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D E C I S I O N
of 22 November 1994

Case Number: T 1075/93 - 3.4.2

Application Number: 87111555.6

Publication Number: 0261369

IPC: G02F 1/133, H01L 29/40, H01L 27/02

Language of the proceedings: EN

Title of invention:
Integrated circuit for liquid crystal display

Applicant:
KABUSHIKI KAISHA TOSHIBA

Opponent:

Headword:

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (after amendments): yes"

Decisions cited:

Catchword:

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Case Number: T 1075/93 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 22 November 1994

Appellant: KABUSHIKI KAISHA TOSHIBA
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Decision under appeal: **Decision of the Examining Division of the European Patent Office dated 20 August 1993 refusing European patent application No. 87 111 555.6 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: E. Turrini
Members: M. Chomentowski
B. J. Schachenmann

Summary of Facts and Submissions

I. European patent application No. 87 111 555.6 (publication No. 0 261 369), which is directed to a liquid crystal display apparatus comprising a liquid crystal display device of a dot matrix type with a substrate for corresponding electrode terminals and a drive device for driving said liquid crystal display device comprising an integrated circuit and a circuit board therefor, was refused for lack of inventive step having regard to D2 = GB-A-2 138 615 and D3 = DE-A-2 532 421.

The Examining Division arrived at the conclusion that the claimed apparatus was not inventive in view of an obvious combination of D2 and D3. Starting from D2, which indeed does not explicitly mention the substrate for the terminals of the liquid crystal elements (pixel) and which describes neither the electronic device for driving the liquid crystal display device nor the location of the drive circuit terminals, the problem to be solved was considered to be the provision of a liquid crystal device apparatus providing an optimal location of the terminal electrodes of the drive device compared to the location of the liquid crystal element electrode terminals so as to avoid crossing of the wirings; no positive contribution to inventive step could be seen in formulating this problem, because it is an obvious and general problem to look for a simple and reliable design to locate corresponding electrode terminals. The circuit board for the liquid crystal elements was considered as implicitly disclosed in D2, and the problem of the optimal location of the electrode terminals as having been solved in an obvious way by taking into account the arrangement of D3, thereby also avoiding crossing of the wirings. The problem introduced by the Applicant and

concerned with wiring crossing was considered as having no substantial technical basis, the real problem being that of the optimal location of the electrode terminals, whereby by solving the real problem the Applicant's mentioned problem was also solved. The combination of D2 and D3 was considered as possible because both documents are concerned with liquid crystal display devices, whereby the fact that D3 is concerned with a liquid crystal display apparatus with seven segments numeric displays was irrelevant in this context since only the electrode terminal structure was of importance.

II. The Appellant (Applicant) lodged an appeal against this decision.

III. In a communication accompanying the invitation to oral proceedings which had been requested auxiliarily by the Appellant the Board of Appeal expressed the opinion that the only claim, which was the same as the claim forming the basis of the decision under appeal, did not appear to be clear; moreover, D2 and D1 = GB-A-2 106 690, which had been taken into consideration during the examination procedure, did not show any circuit board for the integrated circuit and thus did not correspond to the pre-characterising portion of the claim, so that there were doubts about the starting point and about the problem of wiring crossing to be solved mentioned by the Appellant, whereby the subject-matter understandable from said claim could lack an inventive step.

IV. During the oral proceedings of 22 November 1994 the Appellant submitted a new only claim and requested that the decision under appeal be set aside and that the patent be granted on the basis of said claim and of the description and drawings to be adapted. The claim reads as follows:

"A liquid crystal display apparatus comprising: a liquid crystal display device (30) of a dot matrix type comprising pixel electrodes being provided in a matrix pixel electrode array, pixel electrode terminals being provided in a predetermined direction and connected to the pixel electrodes, and a substrate for the pixel electrode terminals, the pixel electrode terminals being provided on different sides of the axis of the pixel electrode array such that the pixel electrode terminals provided on one side of the axis form one pixel electrode terminal array and the pixel electrode terminals provided on the other side of the axis form another pixel electrode terminal array, and a drive device for driving said liquid crystal display device, comprising an integrated circuit (10) and a circuit board (20) for the integrated circuit (10), the integrated circuit (10) having pixel drive signal output terminals, wherein those of said pixel drive signal output terminals which correspond to said pixel electrode terminals of said one pixel electrode terminal array are arrayed to form one output terminal array (21), and those of said pixel drive signal output terminals which correspond to said pixel electrode terminals of said another pixel electrode terminal array are arrayed to form another output terminal array (22), characterized in that said substrate for the pixel electrode terminals is a transparent substrate; successive pixel electrode terminals of the successive pixel electrodes of the matrix pixel electrode array are arranged alternately on different sides of the axis of the pixel electrode array such that the pixel electrode terminals of all odd numbered pixel electrodes are provided on said one side to form said one pixel electrode terminal array and the pixel electrode terminals of all even numbered pixel electrodes are provided on the said other side to form said another pixel electrode terminal array, said pixel drive signal

output terminals of the integrated circuit (10) are arrayed in a sequence in a circumferential direction of the integrated circuit (10) such that the numbers of odd numbered pixel drive signal output terminals are increased in the circumferential direction and the numbers of the even numbered pixel drive signal output terminals are decreased in the same circumferential direction, said odd and even numbered pixel drive signal output terminals being assigned to said one and said another output terminal array (21, 22), respectively, the order of each of the pixel drive signal output terminals in said one and said another output terminal array (21, 22) on the circuit board is the same as that of the corresponding one of said odd and even pixel electrode terminals in said one and said other pixel electrode terminal array on the transparent substrate, respectively, and said odd pixel electrode terminals of said one pixel electrode terminal array and said even pixel electrode terminals of said another pixel electrode terminal array are formed on the same surface of said transparent substrate and said odd and even numbered drive signal output terminals corresponding to the odd and even pixel electrode terminals, respectively, are formed on the same surface of said circuit board (20), so that said pixel electrode terminals (33, 33) and said pixel drive signal output terminals (21, 22) can be connected to each other on said same surfaces of said transparent substrate and said circuit board (20) by wiring on the circuit board (20) without crossing of the wirings."

V. The Appellant submitted the following arguments in support of his request: The claim has been clarified by introducing features derivable from the drawings and showing the specific arrangement in arrays of the terminals of the liquid crystal display device and the driving integrated circuit, and the particular

arrangement of the interconnection wirings on the transparent substrate and on the circuit board, respectively. The closest prior art is D1, which shows a matrix dot liquid crystal device and an integrated circuit. D2, which does not show any integrated circuit, and D3, which is concerned with a liquid crystal display device with a limited number of segments for displaying digits in a device such as a watch, cannot be considered as the starting point for the present invention. The problem of crossing of the wirings is the actual problem to be solved, and this is done in the present apparatus by an arrangement of the features which is not suggested in the prior art.

Reasons for the Decision

1. The appeal is admissible.

2. *Allowability of the amendments*

The liquid crystal display apparatus of the present claim is based on the original disclosure (see page 1, lines 1 to 21; page 4, line 15 to page 6, line 19; page 6, line 26 to page 12, line 1; claims 1 to 6; Fig. 1 and 5 to 8), whereby the present features not explicitly mentioned in the original application, for instance the sequential circumferential arrangement of drive signal output terminals of the integrated circuit and the alternate arrangement of the successive pixel electrode terminals on different sides of the transparent substrate, with the corresponding interconnection wirings between each liquid crystal terminal and each integrated circuit terminal, are directly and unambiguously derivable from the above mentioned Fig.5 to 7 and in particular page 7, lines 20

to 35. Therefore, the European patent application has not been amended in such a way that it contains subject-matter which extends beyond the content of the application as filed (Art.123(2) EPC).

3. *Clarity*

The claim specifies all the important features of the present apparatus, in particular the alternate and sequential arrangement of the respective terminals of the liquid crystal display device and of the driving integrated circuit on the respective surfaces of the transparent substrate and of the circuit board in accordance with the embodiment illustrated by Fig. 1 and 5 to 8. Therefore, the claim is clear in the sense of Article 84 EPC.

4. *Novelty*

No liquid crystal display apparatus comprising all the features of the presently claimed apparatus is known from the prior art. Therefore, the subject-matter of the claim is novel in the sense of Article 54 EPC.

5. *Inventive step*

5.1 A liquid crystal display apparatus is known from D1 (see page 1, lines 7, 8 and 31 to 35; page 1, line 111 to page 2, line 60; Fig.1); the apparatus comprises a liquid crystal display device (2) of a dot matrix type comprising pixel electrodes being provided in a matrix pixel electrode array, pixel electrode terminals being provided in a predetermined direction and connected to the pixel electrodes, and a substrate (3) for the pixel electrode terminals (S0a, S1a, S2a....,S62a, S63a); the pixel electrode terminals are provided on different sides of the axis of the pixel electrode array, i.e. on

opposite surfaces of said substrate (3), such that the pixel electrode terminals (S0a, S2a, ...,S62a) which are provided on one side of the axis, i.e on one surface of the substrate (3), form one pixel electrode terminal array, and the pixel electrode terminals (S1a, S3a, ..., S63a) which are provided on the other side of the axis, i.e. on the other surface of the substrate (3), form another pixel electrode terminal array; the apparatus also comprises a drive device for driving said liquid crystal display device, comprising an integrated circuit (Chip1) and a circuit board (not shown) for the integrated circuit (Chip1); the integrated circuit (Chip1) has pixel drive signal output terminals (S0, S1, S2, ...,S62, S63); those of said pixel drive signal output terminals which correspond to said pixel electrode terminals of said one pixel electrode terminal array are arrayed to form one output terminal array (S0, S2, ..., S62), and those of said pixel drive signal output terminals which correspond to said pixel electrode terminals of said another pixel electrode terminal array are arrayed to form another output terminal array (S1, S3, ..., S63).

However, contrary to the presently claimed apparatus, in the apparatus of D1, the substrate for the pixel electrode terminals is not derivable as being a transparent substrate; successive pixel electrode terminals (S0a, S1a, S2a, ... , S62a, S63a) of the successive pixel electrodes of the matrix pixel electrode array are not arranged on the same surface of the substrate and thus are not arranged alternately on different sides of the axis of the pixel electrode array on said same surface such that the pixel electrode terminals of all odd numbered pixel electrodes are provided on said one side of said surface to form said one pixel electrode terminal array and the pixel electrode terminals of all even numbered pixel

electrodes are provided on the said other side of said surface to form said another pixel electrode terminal array; the order of each of the pixel drive signal output terminals (S0, S2, ...,S62; S1, S3, ..., S63) in said one and said another output terminal array on the circuit board is not mentioned as being the same as that of the corresponding one of said odd and even pixel electrode terminals (S0a, S1a, S2a, ... , S62a, S63a) in said one and said other pixel electrode terminal array on the substrate of the liquid crystal device, respectively; moreover, as mentioned here above, said odd pixel electrode terminals (S1a, S3a, ... , S63a) of said one pixel electrode terminal array and said even pixel electrode terminals (S0a, S2a, ... , S62a) of said another pixel electrode terminal array are not formed on the same surface of said transparent substrate; no indication is derivable from D1 about the way the odd and even numbered drive signal output terminals (S0, S1, S2, ... , S62, S63) corresponding to the odd and even pixel electrode terminals, respectively, are formed on the circuit board; thus, there is no indication that said pixel electrode terminals (S0a, S2a, ...,S62a; S1a, S3a, ..., S63a) and said pixel drive signal output terminals (S0, S2, ..., S62; S1, S3, ..., S63) can be connected to each other on said same surfaces of said substrate and said circuit board by wiring on the circuit board without crossing of the wirings; in this respect, it is to be noted that, in D1 (see Fig.1), indeed, said pixel drive signal output terminals (S0, S2, ...,S62; S1, S3, ..., S63) of the integrated circuit (Chip1) are arrayed in the same longitudinal direction such that the successive terminals have a numbering increasing in the same sense on both sides of the integrated circuit and thus are arrayed in a sequence in a circumferential direction of the integrated circuit (Chip1) such that the numbers of odd numbered pixel drive signal output terminals are

increased in the circumferential direction and the numbers of the even numbered pixel drive signal output terminals are decreased in the same circumferential direction, said odd and even numbered pixel drive signal output terminals being assigned to said one and said another output terminal array, respectively; yet, contrary to the present application, wherein this feature is important for obtaining wirings without crossings on one surface of a substrate as shown in Fig.6 and 7, this sequential numbering is not derivable as being significant in the context of D1 because of the above-mentioned lack of information concerning the wirings connecting pixel electrode terminals (S0a, S2a, ..., S62a; S1a, S3a, ..., S63a) to the pixel drive signal output terminals (S0, S2, ..., S62; S1, S3, ..., S63).

5.2 Since, contrary to the presently claimed apparatus and to the apparatus known from D1, the apparatus known from D2 (see the abstract; page 1, lines 119 to 129; page 2, lines 94 to 119; Fig.6) is not derivable as having as constructive parts an integrated circuit and a corresponding circuit board with the matrix display system shown therein and the apparatus known from D3 (see page 1, first paragraph to page 2, first paragraph; page 3, two last paragraphs; page 8, second paragraph; Fig.1, 5 and 6) comprises a liquid crystal cell (20) for displaying images, e.g. segments forming digits indicative of the time of a day and not a liquid crystal display device of a dot matrix type, D2 and D3 are less relevant than D1.

5.3 In the apparatus known from D1, the pixel electrode terminals (S0a, S2a, ...,S62a; S1a, S3a, ..., S63a) are alternately on the opposed surfaces of the substrate (3) carrying the liquid crystal device (2), i.e. below and above said substrate, and the arrays of pixel drive

signal output terminals (S0, S2, ...,S62; S1, S3, ..., S63) of the integrated circuit (Chip1) are alternately on the lateral sides of the integrated circuit, i.e. on the left side and the right side thereof. Therefore, taking into account these two different alternate arrangements of the respective terminals, the Appellant's argument that the construction of D1 can make crossings of the wirings connecting the respective terminals necessary, and that such crossings are a disadvantage, can be accepted. In this respect, it is to be noted that although the circuit board is not shown in D1, the details of the construction including the integrated circuit and its electrode terminals derivable from Fig.1 of D1 allow to construe a technical problem. On the other hand, although D2 shows an important feature of the presently claimed apparatus, i.e. the alternate arrangement of the terminals of the liquid crystal elements on the same surface on both sides of the dot matrix, however, neither the integrated circuit nor the circuit board therefor are shown, whereby a problem of the optimal location of the wirings would be based only on features which, at best, are implicit, so that the Appellant's argument that a combination of D2 of D3 only results from an "ex-post facto" approach can be accepted.

5.4 No integrated circuit is derivable from D2 (see Fig.6); moreover, the problem addressed by D2 (see page 1, lines 35 to 39 and 95 to 118; page 3, lines 31 to 44) concerns quality of the displayed image without using additional memory means and not wirings; thus, although a construction of the terminals of the liquid crystal device with alternate successive terminals is shown, there is no incitation for a construction according to the present claim. D3 is not concerned with a dot matrix and, thus, the information concerning wirings in the apparatus of D3 having a display with a very limited

number of display segments which are additionally of different shape and number in each column and row cannot be used as an incitation for applying the same scheme to the dot matrix apparatus of D2.

5.5 Incidentally, it is to be noted that in the present application a conventional apparatus is acknowledged on the basis of Fig.1 to 4, whereby in Fig.4 the integrated circuit terminals (1, 2, ..., 6) are connected to corresponding terminals (82) on the right side of the circuit board (53) in the same sequential order without any crossing of the wirings (81); further integrated circuit terminals (7, 8,..., 11, 12) on the other side of the integrated circuit (52), are indeed connected to the corresponding terminals (82) on the other, left side of the circuit board (53) with crossing of the wirings (81), whereby, however, no reason for said crossing of the wirings is derivable. Therefore, it could be argued that, starting from Fig. 4, the person skilled in the art could have been incited by the wiring construction on the right side of the circuit board to also avoid crossings of wirings on the other, left side of the circuit board. However, the Appellant, asked by the Board during the oral proceedings, whether this acknowledged apparatus corresponded to an actual prior art, did not confirm this. Moreover, no such apparatus is known from the documents of the European search report. Therefore, said acknowledged apparatus cannot be used as a prior art for arguing on inventive step. It is also to be noted that the application as originally filed (see page 2, line 35 to page 3, line 3; Fig. 1 to 4) specifies that when liquid crystal devices (52) with the external array shown in Fig. 2 are used to drive dot matrix type liquid crystal display device (51) with the electrode terminal array shown in Fig.3, the wiring pattern of the printed wiring board used for carrying the integrated circuits (52) is illustrated by Fig. 4.

However, it is directly and unambiguously derivable from the drawings that the arrangement of the electrodes on the right and left sides of the substrate (51) of the liquid crystal device (see Fig. 3) does not correspond to the arrangement of the terminals on the integrated circuit carrying circuit board (53) (see Fig. 4), and in particular that neither the former nor the latter terminals are sequentially alternatively located on one side and then on the other side of the substrate (52), respectively of the circuit board (53), as requested by the claim. Therefore, the acknowledged conventional apparatus is ambiguously disclosed so that, also for this reason, it cannot be used for arguing on inventive step.

5.6 Therefore, the subject-matter of the claim involves an inventive step in the sense of Article 56 EPC and, thus, a patent can be granted (Art.52(1) and 97(2) EPC).

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the Examining Division, with the order to grant a patent on the basis of the unique claim presented at the oral proceedings of 22 November 1994 and of description and drawings to be adapted.

The Registrar: The Chairman:

P. Martorana E. Turrini

MCA B.Sch.