operate the magnetostrictive device (14); and
the coarse clock (56) is a quartz clock."

The wordings of the claims of the auxiliary requests filed on 8 and 10 December 2007 are not relevant for the purpose of this Decision.

VI. The arguments of the patent proprietor may be summarised as follows.

The opposition division had considered that the subject-mater of independent claims 1 and 7 of the main request did not involve an inventive step over the combined teachings of documents D1 and D6a. This view is not correct since both claims define the feature which is essential for the invention that the sensor advanced running period acquisition system (given the acronym "SARA") generates the start or interrogation pulse for the magnetostrictive device. In claim 1 this is defined in feature a), in claim 7 it follows from the feature "a pulse generator connected to said acquisition system and having means responsive to said acquisition system ...for generating a start pulse". This feature is illustrated in Figure 1 (arrow from SARA 12 to interrogation pulse 26) and Figure 2 ("STARTOUT" at upper left corner of the control unit/state machine 36). This shows that the generation of the start pulse (via STARTOUT) and the acquisition of the pulse propagation time is integrated in the <u>same</u> device (SARA).

Contrary to the invention the prior art, see for instance document D1, merely discloses the communication of the starting pulse to the acquisition system: in Figure 1 the sequencer 80, which is not part of the acquisition system, commands the pulse generator 46 to issue a start pulse and notifies the counter 60 in the readout circuit 25. Therefore in this circuit the generation of the start pulse is <u>separated</u> from and not controllable by the acquisition system (readout circuit 25). In this respect Figure 1 would suggest by the dashed line around the readout circuit 25 that the pulse generator 46 is part of this circuit, however from the wiring shown in this Figure it is clear that the pulse generator is only electrically connected to the sequencer. As is shown in Figure 2 of D1, the sequencer issues a start pulse to the pulse generator and at the same time triggers the multivibrator 84 to reset the counter 60. This counter is connected to a clock (crystal oscillator) and starts counting with the frequency of this clock. The propagation of the measurement pulse starts somewhere within a period of the crystal oscillator and, similarly, also the stop pulse arrives somewhere within a period, therefore the total error of the measurement adds to two oscillation periods of the crystal clock.

Document D6a discloses a time to digital converter (TDC) which was designed to measure short time differences without needing an (expensive) quartz crystal clock. Instead in this device an RC-oscillator (coarse clock) in connection with a fine clock is employed. As can be seen from the schematic diagram on page 5 of document D6a, this device, similar to the acquisition system in D1, does not have any provisions for generating a start pulse (no "START"-output line). Therefore in order to start a measurement, the circuit must first detect the pulse to be measured, which is, as in the device of D1, associated with an uncertainty of one period of the oscillator. As is shown in Figure 4 on page 12 of D6a, the TDC-device compensates a part of this measurement error by its fine clock. Because the TDC does not know when the next measurement pulse arrives, it is implicit to its construction that a calibration must be carried out immediately after the measurement. This calibration causes a further delay before a next measurement and can therefore be switched off, however at the price of further inaccuracy.

It is concluded that neither document D1 nor D6a disclose the generation of a start pulse from the acquisition system as defined in claim 1 of the main request nor the connection between the pulse generator and the acquisition system as defined in claim 7. Therefore even a combination of the teachings of these documents would not result in the subject-matter of these claims and the claimed resolution of about 280 ps would not be obtained. Since by virtue of this feature the resolution in the measurement can be improved to less than about 280 ps, the invention as defined in the claims of the main request offers a significant improvement in performance compared to the prior art and therefore involves an inventive step.

The auxiliary request maintained by the opposition division defines the further features that the system runs in a continuous mode; that the acquisition system includes a control unit; and that the coarse clock is a quartz clock. With respect to the prior art, it was mentioned already that the TDC-device of document D6a needs to be calibrated periodically, therefore it is not able to carry out measurements continuously. Furthermore this device uses the input of an RC-oscillator. Although this is less expensive than a quartz clock, it is also less accurate. Therefore the additional features of the independent claims according to this request further improve the performance (continuous measurements, higher precision) of the device. These are not disclosed in the prior art and could only be implemented by basically changing the design of these devices, for which the skilled person does not have any incentive. The excellent performance of the SARA-based magnetostrictive system is confirmed by its commercial success.

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

The patent proprietor has alleged that feature a) of claim 1 and the feature relating to the "pulse generator connected to said acquisition system" of claim 7 are an essential feature of the invention in that these would define that the starting pulse is generated within the SARA system. The wording of claim 7 clearly disproves this allegation, because claim 7 merely defines that a pulse generator is connected to the acquisition system, from which it is concluded that the pulse generator is not part of the SARA system. Furthermore during the proceedings it was suggested that in the apparatus and the method of the patent in suit the measurement would start together with an oscillation period of the coarse counter and that therefore only at the end of the measurement would the duration of the last time interval be recorded by the fine counter, this being in apparent contrast to the counter in document D6a, where the first and last measurement intervals are resolved by fine counting intervals FC1 and FC2. In this respect it is noted that there is no support whatsoever in the patent specification for such a feature. Rather, according to the Section "SARA System Operation" starting in paragraph [0057] of the patent specification, it is discussed that the fine count by the ring oscillator is carried out during the entire duration of the time interval of the measurement, this also being illustrated by the diagram in Figure 6. Also it is evident to the skilled person that this feature of the TDC device of document D6a, to resolve the first and last intervals FC1 and FC2, is only required if the start of the time measurement cannot be synchronised with the crystal clock. If, in a typical application, such a synchronisation is possible, it would be obvious to the skilled person to apply it, thereby rendering the first interval FC1 unnecessary. Furthermore, as shown in Figure 1 of document D1, the sequencer 80 triggers both the pulse generator 46 and the counter 60, so that it can start both components simultaneously. This is irrespective of whether these parts are on the same circuit board or separate components connected via electrical wiring.

Therefore, concurring with the analysis in the decision under appeal, document D1, which is considered to form the closest prior art, discloses the features a), b), c), d), e (first part) and g) of method claim 1 and the corresponding features of apparatus claim 7 of the granted patent. In the decision it was correctly noted that document D6a discloses a system for time measurement and the related leaflet D6b mentioned that one of the applications of this component is in ultrasonic position measurement systems. The system of document D6a comprises a fine clock and a coarse clock which are combined to form a resultant time interval having a resolution of 270 ps. Since the skilled person knows that these ultrasonic position measuring systems are usually magnetostrictive displacement transducers he would consider incorporating the TDC device of D6a into the magnetostrictive system of document D1 in order to improve the resolution of the latter. Thereby he would arrive at the subject-matter of the independent claims without an inventive step being involved.

With respect to the independent claims of the auxiliary request maintained by the opposition division, the feature that the SARA system runs in a continuous measurement mode [feature h) of claim 1 and corresponding feature in claim 6] is known or at least suggested by the TDC system in document D6a, since that system can perform three consecutive measurements without time break. This number is only restricted by the number of registers which can, of course, be increased if the skilled person finds that this is useful in the particular application. The further feature defining that the acquisition system includes a control unit is not inventive since, as noticed in the decision under appeal, point 5.2, the sequencer comprised in the device of D1 falls within the meaning of a "control unit which is a state machine programmed for the desired sequence of events as necessary to operate the magnetostrictive device". Finally as to the last feature that "the coarse clock is a quartz clock" the opposition division believed that the TDC uses a divider as a coarse clock, which has to be calibrated after the measurement by using an external calibration clock. For calibration document D6a would recommend the use of an RC-oscillator. Since, according to the opposition division, document D6a did not contain any incentive to replace the divider by a quartz clock, by virtue of this feature claim 1 according to this request was considered to involve an inventive step.

However, this so-called "divider" (in D6a, page 6, point 1.1.b the German expression "chipinterner Vorteiler" is used) is not a coarse clock but rather an operating principle according to which, on the basis of one and the same clock cycle, for one a coarse time interval, for another a fine time interval are measured and these values are subsequently added. Furthermore it is not correct that this document would suggest the use of an RC-oscillator for calibration of the time interval measurements: rather such an oscillator is recommended only for temperature measurements, see Section 2.1.2.1, where it is stated in the context of temperature measurements "Therefore an RC-oscillator as a calibration source is adequate for this case" (i.e. temperature measurement). Indeed, in case of a temperature measurement the absolute value and the long-term precision of the calibration clock period is not relevant, since the ratio forming method of the temperature measurement of the TDC 501 merely requires within a short time period calibration time periods of equal length, whose absolute precision is not evaluated since they are only scaled against reference resistances and not against absolute time intervals. However, for the absolute time interval measurements the use of a "quarzgenauen" clock cycle is recommended, see page 12, Section 2.1.3.1. This teaches the skilled person to employ a quartz crystal clock, which view is supported by the block diagram on page 5 of document D6a: from this it follows that the coarse clock includes the clock input with symbol "Cal_Clock", which, because a quartz crystal cannot be integrated on a chip, is positioned external of the chip, and a counter with symbol "Coarse Counter", which is part of the electronics in the chip. In any case quartz crystal clocks are well known in the art and such a clock is anyway already used as a source in the measurement system disclosed in document D1, see Figure 1, clock 62. Therefore the additional features of the independent claims of the auxiliary request do not contribute to inventive step.

As to the alleged commercial success of the SARA-system by the proprietor it is noted that firstly no evidence of such success have been provided and, furthermore, even if the proprietor's company was successful in selling a certain type of measurement equipment, it has by not been proven that such equipment corresponds to the features of the independent claims.

Reasons for the Decision

1. The appeal is admissible.

2. *Main Request*

2.1.1 Whereas it appears to be common ground that document D1 may be seen as the closest prior art, the parties disagree which method steps of claim 1 (and the corresponding apparatus features of claim 7) are disclosed in this document. According to the proprietor in the system shown in Figure 1 of document D1 it is the sequencer 80 which controls the command for the start pulse. In its opinion the sequencer is not part of the acquisition system, rather, in the system disclosed in D1 the readout circuit 25 carries out the acquisition of the measurement data.

2.1.2 On the other hand, in point 2.1 of the Reasons of the Decision under appeal it was considered that step a) in claim 1 "generating a starting pulse from an acquisition system" was known from D1 (making reference to column 5, lines 16 to 24); and that moreover the sequencer 80 is a device designed to control a sequence of events necessary to operate the magnetostrictive device and that, consequently, this sequencer falls within the meaning of a "control unit which is a state machine programmed for the desired sequence of events as necessary to operate the magnetostrictive device" (point 5.2 of the Reasons). Hence in a broader sense the expression "acquisition system" may encompass a device architecture designed to measure and process data of a measuring device. In this interpretation the components of the acquisition system in Figure 1 of document D1 include not only the readout circuit but also the further parts needed for generating the measurement pulse, i.e. the sequencer 80 and the pulse generator 46. It is also noted that the concepts "sequencer", "state machine" and "microprocessor" are often used interchangeably. This more general interpretation of "acquisition system" is also corroborated by the observation that the expression "sensor advanced running period acquisition system" or "SARA" in claims 1 and 7 does not define a well established unique concept: for instance, in Figure 1 of the patent specification a box labelled "SARA" with reference sign "12" appears, which is shown in further detail in Figure 2. The "coarse clock in the megahertz ranges" which, according to claim 7 should also be part of the SARA system is, however, in Figure 1 a separate unit (namely: CXO 24) and also in Figure 2 it is not shown as being included in the SARA-system. Furthermore the opponent had already pointed out in the context of the coarse clock in document D6a that in any case a quartz oscillator (being part of the coarse clock) cannot be integrated on a chip and must therefore be mounted externally to the microprocessor.

2.1.3 For these reasons the board considers that feature a) of claim 1 is known from document D1.

2.1.4 Features b), c) d) and g) of claim 1 are features common to prior art magnetostrictive measurement devices; this also follows from the fact that these features are found as corresponding features in the preamble of independent apparatus claim 7 and, indeed, they are present in the system of D1.

2.2 As to the further features e) and f), the method step "storing a coarse count generated by a coarse clock in the megahertz ranges ...at the occurrence of the stop pulse" appears to be disclosed in document D1, because the counter 60 is driven by a conventional high speed clock 62 having high stability, which is advantageously a crystal oscillator (column 6, lines 38 to 41).

2.2.1 The subject-matter of claim 1 thus differs from the measuring method known from document D1 in that, additionally to the counting by the coarse clock, a fine count generated by a fine clock in the gigahertz range is stored, and that the coarse count and fine count are added to form a resultant time interval having a resolution of less than about 280 ps.

2.2.2 The technical problem addressed by the combination of a fine clock together with the coarse clock may be seen as improving the temporal (and thereby the positional) accuracy of the prior art magnetostrictive measurement system. Since the skilled person in the field of measuring devices always strives to improve their performance the formulation of the technical problem as such does not include an inventive step.

2.2.3 Documents D6a and D6b disclose the TDC501 device which allows "highly precise time interval measurements in CMOS" (see the Title of these leaflets). As a typical recommended application for this TDC device "ultrasound positioning devices" are disclosed (document D6b, page 5, Section 2.0). Since magnetostrictive devices belong to the class of ultrasound measurement devices the skilled person would contemplate whether the time interval measurement applied in document D1 and based on a crystal clock could be improved by applying the principles of the TDC laid down in document D6a.

2.2.4 For accurate measurement of a time interval the TDC device relies on an accurate clock, which should be "quarzgenau" (page 12, first para) and therefore is preferably a crystal clock. Since generally a time interval starts at an unknown moment for which the phase of the free-oscillating crystal calibration clock is not known, at the slope of the "start" pulse the TDC device starts a fine-quantisation unit which stops at the next positive slope of the calibration clock and measures a fine count interval FC1, see document D6a, page 6, Section 1.1.b "Messbereich 2: 400 ns - 25 ms" and Figure 4 on page 12. This fine quantisation unit is formed by a ring oscillator disclosed in more detail in document D3 and also acknowledged in the patent specification starting in paragraph [0023]. An important feature of this ring oscillator is that it starts phase-synchronously with the "start" pulse. Similarly, as soon as the measurement circuit receives a "stop" pulse, this pulse again starts the ring oscillator to measure a second time interval FC2 until the next positive slope of the calibration clock. This principle of separating the time interval in a coarse time interval including a (large) integer number of oscillation periods of the calibration clock and counted by the coarse counter and two fractional intervals preceding and subsequent to this coarse interval and measured by the ring oscillator corresponds, in the opinion of the board, to what is expressed in D6a as "chipinterner Vorteiler". Therefore the board does not concur with the analysis by the opposition division that the component TDC would use a "divider as a coarse clock" (point 5.2 of the Reasons), rather the "coarse clock" in the sense of the patent appears to be constituted by an external clock, which signal is input at the pin "Cal_Clock" (diagram on page 5) and by the "coarse counter" as being part of the electronics circuit of the TDC shown in this diagram.

2.2.5 Since the measurement system of document D1 already comprises a crystal clock in its readout circuit it would appear obvious for the skilled person to apply the principles of the TDC device for high resolution of the time interval to be measured and replace the counter circuit by a coarse counter and fine quantisation circuit as disclosed in document D6a. According to this document, see page 6, point 1, using this principle a time resolution of typically 270 ps can be obtained.

2.2.6 By modifying the prior art measurement method and device the skilled person would arrive at the method defined in claim 1 and similarly to the apparatus of claim 7 without an inventive step being involved.

2.3 At the oral proceedings the patent proprietor forwarded basically the following objections against a combination of the teachings of documents D1 and D6a:
i) in neither document is it disclosed that the acquisition system generates the start pulse;
ii) by the generation of the start pulse in the acquisition system of the invention the error of two oscillatory cycles in the prior art device of D1, respectively the remaining uncertainty and the necessary subsequent calibration of the TDC device in D6a are avoided;
iii) document D6a teaches that the calibration is carried out by an RC-oscillator clock, which is why the skilled person would not have combined this device with a readout circuit based on a crystal oscillator clock as the one in document D1.

2.3.1 Concerning the first objection i), it has already been discussed that a "sensor advanced running period acquisition system" is not a concept with a unique meaning: whereas claim 1 appears to suggest that the acquisition system generates the interrogation pulse and that therefore the pulse generator is integrated in the acquisition system, in claim 7 the pulse generator is "connected to" the acquisition system, and therefore external to it; in claim 7 it is defined that the coarse clock is included in the SARA system, but according to Figure 1 the coarse clock "CXO" 24 is external to the SARA system, which is in agreement with the description in paragraph [0020] where it is disclosed that the "CXO 24" is included in the sensor device 10. Therefore the claim has to be constructed to encompass the meaning that an acquisition system is not necessarily restricted to the particular electronics diagram shown in Figure 2 of the patent, but that such a system may include all the components needed for providing and processing the measurement. In the system shown in Figure 1 of document D1 the pulse generator, the sequencer and the readout circuit are needed for the acquisition of the measurement data and the start pulse is generated by this system.

2.3.2 Concerning the objection ii), document D6a claims that the TDC device can measure time intervals between 400 ns to 25 ms (Sections 1.1.b and 2.1.3.1) with a time resolution of 270 ps (top of page 6). This is accomplished by a crystal controlled ("quarzgenau") coarse counting clock and a fine clock activated to measure the fractional periods of an oscillation cycle of the quartz oscillator at the beginning (period FC1) and at the end (period FC2, see Figure 4) of the time interval to be measured. Since the fine clock comprises a CMOS ring oscillator as disclosed in D3, the measurement FC1 starts phase-synchronously with the "start" pulse. At the end of the measurement the coarse count and fine count are added to form a resultant time interval having a resolution of less than about 280 ps. Therefore it appears that this time interval measurement principle, based on a coarse quartz clock and a fine (ring oscillator) clock, if implemented in the system of document D1, necessarily results in the subject-matter of claim 1 and of claim 7. The objection of the patent proprietor that the system of D6a suffers from the disadvantage that it must be calibrated is beside the point since the independent claims do not define any measures which would make such a calibration obsolete; rather it would appear that, since the SARA system uses the same type of CMOS-based ring oscillator, a calibration from the ring oscillator periods to absolute time units is necessary as well.

2.3.3 Objection iii) that in the TDC device the calibration is carried out with an RC-oscillator clock is only acceptable to the extent to which such an oscillator is recommended as being sufficient for temperature calibration. Indeed, for absolute time interval measurements the clock should be "quarzgenau", which in any case is self-evident to the skilled person, because measuring a time interval of up to 25 ms with a long-term stability and an absolute precision of 270 ps requires a stability of 25.10^{-3} / $270.10^{-12} \approx 9.10^{7}$, which cannot be guaranteed with an RC-oscillator.

2.3.4 The board notices that in its arguments in favour of the claimed subject-matter the patent proprietor repeatedly relied on the alleged superiority of the measurement system it actually offers on the market over the system such as would result from a practical implementation of the specific electronic circuitry disclosed in document D6a in a similar application. This line of argument however misses the point, because what has to be decided here is only whether the skilled person would in an obvious way have contemplated the combination of features as actually claimed. In the board's view the skilled person would indeed for the reasons set out above have been prompted by document D6a to supplement the closest prior art time measuring method and apparatus of document D1 which uses a single quartz clock only with a quartz clock controlled coarse and fine counting scheme as taught in document D6a, which is sufficient to arrive at the claimed combination of features. The fact that the proprietor produces a device the success of which may be the consequence e.g. of its marketing skill or of technical choices not set out in the claims, or that the D6a circuitry might exhibit certain disadvantageous features beyond those actually used by the skilled person, namely the claimed quartz clock controlled coarse-fine counting scheme, cannot have any impact on the above reasoning.

2.4 The main request is therefore not allowable.

3. *Admissibility of Auxiliary Requests 1 to 7*

The patent proprietor filed seven auxiliary requests by fax on 8 December 2007 under cover of a letter which said only that, since these requests contained essentially the features claimed in the previous auxiliary requests (those before the opposition division and maintained with the grounds of appeal), no detailed remarks would be made on the new features of the claims in these requests. The appellant filed a further auxiliary request 6a by fax on 10 December 2007 with a covering letter which briefly indicated the alleged support for the additional material in the request. Otherwise no attempt was made to indicate the support for any of the amendments made in any of these requests, nor was any argument put forward as to how any of these requests overcame the objection of inventive step, nor was any explanation provided as to why these requests were filed at such a late stage of the appeal proceedings. Since these requests were filed so late, since they did not constitute a response to the observations in the board's communication of 26 October 2007, since, contrary to the appellant's assertions, they included several features taken from the description which (if the requests were considered) might require additional searches, and since the board and the other party had no explanation for or arguments about the requests with which to prepare for discussion at the oral proceedings, the board finds no reason to exercise its discretion in favour of the proprietor (viz. Article 13(1) and (3) of the Rules of Procedure of the Boards of Appeal, see OJ 11/2007, p. 536). The auxiliary requests filed on 8 and 10 December 2007 are therefore found to be inadmissible.

4. *Last Auxiliary Request*

4.1.1 As compared to the corresponding claims of the main request, the independent claims of this request define the following further features:

i) the acquisition system runs in a continuous mode;

ii) this system includes a control unit which is a state machine programmed for the desired sequence of events as necessary to operate the magnetostrictive device; and

iii) the coarse clock is a quartz clock.

4.1.2 With respect to feature i) the proprietor had argued that the TDC device could not operate in a continuous mode, since it had to be calibrated periodically. Also the TDC device only allows for three measurements (this is discussed on page 15, 6. paragraph of document D6a). However, to the opinion of the board the feature "running in a continuous mode" does not put a restriction on the frequency or repetition rate of the measurements. Furthermore it appears that in magnetostrictive devices measurements are often repeated with a predetermined frequency, see document D1, column 4, lines 35 to 43 and lines 67 to 68. Therefore the skilled person would as a matter of course also include this feature, already present in the device of D1 if he implemented the time interval principle of document D6a. It is added that the provision of only three time registers in the TDC device does not appear to be an unavoidable limitation intrinsic to such a device: if necessary, the skilled person could add more registers.

4.1.3 With respect to feature ii) it is noted that the device of D1 is able to operate at the desired frequency (see previous point 4.1.2) and therefore at the desired sequence of events as necessary to operate the magnetostrictive device. Furthermore in point 2.1.2 supra it was noted that the concepts "sequencer", "state machine" and "microprocessor" are often used interchangeably. In any case, even if in the particular system disclosed in D1, a document filed in 1980 and published in 1983, the sequencer was still configured as a set of discrete hardware multivibrators, there can be little doubt that the skilled person in the 1990s would have rebuilt this system integrated in a single circuit, whereby the sequencer and the readout system would have been integrated onto one single control board.

4.1.4 With respect to feature iii) it has been repeatedly shown that both the clock in document D1 as well as the one used for absolute time calibration and for the coarse counting in D6a are quartz crystal clocks.

4.2 Therefore the claims of this auxiliary request are not allowable, either.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is revoked.

The Registrar: The Chairman:

M. Kiehl A. G. Klein