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DISPLAY DEVICE AND ELECTRONIC APPARATUS

Abstract

A display device includes a first substrate, a second substrate, a vacuum layer, a first seal portion, a light-blocking layer, and a first translucent layer. The first substrate has a principal surface that is divided into a display area and a non-display area. The first seal portion surrounds the vacuum layer. The light-blocking layer is provided with a first opening facing the vacuum layer and a second opening facing the vacuum layer. The second opening is placed at a spacing from the first opening. The first translucent layer is disposed not to overlap the first opening but to overlap the second opening.

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Background/Summary

BACKGROUND

1. Field

[0001] The present disclosure relates to a display device and an electronic apparatus with a sufficiently ensured amount of transmitted light and a reduction in change in hue of the transmitted light.

2. Description of the Related Art

[0002] As an example of a liquid crystal display device that is a type of display device, a liquid crystal display device described in Japanese Unexamined Patent Application Publication No. 2019-184828 has conventionally been known. The liquid crystal display device described in Japanese Unexamined Patent Application Publication No. 2019-184828 allows light from a camera to be transmitted through part of a liquid crystal panel. The liquid crystal panel is configured such that a retardation in a liquid crystal layer in a camera light transmission area through which the light from the camera is transmitted is $R1=m\lambda$ (where m is a positive integer and λ is the wavelength of light that is transmitted through the liquid crystal layer). Further, a retardation in the liquid crystal layer in a camera light non-transmission area excluding the camera light transmission area is $R2=\lambda/2(2k+1)$ (where k is 0 and an integer).

[0003] According to Japanese Unexamined Patent Application Publication No. 2019-184828, in a case where polarized light from an outside source falls on the camera via the liquid crystal layer, an adverse effect on a camera image by birefringence of the light can be avoided. However, in the camera light transmission area, a pair of alignment films are placed in such a manner that the liquid crystal layer is sandwiched therebetween. For this reason, light traveling toward the camera is absorbed by the pair of alignment films when transmitted through the alignment films, and the tint of the alignment films is reflected in the hue of the transmitted light. As a result, the brightness and hue of an image that is taken by the camera might be different from what they are originally intended to be.

[0004] It is desirable to sufficiently ensure an amount of transmitted light and reduce a change in hue of the transmitted light.

SUMMARY

[0005] According to an aspect of the disclosure, there is provided a display device including a first substrate, a second substrate, a vacuum layer, a first seal portion, a light-blocking layer, and a first translucent layer. The first substrate has translucency and has a principal surface that is divided into a display area where an image is displayed and a non-display area where the image is not displayed. The second substrate has translucency, and is placed at a spacing from the first substrate. The vacuum layer is sandwiched between the first substrate and the second substrate and placed in part of the non-display area. The first seal portion is sandwiched between the first substrate and the second substrate, and surrounds the vacuum layer. The light-blocking layer is provided on a principal surface of the first substrate that faces toward the vacuum layer, placed in at least the non-display area, and configured to block light. The first translucent layer has translucency, is provided on a principal surface of at least either the first substrate or the second substrate that faces toward the vacuum layer, and is placed in part of the non-display area. The light-blocking layer is provided with a first opening facing the vacuum layer and a second opening facing the vacuum layer, and the second opening is placed at a spacing from the first opening. The first translucent layer is disposed not to overlap the first opening but to overlap the second opening.

[0006] According to an aspect of the disclosure, there is provided an electronic apparatus including the display device described above, an imaging element located opposite the first substrate behind the second substrate and disposed to overlap the first opening, and a light-receiving element or a light-emitting element located opposite the first substrate behind the second substrate and disposed to overlap the second opening.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. **1** is a plan view of an electronic apparatus according to Embodiment 1;

[0008] FIG. **2** is a cross-sectional view of the electronic apparatus according to Embodiment 1 as taken along line ii-ii in FIG. **1**;

[0009] FIG. **3** is a plan view showing a pixel array of a liquid crystal panel of a liquid crystal display device provided in the electronic apparatus according to Embodiment 1;

[0010] FIG. **4** is a cross-sectional view showing a cross-sectional configuration of a display area of the liquid crystal panel according to Embodiment 1;

[0011] FIG. **5** is a plan view showing a configuration of a portion of a non-display area of the liquid crystal panel according to Embodiment 1 that overlaps a vacuum layer;

[0012] FIG. **6** is a cross-sectional view of the liquid crystal panel according to Embodiment 1 as taken along line vi-vi in FIG. **5**;

[0013] FIG. **7** is a cross-sectional view of the liquid crystal panel according to Embodiment 1 as taken along line vii-vii in FIG. **5**;

[0014] FIG. **8** is a table showing experimental results of Comparative Experiment 1 according to Embodiment 1;

[0015] FIG. **9** is a plan view showing a configuration of a portion of a non-display area of a liquid crystal panel according to Embodiment 2 that overlaps a vacuum layer; and

[0016] FIG. **10** is a cross-sectional view of the liquid crystal panel according to Embodiment 2 as taken along line x-x in FIG. **9**.

DESCRIPTION OF THE EMBODIMENTS

Embodiment 1

[0017] Embodiment 1 is described with reference to FIGS. **1** to **8**. The present embodiment illustrates an electronic apparatus **1** including a liquid crystal display device **10**. Note that some of the drawings show an X axis, a Y axis, and a Z axis and are drawn so that the direction of each axis is an identical direction in each drawing. Further, FIGS. **2**, **4**, **6**, and **7** show front side up and back side down.

[0018] As shown in FIG. **1**, the electronic apparatus **1** includes a liquid crystal display device **10** formed in the shape of a horizontally long quadrangle, an imaging element **2**, a light-receiving element **3**, and a light-emitting element **4**. The imaging element **2**, the light-receiving element **3**, and the light-emitting element **4** are each placed at the back of (behind) the liquid crystal display device **10**. Specific examples of the electronic apparatus **1** include a tablet terminal, a laptop personal computer, and a smartphone. FIG. **1** uses dashed lines to illustrate the imaging element **2**, the light-receiving element **3**, and the light-emitting element **4**, which are placed at the back of the liquid crystal display device **10**.

[0019] As shown in FIGS. **1** and **2**, the liquid crystal display device **10** includes at least a liquid crystal panel (display device, display panel) **11** configured to display an image and a backlight device (lighting device) **12** serving as an outside light source configured to illuminate the liquid crystal panel **11** with light for use in display. The backlight device **12** is placed at the back of the liquid crystal panel **11**. The backlight device **12** includes a light source (such as an LED) configured to emit white light, an optical member configured to convert the light from the light source into planar light by imparting an optical effect to the light, or other components.

[0020] As shown in FIG. **1**, the liquid crystal panel **11** has a screen (principal surface) a central portion of which serves as a display area AA where an image is displayed. On the other hand, a frame-shaped outer peripheral portion of the screen of the liquid crystal panel **11** that surrounds the display area AA serves as a non-display area NAA where the image is not displayed. As shown in FIG. **2**, the liquid crystal panel **11** includes a pair substrates **20** and **21** bonded to each other. A front one of the two substrates **20** and **21** is a counter substrate (first substrate) **20**, and a back one of the two substrates **20** and **21** is an array substrate (second substrate) **21**. The counter substrate **20** and the array substrate **21** are each made of glass and include various types of films joined on top of each other on the inner surfaces of the substrates by using a known photolithographic process or other processes. Specifically, the counter substrate **20** and the array substrate **21** are made of an inorganic glass material that is substantially transparent and superior in translucency (such as alkali-free glass or quartz glass) and have a refractive index of, for example, approximately 1.5.

[0021] As shown in FIGS. **1** and **2**, while the counter substrate **20** has a short-side dimension that is shorter than a short-side dimension of the array substrate **21**, the counter substrate **20** is bonded to the array substrate **21** so that a first end of the counter substrate **20** in a short-side direction (Y-axis direction) is aligned with a first end of the array substrate **21** in the short-side direction. Accordingly, a second end of the array substrate **21** in the short-side direction serves as a protruding area (exposed area) **21**A protruding laterally with respect to the counter substrate **20** and not overlapping the counter substrate **20**. The protruding area **21**A is provided with drivers (signal supply units) **13** for the supply of various types of signals. The driver **13** is COG (chip on glass) mounted on the protruding area **21**A of the array substrate **21**. The drivers **13** are each composed of an LSI chip having a driving circuit inside and process various types of signals that are supplied from an outside source. Further, connected to the protruding area **21**A is a flexible substrate through which signals from an external signal supply source (such as a control substrate) are supplied to the drivers **13**.

[0022] Sandwiched between the two substrates **20** and **21** are a liquid crystal layer (medium layer) **22** containing liquid crystal molecules constituting a substance whose optical properties change in the presence of the application of an electric field and a vacuum layer **23** containing almost no air. The liquid crystal layer **22** is disposed to overlap the whole of the display area AA. The vacuum layer **23** is disposed to overlap part of the non-display area NAA. In particular, the vacuum layer **23** is disposed to overlap an end side portion of the non-display area NAA opposite (in FIG. **2**, right) the protruding area **21**A (drivers **13**) in the Y-axis direction and falls within a horizontally long range extending along the X-axis direction (see FIG. **1**). Sandwiched between the two substrates **20** and **21** is a first seal portion **24** surrounding the vacuum layer **23** (part of the non-display area NAA) and a second seal portion **25** surrounding the liquid crystal layer **22** (display area AA). The first seal portion **24** is formed in the shape of a long and thin horizontally long quadrangular frame (endless ring) in a plan view so as to surround the vacuum layer **23** and can keep the vacuum layer **23** under vacuum. The second seal portion **25** is formed in the shape of a horizontally long frame in a plan view so as to surround the liquid crystal layer **22** and can keep the liquid crystal layer **22** sealed. The first seal portion **24** and the second seal portion **25** are used in common as a portion located at a boundary between the display area AA and the non-display area NAA in the Y-axis direction (i.e. a portion that separates the liquid crystal layer **22** and the vacuum layer **23** from each other). Note that polarizing plates **14** are attached separately to each of the outer surfaces of the two substrates **20** and **21**.

[0023] As shown in FIG. **2**, the backlight device **12** is disposed to overlap the whole of the display area AA and part of the non-display area NAA (excluding the vacuum layer **23**) of the liquid crystal panel **11**. Meanwhile, the imaging element **2**, the light-receiving element **3**, and the light-emitting element **4** are disposed to overlap part of the non-display area NAA (vacuum layer **23**) of the liquid crystal panel **11**. That is, the imaging element **2**, the light-receiving element **3**, and the light-emitting element **4** are disposed to be adjacent to the backlight **12** in the Y-axis direction. The imaging element **2** can receive, through the liquid crystal panel **11**, light falling on the liquid crystal panel **11** from the front and take an image based on the light thus received. The light-receiving element **3** can receive, through the liquid crystal panel **11**, light falling on the liquid crystal panel **11** from the front. The light-receiving element **3** is, for example, an illuminance sensor configured to receive visible light or an infrared sensor or an infrared camera configured to receive infrared radiation. The light-emitting element **4** can emit light forward and can cause the light thus emitted to exit to an area outside the front of the liquid crystal panel **11** through the liquid crystal panel **11**. The light-emitting element **4** is, for example, an infrared LED configured to emit infrared radiation or an LED configured to emit visible light. Note that although FIG. **2** representatively illustrates the imaging element **2**, the light-receiving element **3** and the light-emitting element **4** are placed in the same manner as the imaging element **2**.

[0024] Next, a configuration of the display area AA of the liquid crystal panel **11** is described with reference to FIGS. **3** and **4**. On the inner surface of the array substrate **21** in the display area AA, as shown in FIG. **3**, a plurality of gate lines (scanning lines) **26** and a plurality of source lines (pixel lines) **27** are arranged in gridlike fashion. Near intersections of the gate lines **26** and the source lines **27**, TFTs (switching elements, thin-film transistors) **28** and pixel electrodes **29** are provided. The gate lines **26** extend substantially along the X-axis direction in such a manner as to cross the display area AA, and are each connected to gate electrodes **28**A of corresponding ones of the TFTs **28**. The plurality of gate lines **26** are placed at spacings from each other in the Y-axis direction. The source lines **27** extend substantially along the Y-axis direction in such a manner as to traverse the display area AA longitudinally, and are each connected to source electrodes **28**B of corresponding ones of the TFTs **28**. The plurality of source lines **27** are placed at spacings from each other in the X-axis direction. While the gate lines **26** and the source lines **27** intersect each other, the gate lines **26** and the source lines **27** are insulated from each other by an insulating film (gate insulating film **39**, which will be described later) sandwiched therebetween. The plurality of TFTs **28** and the plurality of pixel electrodes **29** are regularly arrayed along the X-axis direction and the Y-axis direction to be planarly arranged in a matrix (rows and columns). The pixel electrodes **29** are each connected to a drain electrode **28**C a corresponding one of the TFTs **28**. The pixel electrodes **29** are made of a transparent electrode material such as ITO (indium tin oxide). Each of the TFTs **28** has a semiconductor component **28**D in addition to the aforementioned gate electrode **28**A, the aforementioned source electrode **28**B, and the aforementioned drain electrode **28**C. The semiconductor component **28**D is made of a semiconductor material and connected to the source electrode **28**B and the drain electrode **28**C. Moreover, when driven in accordance with scanning signals that are supplied to the gate lines **26**, the TFTs **28** charge the pixel electrodes **29** to potentials based on image signals (data signals) that are supplied to the source lines **27**. Note that FIG. **4** illustrates the aforementioned gate lines **26**, the aforementioned source lines **27**, and the aforementioned TFTs **28** as a “pixel circuit unit **30**” in a simplistic form.

[0025] In the display area AA of the array substrate **21** of the liquid crystal panel **11**, as shown in FIG. **4**, the pixel circuit unit **30**, a planarizing film **31**, a common electrode **32**, a second interlayer insulating film **33**, the pixel electrodes **29**, and a first alignment film (alignment film) **34** are provided in this order from the bottom. Of these components, the common electrode **32** is made of a transparent electrode material as is the case with the pixel electrodes **29**. The common electrode **32** has a size about equal to that of the display area AA as a whole. The common electrode **32** is disposed to overlap all pixel electrodes **29** via the second interlayer insulating film **33**. The common electrode **32** is supplied with a common potential (reference potential). Accordingly, a potential difference based on the potentials charged to the pixel electrodes **29** is generated between the common electrode **32** and the pixel electrodes **29**. This potential difference can be used to control an alignment state of liquid crystal molecules contained in the liquid crystal layer **22**. The first alignment film **34** for aligning the liquid crystal molecules contained in the liquid crystal layer **22** is provided at a higher layer than the pixel electrodes **29** (i.e. at the innermost surface of the array substrate **21**). The first alignment film **34** is made of polyimide or other polymers and has a refractive index of, for example, approximately 1.6.

[0026] In the display area AA of the counter substrate **20** of the liquid crystal panel **11**, as shown in FIG. **4**, a large number of color filters **35** are provided in such positions as to overlap the pixel electrodes **29** of the array substrate **21**. The color filters **35** are arrayed in stripes as a whole such that three colors, namely red (R), green (G), and blue (B), are repeatedly and alternately arranged along the X-axis direction and those arrangements of colors extend along the Y-axis direction. Each color of color filter **35** faces a corresponding one of the pixel electrodes **29** of the array substrate **21**. In the display area AA of the counter substrate **20**, a black matrix **36** is provided so that a color mixture can be avoided by partitioning adjacent ones of the color filters **35** from each other. The black matrix **36** is made of a light-blocking material such as carbon black or a metal material and has a superior light blocking effect (light absorption properties). The black matrix **36** is located at a lower layer (i.e. closer to the counter substrate **20**) than the color filters **35**. The black matrix **36** is in such gridlike fashion as to overlap the gate lines **26** and the source lines **27**. A second alignment film (alignment film) **37** for aligning the liquid crystal molecules contained in the liquid crystal layer **22** is provided at a higher layer than space between the color filters **35** (i.e. at the innermost surface of the counter substrate **20**). As is the case with the first alignment film **34**, the second alignment film **37** is made of polyimide or other polymers and has a refractive index of, for example, approximately 1.6.

[0027] Next, a configuration of a portion of the non-display area NAA of the liquid crystal panel **11** that overlaps the vacuum layer **23** is described with reference to FIGS. **5** to **7**. On a principal surface of the counter substrate **20** that faces toward the vacuum layer **23** (i.e. inward), as shown in FIGS. **6** and **7**, a light-blocking layer **38** that blocks light is provided. The light-blocking layer **38** is substantially solidly placed over the whole area of the non-display area NAA of the principal surface of the counter substrate **20**. Blocking of light by the light-blocking layer **38** makes it hard to view from outside a structure that is present in the non-display area NAA of the liquid crystal panel **11**. The light-blocking layer **38** is made of the same light-blocking material as the black matrix **36** placed in the display area AA and is formed in an identical step in manufacturing the array substrate **21**. A portion of the light-blocking layer **38** that overlaps the vacuum layer **23** is provided with a first opening **38**A and a second opening **38**B. As shown in FIG. **5**, the first opening **38**A and the second opening **38**B are disposed to form a line along the X-axis direction, and are arrayed at a spacing from each other in the X-axis direction. As shown in FIGS. **5** and **6**, one first opening **38**A is provided in such a position as to overlap the imaging element **2**. The first opening **38**A is disposed to face the vacuum layer **23**. The first opening **38**A allows light falling on the counter substrate **20** from outside the front to enter the imaging element **2**. This allows the imaging element **2** to take an image. As shown in FIGS. **5** and **7**, a plurality of the second openings **38**B are provided in such positions as to overlap the light-receiving element **3** and the light-emitting element **4**, and are placed at spacings from the first opening **38**A in the X-axis direction. Although FIG. **7** representatively illustrates the light-receiving element **3**, the light-emitting element **4** is placed in the same manner as the light-receiving element **3**. Each of the second openings **38**B is disposed to face the vacuum layer **23**. The second opening **38**B that overlaps the light-receiving element **3** allows light falling on the counter substrate **20** from outside the front to enter the light-receiving element **3**. This allows the light-receiving element **3**, for example, to detect an amount of light. The second opening **38**B that overlaps the light-emitting element **4** allows light emitted from the light-emitting element **4** to exit to an area outside the front of the counter substrate **20**.

[0028] Let it be assumed below that as shown in FIGS. **5** to **7**, areas of the counter substrate **20** and the array substrate **21** that overlap the vacuum layer **23** (i.e. areas surrounded by the first seal portion **24**) include a first area A**1** serving as a range that overlaps the light-blocking layer **38**, a second area A**2** serving as a range that overlaps the first opening **38**A, and a third area A**3** serving as a range that overlaps the second opening **38**B.

[0029] Note here that as shown in FIGS. **6** and **7**, light (outside light) that is present on the front of the liquid crystal panel **11** is shone on the counter substrate **20** from a side opposite to the vacuum layer **23**. In a portion (i.e. the first area A**1**) of the counter substrate **20** that overlaps the light-blocking layer **38**, while a large portion of the light is transmitted through the counter substrate **20** and absorbed by the light-blocking layer **38**, a portion of the light is reflected off a pair of principal surfaces of the counter substrate **20** (i.e. a principal surface of the counter substrate **20** that faces toward the vacuum layer **23** and a principal surface of the counter substrate **20** that faces away from the vacuum layer **23**). On the other hand, in portions (i.e. the second area A**2** and the third area A**3**) of the counter substrate **20** that overlap the first opening **38**A and the second opening **38**B, while a large portion of the light is transmitted through the counter substrate **20** and enters the vacuum layer **23** through the first opening **38**A and the second opening **38**B, a portion of the light is reflected off the pair of principal surfaces of the counter substrate **20**. The light having entered the vacuum layer **23** is absorbed by the light-blocking layer **38** to some extent in the process of repeating reflection within the vacuum layer **23**. For this reason, the amount of light that exits from within the vacuum layer **23** through the first opening **38**A and the second opening **38**B toward the counter substrate **20** might become smaller than the amount of light that falls on the vacuum layer **23**. In particular, a decrease in the amount of light that exits through the second opening **38**B causes a difference in appearance between the portion (first area A**1**) of the counter substrate **20** that overlaps the light-blocking layer **38** and a portion (third area A**3**) of the counter substrate **20** that overlaps the second opening **38**B, and this difference may lead to deterioration in appearance.

[0030] At a principal surface of the array substrate **21** that faces toward the vacuum layer **23** (inward), as shown in FIGS. **6** and **7**, a gate insulating film **39** and a first interlayer insulating film **40** are provided in addition to the aforementioned planarizing film **31** and the aforementioned second interlayer insulating film **33**. The gate insulating film **39** is located closest to the array substrate **21**, and the first interlayer insulating film **40** is located between the gate insulating film **39** and the planarizing film **31**. Note that the gate insulating film **39** and the first interlayer insulating film **40** are also provided in the display area AA. The planarizing film **31** is selectively not formed in a range of the non-display area NAA that overlaps the vacuum layer **23**. That is, the planarizing film **31** is provided with a first groove portion **31**A that overlaps the vacuum layer **23**. As is the case with the vacuum layer **23**, the first groove portion **31**A is formed in a thin and long horizontally long range along the X-axis direction. Further, a portion of the planarizing film **31** that overlaps a portion of the first seal portion **24** (i.e. a portion of the first seal portion **24** that is not used in common) is provided with a plurality of second groove portions **31**B extending along a direction of extension of the first seal portion **24**. The second groove portions **31**B enhance the adhesion strength of the first seal portion **24**. Note that the second groove portions **31**B are also provided in a portion of the second seal portion **25** (i.e. a portion of the second seal portion **25** that is not used in common) in addition to the first seal portion **24**. The gate insulating film **39**, the first interlayer insulating film **40**, and the second interlayer insulating film **33** are selectively not formed in ranges of the non-display area NAA that overlap the first opening **38**A and the second opening **38**B of the light-blocking layer **38**. That is, the gate insulating film **39**, the first interlayer insulating film **40**, and the second interlayer insulating film **33** are provided with first holes H**1** that overlap the first opening **38**A and that communicate with one another and second holes H**2** that overlap the second opening **38**B and that communicate with one another.

[0031] On principal surfaces of the counter substrate **20** and the array substrate **21** of the liquid crystal panel **11** according to the present embodiment that face toward the vacuum layer **23**, as shown in FIGS. **5** to **7**, a first translucent layer **41** and a second translucent layer **42** each having translucency are provided in a range that overlaps a portion of the non-display area NAA when seen in a plan view. FIG. **5** illustrates the range of formation of the first translucent layer **41** and the second translucent layer **42** as a shaded area. The first translucent layer **41** and the second translucent layer **42** are formed in a range of the non-display area NAA surrounded by the first seal portion **24**, i.e. the range that overlaps the vacuum layer **23**, and are not formed in ranges that overlap the seal portions **24** and **25**.

[0032] Moreover, as shown in FIGS. **5** to **7**, the first translucent layer **41** is disposed not to overlap the first opening **38**A but to overlap the second opening **38**B. That is, the first translucent layer **41** is not formed in the range (i.e. the second area A**2**) that overlaps the first opening **38**A, and is formed in the range (i.e. the third area A**3**) that overlaps the second opening **38**B. The first translucent layer **41** includes a first translucent layer **41** provided to the counter substrate **20** and a first translucent layer **41** provided to the array substrate **21**. In the following, in a case where these first translucent layers **41** are distinguished from each other, the first translucent layer **41** provided to the counter substrate **20** is referred to as a "counter-side first translucent layer (first first translucent layer) **41**α", and the first translucent layer **41** provided to the array substrate **21** is referred to as an "array-side first translucent layer (second first translucent layer) **41**B". The first translucent layer **41** is made of the same material as the alignment films **34** and **37**. That is, the first translucent layer **41** is made of polyimide or other polymers and has a refractive index of, for example, approximately 1.6. The first translucent layer **41** is higher in refractive index than both the counter substrate **20** and the array substrate **21**.

[0033] Since the first translucent layer **41** is disposed not to overlap the first opening **38**A but to overlap the second opening **38**B, light that is shone from outside the front onto a portion (i.e. the second area A**2**) of the counter substrate **20** that overlaps the first opening **38**A is partially reflected off the pair of principal surfaces of the counter substrate **20** as shown in FIG. **6** without being directly reflected by a pair of principal surfaces of the first translucent layer **41** or being directly transmitted through the first translucent layer **41**. On the other hand, light that is shone from outside the front onto the portion (i.e. the third area A**3**) of the counter substrate **20** that overlaps the second opening **38**B is partially reflected off the pair of principal surfaces of the counter substrate **20** and reflected off the pair of principal surfaces of the first translucent layer **41** as shown in FIG. **7**. That is, the amount of light that exits from the portion (i.e. the third area A**3**) of the counter substrate **20** that overlaps the second opening **38**B toward the front (i.e. toward the side opposite to the vacuum layer **23**) is larger than the amount of light that exits from the portion (i.e. the second area A**2**) of the counter substrate **20** that overlaps the first opening **38**A toward the front. Accordingly, even if the amount of light that exits through the second opening **38**B decreases because light having entered the vacuum layer **23** through the second opening **38**B is absorbed by the light-blocking layer **38** in the process of repeating reflection within the vacuum layer **23**, the amount of light that exits from the portion (i.e. the third area A**3**) of the counter substrate **20** that overlaps the second opening **38**B toward the front can be brought close to the amount of light that exits from the portion (i.e. the first area A**1**) of the counter substrate **20** that overlaps the light-blocking layer **38** toward the front. This reduces the possibility of a difference between an appearance that is produced by the light traveling from the portion (i.e. the first area A**1**) of the counter substrate **20** that overlaps the light-blocking layer **38** toward the front and an appearance that is produced by the light traveling from the portion (i.e. the third area A**3**) of the counter substrate **20** that overlaps the second opening **38**B toward the front. That is, this makes it hard for the second opening **38**B to be visually recognized a structure that is present in the non-display area NAA. Both the light-receiving element **3** and the light-emitting element **4** are affected by reflection and absorption of light by the first translucent layer **41**, as light passing through the second opening **38**B is transmitted through the first translucent layer **41**; however, the optical performance of the light-receiving element **3** and the light-emitting element **4** is less adversely affected than that of the imaging element **2**.

[0034] Meanwhile, as shown in FIG. **6**, light having entered the vacuum layer **23** and traveling toward a portion (i.e. the second area A**2**) of the array substrate **21** that overlaps the first opening **38**A is hardly affected by reflection or absorption of light by the first translucent layer **41**. Accordingly, the amount of light that is transmitted through the portion (i.e. the second area A**2**) of the array substrate **21** that overlaps the first opening **38**A becomes larger than the amount of light that is transmitted through a portion (i.e. the third area A**3**) of the array substrate **21** that overlaps the second opening **38**B, and a change in hue is reduced. As a result of this, the brightness and hue of an image that is taken by the imaging element **2**, which is placed opposite the vacuum layer **23** behind the array substrate **21** so as to overlap the first opening **38**A, can be brought close to what they are originally intended to be. Moreover, since the first translucent layer **41** is disposed not to overlap the first opening **38**A but to overlap the second opening **38**B, the light-receiving element **3** and the light-emitting element **4** are hardly seen from outside, whereas the imaging element **2** is daringly easily seen from outside. This brings about improvement in appearance of the electronic apparatus **1**.

[0035] Further, since, as shown in FIG. **7**, the counter substrate **20** and the array substrate **21** are each provided with the aforementioned first translucent layer **41**, the light that is shone from outside the front onto the portion (i.e. the third area A**3**) of the counter substrate **20** that overlaps the second opening **38**B is partially reflected off a pair of principal surfaces of the counter-side first translucent layer **41**α provided to the counter substrate **20** and reflected of a pair of principal surfaces of the array-side first translucent layer **418** provided to the array substrate **21**. This makes it possible to further increase the amount of light that exits from the portion (i.e. the third area A**3**) of the counter substrate **20** that overlaps the second opening **38**B toward the front. This further reduces the possibility of a difference between an appearance that is produced by the light traveling from the portion (i.e. the first area A**1**) of the counter substrate **20** that overlaps the light-blocking layer **38** toward the front and an appearance that is produced by the light traveling from the portion (i.e. the third area A**3**) of the counter substrate **20** that overlaps the second opening **38**B toward the front.

[0036] Further, the refractive index (approximately 1.6) of the first translucent layer **41** is higher than both the refractive indices (approximately 1.5) of the counter substrate **20** and the array substrate **21**. In this way, a reflectance of reflected light that is produced at an interface between the first translucent layer **41** and the vacuum layer **23** is higher than a reflectance of reflected light that is produced at an interface between the counter substrate **20** or the array substrate **21** and the vacuum layer **23** if the first translucent layer **41** is not formed. This makes it possible to further increase the amount of light that exits from the portion (i.e. the third area A**3**) of the counter substrate **20** that overlaps the second opening **38**B toward the front, thus further reducing the possibility of a difference between an appearance that is produced by the light traveling from the portion (i.e. the first area A**1**) of the counter substrate **20** that overlaps the light-blocking layer **38** toward the front and an appearance that is produced by the light traveling from the portion (i.e. the third area A**3**) of the counter substrate **20** that overlaps the second opening **38**B toward the front. Further, since the first translucent layer **41** is made of the same material as the alignment films **34** and **37**, the material of the first translucent layer **41** can be applied with no need for a photolithographic step during manufacture. Specifically, for example, using an inkjet device or other devices enables pinpoint application of the material of the first translucent layer **41** to the range surrounded by the first seal portion **24**. This makes it possible to easily form the first translucent layer **41**.

[0037] As shown in FIGS. **5** to **7**, the second translucent layer **42** is disposed not to overlap the first opening **38**A or the second opening **38**B but to overlap the light-blocking layer **38**. That is, the second translucent layer **42** is not formed in the ranges (i.e. the second area A**2** and the third area A**3**) that overlap the first opening **38**A and the second opening **38**B, and is formed in the range (i.e. the first area A**1**) that overlaps the light-blocking layer **38**. The second translucent layer **42** includes a second translucent layer **42** provided to the counter substrate **20** and a second translucent layer **42** provided to the array substrate **21**. In the following, in a case where these second translucent layers **42** are distinguished from each other, the second translucent layer **42** provided to the counter substrate **20** is referred to as a “counter-side second translucent layer (first second translucent layer) **42**α”, and the second translucent layer **42** provided to the array substrate **21** is referred to as an “array-side second translucent layer (second second translucent layer) **42**B”. The second translucent layer **42** is made of the same material as the alignment films **34** and **37** and the first translucent layer **41**. That is, the second translucent layer **42** is made of polyimide or other polymers and has a refractive index of, for example, approximately 1.6. The second translucent layer **42** is higher in refractive index than both the counter substrate **20** and the array substrate **21**.

[0038] Since the second translucent layer **42** is disposed not to overlap the first opening **38**A or the second opening **38**B but to overlap the light-blocking layer **38**, a large portion of light shone from the front onto the portions (i.e. the third area A**3**) of the counter substrate **20** that overlap the first opening **38**A and the second opening **38**B is transmitted through the counter substrate **20**, enters the vacuum layer **23** through the first opening **38**A and the second opening **38**B, and is then reflected off a principal surface of the second translucent layer **42** that overlaps the light-blocking layer **38** within the vacuum layer **23**. This inhibits the absorption of light by the light-blocking layer **38** within the vacuum layer **23**, thus making it possible to increase the amount of light that exits from within the vacuum layer **23** through the first opening **38**A and the second opening **38**B toward the front (i.e. toward the counter substrate **20**).

[0039] Further, since, as shown in FIGS. **6** and **7**, the aforementioned second translucent layer **42** is provided to the counter substrate **20**, the second translucent layer **42** is placed such that the light-blocking layer **38** is sandwiched between the counter substrate **20** and the second translucent layer **42**. Reflection by the principal surface of the second translucent layer **42** of light traveling toward the light-blocking layer **38** within the vacuum layer **23** makes it possible to effectively inhibit the absorption of the light by the light-blocking layer **38**. This makes it possible to further increase the amount of light that exits from within the vacuum layer **23** through the first opening **38**A and the second opening **38**B toward the front. Moreover, since the counter substrate **20** and the array substrate **21** are each provided with the second translucent layer **42**, the light traveling toward the light-blocking layer **38** within the vacuum layer **23** is reflected by a principal surface of the counter-side second translucent layer **42**α provided to the counter substrate **20**. This makes it possible to effectively inhibit the absorption of the light by the light-blocking layer **38**. Meanwhile, light traveling toward the array substrate **21** within the vacuum layer **23** is reflected by a principal surface of the array-side second translucent layer **42** provided to the array substrate **21**. This makes it possible to direct the light toward the second translucent layer **42** provided to the counter substrate **20** or direct the light toward the first opening **38**A and the second opening **38**B. This makes it possible to further increase the amount of light that exits from within the vacuum layer **23** through the first opening **38**A and the second opening **38**B toward the front.

[0040] Further, as shown in FIGS. **5** to **7**, the aforementioned second translucent layer **42** is not formed around the first opening **38**A but formed around the second opening **38**B. That is, the second translucent layer **42** is not formed in the whole of the first area A**1** of both substrates **20** and **21** that overlaps the light-blocking layer **38** and is selectively not formed in an annular region that surrounds the first opening **38**A. Accordingly, around the first opening **38**A within the vacuum layer **23**, light is not reflected by the second translucent layer **42**, nor is light transmitted through the second translucent layer **42**. As a result of this, light having entered the vacuum layer **23** and traveling toward the portion (i.e. the second area A**2**) of the array substrate **21** that overlaps the first opening **38**A is hardly affected by reflection or absorption of light by the second translucent layer **42**; therefore, the amount of light that is transmitted through the portion (i.e. the second area A**2**) of the array substrate **21** that overlaps the first opening **38**A is sufficiently ensured, and a hue is secured.

[0041] Next, the following Comparative Experiment 1 was conducted to confirm superiority of the liquid crystal panel **11** according to the present embodiment. In Comparative Experiment 1, the brightness of reflected light produced when outside light was shone from outside the front onto each of the liquid crystal panels according to the following Examples 1 to 4 and Comparative Examples 1 to 3 was found, and the quality of appearance was determined. Examples 1 to 4 are liquid crystal panels **11** configured as described up to this paragraph. Examples 1 and 2 differ in light-blocking material of the light-blocking layers **38** and material of the color filters **35** from Examples 3 and 4. Examples 3 and 4 differ in firing temperature at which the color filters **35** are fired in manufacturing the counter substrates **20**. Comparative Examples 1 to 3 differ in configuration from the liquid crystal panel **11** described up to this paragraph in that they do not include a first translucent layer **41** or a second translucent layer **42**. Comparative Examples 1 to 3 differ in production lot. In Comparative Experiment 1, outside light was shone from outside the front onto each of the liquid crystal panels **11** according to Examples 1 to 4 and Comparative Examples 1 to 3, and light reflected by each liquid crystal panel and traveling toward the front as detected with a predetermined measuring device, and Y values (luminous reflectances: in “%”) were measured as indices of brightness in the first area A**1** and the third area A**3**. In Comparative Experiment 1, the measuring device used was a spectrophotometric colorimeter “CM-700d” manufactured by KONICA MINOLTA, INC. In Comparative Experiment 1, a difference in Y value was calculated by subtracting the Y value of the first area A**1** from the Y value of the third area A**3** thus measured. Furthermore, a sensory evaluation for determining the quality of appearance was made by shining outside light from outside the front onto each of the liquid crystal panels **11** according to Examples 1 to 4 and Comparative Examples 1 to 3 and letting an inspector visually inspect the first area A**1**, the third area A**3**, and the areas therearound. In this sensory evaluation, in a case where a boundary between the first area A**1** and the third area A**3** (i.e. the shape of an opening edge of the second opening **38**B) is visually recognized, it is determined that the “appearance is poor (POOR)”, and in a case where the boundary between the first area A**1** and the third area A**3** is substantially not visually recognized, it is determined that the “appearance is good (GOOD)”. Experimental results of Comparative Experiment 1 are shown in FIG. **8**. FIG. **8** is a table showing, for each of Examples 1 to 4 and Comparative Examples 1 to 3, the result of a determination as to the quality of appearance, the Y values of the first areas A**1** and the third area A**3**, and a difference in Y value calculated by subtracting the Y value of the first area A**1** from the Y value of the third area A**3**. FIG. **8** uses the word “GOOD” for a case where the result of a determination as to the quality of appearance was good, and uses the word “POOR” for a case where the result of a determination as to the quality of appearance was poor.

[0042] The experimental results of Comparative Experiment 1 are explained. According to FIG. **8**, regarding the results of the determinations as to the quality of appearance, Examples 1 to 4 were all good in appearance, whereas Comparative Examples 1 to 3 were all poor in appearance. Regarding the Y values, in each of Comparative Examples 1 to 3, the Y value of the third area A**3** is much smaller than the Y value of the first area A**1**, and the absolute value of a difference therebetween is at minimum “0.68” and at maximum “0.76”. A presumable reason why the Y value of the third area A**3** is much smaller than the Y value of the first area A**1** in each of Comparative Examples 1 to 3 is that light having entered the vacuum layer **23** through the second opening **38**B of the light-blocking layer **38** was absorbed by the light-blocking layer **38** in the process of being reflected within the vacuum layer **23** and, as a result, the amount of light that exited to an area outside the front through the second opening **38**B decreased. On the other hand, in each of Examples 1 to 4, the Y value of the third area A**3** is close to the Y value of the first area A**1**, and the absolute value of a difference therebetween is at minimum “0.03” and at maximum “0.16”. A presumable reason why the Y value of the third area A**3** is close to the Y value of the first area A**1** in each of Examples 1 to 4 is that reflection by the pair of principal surfaces of the first translucent layer **41** of light traveling from outside the front toward the second opening **38**B of the light-blocking layer **38** and reflection by the principal surface of the second translucent layer **42** of light having entered the vacuum layer **23** inhibit the absorption of light by the light-blocking layer **38**, thereby sufficiently ensuring the amount of light that exits to an area outside the front through the second opening **38**B. As noted above, the absolute values of the differences in Y value in Examples 1 to 4 are much lower than, i.e. are less than a quarter of, the absolute values of the differences in Y value in Comparative Examples 1 to 3. This means that in each of Examples 1 to 4, the first area A**1** and the third area A**3** are so close in brightness, i.e. in appearance, to each other that it becomes hard to visually recognize the boundary between the first area A**1** and the third area A**3**, and does not contradict the result of a determination as to the quality of appearance.

[0043] As described above, a liquid crystal panel (display device) **11** of the present embodiment includes a counter substrate (first substrate) **20**, an array substrate (second substrate) **21**, a vacuum layer **23**, a first seal portion **24**, a light-blocking layer **38**, and a first translucent layer **41**. The counter substrate **20** has translucency and has a principal surface that is divided into a display area AA where an image is displayed and a non-display area NAA where the image is not displayed. The array substrate **21** has translucency, and is placed at a spacing from the counter substrate **20**. The vacuum layer **23** is sandwiched between the counter substrate **20** and the array substrate **21** and placed in part of the non-display area NAA. The first seal portion **24** is sandwiched between the counter substrate **20** and the array substrate **21**, and surrounds the vacuum layer **23**. The light-blocking layer **38** is provided on a principal surface of the counter substrate **20** that faces toward the vacuum layer **23**, placed in at least the non-display area NAA, and configured to block light. The first translucent layer **41** has translucency, is provided on a principal surface of at least either the counter substrate **20** or the array substrate **21** that faces toward the vacuum layer **23**, and is placed in part of the non-display area NAA. The light-blocking layer **38** is provided with a first opening **38**A facing the vacuum layer **23** and a second opening **38**B facing the vacuum layer **23**. The second opening **38**B is placed at a spacing from the first opening **38**A. The first translucent layer **41** is disposed not to overlap the first opening **38**A but to overlap the second opening **38**B.
[0044] By surrounding the vacuum layer **23** placed in part of the non-display area NAA, the first seal portion **24** sandwiched between the counter substrate **20** and the array substrate **21** keeps the vacuum layer **23** under vacuum. In a portion of the counter substrate **20** that overlaps the light-blocking layer **38**, while a large portion of light shone on the counter substrate **20** from the side opposite to the vacuum layer **23** is transmitted through the counter substrate **20** and absorbed by the light-blocking layer **38**, a portion of the light is reflected off a pair of principal surfaces of the counter substrate **20**. On the other hand, in portions of the counter substrate **20** that overlap the first opening **38**A and the second opening **38**B, while a large portion of the light is transmitted through the counter substrate **20** and enters the vacuum layer **23** through the first opening **38**A and the second opening **38**B, a portion of the light is reflected off the pair of principal surfaces of the counter substrate **20**. The light having entered the vacuum layer **23** is absorbed by the light-blocking layer **38** to some extent in the process of repeating reflection within the vacuum layer **23**. For this reason, the amount of light that exits from within the vacuum layer **23** through the first opening **38**A and the second opening **38**B toward the counter substrate **20** becomes smaller than the amount of light that falls on the vacuum layer **23**.
[0045] Note here that the first translucent layer **41** provided on the principal surface of at least either the counter substrate **20** or the array substrate **21** that faces toward the vacuum layer **23** is disposed not to overlap the first opening **38**A but to overlap the second opening **38**B. Accordingly, light that is shone on a portion of the counter substrate **20** that overlaps the first opening **38**A is partially reflected off the pair of principal surfaces of the counter substrate **20** without being directly reflected by a pair of principal surfaces of the first translucent layer **41** or being directly transmitted through the first translucent layer **41**. On the other hand, light that is shone on a portion of the counter substrate **20** that overlaps the second opening **38**B is partially reflected off the pair of principal surfaces of the counter substrate **20** and reflected off the pair of principal surfaces of the first translucent layer **41**. That is, the amount of light that exits from the portion of the counter substrate **20** that overlaps the second opening **38**B toward the side opposite to the vacuum layer **23** is larger than the amount of light that exits from the portion of the counter substrate **20** that overlaps the first opening **38**A toward the side opposite to the vacuum layer **23**. Accordingly, even if the amount of light that exits through the second opening **38**B decreases because light having entered the vacuum layer **23** through the second opening **38**B is absorbed by the light-blocking layer **38** in the process of repeating reflection within the vacuum layer **23**, the amount of light that exits from the portion of the counter substrate **20** that overlaps the second opening **38**B toward the side opposite to the vacuum layer **23** can be brought close to the amount of light that exits from the

portion of the counter substrate **20** that overlaps the light-blocking layer **38** toward the side opposite to the vacuum layer **23**. This reduces the possibility of a difference in appearance between the portion of the counter substrate **20** that overlaps the light-blocking layer **38** and the portion of the counter substrate **20** that overlaps the second opening **38**B. Meanwhile, light having entered the vacuum layer **23** and traveling toward a portion of the array substrate **21** that overlaps the first opening **38**A is hardly affected by reflection or absorption of light by the first translucent layer **41**. Accordingly, the amount of light that is transmitted through the portion of the array substrate **21** that overlaps the first opening **38**A becomes larger than the amount of light that is transmitted through a portion of the array substrate **21** that overlaps the second opening **38**B, and a change in hue is reduced. As a result of this, in a case where the imaging element **2** is placed opposite the vacuum layer **23** behind the array substrate **21**, the brightness and hue of an image that is taken by the imaging element **2** can be brought close to what they are originally intended to be. The present embodiment makes it possible to sufficiently ensure an amount of transmitted light and reduce a change in hue of the transmitted light.

[0046] Further, the counter substrate **20** and the array substrate **21** are each provided with the first translucent layer **41**. Light that is shone on the portion of the counter substrate **20** that overlaps the second opening **38**B is partially reflected off the pair of principal surfaces of the first translucent layer **41** provided to the counter substrate **20** and reflected off the pair of principal surfaces of the first translucent layer **41** provided to the array substrate **21**. This makes it possible to further increase the amount of light that exits from the portion of the counter substrate **20** that overlaps the second opening **38**B toward the side opposite to the vacuum layer **23**, thus further reducing the possibility of a difference in appearance between the portion of the counter substrate **20** that overlaps the light-blocking layer **38** and the portion of the counter substrate **20** that overlaps the second opening **38**B.

[0047] Further, the first translucent layer **41** is higher in refractive index than one of the counter and array substrates **20** and **21** that is provided with the first translucent layer **41**. A reflectance of reflected light that is produced at an interface between the first translucent layer **41** and the vacuum layer **23** is higher than a reflectance of reflected light that is produced at an interface between the counter substrate **20** or the array substrate **21** and the vacuum layer **23** if the first translucent layer **41** is not formed. This makes it possible to further increase the amount of light that exits from the portion of the counter substrate **20** that overlaps the second opening **38**B toward the side opposite to the vacuum layer **23**, thus further reducing the possibility of a difference in appearance between the portion of the counter substrate **20** that overlaps the light-blocking layer **38** and the portion of the counter substrate **20** that overlaps the second opening **38**B.

[0048] Further, the liquid crystal panel **11** further includes a pair of alignment films **34** and **37** provided on principal surfaces of the counter and array substrates **20** and **21** that face toward the vacuum layer **23** and placed in the display area AA, and the first translucent layer **41** is made of a material that is identical to that of the alignment films **34** and **37**. In general, the material of the alignment films **34** and **37** is higher in refractive index than the counter substrate **20** and the array substrate **21**. Further, since the first translucent layer **41** is made of the same material as the alignment films **34** and **37**, the first translucent layer **41** can be easily formed by applying the material of the first translucent layer **41** with no need for a photolithographic step during manufacture.

[0049] Further, the liquid crystal panel **11** further includes a second translucent layer **42** having translucency. The second translucent layer **42** is provided on a principal surface of at least either the counter substrate **20** or the array substrate **21** that faces toward the vacuum layer **23** and placed in part of the non-display area NAA. The second translucent layer **42** is disposed not to overlap the first opening **38**A or the second opening **38**B but to overlap the light-blocking layer **38**. A large portion of light shone from the side opposite to the vacuum layer **23** onto the portions of the counter substrate **20** that overlap the first opening **38**A and the second opening **38**B is transmitted through the counter substrate **20**, enters the vacuum layer **23** through the first opening **38**A and the second opening **38**B, and is then reflected off a principal surface of the second translucent layer **42** that overlaps the light-blocking layer **38** within the vacuum layer **23**. This inhibits the absorption of light by the light-blocking layer **38**, thus making it possible to increase the amount of light that exits from within the vacuum layer **23** through the first opening **38**A and the second opening **38**B toward the counter substrate **20**.

[0050] Further, at least the counter substrate **20** is provided with the second translucent layer **42**. In this way, the second translucent layer **42** is placed such that the light-blocking layer **38** is sandwiched between the counter substrate **20** and the second translucent layer **42**. Reflection by the principal surface of the second translucent layer **42** of light traveling toward the light-blocking layer **38** within the vacuum layer **23** makes it possible to effectively inhibit the absorption of the light by the light-blocking layer **38**. This makes it possible to further increase the amount of light that exits from within the vacuum layer **23** through the first opening **38**A and the second opening **38**B toward the counter substrate **20**.

[0051] Further, the counter substrate **20** and the array substrate **21** are each provided with the second translucent layer **42**. The light traveling toward the light-blocking layer **38** within the vacuum layer **23** is reflected by a principal surface of the second translucent layer **42** provided to the counter substrate **20**. This makes it possible to effectively inhibit the absorption of the light by the light-blocking layer **38**. Meanwhile, light traveling toward the array substrate **21** within the vacuum layer **23** is reflected by a principal surface of the second translucent layer **42** provided to the array substrate **21**. This makes it possible to direct the light toward the second translucent layer **42** provided to the counter substrate **20** or direct the light toward the first opening **38**A and the second opening **38**B. This makes it possible to further increase the amount of light that exits from within the vacuum layer **23** through the first opening **38**A and the second opening **38**B toward the counter substrate **20**.

[0052] Further, the second translucent layer **42** is not formed around the first opening **38**A but formed around the second opening **38**B. Around the first opening **38**A within the vacuum layer **23**, light is not reflected by the second translucent layer **42**, nor is light transmitted through the second translucent layer **42**. As a result of this, light having entered the vacuum layer **23** and traveling toward the portion of the array substrate **21** that overlaps the first opening **38**A is hardly affected by reflection or absorption of light by the second translucent layer **42**; therefore, the amount of light that is transmitted through the portion of the array substrate **21** that overlaps the first opening **38**A is sufficiently ensured, and a hue is secured.

[0053] Further, the liquid crystal panel **11** further includes a second seal portion **25** and a liquid crystal layer **22**. The second seal portion **25** is sandwiched between the counter substrate **20** and the array substrate **21**, and surrounds the display area AA. The liquid crystal layer **22** is sandwiched between the counter substrate **20** and the array substrate **21** and surrounded by the second seal portion **25**. An image can be displayed in the display area AA by controlling an alignment state of liquid crystal molecules contained in the liquid crystal layer **22**. The liquid crystal layer **22** is sealed by being surrounded by the second seal portion **25** and avoids leaking out toward the vacuum layer **23** surrounded by the first seal portion **24**. Light introduced through the first opening **38**A and the second opening **38**B better avoids being affected by birefringence caused by the liquid crystal layer **22** than if the liquid crystal layer **22** is formed in the vacuum layer **23**.

[0054] Further, an electronic apparatus **1** according to the present embodiment includes the liquid crystal panel **11** described above, an imaging element **2** located opposite the counter substrate **20** behind the array substrate **21** and disposed to overlap the first opening **38**A, and a light-receiving element **3** or a light-emitting element **4** located opposite the counter substrate **20** behind the array substrate **21** and disposed to overlap the second opening **38**B. The imaging element **2** takes an image by utilizing light that is transmitted through the portion of the array substrate **21** that overlaps the first opening **38**A. Since the light that is transmitted through the portion of the array substrate **21** that overlaps the first opening **38**A is hardly affected by absorption or reflection of light by the first translucent layer **41**, the amount of light that is received by the imaging element **2** is sufficiently ensured, and a change in hue of the light is reduced. As a result of this, the brightness and hue of an image that is taken by the imaging element **2** can be brought close to what they are originally intended to be. In a case where the light-receiving element **3** is disposed to overlap the second opening **38**B, the light-receiving element **3** can detect, for example, the amount of light by utilizing the light that is transmitted through the portion of the array substrate **21** that overlaps the second opening **38**B. In a case where the light-emitting element **4** is disposed to overlap the second opening **38**B, light emitted from the light-emitting element **4** exits outward by being transmitted through the portion of the array substrate **21** that overlaps the second opening **38**B and transmitted through the counter substrate **20** through the second opening **38**B. Both the light-receiving element **3** and the light-emitting element **4** are affected by reflection and absorption of light by the first translucent layer **41**, as light passing through the second opening **38**B is transmitted through the first translucent layer **41**; however, the optical performance of the light-receiving element **3** and the light-emitting element **4** is less adversely affected than that of the imaging element **2**. Moreover, since the first translucent layer **41** is disposed not to overlap the first opening **38**A but to overlap the second opening **38**B, the light-receiving element **3** and the light-emitting element **4** are hardly seen from outside, whereas the imaging element **2** is easily seen from outside. This brings about improvement in appearance of the electronic apparatus **1**.

Embodiment 2

[0055] Embodiment 2 is described with reference to FIG. **9** or **10**. Embodiment 2 illustrates the case of a change in range of formation of a second translucent layer **142**. Note that a repeated description of structures, actions, and effects which are similar to those of Embodiment 1 is omitted.

[0056] As shown in FIGS. **9** and **10**, the second translucent layer **142** according to the present embodiment is also formed around a first opening **138**A of a light-blocking layer **138**. That is, the second translucent layer **142** is formed across substantially the whole of a first area A**101** of both substrates **120** and **121** that overlaps the light-blocking layer **138**. Note that FIG. **9** illustrates the range of formation of a first translucent layer **141** and the second translucent layer **142** as a shaded area. In particular, in the counter substrate **120**, substantially the whole of the light-blocking layer **138**, which faces a vacuum layer **123**, is covered by a counter-side second translucent layer **142**α from inside. In the array substrate **121**, substantially the whole of an inner surface facing the vacuum layer **123** is covered by an array-side second translucent layer **1428** from inside. Accordingly, light having entered the vacuum layer **123** through the first opening **138**A and a second opening **138**B from outside the front is reflected by the respective principal surfaces of the counter-side second translucent layer **142**α and the array-side second translucent layer **142**B both around the first opening **138**A and around the second opening **138**B. This further inhibits absorption by the light-blocking layer **138** and therefore further increases the amount of light that exits toward an area outside the front through the first opening **138**A and the second opening **138**B, thus bringing about further improvement in appearance.

Other Embodiments

[0057] The present disclosure is not limited to the embodiments described above with reference to the drawings. The following embodiments may be included in the technical scope of the present disclosure.

[0058] (1) Only the counter substrates **20** and **120** or only the array substrates **21** and **121** may be provided with the first translucent layers **41** and **141**.

[0059] (2) Only the counter substrates **20** and **120** or only the array substrates **21** and **121** may be provided with the second translucent layers **42** and **142**.

[0060] (3) The material of the first translucent layers **41** and **141** and the second translucent layers **42** and **142** may be different from the material of the alignment films **34** and **37**. Specifically, for

example, an inorganic insulating material, an organic insulating material, or other materials can be used as the material of the first translucent layers **41** and **141** and the second translucent layers **42** and **142**.
[0061] (4) The refractive indices of the first translucent layers **41** and **141** and the second translucent layers **42** and **142** may be higher than 1.6 or may be lower than 1.6.
[0062] (5) The second translucent layers **42** and **142** may not be formed.
[0063] (6) The light-blocking layers **38** and **138** may be configured to have a plurality of the first openings **38**A and **138**A. In that case, the electronic apparatus **1** is configured to include a plurality of the imaging elements **2**.
[0064] (7) The light-blocking layers **38** and **138** may each be configured to have only one second opening **38**B or **138**B. In that case, the electronic apparatus **1** is configured to have one light-receiving element **3** or one light-emitting element **4**.
[0065] (8) The specific planar shapes of the first openings **38**A and **138**A can be appropriately changed to those not illustrated. Similarly, the specific planar shapes of the second openings **38**B and **138**B can be appropriately changed to those not illustrated.
[0066] (9) The counter substrates **20** and **120** may each be provided with an overcoat layer located at a higher layer than the color filter **36** and at a lower layer than the second alignment film **37**. Providing the overcoat layer causes the second alignment film **37** to be planarized. In that case, as in the case of the planarizing film **31**, a portion of the overcoat film that overlaps the vacuum layer **23** or **123** may be selectively removed.
[0067] (10) The specific patterns of the first seal portion **24** and the second seal portion **25** in a plan view can be appropriately changed to those not illustrated. The ranges of formation of the vacuum layers **23** and **123** in a plan view can be changed accordingly.
[0068] (11) The numbers of insulating films **33**, **39**, **40** and planarizing films **31** that are provided in the array substrates **21** and **121** can be appropriately changed to those not illustrated.
[0069] (12) The number of drivers **13** that are provided can be appropriately changed to that not illustrated.
[0070] (13) The planar shape of the liquid crystal panel **11** may be a vertically long oblong, a regular square, a circle, a semicircle, an oval, a trapezoid, or other shapes.
[0071] (14) The liquid crystal panel **11** may be of a reflective type or a semi-transmissive type instead of being of a transmissive type.
[0072] The present disclosure contains subject matter related to that disclosed in Japanese Priority Patent Application JP 2024-022811 filed in the Japan Patent Office on Feb. 19, 2024, the entire contents of which are hereby incorporated by reference.
[0073] It should be understood by those skilled in the art that various modifications, combinations, sub-combinations and alterations may occur depending on design requirements and other factors insofar as they are within the scope of the appended claims or the equivalents thereof.

Claims

1. A display device comprising: a first substrate having translucency and having a principal surface that is divided into a display area where an image is displayed and a non-display area where the image is not displayed; a second substrate having translucency, the second substrate being placed at a spacing from the first substrate; a vacuum layer sandwiched between the first substrate and the second substrate and placed in part of the non-display area; a first seal portion sandwiched between the first substrate and the second substrate, the first seal portion surrounding the vacuum layer; a light-blocking layer provided on a principal surface of the first substrate that faces toward the vacuum layer, placed in at least the non-display area, and configured to block light; and a first translucent layer having translucency, the first translucent layer being provided on a principal surface of at least either the first substrate or the second substrate that faces toward the vacuum layer and placed in part of the non-display area, wherein the light-blocking layer is provided with a first opening facing the vacuum layer and a second opening facing the vacuum layer, the second opening being placed at a spacing from the first opening, and the first translucent layer is disposed not to overlap the first opening but to overlap the second opening.

2. The display device according to claim 1, wherein the first substrate and the second substrate are each provided with the first translucent layer.

3. The display device according to claim 1, wherein the first translucent layer is higher in refractive index than one of the first and second substrates that is provided with the first translucent layer.

4. The display device according to claim 3, further comprising a pair of alignment films provided on principal surfaces of the first and second substrates that face toward the vacuum layer and placed in the display area, wherein the first translucent layer is made of a material that is identical to that of the alignment films.

5. The display device according to claim 1, further comprising a second translucent layer having translucency, the second translucent layer being provided on a principal surface of at least either the first substrate or the second substrate that faces toward the vacuum layer and placed in part of the non-display area, wherein the second translucent layer is disposed not to overlap the first opening or the second opening but to overlap the light-blocking layer.

6. The display device according to claim 5, wherein at least the first substrate is provided with the second translucent layer.

7. The display device according to claim 5, wherein the first substrate and the second substrate are each provided with the second translucent layer.

8. The display device according to claim 5, wherein the second translucent layer is not formed around the first opening but formed around the second opening.

9. The display device according to claim 1, further comprising: a second seal portion sandwiched between the first substrate and the second substrate, the second seal portion surrounding the display area; and a liquid crystal layer sandwiched between the first substrate and the second substrate and surrounded by the second seal portion.

10. An electronic apparatus comprising: the display device according to claim 1; an imaging element located opposite the first substrate behind the second substrate and disposed to overlap the first opening; and a light-receiving element or a light-emitting element located opposite the first substrate behind the second substrate and disposed to overlap the second opening.