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Datasheet for the decision of 19 October 2021

Case Number: T 0970/19 - 3.4.02

Application Number: 11818595.8

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IPC: G02F1/1347, H04N13/04, G02F1/13363

Language of the proceedings: EN

Title of invention:
HIGH-SPEED LIQUID CRYSTAL POLARIZATION MODULATOR

Applicant:
LC-TEC Displays AB

Headword:

Relevant legal provisions:
EPC Art. 56
RPBA 2020 Art. 13(2), 13(1)

Keyword:
Inventive step - (no)
Amendment after summons - taken into account (no)

Decisions cited:

Catchword:

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Boards of Appeal

Chambres de recours

Boards of Appeal of the
European Patent Office
Richard-Reitzner-Allee 8
85540 Haar
GERMANY
Tel. +49 (0)89 2399-0
Fax +49 (0)89 2399-4465

Case Number: T 0970/19 - 3.4.02

D E C I S I O N
of Technical Board of Appeal 3.4.02
of 19 October 2021

Appellant: (Applicant)	LC-TEC Displays AB Tunavägen 281 781 73 Borlänge (SE)
Representative:	Murgitroyd & Company Murgitroyd House 165-169 Scotland Street Glasgow G5 8PL GB
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 16 October 2018 refusing European patent application No. 11818595.8 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	B. Müller
Members:	C. Kallinger
	A. Hornung

Summary of Facts and Submissions

I. The applicant lodged an appeal against the decision of the examining division refusing European patent application No. 11 818 595, because the subject-matter of claim 1 of the sole request did not involve an inventive step in the meaning of Article 56 EPC.

II. In the statement setting out the grounds of appeal the appellant requested that the decision of the examining division be set aside and that a patent be granted based on the application as refused, i.e. based on claims 1 to 31 filed with the letter dated 23 July 2018. As a precaution, the appellant requested oral proceedings.

III. Oral proceedings were appointed as requested. In a communication pursuant to Article 15 RPBA 2020 the appellant was informed about the board's preliminary view that the subject-matter of claim 1 lacked inventive step.

IV. With a letter dated 27 August 2021 the appellant withdrew the request for oral proceedings, announced that it would not attend the oral proceedings which were scheduled for 5 October 2021, filed claims of an auxiliary request and provided arguments with respect to inventive step in relation to both the main and the auxiliary requests pending.

V. Further to this letter, the board cancelled the oral proceedings.

VI. Reference is made to the following documents:

D1 GB 2 040 134 A
D2 WO 02/09335 A1
D12 Combined timing diagram, submitted by the appellant

VII. Claim 1 of the main request reads as follows:

"1. An optical polarization state modulator (20) for time-multiplexed stereoscopic three-dimensional image viewing (150) by an observer, the modulator configured to receive light in an input polarization state (42) and carrying, in alternating sequence, first and second perspective view images of a scene in different ones of first and second subframes, characterized in that the subframes are of substantially equal duration and have beginnings:

first and second liquid crystal devices (26, 28) combined in optical series so that polarized light propagating through them can undergo polarization state changes in response to voltages (V_L, V_H) applied to the first and second liquid crystal devices;

the first and second liquid crystal devices having respective first and second sets of directors (34c, 34n; 40c, 40n) and constructed and oriented to cause, in response to removal of applied equal voltages, the directors in the first and second sets to cooperatively relax and thereby dynamically offset the polarization state changes so that multiple wavelengths of the incident light propagating through and exiting the combination of first and second liquid crystal devices are in the input polarization state (42);

drive circuitry (52) configured to deliver first and second drive signals (50i, 5O2) to the respective first and second liquid crystal devices, the first and second drive signals including lower voltage magnitude

levels (Vl) that establish corresponding lower voltage magnitude director field states for the first and second liquid crystal devices, and the first and second drive signals including pulses having lower-to-higher voltage magnitude level powered transitions that establish corresponding higher voltage magnitude director field states for the first and second liquid crystal devices

the first and second drive signals operably cooperating at the beginning of one of the first and second subframes to cause, in the first and second liquid crystal devices, formation of the higher voltage magnitude director field states from which the directors relax (58) during the one subframe such that the directors in the first and second sets of directors offset the polarization state changes and thereby impart, to the image-carrying polarized light propagating through the combination offirst and second liquid crystal devices, a first output polarization state (44) that is the input polarization state (42); and

the first and second drive signals cooperating at the beginning of the other of the first and second subframes to cause, in one of the first and second liquid crystal devices, formation of the higher voltage magnitude director field state during the other subframe such that the directors in the first and second sets of directors do not offset the polarization state changes and thereby impart, to the image-carrying polarized light propagating through the combination of first and second liquid crystal devices, a second output polarization state (44) that is different from the first output polarization state."

VIII. Claim 1 of the auxiliary request reads as follows:

"1. An optical polarization state modulator (20) for time-multiplexed stereoscopic three-dimensional image viewing (150) by an observer, the modulator configured to receive light in an input polarization state (42) and carrying, in alternating sequence, first and second perspective view images of a scene indifferent ones of first and second subframes, characterized in that the subframes are of substantially equal duration and have beginnings:

first and second liquid crystal devices (26, 28) combined in optical series with no polarization-altering optical element positioned between them so that polarized light propagating through them can undergo polarization state changes in response to voltages (VL, VH) applied to the first and second liquid crystal devices;

the first and second liquid crystal devices having respective first and second sets of directors (34c, 34n; 40c, 40n) and constructed and oriented to cause, in response to removal of applied equal voltages, the directors in the first and second sets to cooperatively relax and thereby dynamically offset the polarization state changes so that multiple wavelengths of the incident light propagating through and exiting the combination of first and second liquid crystal devices are in the input polarization state (42);

drive circuitry (52) configured to deliver first and second drive signals (501, 502) to the respective first and second liquid crystal devices, the first and second drive signals including lower voltage magnitude levels (VL) that establish corresponding lower voltage magnitude director field states for the first and second liquid crystal devices, and the first and second drive signals including pulses having lower-to-higher

voltage magnitude level powered transitions that establish corresponding higher voltage magnitude director field states for the first and second liquid crystal devices

the first and second drive signals operably cooperating at the beginning of one of the first and second subframes to cause, in the first and second liquid crystal devices, formation of the higher voltage magnitude director field states from which the directors relax (58) during the one subframe such that the directors in the first and second sets of directors offset the polarization state changes and thereby impart, to the image-carrying polarized light propagating through the combination of first and second liquid crystal devices, a first output polarization state (44) that is the input polarization state (42); and

the first and second drive signals cooperating at the beginning of the other of the first and second subframes to cause, in one of the first and second liquid crystal devices, formation of the higher voltage magnitude director field state during the other subframe such that the directors in the first and second sets of directors do not offset the polarization state changes and thereby impart, to the image-carrying polarized light propagating through the combination of first and second liquid crystal devices, a second output polarization state (44) that is different from the first output polarization state."

Reasons for the Decision

1. Main request - Inventive step - Article 56 EPC

1.1 Closest prior art

The examining division considered document D1 as closest prior art. This was not contested by the appellant.

1.2 Difference

The subject-matter of claim 1 differs from D1 by the features from line 10 of claim 1 (as presented in point VII. above) onwards. This was not contested by the appellant.

1.3 Problem to be solved

1.3.1 The examining division defined the objective technical problem to be solved as to modify the polarizer of D1 to reduce or eliminate the impact of the slow switching of its liquid crystal display.

1.3.2 The appellant argued that this problem was artificial and derived with the benefit of hindsight. Based on different passages of the description (paragraphs [0002], [0018] and the last lines of each of paragraphs [0007] and [0010]) the appellant formulated the problem as the prevention of image crosstalk, loss of brightness and other artefacts in time-multiplexed stereoscopic 3D applications.

1.3.3 The board is of the opinion that the immediate technical effect which is achieved by the

distinguishing features is a fast and powered switching between the two polarization states. This is in line with the description (see paragraphs [0017], last sentence and paragraph [0067]). The technical problem as defined by the examining division is based on this effect. The board therefore agrees to the objective technical problem as formulated by the examining division.

1.4 Combination with document D2

1.4.1 The examining division found that the subject-matter of claim 1 lacked inventive step with respect to the combination of documents D1 and D2 (see point 1 of the decision).

1.4.2 The appellant argued that document D2 was directed to the on-demand switching of optical beams in the field of optical communication networks whereas D1 and the present application related to stereoscopic television systems. Due to the inherent differences between the two fields of technology it was not obvious to the person skilled in the art to combine the slow, single-cell polarization modulator of the stereoscopic system of D1 with the faster, two-cell polarization modulator of D2.

Furthermore, D2 (see page 3, lines 5-18) suggested that the two-cell approach implemented in the routing switch was not suitable for a display with many pixels. D2 therefore taught away from using the two-cell approach for a stereoscopic television system.

In addition, it was evident that the problem (as defined by the appellant) was neither mentioned in D2 nor did it arise in optical routing switches.

In conclusion, the skilled person would not have combined the teaching of documents D1 and D2.

The appellant further argued that, even if the skilled person would have combined D1 and D2, the teaching of D2 was incompatible with that of the present invention or D1.

D2 related to an optical router and described (see page 9, line 18 to page 10, line 17) four states to which liquid crystal (LC) cells 22, 23 were driven sequentially to provide fast switching actions (see page 10, lines 16-17). In contrast to this, the present patent application described (see paragraphs [0067] and [0068] and Figure 4) a two-subframe switching technique coordinating powered and unpowered transitions with an alternating sequence of images produced by an image source. There existed a substantial difference between the four-state cycle drive sequence of the liquid crystal devices of the routing switch of D2 and the two-subframe image frame cycle drive sequence of the claimed optical state modulator for time-multiplexed stereoscopic three-dimensional image viewing. The skilled person would therefore not implement the four-state cycle disclosed in D2 onto a two-subframe image frame known from D1 because D2 disclosed that three of the four states were "through" states.

In this respect the appellant also referred to the combined timing diagram D12 which mapped the timing sequence described in D2 (see page 9, lines 18 to page 10, line 17) into Figure 4 of the present application. This diagram showed that a combination of the teachings of D1 and D2 did not result in the claimed solution.

Furthermore, in the optical routing switch, the shutter states changed on demand and therefore resulted in a random sequence of switching states. This was in contrast to the regular sequence of subframes and shutter states of substantially equal duration characterizing the multiplexed stereoscopic display systems of D1 and the present application. Therefore the skilled person would not have found any hint in D2 that would have led him to the solution of claim 1. As D2 disclosed switching at arbitrary times and thus defined *"subframes"* of arbitrary durations, D2 even taught away from the solution of claim 1 in which *"the subframes are of substantially equal duration"*.

Finally, the appellant argued with reference to Figure 1 and 2 of document D1, which together showed the complete television system of D1 in which LC cells 11 and 19 were separated from each other by polariser 12, camera 7, broadcast signal-transmitting system 14 and its antenna 15. In the appellant's view, substituting the LC cells 22 and 23 of D2 for the LC cells 11 and 19 present in the stereoscopic television of D1 would result in an inoperable optical polarization state modulator for time-multiplexed stereoscopic three-dimensional image viewing.

Therefore, even if the skilled person would combine D1 with D2, the combination would not result in the claimed solution, which provides a rapid and efficient mechanism for stereoscopic three-dimensional viewing.

1.4.3 The appellant's arguments are not convincing for the following reasons.

(a) This applies, first, to the argument that the technical field of liquid crystal displays was too

far removed from the technical field of routing switches for optical communication networks. The effect which the claimed subject-matter achieves over the closest prior art is to reduce or eliminate the impact of the slow switching of liquid crystal cells on the polarisation state. Therefore, the objective technical problem is not related to stereoscopic liquid crystal devices per se, but to the broader field of polarisation modulators based on liquid crystal cells. D1 (see page 2, lines 46 to 47) as well as D2 (see section 2: *"Statement of the Problem"*) both explicitly mention the problem of slow response times of liquid crystal based polarizers. D2 presents a solution based on symmetric liquid crystal cells which offer increased switching speed (see page 1, lines 4 to 8 and section 4: *"Solution to the Problem"*). Thus, a skilled person in search for a way of reducing or eliminating the impact of the slow switching of liquid crystal cell based polarizers will consult document D2 and find a possible solution to the problem.

The fact that D2 mentions that a similar approach was not suitable for LC displays (due to increased costs and weight) does not prevent the skilled person from attempting to achieve this solution. D2 explicitly hints at the use of such a switching scheme in the area of LC based stereoscopic displays (see page 3, lines 5 to 10) and only speculates about why this scheme has not been commercialized (see page 3, lines 10 to 14). This passage therefore does not prevent the skilled person from using the fast switching described in D2 in stereoscopic displays.

The argument that the problem of artifacts did not arise in D2 is not convincing either, as the technical problem as formulated above does not relate to artifacts.

In conclusion, the board is of the opinion that the skilled person would consult D2 in order find a solution to the objective technical problem.

(b) The board is also of the opinion that a combination of the teachings of documents D1 and D2 leads the skilled person to the claimed solution.

D1 relates to a stereoscopic television system in which alternating images for the left and right eye of an observer are formed (see title, abstract and Figure 2). It is therefore implicitly disclosed that the subframes are of substantially equal duration.

In order to solve the objective technical problem (as mentioned in point 1.3 above) the skilled person would apply the teaching of D2 to the device of document D1 by replacing the polarisation state modulator comprising the single liquid crystal cell 19 by the two liquid crystal cells 22, 23 of document D2 and by adapting the drive circuitry as taught by document D2.

When implementing the switching cycle of D2 in such a system, the skilled person would necessarily synchronise the switching cycle of D2 to the frame rate of the polarisation state modulator known from D1 (see D1, Figure 2: frame rate switch 17) such that the fast transitions between the "through" and "cross" states coincide with the beginnings of the

subframes. As the arrangement of document D2 is not limited to switching at particular times, there is no problem in adapting it to the requirements imposed by document D1, i.e. to a switching with subframes of equal length.

A correctly synchronized switching cycle as known from D2 (see page 8, line 3 to page 10, line 23 and Figures 2 and 3) corresponds to the claimed switching cycle and, in substance, also to that of figure 4 of the application. The "through" state (step "(a)" in D2) occurring after the relaxation period falls within one of the subframes, e.g. the first subframe (i.e. before t_2 in Figure 4); the powered transition to the "cross" state (step "(b)") will then occur at a time corresponding to t_2 in Figure 4 (i.e. at the beginning of the second subframe); the powered transition to the "through" state (step "(c)") occurs at the beginning of the next subframe, i.e. at a time corresponding to t_3 in Figure 4; the relaxation (step "(d)") occurs during that subframe and results in the "through" state (step "(a)"). Therefore, the appellant's arguments with respect to the timing diagram as presented in D12 (where three "through" states of a four-state-cycle sequence are mapped on two subframes) are not convincing.

1.5 In its overall conclusion, the board is of the opinion that the switching sequence presented in document D2 is identical to the one claimed in the present application. In combining the teachings of documents D1 and D2 the skilled person arrives in an obvious way at an optical polarization state modulator comprising all of the features of claim 1. Therefore, the subject-

matter of claim 1 does not involve an inventive step within the meaning of Article 56 EPC.

2. Auxiliary request - Admittance - Article 13 (1) and (2) RPBA 2020

The amended claims of the auxiliary request were filed with the letter dated 27 August 2021, i.e. after notification of the summons to oral proceedings (Article 13 (2) RPBA 2020) and thus logically after the preceding filing of the grounds of appeal (Article 13 (1) RPBA 2020).

The appellant argued that the amendments in claim 1 were *"to expressly state a feature that the applicant believed was implicit in the claim construction, and which appears only now from the Board's Preliminary Opinion to be not so considered"*. Therefore, the filing of an amended claim was *"a legitimate response to the analysis provided by the Board in the Preliminary Opinion."*

2.1 According to Article 13(2) RPBA 2020, *"[a]ny amendment to a party's appeal case made ... after notification of a summons to oral proceedings shall, in principle, not be taken into account unless there are exceptional circumstances, which have been justified with cogent reasons by the party concerned"*.

The board is of the opinion that amended claim 1 is an attempt to address the inventive-step objection based on documents D1 and D2. This objection was already raised by the examining division for claim 1 of the main request in the decision under appeal and confirmed by the board in its provisional opinion. Thus, the

board cannot recognise exceptional circumstances leading to the amendment, which have been justified with cogent reasons by the appellant.

2.2 In addition, the criteria of Article 13(1) RPBA 2020 may be relied on (see T 1767/16, point 5.1). According to that provision, any *"amendment to a party's appeal case after it has filed its grounds of appeal or reply is subject to the party's justification for its amendment and may be admitted only at the discretion of the Board."*

The amendment introduced in claim 1 of the auxiliary request concerns the addition of a negative feature (*"no polarization altering element"*) which possibly raises objections under Articles 123(2) and 84 EPC. Furthermore, document D2 (see Figure 5) seems to disclose a set-up with no polarization-altering optical element positioned between the two liquid crystal devices 22 and 23 (Article 56 EPC). The board is therefore of the opinion that the amendment gives rise to new objections and is prima facie not suitable to overcome the inventive-step objection.

2.3 As a consequence, the board, exercising its discretion under Article 13 (1) and (2) RPBA 2020, does not admit the auxiliary request into the appeal proceedings.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

L. Gabor B. Müller

Decision electronically authenticated