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AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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(54) **Title:** ELECTRONIC APPARATUS WITH A DISPLAY

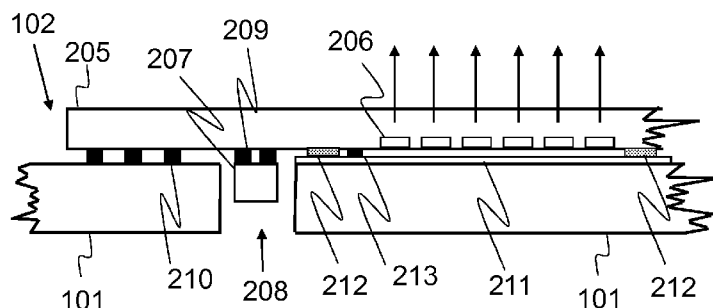


Fig. 2A

(57) **Abstract:** An apparatus including a base element (101) with wiring for one or more electronic components and a film of blocking material (211), a display element (102) comprising a transparent layer (205) and electrodes (206) configured to emit light through the transparent layer. The display element (102) faces the film of blocking material (211) of the base element (101) and the film of blocking material (211) of the base element (101) is configured to provide an encapsulation structure for the display element (102).



ELECTRONIC APPARATUS WITH A DISPLAY

TECHNICAL FIELD

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The present application relates generally to an electronic apparatus comprising a display.

BACKGROUND

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Display is one of the most expensive components in many electronic devices, such as mobile phones, MP3 players and cameras. One of the key factors in low end market is low cost structure, i.e. the aim is to reduce component costs.

15 SUMMARY

Various aspects of examples of the invention are set out in the claims.

20

According to a first aspect of the invention there is provided an apparatus, comprising:

a base element comprising wiring for one or more electronic components and a film of blocking material,

a display element comprising a transparent layer and electrodes configured to emit light through the transparent layer,

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wherein the display element faces the film of blocking material of the base element, and

wherein the film of blocking material of the base element is configured to provide an encapsulation structure for the display element.

30

According to a second aspect of the invention there is provided a method, comprising:

providing a base element comprising wiring for one or more electronic components and a film of blocking material,

placing a display element on top of the base element so that the display element faces the film of blocking material of the base element, the display element comprising a transparent layer and electrodes configured to emit light through the transparent layer,

- 5 wherein the film of blocking material of the base element provides an encapsulation structure for the display element.

Different non-binding example aspects and embodiments of the present invention have been illustrated in the foregoing. The above embodiments are used merely to
10 explain selected aspects or steps that may be utilized in implementations of the present invention. Some embodiments may be presented only with reference to certain example aspects of the invention. It should be appreciated that corresponding embodiments may apply to other example aspects as well. Any appropriate combinations of the embodiments may be formed.

15

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of example embodiments of the present invention, reference is now made to the following descriptions taken in connection
20 with the accompanying drawings in which:

- Fig. 1 shows an apparatus according to an embodiment of the invention;
Fig. 2A shows a partial cross sectional view of an apparatus according to an embodiment of the invention;
25 Fig. 2B shows a partial cross sectional view of a base element according to an embodiment of the invention;
Fig. 3 shows a top view of an apparatus according to an embodiment of the invention;
Fig. 4A shows a rough flow diagram showing a method in accordance with an
30 example embodiment of the invention; and
Fig. 4B shows a rough flow diagram showing a method in accordance with another example embodiment of the invention.

DETAILED DESCRIPTION

Example embodiments of the present invention and their potential advantages are understood by referring to Figs. 1 through 4 of the drawings. In the following
5 description, like numbers denote like elements.

In an example embodiment of the invention a base element such as a printed circuit board of an electronic apparatus is configured to provide an encapsulation structure for a display element such as an organic light emitting diode (OLED)
10 display element or more specifically a bottom emission OLED display element. In this way no separate components are needed for encapsulation of the display element.

A printed circuit board usually comprises one or more metal film layers, which are
15 etched to provide desired wiring in the board. In an embodiment of the invention the metal film that is readily part of the circuit board is used for providing encapsulation of a display element. In the etching process the metal film is not etched away from certain area where the display element will be placed.

20 In an example embodiment of the invention there is provided an apparatus that comprises a base element, such as a printed circuit board or a printed wiring board, that comprises wiring for one or more electronic components and a film of blocking material. Additionally there is a display element comprising a transparent layer and electrodes configured to emit light through the transparent layer. The
25 display element is placed on top of the film of blocking material. That is, the display element faces the film of blocking material. The film of blocking material of the base element is configured to provide encapsulation structure for the transparent layer of the display element.

30 In an example embodiment the apparatus further comprises a display driver component and the base element comprises a cavity configured to receive the display driver component.

In another example embodiment the apparatus further comprises a display driver component and the base element comprises an aperture or a hole configured to receive the display driver component.

- 5 In an example embodiment the display element is a bottom emission organic light emitting diode display element.

In an example embodiment the transparent layer of the display element comprises a first surface and a second surface, and the electrodes of the display element
10 reside on a first surface of the transparent layer and are configured to emit light towards the second surface of the transparent layer. The first surface may be a bottom surface of the transparent layer and the second surface may be a top surface of the transparent layer.

- 15 In an example embodiment the apparatus further comprises a ring of sealing material that seals the base element and the film of blocking material to the transparent layer of the display element.

In an example embodiment the transparent layer is made of glass.
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In an example embodiment the transparent layer is made of plastic or some suitable polymer structure.

In an example embodiment the blocking film is a metal film.
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Figure 1 shows an apparatus according to an embodiment of the invention. The apparatus comprises a base element 101, which may be for example a printed circuit board (PCB). The base element can be called a printed wiring board (PWB), an etched wiring board, or a printed circuit assembly (PCA). In an example
30 embodiment the base element 101 comprises electronic circuits. The electronic circuits can be for example baseband circuits (especially in telecommunication devices) or other circuits. Additionally the apparatus comprises a display element 102, a battery 103, and a plurality of keys 104. It must be noted that this only one

example configuration and for example the battery 103 and the keys 104 are not mandatory. Instead of plurality of keys there may be only one key or no keys at all. Figure 2A shows a partial cross sectional view of an apparatus according to an embodiment of the invention. The apparatus may be the apparatus of Figure 1.

5

The apparatus comprises a base element 101 and a display element 102. The display element 102 is a bottom emission OLED (organic light emitting diode) display comprising a glass layer 205 and a plurality of transparent or semitransparent electrodes 206 in the bottom of the glass layer 206. The electrodes 206 are configured to emit light through the glass layer 206. The electrodes 206 may be for example thin film transistors (TFT) and there may a TFT for each pixel of the display element 102. It must be noted that instead of glass also some other transparent material, such as plastic or some suitable polymer structure, may be used in the display element 102. The display element 102 may be an active or passive matrix display.

Additionally the apparatus comprises a display driver component 207 and the base element 101 comprises a hole or an aperture 208 configured to receive the display driver component 207. The display driver component 207 is operatively coupled to the display element 102 through connections 209. Connections 210 connect the glass layer 205 (e.g. a display interface on top of the glass layer) to the base element 101. The connections 209 and 210 may be metal bumps or anisotropic conductive film (ACF) connections or other applicable connections.

In an example embodiment there is a cavity configured to receive the display driver component 207 instead of the hole 208.

Still further the base element 101 comprises a metal film 211 under the display element 102. The display element 102 is sealed to the metal film 211 with a sealing material 212. The structure comprises also a desiccant 213 placed between the metal film 211 and the display element 102. The desiccant 213 is configured for removal of moisture, oxygen and/or other harmful gases. One purpose of the sealing 212 is to make room for the desiccant 213. It must be noted

that it is not mandatory to have the desiccant 213.

5 The metal film 211 of the base element 101 forms an encapsulation structure for the display element 102. For a bottom emission OLED display such encapsulation structure can be placed on the non-viewing side of the display, i.e. on the back or bottom side of the display.

In an example embodiment a layer of some other well blocking material is used instead of the metal film 211. .

10 Figure 2B shows a partial cross sectional view of a base element 101 according to an embodiment of the invention. The base element 101 may be part of the apparatus of Figure 1 or Figure 2A.

15 The base element comprises a metal film 211 and wiring 215. The metal film has been etched away from areas 216 to form the desired wiring 215.

Figure 3 shows a top view of an apparatus according to an embodiment of the invention. The apparatus may be the apparatus of Figure 1. The apparatus comprises a base element 101 and a display element 102 on top of the base
20 element 101. Additionally the apparatus comprises a hole or cavity 308 (shown with dashed line) in the base element 101 under the display element 102. In an example embodiment, the cavity 308 is configured to receive a display driver component of the display element 102.

25 Figure 4A shows a rough flow diagram showing a method in accordance with an example embodiment of the invention.

In phase 401, a circuit board that includes an area of metal film or some other blocking material is provided. In phase 402, a display element such as an OLED
30 display element is provided. In phase 403, the display element is placed on top of the metal film of the circuit board. In phase 404, the metal film is sealed to the display element to provide encapsulation structure for the display. The sealing may be done using suitable sealing material.

In phase 405, electrical connections are formed between the circuit board and the display element. In an example embodiment, the electrical connections are formed concurrently with the sealing in phase 404. In an example embodiment, the electrical connections are formed using metal bumps. In another example embodiment the connections are formed using anisotropic conductive film (ACF) connections.

Figure 4B shows a rough flow diagram showing a method in accordance with another example embodiment of the invention.

In phase 401, a circuit board that includes an area of metal film or some other blocking material is provided. Additionally, the circuit board includes a cavity or a hole for receiving a display driver component. In phase 402, a display element such as an OLED display element is provided. The display element comprises a display driver component. In phase 403, the display element is placed on top of the metal film so that the display driver component is fitted into the cavity/hole of the circuit board. In phase 404, the metal film is sealed to the display element to provide encapsulation structure for the display. The sealing may be done using suitable sealing material.

In phase 405, electrical connections are formed between the circuit board and the display element. In an example embodiment, the electrical connections are formed concurrently with the sealing in phase 404. In an example embodiment, the electrical connections are formed using metal bumps. In another example embodiment the connections are formed using anisotropic conductive film (ACF) connections.

Herein it must be noted that it is not mandatory to perform all phases shown in Figures 4A and 4B.

In this way, one may produce for example the apparatuses of Figures 1-3. It must be noted that the method shown in Figures 4A and 4B may include further steps

that are not currently shown for the sake of clarity and conciseness.

Without in any way limiting the scope, interpretation, or application of the claims appearing below, certain technical effects of one or more of the example
5 embodiments disclosed herein are listed in the following: A technical effect is low cost structure. Display is one of the most expensive parts in many electronic device. In various embodiment of the invention mechanical structures of an electronic device are used as mechanical parts needed for a display structure, whereby it is possible to save space and cost.

10

The feature that electrical connections between the display element and the circuit board are formed concurrently with attaching the display element to the circuit board provides the technical effect that no separate display flex is needed for connecting the display element to the circuits of the circuit board. Another
15 technical effect is that no separate OLED encapsulation is needed since the mechanical structures already present in the base element are used to provide the encapsulation. Another technical effect is thin overall structure. In an example embodiment display element's thickness is about 0.4mm plus the thickness of a possibly needed polarizer component. A polarizer component can be used for
20 example with a Nokia Clear Black Display.

Various embodiments have been presented. It should be appreciated that in this document, words comprise, include and contain are each used as open-ended expressions with no intended exclusivity.

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The foregoing description has provided by way of non-limiting examples of particular implementations and embodiments of the invention a full and informative description of the best mode presently contemplated by the inventors for carrying out the invention. It is however clear to a person skilled in the art that the invention
30 is not restricted to details of the embodiments presented above, but that it can be implemented in other embodiments using equivalent means or in different combinations of embodiments without deviating from the characteristics of the invention.

If desired, the different functions discussed herein may be performed in a different order and/or concurrently with each other. Furthermore, if desired, one or more of the above-described functions may be optional.

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Furthermore, some of the features of the above-disclosed embodiments of this invention may be used to advantage without the corresponding use of other features. As such, the foregoing description shall be considered as merely illustrative of the principles of the present invention, and not in limitation thereof.

10 Hence, the scope of the invention is only restricted by the appended patent claims.

Claims:

1. An apparatus, comprising:
 - a base element comprising wiring for one or more electronic components
 - 5 and a film of blocking material,
 - a display element comprising a transparent layer and electrodes configured to emit light through the transparent layer,
 - wherein the display element faces the film of blocking material of the base element, and
 - 10 wherein the film of blocking material of the base element is configured to provide an encapsulation structure for the display element.
2. The apparatus of claim 1, wherein the apparatus further comprises a display driver component and the base element comprises a cavity configured to
- 15 receive the display driver component.
3. The apparatus of claim 1, wherein the apparatus further comprises a display driver component and the base element comprises an aperture configured to receive the display driver component.
- 20 4. The apparatus of any one of claims 1-3, wherein the base element is a printed circuit board.
5. The apparatus of any one of claims 1-4, wherein the display element is a
- 25 bottom emission organic light emitting diode display element.
6. The apparatus of any one of claims 1-5, wherein the transparent layer comprises a first surface and a second surface, and wherein the electrodes reside on a first surface of the transparent layer and are configured to emit light
- 30 towards the second surface of the transparent layer.
7. The apparatus of any one of claims 1-6, further comprising a ring of sealing material that seals the film of blocking material of the base element to the

transparent layer of the display element.

8. The apparatus of any one of claims 1-7, wherein the film of blocking material is a metal film.

5

9. The apparatus of any one of claims 1-8, wherein the transparent layer is made of glass.

10

10. The apparatus of any one of claims 1-8, wherein the transparent layer is made of plastic.

11. A method, comprising:

providing a base element comprising wiring for one or more electronic components and a film of blocking material,

15

placing a display element on top of the base element so that the display element faces the film of blocking material of the base element, the display element comprising a transparent layer and electrodes configured to emit light through the transparent layer,

20

wherein the film of blocking material of the base element provides an encapsulation structure for the display element.

12. The method of claim 11, further comprising

sealing the transparent layer of the display element to the film of blocking material of the base element.

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13. The method of claim 12, further comprising

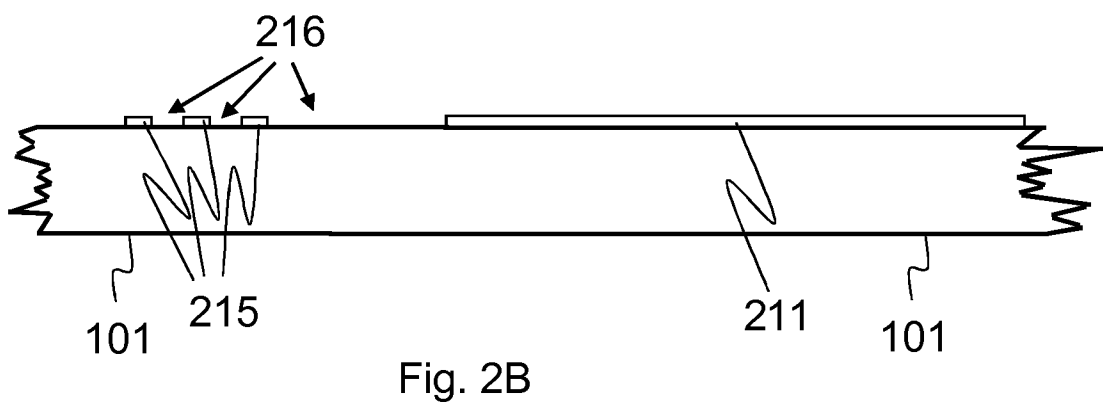
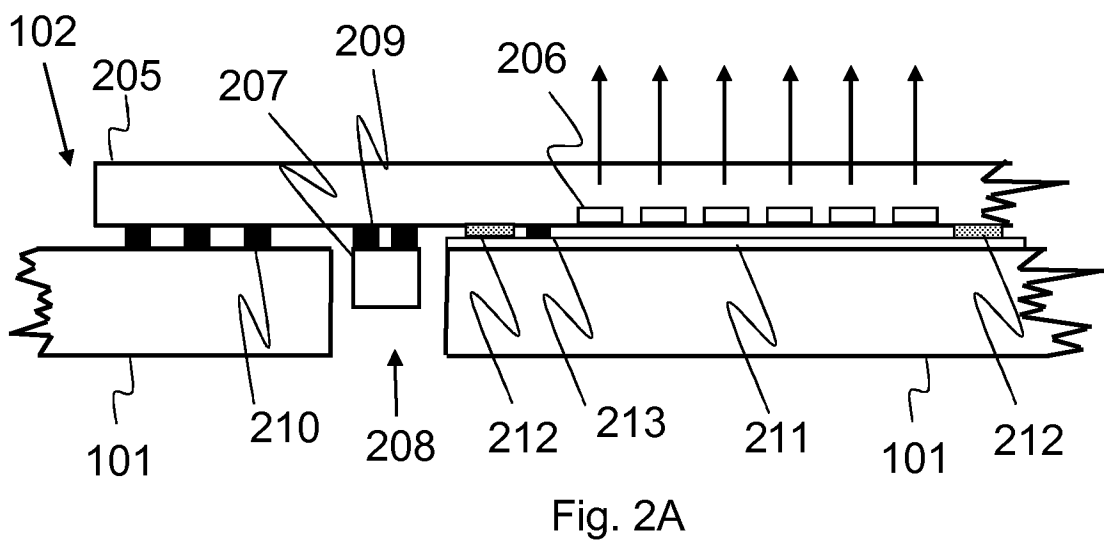
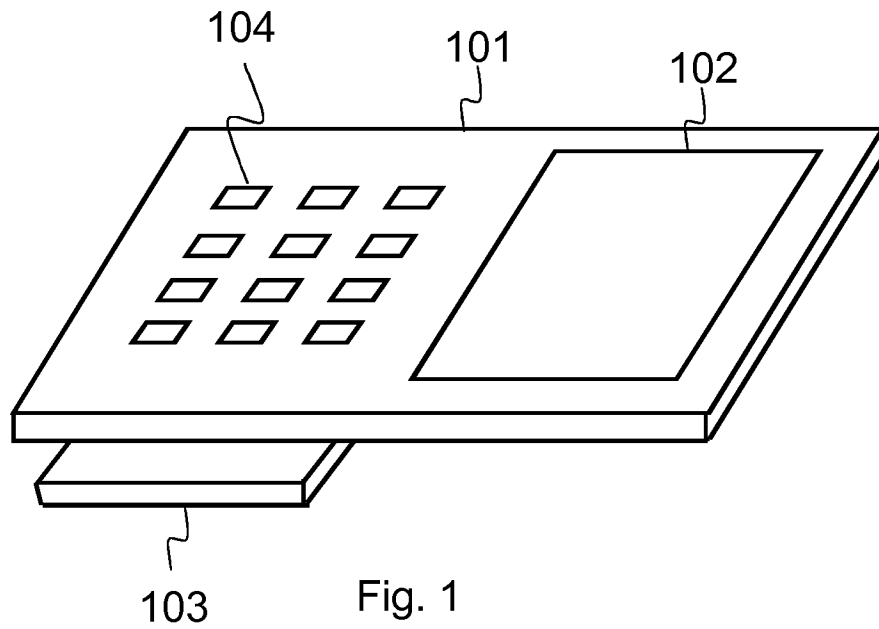
forming electrical connections between the display element and the wiring of the base element concurrently with the sealing.

30

14. The method of any one of claims 11-13, further comprising

fitting a display driver component of the display element into a cavity of the base element.

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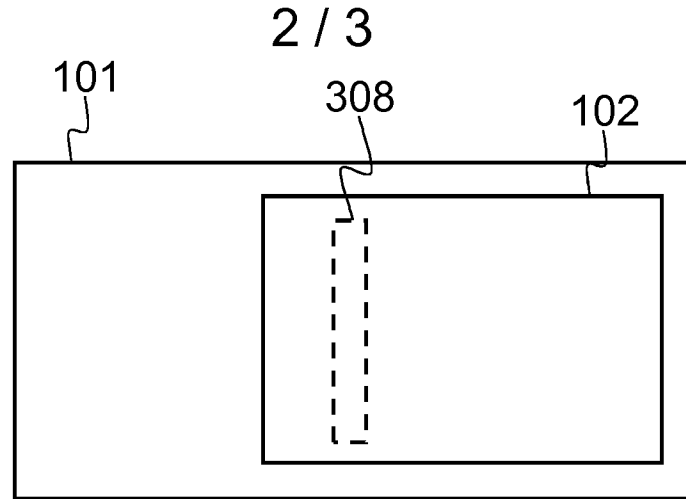


Fig. 3

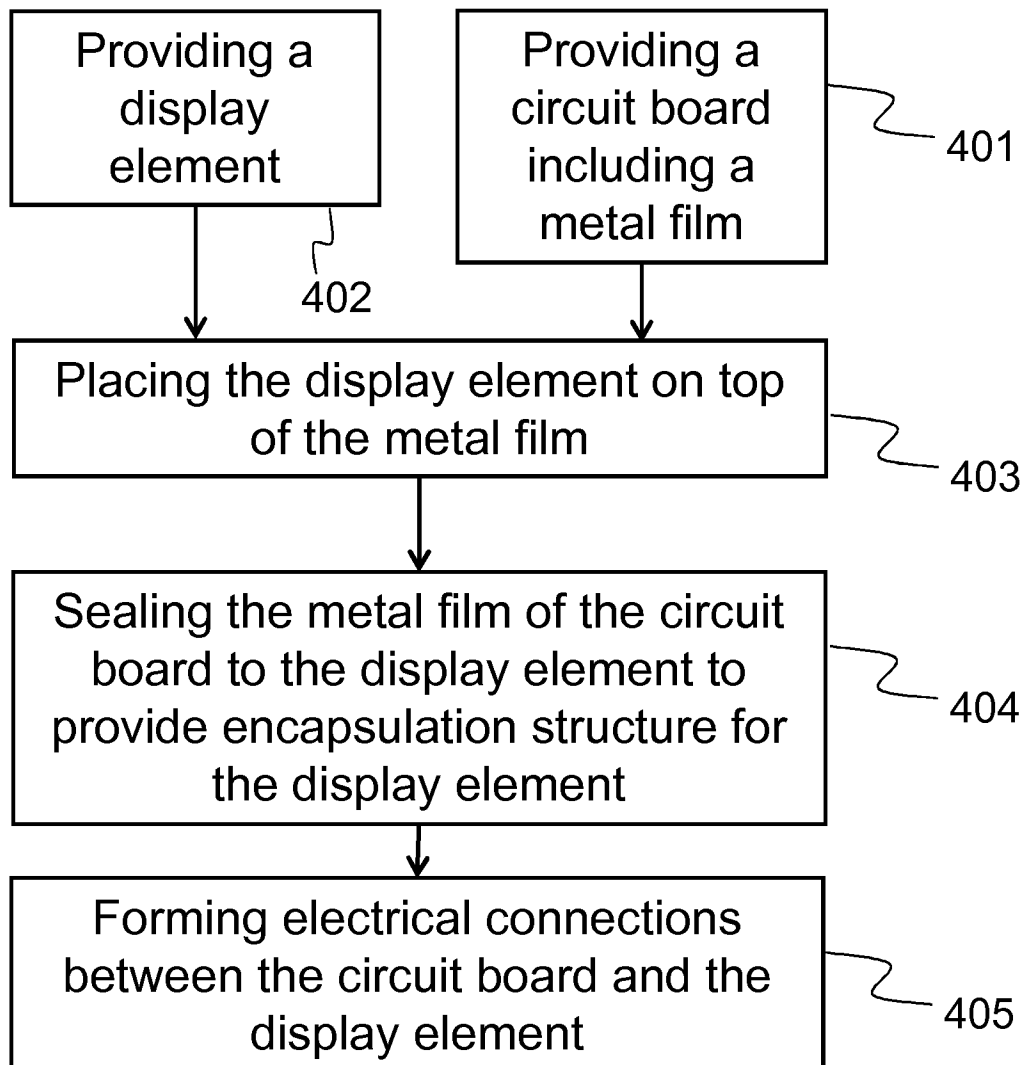


Fig. 4A

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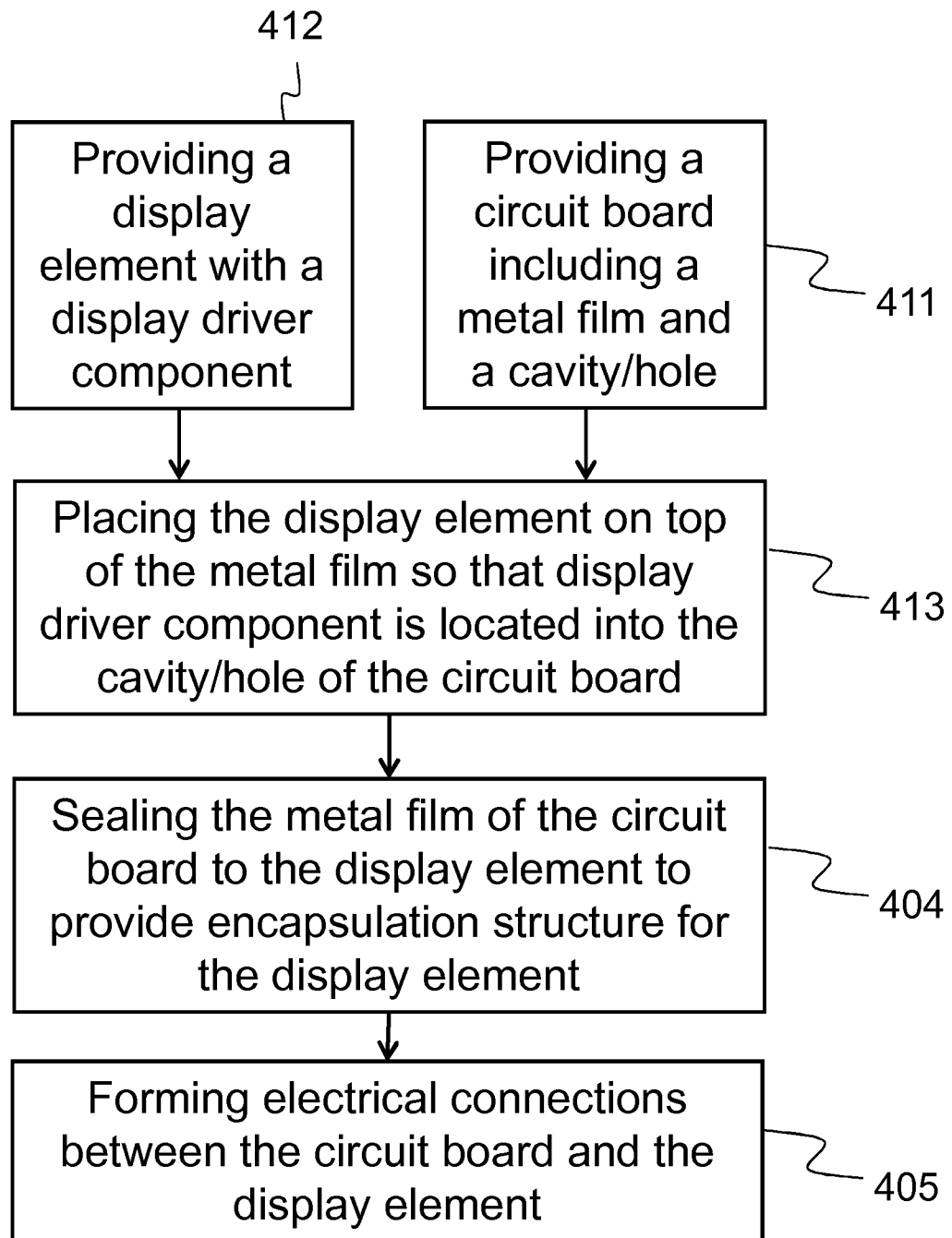


Fig. 4B

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI2011/050370

A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: G02F1, H05K1

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

FI, SE, NO, DK

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	EP 2133736 A1 (SUN RUNWEN) 16 December 2009 (16.12.2009) abstract, paragraphs [0002]-[0005], figure 1	1, 4 and 7-13
X	US 2006012745 A1 (KOBAYASHI SHINICHI et al.) 19 January 2006 (19.01.2006) abstract, paragraphs [0001]-[0005] and [0053]-[0058], figures 1 and 2	1, 4, 7 and 9-13
X	US 2009268147 A1 (TANG PAO-YUN et al.) 29 October 2009 (29.10.2009) abstract, paragraphs [0004]-[0005] and [0012]-[0014], figure 1	1, 4, 7 and 9-13
X	US 2009195485 A1 (MOON CHAN-KYOUNG et al.) 06 August 2009 (06.08.2009) abstract, paragraphs [0006] and [0025]-[0028], figure 1	1, 4-7 and 9-13

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International application No.

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0888036 A1 (SAMSUNG ELECTRONICS CO LTD) 30 December 1998 (30.12.1998) abstract, figure 3B	1-4, 7 and 9-14
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CLASSIFICATION OF SUBJECT MATTER

Int.Cl.

H05K 1/18 (2006.01)**G02F 1/1333** (2006.01)