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D E C I S I O N
of 3 July 2001

Case Number: T 0965/97 - 3.4.2

Application Number: 89308534.0

Publication Number: 0366235

IPC: G01N 21/89

Language of the proceedings: EN

Title of invention:
Monitoring systems and methods

Patentee:
Picker International, Inc.

Opponent:
Wessex Technology Opto-Electronic Products Limited

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (main request: no, 1st subsidiary request: yes)"

Decisions cited:
-

Catchword:
-



Case Number: T 0965/97 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 3 July 2001

Appellant: Wessex Technology Opto-Electronic
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Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 16 July 1997
rejecting the opposition filed against European
patent No. 0 366 235 pursuant to Article 102(2)
EPC.

Composition of the Board:

Chairman: E. Turrni
Members: A. G. Klein
B. J. Schachenmann

Summary of Facts and Submissions

I. The opposition filed against European patent No. 0 366 235 (application No. 89 308 534.0), which was founded on the ground that the subject-matter of the patent lacked an inventive step in view in particular of the following documents:

E1: US-A-4 578 810;

E2: US-A-3 833 762;

E7: Photonics Spectra, Vol. 22, No. 9, September 1988, full-page advertisement for "EG&G Reticon" and US copyright Registration Certificate; and

E8: US-A-RE 32 164,

was rejected by the Opposition Division.

II. The appellant (opponent) lodged an appeal against the Opposition Division's decision to reject the opposition.

III. Oral proceedings were held before the Board on 3 July 2001 at which the appellant requested that the decision under appeal be set aside and that the patent be revoked.

The respondent (patentee) as its main request requested that the appeal be dismissed and that the patent be maintained in amended form on the basis of the documents filed with letter of 5 June 2001. Claim 1 of the set of claims of the main request reads as follows:

"1. A monitoring system comprising: a conveyor (10) for transporting an object (12) to be examined through an examination region (14) at an adjustable speed; lighting means (16) for illuminating said examination region (14); an optical system (20) for focusing a light image of the examination region (14) onto an image section (22) comprising an array of light sensitive elements which integrate light received through the optical system (20) to produce individual pixel values that are indicative of an amount of light received thereby to form a pattern of pixel values representing said image; a transfer means (22a) for serially shifting the pixel values across the light sensitive elements to create a video signal representing said image of the examination region (14); and a control means (C) for controlling the transfer means (22a), characterised in that said control means (C) controls the transfer means (22a) so as to adapt its serial shifting of pixel values to the movement of the conveyor (10) so that the pixel values are shifted across the image section (22) in synchronization with the movement across the image section (22) of said light focused from the examination region (14) as the conveyor (10) moves such that subsequent images on the image section superimpose directly on the shifted previous image representing pixel value pattern."

As its first subsidiary request the respondent requested that the patent be amended on the basis of a set of claims filed at the oral proceedings, of which claim 1, the only independent claim reads as follows:

"1. A monitoring system comprising: a conveyor (10) for transporting an object (12) to be examined through an examination region (14) at an adjustable speed;

lighting means (16) for illuminating said examination region (14); an optical system (20) for focusing a light image of the examination region (14) onto an image section (22) comprising an array of light sensitive elements which integrate light received through the optical system (20) to produce individual pixel values that are indicative of an amount of light received thereby to form a pattern of pixel values representing said image; a transfer means (22a) for serially shifting the pixel values across the light sensitive elements to create a video signal representing said image of the examination region (14); and a control means (C) for controlling the transfer means (22a), characterised in that said control means (C) controls the transfer means (22a) so as to adapt its serial shifting of pixel values to the movement of the conveyor (10) so that the pixel values are shifted across the image section (22) in synchronization with the movement across the image section (22) of said light focused from the examination region (14) as the conveyor (10) moves such that subsequent images on the image section superimpose directly on the shifted previous image representing pixel value pattern; said control means (C) including a clock generator (78) for generating clock pulses for controlling shifting of pixel values across the image section (22), said control means (C) further including a monitoring means (32) for monitoring the speed of the conveyor (10), the clock generator (78) being connected with the monitoring means (32) such that the frequency of clock pulses generated by the clock generator (78) is controlled in accordance with the monitored conveyor speed."

The respondent also filed three further subsidiary

requests based on further limited claims.

- IV. In support of its request the appellant first stressed that the reference in the claims to the conveyor transporting an object at an "adjustable" speed should not be interpreted in the sense that the conveyor speed might vary in a continuous and uncontrolled manner, for which there was no support in the patent description. This expression only meant that the conveyor speed can be set at different predetermined values.

Accordingly, the operation of the claimed monitoring system in the TDI (time delay and integration) mode only allowed for an increased absolute speed of the conveyor.

However, starting from a prior art monitoring system as set out in the preamble of claim 1 of the main request, or from the monitoring system of document E1, the skilled person striving at achieving an increased monitoring speed would immediately find in document E7 the teaching that operating the known CCD (charge-coupled device) detectors in the TDI mode would achieve the desired high speed image capture and inspection.

Since it was self-evident that the charge shifting over the detector area shall be synchronised with the actual movement of the image formed on it, and since furthermore the monitoring system of document E1 already comprised most of the required technical features, in particular means for providing clocking signals both to the CCD area and to the transport control means, and a tachometer for the measurement of conveyor speed, the skilled person would have readily envisaged to make the shifting of the charges across

the detector dependent on conveyor speed. This was only one of a small number of equivalent possibilities, a further one consisting in controlling the speed of the conveyor in accordance with the clocking rate of the CCD detector, as was confirmed in the description of the patent itself.

Document E2, which also related to the control of a CCD area operating in the TDI mode, proposed direct optical detection of the movement of the image over the detector, in case the object to be imaged (e.g. a truck) moved at a speed which was not preset. This implied that conversely, in the case of a preset speed, charge transfer could be controlled so as to be directly dependent on such preset speed, like in the patent in suit.

- V. The respondent, for its part, insisted that the detector areas of the monitoring system disclosed in document E1 were of the linear type and that the document did not disclose any charge transfer controlled by a master signal derived from the conveyor speed.

Document E7 was dedicated to monitoring systems achieving high imaging quality, which implied an optimised timing for the detector electronics. This effectively hinted away from making the signal clock for the CCD dependent on uncontrolled variations of the conveyor speed, as were inherent to any conveyor system.

Reasons for the Decision

1. The appeal is admissible.
2. *Respondent's main request*
- 2.1 Proper construction of claim 1

As compared to claim 1 as granted, claim 1 of the main request has *inter alia* been supplemented with an indication that the object to be examined can be transported by the conveyor "at an adjustable speed". The appellant submitted that this amendment aimed at suggesting that the claimed monitoring system was able to compensate for uncontrolled speed variations of the conveyor, and that it thus solved a technical problem which was not supported by the originally filed application documents.

The patent specification does not afford any explanation of the expression "at an adjustable speed", which therefore in the Board's view should be understood in its most common sense, i.e. to the effect that the speed of the conveyor can be adjusted at different values. The question whether the conveyor speed may also be subject to uncontrolled variations, and of whether any such uncontrolled variations may be compensated for by the characterising features of the claim, is a different issue which might certainly be of interest in the assessment of the technical advantages afforded by the claimed subject-matter. This issue might however have arisen also in the context of a non-adjustable conveyor speed, and it is thus totally unrelated to the introduction of the expression "at an adjustable speed" into claim 1.

Claim 1 has been further amended to specify that the

control means controls the transfer means for serially shifting the pixel values across the light sensitive elements "so as to adapt its serial shifting of pixel values to the movement of the conveyor". The respondent indicated that this amendment was meant to clarify that it was the movement of the conveyor which was used as a master signal for controlling the operation of the pixel values transfer means. In the Board's view, however, the broad reference to adapting the serial shifting of pixel values to the movement of the conveyor only implies that such shifting is controlled so as to take into account the movement of the conveyor. This does not necessarily imply the use of a signal delivered directly by the conveyor. Adaptation of the pixel values shifting to the movement of the conveyor within the meaning of claim 1 in the Board's view also encompasses indirect sensing of the movement of the conveyor, for instance by analysing the movement of the image of the object transported by the conveyor.

2.2 Novelty

- 2.2.1 Document E1 discloses a monitoring system comprising a conveyor (12) for transporting an object (a printed wiring board (10)) to be examined through an examination region, an optical system (20a, 20b) for focusing a light image of the examining region onto an image section (22a, 22b) comprising an area of light sensitive elements which integrate light received through the optical system to produce individual pixel values that are indicative of an amount of light received thereby to form a pattern of pixel values representing said image, a transfer means (drive 46) for serially shifting the pixel values across the light sensitive element to create a video signal representing

said image of the examining region and a control means (scanner command and status unit (40)) for controlling the transfer means (46), as is set out in the preamble of claim 1 (see column 5, lines 3 to 22, the paragraph bridging columns 5 and 6, and Figure 1).

This prior art monitoring system comprises linear CCD devices mounted orthogonally to the direction of movement of the conveyor (12) (see in particular column 6, lines 6 to 18 and the "footprints" of the detectors as shown in Figure 2). The pixel values cannot therefore be shifted across the image section in synchronisation with the movement of the image so that subsequent images superimpose directly on the shifted previous image representing pixel value pattern within the meaning of the characterising portion of claim 1. The document does not specify either whether the speed of the conveyor is adjustable.

2.2.2 Document E2 generally relates to detectors for converting moving images into video signals. The detectors comprise an area of light sensitive elements which integrate light received through an optical system to produce individual pixel values that are indicative of an amount of light received thereby to form a pattern of pixel values representing said image, and transfer means for serially shifting the pixel values across the light sensitive elements in synchronisation with the movement of the image over the detector, so that subsequent images on the image section superimposed directly on the shifted previous pixel value pattern (see claim 8 in conjunction with claim 1).

A specific embodiment of the detector disclosed in

document E2 in conjunction with Figure 5 is directed to the imaging of a moving truck (132). Synchronization of the shifting of pixel values across the detector with the movement of the truck is achieved using an optical image speed sensor mounted alongside the detector (see column 5, lines 34 to 55).

This prior art document does not disclose the monitoring of objects transported by a conveyor.

- 2.2.3 Document E7 is a full-page advertisement by the company EG&G Reticon for photodiode arrays suitable for a number of applications like inspection and machine vision, high speed image capture or high speed inspection. The advertisement in particular stresses the availability of "sensitive time-delay and integration arrays" for such applications.

This document does not however disclose details of any monitoring system, nor of the control and synchronization of the TDI detectors it refers to.

- 2.2.4 Document E8 discloses a radiographic system in which a CCD detector operated in the TDI mode receives radiation from an X-ray tube after it has passed a patient's body on a movable table (26). The movement of the table and the shifting of the charges on the detector in the TDI mode are controlled in synchronism through a common clock (100); see column 9, line 45 to column 10, line 43 and Figure 4.

This document does not relate to the monitoring of an object transported on a conveyor.

- 2.2.5 The remaining citations on the file do not come closer

to the subject-matter of claim 1 which, accordingly, is novel within the meaning of Article 54 EPC.

2.3 Inventive step

2.3.1 The monitoring system of document E1 comprises only linear CCD areas disposed orthogonally to the movement of the object to be examined, which cannot be operated in the TDI mode for improving light integration. Furthermore, the signals produced by these CCD areas, although consisting of pixel values representing an image within the meaning the preamble of claim 1, are not converted so as to form a video image of the object, as in the numerous citations on the file relating to the TDI operation mode of a CCD. The sequential pixel values produced by the CCD detector of document E1 are processed instead in such a way as to form a digitised signal to be represented in a bit matrix of points, defect detection being achieved by sampling certain matrix points and by applying to them predetermined logical conditions (see claim 1). For these reasons, document E1 is not considered a proper starting point for an invention which involves image light integration in the TDI mode.

Accordingly, the closest prior art in the Board's view is constituted by a monitoring system as set out in the preamble of claim 1, which actually comprises a CCD sensor or camera for producing images of the object to be examined, like those referred to in the introductory portion of the specification of the patent in suit (see column 1, line 13 to column 2, line 32). The respondent at the oral proceedings confirmed that monitoring systems as set out in the preamble of claim 1 were actually part of the prior art at the filing date of

the patent.

2.3.2 Control of the pixel value transfer means as set out in the characterising portion of claim 1 allows for light being integrated by the light sensitive elements during the whole period of time for which an image point moves across the image section of the detector, which alleviates the limits set to the prior art monitoring systems in terms of lighting intensity or conveyor speed (see the specification of the present patent, column 2, lines 12 to 32).

2.3.3 The skilled person starting from the closest prior art monitoring system and striving at increasing its speed of operation would find in document E7 the indication that detector arrays operating in the TDI mode are particularly suitable for high speed inspection. This document does not provide any details of the practical implementation of such TDI mode of operation.

However, document E2, which is explicitly dedicated to the conversion of fast moving and dim images by solid states devices (see column 1, lines 28 to 32) teaches that the transfer rate of the charges on the detector should be synchronized with the rate of motion of the imaged focused thereon (see claim 8), and that it can be instantaneously adjusted to correspond to the rate of motion of the image being converted (see column 1, lines 39 to 42). In the specific embodiment disclosed in conjunction with Figure 5, image motion is sensed by an image speed sensor located alongside the detector. The signal of said image speed sensor is fed to the control means for controlling the shifting of the pixel values across the image section of the detector in synchronization with the movement of the image, so as

to adapt the shifting to the actual movement of the object, which here is a moving truck (see column 5, lines 34 to 56 and Figure 5).

Applying the same technique to the closest prior art monitoring system (see point 2.8.1 supra), i.e. sensing image speed through an image speed sensor provided alongside the CCD array and controlling pixel shifting so as to adapt it to the movement of the image and hence of the conveyor, immediately leads to the monitoring system set out in claim 1 of the main request.

Accordingly, the subject-matter of claim 1 of the main request does not involve an inventive step within the meaning of Article 56 EPC.

3. *Respondent's first subsidiary request*

3.1 Compliance of the amendments brought to the claims with the requirements of Article 123(2) and (3) EPC.

As compared to claim 1 as granted, claim 1 of the respondent's first subsidiary request was supplemented with a series of additional features, which were adequately disclosed in the application documents in originally filed.

In particular, the "conveying means" in claim 1 as granted are now specified to consist in a "conveyor" which transports an object "at an adjustable speed" as disclosed in the first sentence of the last paragraph of page 5 of the description as originally filed and in the second paragraph of page 6.

The further indication that the control means controls the transfer means "so as to adapt its serial shifting of pixel values to the movement of the conveyor" is supported by the disclosure in the first paragraph of page 6 of the description as originally filed, which in particular states that the synchronising means preferably adapts the sampling of the transducer to movement of the object.

Finally, the specific arrangement of the control means as now defined at the end of the claim, with a clock generator for controlling shifting of pixel values across the image section being connected with monitoring means for monitoring the speed of the conveyor such that the frequency of clock pulses generated by the clock generator is controlled in accordance with the monitored conveyor speed, was defined in claims 4 and 5 as originally filed.

These additional features also clearly limit the scope of claim 1, as compared to the scope of claim 1 as granted.

Dependent claims 2 to 5 correspond to claims 2, 3, 6 and 7 as granted.

For these reasons, the requirements of Article 123(2) and (3) EPC are met.

3.2 Inventive step

As compared to claim 1 of the main request, claim 1 of the respondent's first subsidiary request further specifies that adaptation of the serial shifting of pixel values to the movement of the conveyor is

achieved through a monitoring means for monitoring the speed of the conveyor, which is connected to the clock generator which generates clock pulses for controlling shifting of pixel values across the image section, such that the frequency of clock pulses generated by the clock generator is controlled in accordance with the monitored conveyor speed.

This arrangement, in which the clock generator for the control of the TDI mode operation of the detector is controlled directly by the signal from a monitoring means for monitoring the speed of the imaged object, which amounts to the conveyor speed monitoring means delivering a master signal for the optical detector operating as the slave, is not suggested in an obvious way by the citations on the file.

In particular, document E2 which discloses an optical detector controlled in response to the speed of the object to be monitored, using an optical image speed sensor, explicitly specifies that this solution is recommended "if the speed of the image is not preset" (see column 5, lines 40 to 44). This indication implies that image speed sensing is not required when the image speed is preset, which is the case in the closest prior art monitoring system where the conveyor speed is adjustable and can thus be set at different predetermined values (see point 2.3.1 supra). The control means for the shifting of pixel values across the image section, and in particular the clocking of the pixel value shifting, can then also be set at a fixed value corresponding to the selected object speed.

Moreover, the claimed control of the frequency of the clock pulse generator for the shifting of pixel values

by a monitoring means for monitoring the speed of the conveyor may quicker respond to any uncontrolled speed variation of the conveyor than the system of document E2 in which an optical detector must first analyse the movement of the image of the object transported by the conveyor, which furthermore might be difficult if the object does not exhibit any easily detectable surface structure for analysis by the optical speed detector.

In the monitoring system of citation E1, the transport control means (30) which controls the motor (24) of conveyor (12) is shown to receive a reference clock signal from the scanner command and status means (40) which also controls pixel shifting in the linear CCD area (22) (see column 5, lines 18 to 22 and Figure 1). Thus, the conveyor speed monitoring means (26) (tachometer) shown also on this Figure does not control the clock generator for the pixel values shifting as required by present claim 1.

In the patient monitoring system of document E8, it is also a common clock generator (100) which simultaneously controls shifting of pixel values across detector (32) and corresponding translation of the patient table (26) through table control means (102) (see column 10, lines 18 to 43 and Figure 4). Incidentally, it is noticed that if the central clock generator (100) of the patient monitoring system of document E8 was designed so as to allow for the selection between different clock pulse frequencies, the patient table (26) could also be translated at an adjustable speed with the pixel value shifting being automatically adapted thereto. This shows that the adjustability of the conveyor speed of the closest

prior art monitoring system does not necessarily call for the clock pulse generator being controlled directly by a monitoring means for monitoring the speed of the conveyor in a master-slave configuration.

None of the remaining citations on the file comes closer to the claimed subject-matter than document E2, in respect of the controlling of pixel value shifting in response to the actual movement of the object to be monitored.

Document E7 in particular lacks any detail of the synchronization technique required by the optical detectors offered there when operated in the TDI mode.

Document EP-A-0 214 436 (F6) as filed by the appellant with its statement of the grounds of appeal but not relied upon by it at the oral proceedings, discloses a monitoring system for the monitoring of defects in a photomask. To this effect, a hologram of the photomask is first constructed, and a defect image as developed from the hologram, maintained at a fixed position, is analysed by a CCD detector mounted onto an X-Y positioning table for movement along two orthogonal directions in relation to the fixed holographic image. Such monitoring system, which for each object to be monitored calls for a hologram being constructed and individually inspected, is clearly not suitable for the continuous monitoring of objects transported by a conveyor.

Accordingly, the subject-matter of claim 1 of the respondent's first subsidiary request in the Board's opinion involves an inventive step within the meaning of Article 56 EPC. The same conclusion applies to the

subject-matter of the remaining claims 2 to 5, by virtue of their appendence to claim 1.

3.3 For the above reasons the patent can be maintained as amended on the basis of the set of claims in accordance with the respondent's first subsidiary request.

3.4 Further prosecution

The specification of the patent still comprises passages which state that as an alternative to the pixel value shifting being adapted to the movement of the object it could also be advantageous to vary the speed of the object so as to match the shifting frequency of the transducer (see column 4, lines 5 to 7 or column 5, lines 22 to 25). During the opposition proceedings, the respondent had requested these passages to be deleted so as to exclude the broad interpretation of the granted claim 1 as was relied upon by the appellant, but this deletion was refused by the Opposition Division on the ground that it was not specifically necessitated by the grounds advanced by the opposition (see the minutes of the oral proceedings of 30 June 1997, page 1, fourth paragraph and page 2, second paragraph).

However, from the above reasons of the Board it is apparent that the specific way of controlling the frequency of the clock generator in accordance with the monitored conveyor speed as now set out in claim 1 of the respondent's first subsidiary request is essential to the patentability of its subject-matter.

The evident contradiction between the above mentioned passages of the specification and the actual wording of

claim 1 of the respondent's first subsidiary request should therefore be removed, as required under Rule 27(1)(c) EPC. Whether the introductory statement in the specification that the invention may find other applications like stop action photography or video security (see column 1, lines 5 to 12) is consistent with the wording of claim 1 also requires consideration, for similar reasons.

The amendments brought to independent claim 1 and the cancellation of all the granted method claims would also appear to call for adaptation of the description (see in particular the passage from column 2, line 41 to column 3, line 39).

Whether the description should be supplemented with a short summary of the relevant content of document E2 for compliance with the requirement of Rule 27(1)(b) EPC is still to be considered, too.

For these reasons, the Board considers it appropriate in the present circumstances to make use of the possibility given to it under Article 111(1) EPC to remit the case to the Opposition Division for the necessary adaptation of the specification to the set of claims as amended in accordance with the respondent's first subsidiary request.

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 in amended form as follows:

Claims: 1 to 5 of the respondent's first subsidiary request presented at the oral proceedings of 3 July 2001;

Description: to be adapted;

Drawings: as in the patent specification.

The Registrar:

The Chairman:

A. Townend

E. Turrini