

BOTH-SIDES ADHESIVE OPTICAL FILM AND IMAGE DISPLAY DEVICE

TECHNICAL FIELD

[0001] The present invention relates to an adhesive optical film having a pressure sensitive adhesive layer on both sides of an optical film, and an image display device.

BACKGROUND ART

[0002] Liquid crystal display devices and organic EL display devices are widely used as various image display devices such as a cell phone, a smartphone, a car navigation device, a monitor, a television, and the like. In a liquid crystal display device, a polarizing plate is disposed on a viewer-side surface of a liquid crystal cell due to the display principle of the liquid crystal display device. In a light-emitting display device such as an organic EL display device, although polarizing plate is not required based on optical principle of image display, a circularly polarizing plate (a laminate formed of a polarizing plate and a quarter-wave plate) may be arranged on a viewer-side surface of a cell in order to prevent a metal electrode (cathode) from reflecting external light and being viewed like a mirror surface.

[0003] Image display devices have been popularized in which a front transparent member such as a touch sensor or a cover glass is arranged on a surface of an image display panel. Such a configuration is becoming mainstream in mobile equipment and on-vehicle equipment. By bonding together a polarizing plate on the surface of the image display panel and the front transparent member with a pressure sensitive adhesive layer interposed therebetween, the difference in refractive index at the interface decreases. Therefore, lowering of visibility due to reflection and scattering can be suppressed. In formation of an image display device having this configuration, it is proposed (*e.g.*, in Patent Document 1) to use a both-sides adhesive optical film having on one surface of a polarizing plate a first pressure sensitive adhesive layer configured to be bonded to an image display cell, and having on the other surface of the polarizing plate a second pressure sensitive adhesive layer configured to be bonded to the front transparent plate.

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0004] Patent Document 1: JP 2014-115468 A

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0005] A need for narrowing frames of display devices has been growing, and various ideas have been devised in routing of wiring on the periphery of screens, arrangement of flexible printed circuits, and the like. On the other hand, the space capable of accommodating constituent members of the image display device has tended to be increasingly limited because for example, cover glass or a casing having a curved shape portion at an end portion of a screen has come to be used.

[0006] The present invention provides an image display device capable of securing a space for accommodating constituent members, and an adhesive optical film to be used for the image display device.

MEANS FOR SOLVING THE PROBLEMS

[0007] An adhesive optical film of the present invention includes a pressure sensitive adhesive layer on both sides of an optical film such as a polarizing plate. At least one surface of the optical film partially has an adhesive-free area where the optical film is exposed without being covered with the pressure sensitive adhesive layer. The adhesive-free area forms a vacant space when the both-sides adhesive optical film is bonded to an image display panel and a front transparent member. The space can be effectively utilized by arranging a constituent member of the image display device such as an electrical connection member with a flexible printed circuit (FPC), curved shape portions of a casing and a front transparent plate, a resin material and an electroconductive material in the vacant space.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1A is a plan view of an both-sides adhesive optical film, and FIG. 1B is a cross-sectional view of the both-sides adhesive optical film.

FIG. 2 is a sectional view of a both-sides adhesive optical film having protective sheets on pressure sensitive adhesive sheets.

FIG. 3 is a sectional view of a both-sides adhesive optical film having protective sheets on pressure sensitive adhesive sheets.

FIG. 4 is a cross-sectional view of an image display device.

FIG. 5 is a cross-sectional view of a conventional image display device.

FIG. 6 is a cross-sectional view of an image display device.

FIG. 7 is a cross-sectional view of an image display device.

FIG. 8 is a cross-sectional view of an image display device.

FIG. 9 is a plan view of a both-sides adhesive optical film.

FIG. 10 is a schematic perspective view of an image display device.

FIG. 11 is a plan view of an both-sides adhesive optical film.

FIG. 12 is a plan view of an both-sides adhesive optical film.

FIG. 13 is a plan view of an both-sides adhesive optical film.

FIG. 14 is a cross-sectional view of an image display device.

FIG. 15 is a plan view of an both-sides adhesive optical film.

FIG. 16 is a plan view of an both-sides adhesive optical film.

FIG. 17A is a plan view of an both-sides adhesive optical film, and FIG. 17B is a cross-sectional view of the both-sides adhesive optical film.

FIG. 18 is a cross-sectional view of an image display device.

FIG. 19 is a plan view of an both-sides adhesive optical film.

FIG. 20 is a plan view of an both-sides adhesive optical film.

FIG. 21 is a plan view of an both-sides adhesive optical film.

MODE FOR CARRYING OUT THE INVENTION

[0009] A both-sides adhesive optical film of the present invention includes an optical film such as a polarizing plate, a first pressure sensitive adhesive layer disposed on a first principal surface of the optical film, and a second pressure sensitive adhesive layer disposed on a second principal surface of the optical film. On the first principal surface of the optical film, an adhesive-free area is present where the first pressure sensitive adhesive layer is not disposed. In the image display device, the optical film and the front transparent member or the image display cell are bonded together with the first pressure sensitive adhesive layer interposed therebetween, and a vacant space is present in the adhesive-free area where the first pressure sensitive adhesive layer is not disposed. By arranging, in this vacant space, a printed circuit board, a front transparent member, a casing, an electroconductive paste, a resin material, etc., the space can be effectively utilized to narrow the frame and reduce the size.

[0010] [First Embodiment]

<Adhesive optical film>

A both-sides adhesive optical film of the first embodiment includes, along the peripheral edge of a first principal surface of the optical film, a region (adhesive area) where a first pressure sensitive adhesive layer is disposed on the optical film, and a region (adhesive-free area) where the optical film is exposed without being covered with the first pressure sensitive adhesive layer.

[0011] FIG. 1A is a plan view of first principal surface of a both-sides adhesive optical film 51 of one embodiment, and FIG. 1B is a sectional view taken along line B1-B2. The both-sides adhesive optical film 51 includes a first pressure sensitive adhesive layer 21 on one principal surface of an optical film 11 and a second pressure sensitive adhesive layer 22 on the other principal surface.

[0012] (Optical Film)

A polarizing plate may be used, for example, as the optical film 11. In a general polarizing plate, an appropriate transparent protective film is disposed on one or both surfaces of a polarizer as necessary. For example, the polarizer is obtained by causing a hydrophilic polymer film to adsorb dichroic substances such as iodine or a dichroic dye, and orienting the dichromatic substances by stretching. Examples of the hydrophilic polymer film include a polyvinyl alcohol film, a partially formalized polyvinyl alcohol film, and an ethylene-vinyl acetate copolymer type partially saponified film. As the transparent protective film disposed on the surface of the polarizer, a material excellent in transparency, mechanical strength and thermal stability is preferably used. Examples of the material include a cellulose resin, a cyclic polyolefin resin, an acrylic resin, a phenylmaleimide resin, and a polycarbonate resin. As the transparent protective film of the polarizer, an optically anisotropic film such as a retardation film may be used.

[0013] The optical film 11 may be a stack of a plurality of films with an appropriate adhesive layer or pressure sensitive adhesive layer interposed therebetween. Examples of the optical film other than the polarizing plate include a film used for manufacturing an image display device such as a retardation film, a wide-viewing angle film, a viewing angle restricting (anti-peeping) film, and a brightness enhancement film. A touch sensor or the like may be arranged on the optical film. In addition, a hard coat layer, an anti-reflection layer, an anti-glare layer, an anti-sticking layer, or the like may be arranged on the surface of the optical film. A surface treatment for improving bondability or the like may be performed on the surface of the optical film.

[0014] (Pressure sensitive adhesive layer)

Preferably, the first pressure sensitive adhesive layer 21 disposed on the first principal surface of the optical film 11 and the second pressure sensitive adhesive layer 22 disposed on the second principal surface of the optical film 11 are each composed of an optically transparent pressure sensitive adhesive. One of the first pressure sensitive adhesive layer 21 and the second pressure sensitive adhesive layer 22 is used for bonding the optical film 11 to an image display cell, and the other is used for bonding the optical film 11 to a front transparent member (a transparent plate such as cover glass, a touch sensor or the like).

[0015] As the pressure sensitive adhesive constituting the pressure sensitive adhesive layers 21 and 22, one having a base polymer may be appropriately selected and used. Examples of the base polymer include acrylic polymers, silicone polymers, polyesters, polyurethanes, polyamides, polyvinyl ethers, vinyl acetate-vinyl chloride copolymers, modified polyolefins, epoxy polymers, fluoropolymers, and rubber polymers such as natural rubber or synthetic rubber. In particular, an acrylic pressure sensitive adhesive is preferably used because an acrylic pressure sensitive adhesive exhibits excellent optical transparency, adhesive properties such as appropriate wettability, cohesiveness, bondability, and the like, and is excellent in weather resistance, heat resistance, and the like. Each of the first pressure sensitive adhesive layer 21 and the second pressure sensitive adhesive layer 22 may be a stack of a plurality of pressure sensitive adhesive layers.

[0016] The pressure sensitive adhesive constituting the first pressure sensitive adhesive layer 21 and the second pressure sensitive adhesive layer 22 may be a photocurable pressure sensitive adhesive which can be cured by light irradiation after bonding the adherent such as image display cell, front transparent member and the like. For example, if a photocurable pressure sensitive adhesive is used for bonding with a front transparent member having a raised portion such as decorative printing, bonding is performed before the pressure sensitive adhesive is photocured, and therefore the pressure sensitive is soft enough to absorb a level difference. As a result, it is possible to reduce the likelihood that air bubbles or the like will be formed in the vicinity of the raised portion. After the bonding, the pressure sensitive adhesive is photocured by irradiating with UV etc., so that adhesion reliability can be improved. The photocurable pressure sensitive adhesive preferably includes, for example, a polymer, a monomer or oligomer having a photopolymerizable functional group, and a photopolymerization initiator. As the

monomer or oligomer having a photopolymerizable functional group, a cross-linkable monomer having two or more polymerizable functional groups per molecule may be used.

[0017] The thickness of the each of the pressure sensitive adhesive layers 21 and 22 is not particularly limited, and is generally about 5 to 500 μm . The thickness of the pressure sensitive adhesive layer used for bonding the optical film 11 and the image display cell is preferably about 5 to 50 μm . The thickness of the pressure sensitive adhesive layer used for bonding the optical film 11 and the front transparent member may be appropriately set according to the configuration of the front transparent member or the like. For example, in a case where the front transparent member has a raised portion due to decorative printing or the like, in order to prevent air bubbles from entering the periphery of the raised portion, it is preferable to set the thickness of the pressure sensitive adhesive layer to 50 μm or more so that the pressure sensitive adhesive layer can absorb the level difference.

[0018] (Adhesive-free area)

In the both-sides adhesive optical film 51 illustrated in FIG. 1, peripheral edges along three sides 11a₂, 11a₃, and 11a₄ of the four sides of the optical film 11 are adhesive areas to which the first pressure sensitive adhesive layer 21 is disposed. The first pressure sensitive adhesive layer 21 is not disposed on the optical film 11 at the peripheral edge along the side 11a₁ extending in the y direction. In this adhesive-free area 2x, the principal surface of the optical film 11 is exposed, and a vacant space exists on the optical film 11.

[0019] At the peripheral edges along the sides 11a₂, 11a₃ and 11a₄, the laterals of the optical film 11 and the first pressure sensitive adhesive layer 21 are aligned with each other. In the adhesive-free area 2x along the side 11a₁, the lateral 21e of the first pressure sensitive adhesive layer 21 is located more inward than the lateral 11e of the optical film 11. The laterals 11e and 21e extend parallel to the y direction along the side 11a₁.

[0020] The width W₁ of the adhesive-free area 2x, *i.e.*, the offset amount between the lateral 11e of the optical film 11 and the lateral 21e of the first pressure sensitive adhesive layer 21 may be appropriately set according to the shape, the size, or the like of a member arranged on the adhesive-free area. In order to effectively utilizing the space on the peripheral edge of a screen and the vicinity, W₁ is preferably 10 μm or more, more preferably 50 μm or more, further preferably 100 μm or more.

[0021] The upper limit of W_1 is not particularly limited, and may be set according to the size of the image display device, the screen size or the like. W_1 is, for example, preferably 10% or less, more preferably 5% or less, further preferably 1% or less of the diagonal length of the optical film. W_1 is preferably 50 mm or less, more preferably 10 mm or less, further preferably 5 mm or less, especially preferably 1 mm or less. From the viewpoint of reliably bonding the optical film 11 to a front transparent member, etc. with the first pressure sensitive adhesive layer 21 and preventing peeling, W_1 is preferably as small as possible within the bounds of being able to avoid physical interference between the constituent members of the image display device and the first pressure sensitive adhesive layer.

[0022] The area of the optical film 11 is not particularly limited. In general, the area of the optical film 11 is about 5 to 25000 cm². In a case where the optical film 11 is rectangular, the length of the diagonal line is about 3 to 250 cm. Particularly in a medium-sized or small-sized image display device having an area of 2000 cm² or less, a significant space saving effect is exerted by the configuration of the present invention.

[0023] In a case where the optical film 11 is rectangular, the optical film 11 may be a rectangle having long sides and short sides, or a square having four sides equal in length. The length of the long side of the rectangle is generally 10 times or less of the length of the short side, and may be 5 times or less, 3 times or less, or 2 times or less. In a case where the optical film is an optically anisotropic film such as a polarizing plate or a retardation film, the direction of an optic axis such as an absorption axis or a slow axis may be parallel or perpendicular to the extending direction of a side of the rectangle, or may form a predetermined angle with the extending direction of a side of the rectangle. In a case where the optical film is a stack of a plurality of films, arrangement of the optic axes of the respective films is not particularly limited. The optic axes may be parallel or orthogonal to each other, or may form a predetermined angle. For example, in a circularly polarizing plate, a polarizer and a quarter-wave plate are stacked such that the angle between the direction of the absorption axis of the polarizer and the direction of the slow axis of the quarter-wave plate is 45°.

[0024] In the both-sides adhesive optical film of the first embodiment, some regions along the peripheral edge of the optical film 11 are adhesive-free areas, and in other regions, the first pressure sensitive adhesive layer 21 is disposed on the peripheral edge of the optical film 11, and end portions of the first principal surface are covered with the first

pressure sensitive adhesive layer 21. Since regions where physical interference between the pressure sensitive adhesive and the image display device constituent members is avoided are adhesive-free areas, and other regions are adhesive areas where the pressure sensitive adhesive layer 21 is disposed on the peripheral edge of the optical film 11, the optical film 11 is reliably bonded to cover glass or the like with the pressure sensitive adhesive layer 21, so that peeling can be prevented.

[0025] (Protective sheet)

FIG. 2 is a sectional view of a both-sides adhesive optical film 451 including a protective sheet on a pressure sensitive adhesive layer. A first protective sheet 41 is releasably attached on the first pressure sensitive adhesive layer 21, and a second protective sheet 42 is releasably attached on the second pressure sensitive adhesive layer 22. Thus, when the protective sheet is temporarily attached on the pressure sensitive adhesive layer, the exposed surfaces of the pressure sensitive adhesive layers 21 and 22 can be protected until the optical film 11 is bonded to an adherend.

[0026] As a constituent material of the protective sheet 41, 42, a plastic film such as a polyethylene film, a polypropylene film, a polyethylene terephthalate film, or a polyester film is preferable. The thickness of the protective sheet 41, 42 is usually about 5 to 200 μm , and preferably about 10 to 150 μm . A surface of the protective sheet bonded to the pressure sensitive adhesive may be subjected to release treatment with a silicone release agent or the like.

[0027] (Formation of pressure sensitive adhesive layer and adhesive-free area on optical film)

Examples of the method for providing the first pressure sensitive adhesive layer 21 and the second pressure sensitive adhesive layer 22 on the optical film 11 include a method in which a pressure sensitive adhesive composition is applied to a release-treated sheet or the like to form a pressure sensitive adhesive layer, and the pressure sensitive adhesive layer is then transferred onto the optical film 11; and a pressure sensitive adhesive composition is applied onto the optical film 11. The pressure sensitive adhesive composition after application may be subjected to removal of a solvent by drying, crosslinking treatment, curing treatment and the like if necessary.

[0028] Examples of the method for providing an adhesive-free area 2x on some parts of a principal surface of the optical film 11 include a method in which a region where the first pressure sensitive adhesive layer 21 is disposed on the optical film 11 is controlled; and a

method in which the first pressure sensitive adhesive layer 21 is disposed over the entire principal surface of the optical film, followed by removing the pressure sensitive adhesive layer in a predetermined region. An adhesive-free area may be formed by bonding a pressure sensitive adhesive layer having an area smaller than that of the optical film onto the optical film adjusted to a size suitable for bonding the optical film to an image display device. Alternatively, an adhesive-free area may be formed by removing a predetermined region of the pressure sensitive adhesive layer disposed over the entire surface of the optical film adjusted to a size suitable for bonding the optical film to an image display device.

[0029] A both-sides adhesive optical film formed in a size larger than that of an optical film to be used for bonding to an image display device may be cut to a predetermined size using a Thomson blade, a round blade, a dish blade, a laser cutter or the like. A both-sides adhesive optical film having an adhesive-free area 2x on the peripheral edge of the optical film may be prepared by cutting a region where the first pressure sensitive adhesive layer is not provided on the optical film. For example, when a region where the first pressure sensitive adhesive layer is not provided on the optical film is cut at the time of cutting out a predetermined size both-sides adhesive optical film from a long sheet, a both-sides adhesive optical film having an adhesive-free area along a cut line is obtained. A plurality of films may be cut out from a large sheet film (mother substrate), or a film having a predetermined size may be further cut to prepare a both-sides adhesive optical film having an adhesive-free area on the peripheral edge.

[0030] It is preferable that in the adhesive-free area 2x, the protective sheet 41 covers the first principal surface of the pressure sensitive adhesive layer 21. The position of a lateral 41e of the protective sheet 41 may be aligned with a lateral 21e of the pressure sensitive adhesive layer 21, or aligned with a lateral 11e of the optical film 11. The lateral 41e of the protective sheet 41 may be positioned between the lateral 21e of the pressure sensitive adhesive layer 21 and the lateral 11e of the optical film 11, or positioned outside the lateral 11e of the optical film 11.

[0031] When there is an pressure sensitive adhesive layer-free region where the first pressure sensitive adhesive layer is not provided on the optical film, the entire surfaces of the pressure sensitive adhesive layer-free region and the pressure sensitive adhesive layer-provided region are covered with the protective sheet, and a sheet piece is cut out therefrom, the position of the lateral 11e of the optical film 11 is aligned with the position

of the lateral 41e of the protective sheet 41, as shown in FIG. 2, in both the adhesive area and the adhesive-free area of the sheet piece. When in the adhesive-free area 2x, the lateral 21e of the pressure sensitive adhesive layer 21 lies inside the lateral 11e of the optical film 11 and the lateral 41e of the protective sheet 41, it is possible to suppress glue staining and glue missing on the lateral 21e of the pressure sensitive adhesive layer.

[0032] It suffices that in the adhesive area of the peripheral edge of the optical film, the first pressure sensitive adhesive layer is disposed on the surface of the optical film, so that the principal surface of the optical film is not exposed. In the adhesive area, the position of the lateral of the protective sheet 41 may be aligned with the position of the lateral of the first pressure sensitive adhesive layer 21, and the lateral of the protective sheet 41 may be positioned outside the lateral of the first pressure sensitive adhesive layer 21.

[0033] As in the both-sides adhesive optical film 53 shown in FIG. 3, the lateral 21c may be positioned inside the lateral of the optical film 11 and the lateral of the first protective sheet 41 at the center in the thickness direction of the first pressure sensitive adhesive layer 21. Since in the adhesive area, the lateral 21c at the center in the thickness direction of the pressure sensitive adhesive layer 21 lies inside the lateral of the optical film 11, glue staining and glue missing during transportation of the both-sides adhesive optical film and on the line of processing such as bonding can be suppressed.

[0034] For example, by cutting the both-sides adhesive optical film while pressure is applied from the principal surface side, the position of the lateral of the pressure sensitive adhesive layer can be made coincident with the position of the lateral of the optical film at the interface with the optical film, and the lateral of the pressure sensitive adhesive layer can be positioned inside at the center in the thickness direction of the pressure sensitive adhesive layer. When pressure is applied to the both-sides adhesive optical film with the protective sheets 41 and 42 attached on the pressure sensitive adhesive layers 21 and 22, the pressure sensitive adhesive layer is elastically deformed, and an end portion of the pressure sensitive adhesive layer protrudes from an end portion of the optical film at the center in the thickness direction. By cutting the pressure sensitive adhesive layers 21 and 22 together with the optical film 11 and the protective sheets 41 and 42 in this state, the positions of the laterals of the optical film 11 and the protective sheets 41 and 42 are aligned with the positions of the laterals of the pressure sensitive adhesive layers 21 and 22. When pressure is released after cutting, the pressure sensitive adhesive is deformed, so that the lateral of the pressure sensitive adhesive layer at the center in the thickness

direction is shifted backward to inside the lateral of the optical film 11 to obtain a both-sides adhesive optical film in which the lateral of the pressure sensitive adhesive layer at the center in the thickness direction is positioned inside as shown in FIG. 3.

[0035] When the lateral of the first pressure sensitive adhesive layer 21 at the center in the thickness direction is positioned inside the lateral of the optical film 11 in the adhesive area, a distance W_2 between the lateral of the optical film 11 and the lateral of the first pressure sensitive adhesive layer at the center in the thickness direction is, for example, about 5 μm to 300 μm . W_2 is more preferably about 10 μm to 100 μm , further preferably about 15 μm to 70 μm , from the viewpoint of suppressing protrusion of the pressure sensitive adhesive from the lateral and securing adhesiveness at the end portion. W_2 and W_1 may be the same or different. In general, W_2 is smaller than W_1 .

[0036] The both-sides adhesive optical film 51 shown in FIG. 1 has the adhesive-free area 2x lying along one short side 11a₁ of the four sides of the rectangular optical film 11. The adhesive-free areas may exist two or more sides of a rectangle, or an adhesive-free area may exist along a long side of the rectangle. In the adhesive-free area, the lateral of the first pressure sensitive adhesive layer does not necessarily extend in parallel to a side of the optical film. For example, the adhesive-free area may have a portion whose width decreases from an end of a side of the rectangle (vertex of the rectangle) toward the center of the side. The adhesive-free area does not necessarily lie along the entire length of a side. For example, the adhesive-free area may exist only on part of a side of the rectangle or only on a vertex of the rectangle.

[0037] The shape of the optical film is not limited to a rectangle, and may be an appropriate shape according to the shape and the size of the screen of an image display device. For example, the plan-view shape of the optical film may be a polygon such as a triangle, a rhombus, a parallelogram, a trapezoid, a pentagon and a hexagon, a circle, an ellipse, a pentagram, or the like.

[0038] <Image display device>

FIG. 4 is a cross-sectional view of an image display device 101 manufactured by using the both-sides adhesive optical film 51. In the image display device 101, the optical film 11 is disposed on an image display cell 60, and a touch sensor equipped cover glass 71 is arranged on a viewer side of the optical film 11. The optical film 11 and the image display cell 60 are bonded together with the second pressure sensitive adhesive layer 22 interposed therebetween, and the optical film 11 and the cover glass 71 are bonded

together with the first pressure sensitive adhesive layer 21 interposed therebetween. Examples of the image display cell 60 include a liquid crystal cell, an organic EL (OLED), and a micro LED. Instead of the cover glass 71, a transparent resin plate made of a transparent resin material such as acrylic resin may be used.

[0039] In the vicinity of an end portion of the cover glass 71, a flexible printed circuit (FPC) 91 which is an electrical connection member is connected to a touch sensor (not illustrated) on the surface of the cover glass 71 facing the optical film 11. The FPC 91 is bent so as to go around the back side of the image display cell 60.

[0040] FIG. 5 is a sectional view of an image display device 501 using a conventional both-sides adhesive optical film 551. The image display device 501 has a configuration similar to that of the image display device 101 in FIG. 4, but a pressure sensitive adhesive layer 521 between the optical film 11 and cover glass 571 is disposed over the entire surface of the optical film.

[0041] In the image display device 501, the position of the lateral 11e is aligned with the position of the lateral 521e of the pressure sensitive adhesive layer 521 along the entire peripheral edge of the optical film 11, and the entire space between the optical film 11 and the cover glass 571 is covered with the pressure sensitive adhesive layer 521. Since there is no vacant space between the optical film 11 and the cover glass 571, a contact point 507a between the touch sensor and the FPC 591 is arranged outside the lateral 11e of the optical film 11. Since it is necessary to secure a space for accommodating an electrical connection member such as an FPC outside a display region of a screen, it is difficult to reduce the width of a frame region on the outer periphery of the screen.

[0042] In contrast, in the image display device 101 as shown in Fig. 4 in which the both-sides adhesive optical film 51 of the present invention is used, the FPC 91 is disposed in the space of the adhesive-free area 2x along the side 11a₁, so that a contact point 7a between the touch sensor and the FPC 91 can be arranged on the lateral 11e of the optical film 11 or at a place more inward than the lateral 11e. As described above, the adhesive-free area 2x, on which the first pressure sensitive adhesive layer is not provided, exists on the optical film 11, the FPC or the like is disposed in the vacant space on the adhesive-free area 2x, and thus the space on the peripheral edge of a screen and the vicinity thereof is effectively utilized, thereby reducing the frame width.

[0043] As described above, the lateral 21c of the first pressure sensitive adhesive layer 21 at the center in the thickness direction may lie inside the lateral of the optical film 11 in

the adhesive area of the peripheral edge of the optical film (see FIG. 3). In this embodiment, even when the distance W_2 between the lateral 21c of the first pressure sensitive adhesive layer 21 and the lateral of the optical film in the adhesive area is large, the position of the lateral of the first pressure sensitive adhesive layer is coincident with the positions of the laterals of the optical film 11 and the protective sheet 41 at interfaces with the optical film 11 and the protective sheet 41. Thus, even when W_2 is large, it is difficult to narrow the frame by avoiding physical interference between the FPC, etc. like and the pressure sensitive adhesive layer in the adhesive area.

[0044] The usage of the both-sides adhesive optical film 51 having an adhesive-free area on one side is not limited to the configuration shown in FIG. 4. The both-sides adhesive optical film may be applied to image display devices having other configurations. For example, as in the image display device 102 shown in FIG. 6, the cover glass 72, which is arranged on a surface of the image display device, may have a decorative printing 72a at the peripheral edge of a screen on a surface facing to the optical film 11. In this embodiment, FPC 91 is disposed and a contact point 7a between the touch sensor and the FPC is arranged in the space of the adhesive-free area 2x outside the decorative printing 72a of the cover glass 71.

[0045] As in the image display device 103 shown in FIG. 7, the optical film 11 may be bonded to the touch sensor 73 with the first pressure sensitive adhesive layer 21 interposed therebetween, and cover glass 79 may be bonded thereto with another pressure sensitive adhesive layer 29 interposed therebetween.

[0046] In the image display device, the first pressure sensitive adhesive layer 21-side of the both-sides adhesive optical film is not necessarily arranged on the viewer side, and the first pressure sensitive adhesive layer 21 may be arranged on the image display cell side. For example, in the image display device 104 shown in FIG. 8, the polarizing plate 17 including a touch sensor is bonded onto the image display cell 60 through the first pressure sensitive adhesive layer 21 interposed therebetween, and the cover glass 79 is bonded thereto with the second pressure sensitive adhesive layer 22 interposed therebetween. In the vicinity of an end portion of the polarizing plate 17 as an optical film, the FPC 91 is connected to a touch sensor arranged on a surface facing to the image display cell 60. In this embodiment, an FPC contact point 7a is arranged at the region between the image display cell 60 and the polarizing plate 17 as an optical film, and the adhesive-free area 2x is present at this region, so that the space can be effectively utilized.

[0047] <Modification of first embodiment>

As described above, the position of the adhesive-free area on the first principal surface of the optical film is not limited to a rectangular short side. For example, as shown in FIG. 9, a both-sides adhesive optical film 56 may have adhesive-free area 2x where the first principal surface of the optical film 11 is exposed on the two long sides 11a₂ and 11a₄ of the rectangle.

[0048] FIG. 10 is a schematic perspective view of an image display device 106 prepared using a both-sides adhesive optical film 56 in FIG. 9. The image display device 106 includes cover glass 74 on a surface on the viewer side, and an end portion of the cover glass 74 is bonded to a casing 84. In the cover glass 74, a long side 74a extending in the x direction has a curved shape. When curved shape portion 74a of the cover glass 74 is positioned on the adhesive-free area 2x of the both-sides adhesive optical film, physical interference between the first pressure sensitive adhesive layer 21 and the cover glass 74 can be avoided, thereby effectively utilizing the space in the device.

[0049] In FIG. 10, the long side 74a of the cover glass 74 is chamfered to have a curved shape, but the long side of the cover glass may be chamfered to have a flat shape. The apex portion of the cover glass may be chamfered to have a flat shape or a curved shape. In a chamfered shape portion of a front transparent plate such as cover glass or a casing, the shapes of the outer surface and the inner surface may be identical to or different from each other. Further, a casing may be arranged in the adhesive-free area to avoid physical interference between the pressure sensitive adhesive layer and the casing.

[0050] FIGS. 11 and 12 are plan views first principal surface of both-sides adhesive optical films in other embodiments. A both-sides adhesive optical film 57A shown in FIG. 11 has a rounded adhesive-free area 2x₁ at each of four vertices of a rectangle. For example, when the both-sides adhesive optical film 57A is used for formation of an image display device including a front transparent plate or casing which is rounded at apexes of a rectangle, physical interference between a curved shape portion in the vicinity of the apex of a display region and the first pressure sensitive adhesive layer 21 can be avoided, thereby effectively utilizing the space in the device.

[0051] A both-sides adhesive optical film 57B shown in FIG. 12 has a rounded adhesive-free area 2x₁ at each of both ends of one short side 11a₃, and an adhesive-free area 2x₂ along the entire length of the other short side 11a₁. As shown in FIG. 12, the adhesive-free area 2x₂ lying along the short side 11a₁ is linear along the entire length of the short

side 11a₁, and is not necessarily having rounded corners. Thus, the adhesive-free area lying along the side can be used not only for avoiding physical interference with the front transparent member and the casing, but also for avoiding physical interference with constituent members such as FPC.

[0052] FIG. 13 is a plan view of first principal surface of a both-sides adhesive optical film 58, the both-sides adhesive optical film 58 having an adhesive-free area on a part of the side. The both-sides adhesive optical film 58 has a notched adhesive-free area 2x₃ on the short side 11a₁ of the rectangle.

[0053] FIG. 14 is a sectional view of an image display device 108 prepared using the both-sides adhesive optical film 58. In the image display device 108, an electroconductive wire 98 is arranged for grounding the image display cell 60 and the optical film 11. In the adhesive-free area 2x₃, the optical film 11 is exposed without being covered with the first pressure sensitive adhesive layer 21. Therefore, a grounding point 8a of the electroconductive wire 98 can be arranged on the first principal surface of the optical film 11. The electroconductive wire 98 can be formed of a metal wire, a metal paste or the like. For the purpose of, for example, preventing oxidation of a metal that forms the electroconductive wire 98, an insulating layer such as a resin coating layer may be disposed on the surface of the electroconductive wire.

[0054] In the above descriptions, examples have been shown in which a contact point with FPC is arranged in the adhesive-free area, in which a front transparent plate or a casing is arranged in the adhesive-free area region, and in which a contact point with an electroconductive wire is arranged, as examples in which constituent members of an image display device are arranged in the adhesive-free area on the first principal surface of the optical film. The configuration of the image display device is not limited to these examples, and the member arranged in the adhesive-free area is not particularly limited. The member arranged in the adhesive-free area can be any electroconductive material or insulating material. For example, an electroconductive material or a resin material may be arranged so as to cover the adhesive-free area on the first principal surface of the optical film and the lateral surface of the optical film.

[0055] The electroconductive material or the resin material may be disposed so as to further cover the surface of the image display panel. For example, by sealing an organic EL cell with a resin layer disposed so as to cover the surface of the organic EL cell and the side surface of the optical film, degradation of the organic EL can be suppressed.

[0056] The image display cell is not necessarily a flat shape. For example, the entire surface of the image display cell may be a curved surface, or the end portion of the image display cell may have a curved shape. When the end portion of the image display cell has a curved shape, the curved surface portion may include the adhesive-free area. An electroconductive material or a resin material may be disposed so as to cover the surface of the image display panel. The image display cell may have a curved shape in a non-display portion such as a connection region with FPC.

[0057] In the both-sides adhesive optical film, the second pressure sensitive adhesive layer 22 may be disposed so as to cover the entire second principal surface of the optical film. Since the adhesive-free area does not present along the entire peripheral edge of the second principal surface, the image display cell 60, etc. can be reliably bonded to the optical film 11 to prevent peeling from the end portion. The adhesive-free area may be arranged not only on the first principal surface but also on the second principal surface of the optical film to avoid physical interference with constituent members of the image display device.

[0058] [Second Embodiment]

In a both-sides adhesive optical film of the second embodiment a region (adhesive-free area) where the optical film is exposed without being covered with a first pressure sensitive adhesive layer lies along the entire peripheral edge of a first principal surface of the optical film. In this embodiment, the adhesive-free area may have, along the peripheral edge of the first principal surface of the optical film, regions different in width. On the first principal surface of the optical film 11, the both-sides adhesive optical film of the second embodiment has an adhesive-free area along the entire peripheral edge and thus has no adhesive area along the peripheral edge. Except for the above, the configuration of the both-sides adhesive optical film of the second embodiment is the same as in the first embodiment.

[0059] An example of the both-sides adhesive optical film of the second embodiment is shown in FIG. 15. FIG. 15A is a plan view of first principal surface of a both-sides adhesive optical film 251, and FIG. 15B is a sectional view taken along line B1-B2. The both-sides adhesive optical film of the second embodiment includes a first pressure sensitive adhesive layer 21 on one surface of the optical film 11 and a second pressure sensitive adhesive layer 22 on the other surface as in the first embodiment. A protective sheet (not shown) may be temporarily attached to a surface of each of the pressure

sensitive adhesive layers 21 and 22.

[0060] In the both-sides adhesive optical film 251, a width W_{11} of an adhesive-free area $2x_{41}$ along one short side $11a_1$ is different from a width W_{13} of an adhesive-free area $2x_{43}$ along the other short side $11a_3$. For example, when an image display device is formed, the space of the adhesive-free area $2x_{41}$ forms a connection region of FPC to a touch sensor, and the space of the adhesive-free area $2x_{43}$ forms a region for avoiding physical interference with cover glass, a casing or the like having a curved shape at an end portion. The adhesive-free area along a long side $11a_2$ and a long side $11a_4$ of the rectangular optical film 11 is also a region for avoiding physical interference with the cover glass, the casing or the like. Thus, when the width of the adhesive-free area is adjusted depending on an object with which physical interference is to be avoided, it is possible to effectively utilize the space and secure adhesion reliability with the first pressure sensitive adhesive layer.

[0061] The ratio of the maximum value to the minimum value of the width of the adhesive-free area is not particularly limited. The maximum value of the width of the adhesive-free area is, for example, not less than 1.1 times the minimum value of the width of the adhesive-free area. The maximum value of the width of the adhesive-free area may be not less than 1.3 times, not less than 1.5 times, not less than 2 times, or not less than 3 times the minimum value of the adhesive-free area.

[0062] FIG. 16 is a plan view of first principal surface of the both-sides adhesive optical film 253. In the both-sides adhesive optical film 253, a width $2x_5$ of the adhesive-free area is substantially uniform at the center of the side of the rectangle. In the vicinity of the apex of the rectangle, the adhesive-free area $2x_5$ has a rounded shape in a plan view, and the width of the adhesive-free area decreases as going toward the center side from the side of the rectangle. When the both-sides adhesive optical film 253 having the adhesive-free area $2x_5$ having such a shape is used, physical interference with image display device constituent members such as cover glass and a casing can be avoided along the entire peripheral edge of a display region.

[0063] [Third Embodiment]

An adhesive-free area of a both-sides adhesive optical film may be present in a region other than the peripheral edge of an optical film. In a both-sides adhesive optical film of the third embodiment, a region (adhesive-free area) where the optical film is exposed without being covered with a first pressure sensitive adhesive layer lies inside the

peripheral edge of a first principal surface of the optical film. Except for the above, the configuration of the both-sides adhesive optical film of the third embodiment is the same as in the first and second embodiments. In the both-sides adhesive optical film of the third embodiment, a protective sheet (not shown) may be temporarily attached to the surfaces of pressure sensitive adhesive layers 21 and 22 as in the first and second embodiments.

[0064] An example of the both-sides adhesive optical film of the third embodiment is shown in FIG. 17. FIG. 17 is a plan view of first principal surface of a both-sides adhesive optical film 351. FIG. 18 is a yz sectional view (sectional view taken along the short side direction in FIG. 17) of an image display device 109 prepared using the both-sides adhesive optical film 351.

[0065] The both-sides adhesive optical film 351 has, inside the long side 11a₄, an adhesive-free area 2x₆ extending in parallel with the long side. In the image display device 109, an optical film 11 is disposed on an image display cell 60, and cover glass 372 is arranged on the optical film 11 on the viewer side. The optical film 11 and the image display cell 60 are bonded to each other with the second pressure sensitive adhesive layer 22 interposed therebetween, and the optical film 11 and the cover glass 372 are bonded to each other with the first pressure sensitive adhesive layer 21 interposed therebetween. The cover glass 372 is subjected to decorative printing on a surface facing to the optical film 11, and is arranged in such a manner that a raised portion 372a by decorative printing overlaps the adhesive-free area 2x₆ of the both-sides adhesive optical film 351.

[0066] In the image display device 109, the pressure sensitive adhesive layer is not disposed immediately below the decorative printing raised portion 372a, and the pressure sensitive adhesive is not deformed by the raised portion. For this reason, it is possible to suppress peeling of the pressure sensitive adhesive from the raised portion and display unevenness caused by compressive stress of the pressure sensitive adhesive.

[0067] The both-sides adhesive optical film in FIG. 17 is also associated with the first embodiment because the adhesive-free area 2x₆ lies on the short sides 11a₁ and 11a₃ of the rectangle. Like a both-sides adhesive optical film 352 shown in a plan view in FIG. 19, the both-sides adhesive optical film of the third embodiment may have a configuration in which an adhesive-free area is not present on the peripheral edge of the optical film 11, and an adhesive-free area 2x₇ lies only inside the peripheral edge.

[0068] The both-sides adhesive optical film may have an adhesive-free area in each of

both a region along the peripheral edge of the first principal surface and a region inside the peripheral edge of the optical film. For example, as shown in a plan view in FIG. 20, the both-sides adhesive optical film 353 may have an adhesive-free area 2x along the short side 11a₁ of the rectangle and an adhesive-free area 2x₆ inside the long side 11a₄.

[0069] The adhesive-free area lies on the peripheral edge of the first principal surface and the adhesive-free area lies inside the peripheral edge may be connected to and integrated with each other, or not connected to each other. For example, as shown in a plan view in FIG. 21, a both-sides adhesive optical film 355 may have an adhesive-free area 2x₈ extending in parallel along one side 11a₁ of the rectangle and an adhesive-free area 2x₁ in the vicinity of the apexes of both ends of a side 11a₃.

[0070] As described above, the both-sides adhesive optical film of the present invention has a pressure sensitive adhesive layer disposed on each of both sides of the optical film, and has on at least one surface a region where the optical film is exposed without being covered with the pressure sensitive adhesive layer. Since the adhesive-free area is present, vacant spaces are formed between the optical film and an adherend in formation of an image display device. By disposing constituent members of the image display device in this space, physical interference with the pressure sensitive adhesive can be avoided, and the space can be effectively utilized to contribute to space saving and narrowing of the frame of the image display device.

DESCRIPTION OF REFERENCE SIGNS

[0071]	11	optical film
	21, 22, 29	pressure sensitive adhesive layer
	41, 42	protective sheet
	2x	adhesive-free area
	60	image display cell
	71, 72, 372	touch sensor equipped cover glass
	73	touch sensor
	74, 79	cover glass
	84	casing
	98	electroconductive wire
	91	flexible printed circuit
	72a, 372a	raised portion (printed portion)

51, 53, 56, 57A, 57B, 58, 251, 253, 451	adhesive optical film
101, 102, 103, 104, 106, 108, 109	image display device

CLAIMS

1. An image display device comprising: an image display cell; a both-sides adhesive optical film; and a front transparent member,

wherein

the both-sides adhesive optical film comprises: an optical film having a first principal surface and a second principal surface; a first pressure sensitive adhesive layer disposed on the first principal surface of the optical film; and a second pressure sensitive adhesive layer disposed on the second principal surface of the optical film,

wherein

along a peripheral edge of the first principal surface of the optical film, the both-sides adhesive optical film includes: an adhesive-free area where the optical film is exposed without being covered with the first pressure sensitive adhesive layer; and an adhesive area where the first pressure sensitive adhesive layer is disposed on the optical film,

the optical film is bonded to the image display cell with one of the first pressure sensitive adhesive layer and the second pressure sensitive adhesive layer interposed therebetween,

the optical film is bonded to the front transparent member with the other one of the first pressure sensitive adhesive layer and the second pressure sensitive adhesive layer interposed therebetween, and

any one of constituent members of the image display device is arranged in the adhesive-free area on the first principal surface of the optical film.

2. The image display device according to claim 1, wherein

the optical film is rectangular, and

the adhesive-free area lies along at least one side of a rectangle, and the adhesive area lies along at least one side of the rectangle.

3. The image display device according to claim 1 or 2, wherein

in the adhesive area, the position of a lateral of the pressure sensitive adhesive layer is coincident with the position of a lateral of the optical film at an interface between the first pressure sensitive adhesive layer and the optical film, and

the lateral of the pressure sensitive adhesive layer is positioned inside the lateral of the optical film at the center of the first pressure sensitive adhesive layer in the thickness direction.

4. An image display device comprising: an image display cell; a both-sides adhesive optical film; and a front transparent member,

wherein

the both-sides adhesive optical film comprises: an optical film having a first principal surface and a second principal surface; a first pressure sensitive adhesive layer disposed on the first principal surface of the optical film; and a second pressure sensitive adhesive layer disposed on the second principal surface of the optical film,

wherein

along the entire peripheral edge of the first principal surface of the optical film, the both-sides adhesive optical film includes an adhesive-free area where the optical film is exposed without being covered with the first pressure sensitive adhesive layer, and

a portion where the adhesive-free area has a different width lies along the peripheral edge of the first principal surface of the optical film,

the optical film is bonded to the image display cell with one of the first pressure sensitive adhesive layer and the second pressure sensitive adhesive layer interposed therebetween,

the optical film is bonded to the front transparent member with the other one of the first pressure sensitive adhesive layer and the second pressure sensitive adhesive layer interposed therebetween, and

any one of constituent members of the image display device is arranged in the adhesive-free area on the first principal surface of the optical film.

5. The image display device according to claim 4, wherein

the optical film is rectangular, and

the width of the adhesive-free area on one side of a rectangle is different from the width of the adhesive-free area on the other side of the rectangle.

6. The image display device according to any one of claims 1 to 5, wherein in the adhesive-free area, the lateral of the optical film and the lateral of the first pressure

sensitive adhesive layer extend in parallel along the peripheral edge of the optical film.

7. The image display device according to any one of claims 1 to 6, wherein the optical film is rectangular, and the adhesive-free area has a portion where the width decreases as going toward the center side from the end of the side of a rectangle.

8. An image display device comprising: an image display cell; a both-sides adhesive optical film; and a front transparent member,

wherein

the both-sides adhesive optical film comprises: an optical film having a first principal surface and a second principal surface; a first pressure sensitive adhesive layer disposed on the first principal surface of the optical film; and a second pressure sensitive adhesive layer disposed on the second principal surface of the optical film,

wherein

inside the peripheral edge of the first principal surface of the optical film, the both-sides adhesive optical film includes an adhesive-free area where the optical film is exposed without being covered with the first pressure sensitive adhesive layer,

the optical film is bonded to the image display cell with one of the first pressure sensitive adhesive layer and the second pressure sensitive adhesive layer interposed therebetween,

the optical film is bonded to the front transparent member with the other one of the first pressure sensitive adhesive layer and the second pressure sensitive adhesive layer interposed therebetween, and

any one of constituent members of the image display device is arranged in the adhesive-free area on the first principal surface of the optical film.

9. The image display device according to any one of claims 1 to 8, wherein at least a part of the adhesive-free area has a width of 10 μm or more.

10. The image display device according to any one of claims 1 to 9, wherein the second pressure sensitive adhesive layer lies along the entire peripheral edge of the second principal surface of the optical film, and a region where the second principal surface of the

optical film is exposed does not present.

11. The image display device according to any one of claims 1 to 10, wherein the optical film comprises a polarizing plate.

12. The image display device according to any one of claims 1 to 11, wherein the front transparent member is a touch sensor or a transparent plate.

13. The image display device according to any one of claims 1 to 11, wherein
the front transparent member is a touch sensor,
the optical film is bonded to the touch sensor with the first pressure sensitive adhesive layer interposed therebetween, and
the touch sensor is connected to an electrical connection member in the adhesive-free area.

14. The image display device according to any one of claims 1 to 11, wherein
the optical film comprises a touch sensor, and
the optical film is connected to an electrical connection member in the adhesive-free area.

15. The image display device according to any one of claims 1 to 11, wherein the front transparent member is disposed in the adhesive-free area.

16. The image display device according to any one of claims 1 to 11, wherein a casing is arranged in the adhesive-free area.

17. The image display device according to any one of claims 1 to 11, wherein in the adhesive-free area, an electroconductive material or a resin material is arranged in a state of contacting the first principal surface of the optical film.