(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
17 January 2008 (17.01.2008)

PCT

(10) International Publication Number
WO 2008/007828 A1

(51) International Patent Classification:
H01J 17/49 (2006.01) *G02B 5/20* (2006.01)

(21) International Application Number:
PCT/KR2006/003904

(22) International Filing Date:
28 September 2006 (28.09.2006)

(25) Filing Language: Korean

(26) Publication Language: English

(30) Priority Data:
10-2006-0065508 12 July 2006 (12.07.2006) KR
10-2006-0094688 28 September 2006 (28.09.2006) KR

(71) Applicant *(for all designated States except US)*: **LG ELECTRONICS INC.** [KR/KR]; 20, Yeoeuido-dong, Yongdeungpo-ku, Seoul 150-010 (KR).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **PARK, Yu** [KR/KR]; 3th floor, 405-34, Mangwon1-dong, Mapo-ku, Seoul 121-231 (KR). **SEO, Tae Deok** [KR/KR]; #763 Songjuk 1-ri, Gusung-myun, Kimchun-si, Kyungsang-buk-do 740-924 (KR). **JU, Jun Hwan** [KR/KR]; #105-1303 Buyoung Apt., Joong-ri, Sukjuk-myun, Chilgok-gun, Kyungsangbuk-do 718-833 (KR).

(74) Agent: **PARK, Byung Chang**; 301 Woojin Bldg., 1445-2 Seocho-dong, Seocho-ku, Seoul 137-070 (KR).

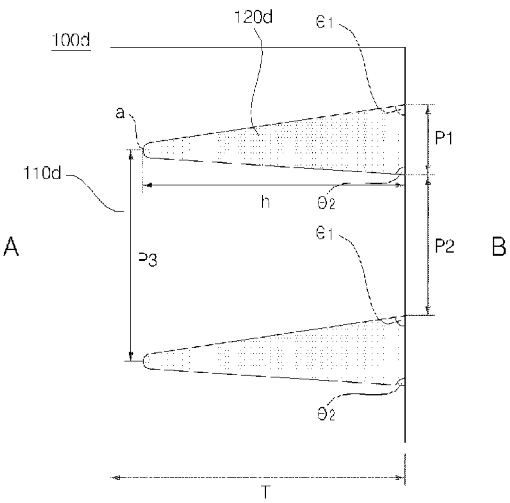
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: PLASMA DISPLAY DEVICE



(57) Abstract: The plasma display apparatus constructed above according to the present invention includes an external light shielding sheet configured to absorb and shield externally incident light to the greatest extent and to secure the aperture ratio of a panel. Accordingly, there are advantages in that a black image of a plasma display panel can be effectively implemented and the luminance of the screen can be improved.

WO 2008/007828 A1

Description

PLASMA DISPLAY DEVICE

Technical Field

[1] The present invention relates, in general, to a plasma display apparatus, and more particularly, to a plasma display apparatus in which an external light shielding sheet made of two materials with a different refractive index in order to shield external light incident from the outside of a panel is disposed at the front of the panel, thereby improving the bright and dark room contrast of the panel and luminance.

Background Art

[2] In general, a Plasma Display Panel (hereinafter, referred to as a "PDP") is an apparatus configured to generate discharge by applying voltage to electrodes disposed in discharge spaces and to display an image including characters and/or graphics by exciting phosphors with plasma generated during the discharge of gas. The PDP is advantageous in that it can be made large, light and thin, can provide a wide viewing angle in all directions, and can implement full colors and high luminance.

[3] In the PDP constructed above, when a black image is implemented, external light is reflected on the front of the panel due to white-based phosphor exposed on a lower plate of the panel. Therefore, a problem arises because a black image is recognized as a bright-based dark color, resulting in a lowered contract.

Disclosure of Invention

Technical Problem

[4] The present invention has been developed in an effort to provide a plasma display apparatus including an external light shielding sheet, having the advantages of preventing the reflection of light by effectively shielding external light incident on a panel, significantly enhancing the bright and dark room contrast of a PDP, and improving the luminance of the panel.

Technical Solution

[5] To solve the above problems, a plasma display apparatus of the present invention includes a PDP, and a filter disposed at the front of the PDP. The filter comprises an external light shielding sheet including a base unit, and a plurality of pattern units formed on the base unit. A thickness of the external light shielding sheet is set in the range of 1.01 to 2.25 times greater than a height of each of the pattern units. A first interior angle formed by an upper-side inclined surface of the pattern unit and a bottom of the pattern unit differs from a second interior angle formed by a lower-side inclined surface of the pattern unit and the bottom of the pattern unit.

[6] The second interior angle of the pattern unit is 1.01 to 1.45 or 1.02 to 1.32 times

greater than the first interior angle. The second interior angle of the pattern unit is 81 to 115 degrees.

[7] Furthermore, a distance between neighboring pattern units is 1.1 to 5 times greater than a bottom width of the pattern unit. A height of the pattern unit is 0.89 to 4.25 times greater than the shortest distance between neighboring pattern units. A distance between tops of neighboring pattern units is 1 to 3.25 times greater than the shortest distance between the pattern units.

[8] Furthermore, a refractive index of the pattern unit is 0.300 to 0.999 times greater than that of the base unit.

[9] Furthermore, the filter includes at least one of an anti-reflection layer configured to prevent reflection of external light, an NIR shielding layer configured to shield NIR radiated from the PDP, and an EMI shielding layer configured to shield EMI.

Advantageous Effects

[10] The plasma display apparatus of the present invention includes an external light shielding sheet capable of absorbing and blocking externally incident light to the greatest extent possible and securing the aperture ratio of a panel. It is therefore possible to effectively implement a black image and improve the luminance of the screen.

Brief Description of the Drawings

[11] FIG. 1 is a perspective view illustrating an embodiment of the construction of a PDP according to an embodiment of the present invention.

[12] FIG. 2 is a view illustrating an embodiment of electrode arrangements of the PDP.

[13] FIG. 3 is a timing diagram showing an embodiment of a method of driving a plasma display apparatus with one frame of an image being time-divided into a plurality of subfields.

[14] FIGS. 4 to 9 are views illustrating several embodiments of the structure of an external light shielding sheet according to an embodiment of the present invention.

[15] FIG. 10 is a view showing the front of the external light shielding sheet according to an embodiment of the present invention.

[16] FIGS. 11 to 14 are cross-sectional views illustrating embodiments of a lamination structure of a filter according to an embodiment of the present invention.

[17] FIG. 15 is a perspective view showing the construction of a plasma display apparatus according to an embodiment of the present invention.

Best Mode for Carrying Out the Invention

[18] A plasma display apparatus according to the present invention will now be described in detail with reference to the accompanying drawings.

[19] It is to be noted that the plasma display apparatus of the present invention is not

limited to the embodiments described in the specification, but may include a number of embodiments.

[20] Hereinafter, the embodiments of the present invention will be described below with reference to the accompanying drawings.

[21] FIG. 1 is a perspective view illustrating an embodiment of the construction of a PDP.

[22] Referring to FIG. 1, the PDP includes a scan electrode 11 and a sustain electrode 12 (i.e., a sustain electrode pair) both of which are formed on a front substrate 10, and address electrodes 22 formed on a rear substrate 20.

[23] The sustain electrode pair 11 and 12 includes transparent electrodes 11a and 12a, and bus electrodes 11b and 12b. The transparent electrodes 11a and 12a are generally formed of Indium-Tin-Oxide (ITO). The bus electrodes 11b and 12b may be formed using metal, such as silver (Ag) or chrome (Cr), a stack of Cr/copper (Cu)/Cr, or a stack of Cr/aluminum (Al)/Cr. The bus electrodes 11b and 12b are formed on the transparent electrodes 11a and 12a and serve to reduce a voltage drop caused by the transparent electrodes 11a and 12a having a high resistance.

[24] The PDP further includes a black matrix (BM) having a light-shielding function of reducing the reflection of external light generated from the outside of the front substrate 10 by absorbing the external light, and a function of improving the purity of the front substrate 10 and the contrast of the PDP.

[25] The black matrix includes a first black matrix 15 formed at a location at which it is overlapped with a barrier rib 21 formed in the rear substrate 20, and second black matrices 11c and 12c formed between the transparent electrodes 11a and 12a and the bus electrodes 11b and 12b.

[26] A black matrix, which is separated into the first black matrix 15 and the second black matrices 11c and 12c as described above, is called a "separation type BM". The second black matrices 11c and 12c are called a "black layer" or a "black electrode layer" since they form a layer between the electrodes.

[27] An upper dielectric layer 13 and a protection layer 14 are laminated on the front substrate 10 in which the scan electrodes 11 and the sustain electrodes 12 are formed in parallel. Charged particles from which plasma is generated are accumulated on the upper dielectric layer 13. The protection layer 14 functions to protect the upper dielectric layer 13 from sputtering of charged particles generated during the discharge of a gas and also to increase emission efficiency of secondary electrons.

[28] The address electrodes 22 are formed in the rear substrate 20 in such a way to cross the scan electrodes 11 and the sustain electrodes 12. A lower dielectric layer 24 and barrier ribs 21 are also formed on the rear substrate 20 in which the address electrodes 22 are formed.

[29] Phosphors 23, which are emitted by UV generated during the discharge of gas to generate a visible ray, is coated on the surfaces of the lower dielectric layer 24 and the barrier ribs 21.

[30] Each of the barrier ribs 21 includes a longitudinal barrier rib 21a parallel to the address electrodes 22, and a traverse barrier rib 21b crossing the address electrodes 22. The barrier ribs 21 function to separate discharge cells physically, and also prevent ultraviolet rays generated by a discharge and a visible ray from leaking to neighboring discharge cells.

[31] The structure of the panel illustrated in FIG. 1 is an embodiment of the structure of the PDP according to the present invention, and therefore the present invention is not limited to the structure of the panel illustrated in FIG. 1.

[32] For example, the PDP according to the present invention may have a structure in which the sustain electrode pair 11 and 12 include only the bus electrodes 11b and 12b, respectively, without including the transparent electrodes 11a and 12a made of ITO. This structure does not use the transparent electrodes 11a and 12a, and is therefore advantageous in that it can save the manufacturing cost of a panel. Furthermore, the bus electrodes 11b and 12b may be formed using a variety of materials, such as a photoresist material, in addition to the above listed materials.

[33] It has been shown in FIG. 1 that the barrier rib structure of the PDP is a close type barrier rib structure in which the discharge cells are closed by the longitudinal barrier ribs 21a and the traverse barrier ribs 21b. However, the barrier rib structure of the present invention is not limited to the above structure, but may include a stripe type not including the traverse barrier ribs 21b, a differential type barrier rib structure in which the longitudinal barrier rib 21a and the traverse barrier rib 21b have a different height, a channel type barrier rib structure in which a channel that can be used as an exhaust passage is formed in at least one of the longitudinal barrier rib 21a and the traverse barrier rib 21b, a hollow type barrier rib structure in which a hollow is formed in at least one of the longitudinal barrier rib 21a and the traverse barrier rib 21b, and so on.

[34] In the differential type barrier rib structure, it is preferred that the traverse barrier rib 21b have a height higher than that of the longitudinal barrier rib 21a. In the channel type barrier rib structure or the hollow type barrier rib structure, it is preferred that a channel or a hollow be formed in the traverse barrier rib 21b.

[35] Meanwhile, in an embodiment of the present invention, it has been shown and described that the R, G, and B discharge cells are arranged on the same line. However, the R, G, and B discharge cells may be arranged in different fashions. For example, the R, G, and B discharge cells may have a delta type arrangement in which they are arranged in a triangle form. Furthermore, the discharge cells may be arranged in a variety of forms, such as square, pentagon and hexagon.

[36] FIG. 2 is a view illustrating an embodiment of electrode arrangements of the PDP. It is preferred that a plurality of discharge cells constituting the PDP be arranged in matrix form, as illustrated in FIG. 2. The plurality of discharge cells are respectively disposed at the intersections of scan electrode lines Y1 to Ym, sustain electrodes lines Z1 to Zm, and address electrodes lines X1 to Xn. The scan electrode lines Y1 to Ym may be driven sequentially or simultaneously. The sustain electrode lines Z1 to Zm may be driven at the same time. The address electrode lines X1 to Xn may be driven with them being divided into even-numbered lines and odd-numbered lines, or may be driven sequentially.

[37] The electrode arrangements illustrated in FIG. 2 is only an embodiment of the electrode arrangements of the PDP according to the present invention. Thus, the present invention is not limited to the electrode arrangements and the driving method of the PDP, as illustrated in FIG. 2. For example, the present invention may be applied to a dual scan method in which two of the scan electrode lines Y1 to Ym are scanned at the same time. The address electrode lines X1 to Xn may be driven with them being divided into upper and lower parts on the basis of the center of the panel.

[38] FIG. 3 is a timing diagram illustrating an embodiment of a method of driving the PDP with one frame of an image being time-divided into a plurality of subfields.

[39] Referring to FIG. 3, a unit frame may be divided into a predetermined number (for example, eight subfields SF1, ..., SF8) in order to represent gray levels of an image. Each of the subfields SF1, ..., SF8 is divided into a reset period (not shown), address periods A1, ..., A8, and sustain periods S1, ..., S8.

[40] In each of the address periods A1, ..., A8, data signals are applied to the address electrodes X, and scan pulses corresponding to the data signals are sequentially applied to the scan electrodes Y. In each of the sustain periods S1, ..., S8, a sustain pulse is alternately applied to the scan electrodes Y and the sustain electrodes Z. Accordingly, a sustain discharge is generated in discharge cells selected in the address periods A1, ..., A8.

[41] The luminance of the PDP is proportional to the number of sustain discharges within the sustain periods S1, ..., S8 occupied in the unit frame. In the case where one frame constituting 1 image is represented by eight subfields and 256 gray levels, a different number of sustain pulses may be sequentially allocated to each subfield in the ratio of 1, 2, 4, 8, 16, 32, 64, and 128. Furthermore, in order to obtain the luminance of 133 gray levels, cells can be addressed during the subfield1 period, the subfield3 period, and the subfield8 period, thus generating a sustain discharge.

[42] Meanwhile, the number of sustain discharges allocated to each subfield may be variably decided depending on the weights of subfields. That is, an example in which one frame is divided into eight subfields has been described by reference to FIG. 3.

However, the present invention is not limited to the above example, but the number of subfields constituting one frame may be changed depending on design specifications. For example, the PDP can be driven by dividing one frame into eight or more subfields, such as 12 or 16 subfields.

[43] FIGS. 4 to 6 are cross-sectional views illustrating embodiments of the structure of an external light shielding sheet according to an embodiment of the present invention.

[44] Referring to FIGS. 4 to 9, an external light shielding sheet 100 of the present invention includes a base unit 110 and pattern units 120.

[45] In general, external light affecting lowering in the bright and dark room contrast of the PDP exists over the head of a user. Such external light is refracted into the pattern units 120 and is absorbed and shielded. In order for light emitted from the panel so as to display an image to be totally reflected from inclined surfaces c and d of the pattern unit 120, it is preferred that a refractive index of each of the pattern units 120 be lower than that of the base unit 110. In this case, by absorbing the external light so that it is not reflected toward a viewer side and increasing the amount of reflection of light emitted from the panel, the bright and dark room contrast of a display image can be improved.

[46] In order to maximize the absorption of external light and the total reflection of panel light considering the angle of the external light incident on the panel, it is preferable that the reflective index of the pattern unit 120 be 0.3 to 0.999 times greater than that of the base unit 110. In order to maximize the total reflection of light emitted from the panel from the inclined surfaces of the pattern unit 120, it is preferred that the reflective index of the pattern unit 120 be 0.3 to 0.8 times greater than that of the base unit 110 considering upper and lower viewing angles of the PDP.

[47] The base unit 110 is formed of a transparent plastic material having a given reflective index, which enables light to be transmitted smoothly and also enables light to be refracted at a given angle. For example, the base unit 110 may be preferably formed using a resin-based material formed by a UV hardening method, but may be formed using a firm glass material in order to increase the effect of protecting the front of the panel.

[48] The pattern units 120 configured to shield external light to the greatest extent possible and formed on the base unit 110 has a sectional shape in which the width of a bottom "b" is greater than that of a top "a". For example, it may be preferred that the sectional shape be a triangle in which the width of the top "a" is close to 0. However, the sectional shape may be a trapezoid having a given width, a curved shape or the like.

[49] In order to maximize the external light shielding effect of the external light shielding sheet 100, it is preferred that the top "a" of the pattern unit 120 be disposed

on a user side A on which light is incident from the outside, and the bottom "b" thereof be disposed on the panel side B.

[50] The pattern units 120 show a color darker than that of the base unit 110 made of a transparent plastic material. The pattern unit 120 may include a material having an optical absorption characteristic in order to further effectively shield and absorb externally incident light. Alternatively, the pattern unit 120 may include a black-based material, or may have surfaces coated with a black-based material.

[51] In order to shield external light, generally existing over the head of a user, and to secured a further widened aperture ratio of the panel, it is preferred that angles formed by the bottom "b" of the pattern unit, and two inclined surfaces c and d, being divided into upper and lower sides on the basis of a location in which an external light source exists, respectively, differ from each other.

[52] In other words, it is preferred that a first interior angle θ1 formed by an upper-side inclined surface c on which external light mainly affecting the bright and dark room contrast of the PDP and the bottom be set smaller than a second interior angle θ2 formed by a lower-side inclined surface d and the bottom. It is also preferred that the second interior angle θ2 of the pattern unit 120 be 1.01 to 1.45 times greater than the first interior angle θ1.

[53] When the second interior angle θ2 of the pattern unit 120 included in the external light shielding sheet 100 is 1.02 to 1.32 times greater than the first interior angle θ1, the aperture ratio of the external light shielding sheet 100 cane be secured by maximum in a range allowable in fabrication of the pattern units, and the external light shielding effect and reflection of interior light of the panel can be maximized.

[54] The following Table 1 is an experimental result on whether the aperture ratio of the external light shielding sheet 100 and the interior light of the panel have been passed depending on the first interior angle θ1 and the second interior angle θ2 of the pattern units 120.

[55] Table 1

θ1 (degrees)	θ2 (degrees)	Aperture Ratio (%)	Internal Light Passed
80	80	50	○
80	82	60	○
80	85	63	○
80	87	65	○
80	90	68	○
80	92	70	○

80	95	73	○
80	98	75	○
80	100	78	○
80	105	80	○
80	110	83	△
80	115	85	△
80	120	88	X
80	125	90	X

[56] Referring to Table 1, in the case where the first interior angle θ1 of the pattern unit 120 is 80 degrees, only when the second interior angle θ2 of the pattern unit 120 is set higher than 80 degrees, an aperture ratio in which the loss of transmittance of the interior light can be minimized compared with the contrast ratio of the panel exceeds 50 %, and at the same time, the aperture ratio gradually increases. If the second interior angle θ2 becomes 120 degrees, however, the aperture ratio increases to 88 %, but light emitted from the interior of the panel can not pass.

[57] In other words, when the second interior angle θ2 of the pattern unit 120 is 1.01 to 1.45 times greater than the first interior angle θ1, the aperture ratio of the external light shielding sheet 100 can be secured sufficiently, and light emitted from the interior of the panel can pass externally sufficiently.

[58] Furthermore, in order to maximize the aperture ratio and the transmission of the panel interior light considering the convenience of a manufacturing process, the second interior angle θ2 of the pattern unit 120 may be set to 1.02 to 1.32 times greater than the first interior angle θ1. However, it is preferable that the second interior angle θ2 be set in the range of 81 to 115 degrees.

[59] As illustrated in FIG. 4, the external light shielding sheet 100 may have an acute angle in which the first interior angle θ1 of the pattern unit 120 and the second interior angle θ2 greater than the first interior angle θ1 is smaller than 90 degrees. As illustrated in FIG. 5, the second interior angle θ2 greater than the first interior angle θ1 of the pattern unit 120a may be a right angle. As illustrated in FIG. 6, the external light shielding sheet 100 may have an obtuse angle in which the second interior angle θ2 greater than the first interior angle θ1 of the pattern unit 120b and 90 degrees is 115 degrees.

[60] At this time, as the second interior angle θ2 greater than the first interior angle θ1 of the pattern unit 120 increases, the aperture ratio is improved. However, in order for light emitted from the panel to be totally reflected from the pattern units 120 and then

to reach the user, it is preferred that the second interior angle θ2 of the pattern unit 120 be set smaller than 115 degrees, as listed in Table 1.

[61] The pattern unit 120 of the external light shielding sheet 100 may have a polygonal shape, such as a square or a trapezoid, as illustrated in FIG. 7, not the triangle. Furthermore, the top "a" of the pattern unit 120d may be curved, as illustrated in FIG. 8.

[62] The structure of the external light shielding sheet according to the present invention will be described in more detail with reference to FIGS. 8 to 9. When a thickness T of the external light shielding sheet is 20 to 250 ㎛, a manufacturing process is convenient, and an adequate optical transmittance can be obtained. In order for light emitted from the panel to be transmitted smoothly and for externally incident light to be refracted and effectively absorbed and shielded by the pattern units 120, and to secure the robustness of the sheet, the thickness T of the external light shielding sheet may be set in the range of 100 to 180 ㎛.

[63] When a height "h" of each of the pattern units included in the external light shielding sheet is 80 to 170 ㎛, the fabrication of the pattern units is most convenient, an adequate aperture ratio of the external light shielding sheet can be secured, and the external light shielding effect and the effect of reflecting light emitted from the panel can be maximized.

[64] The height "h" of the pattern unit may be varied depending on the thickness T of the external light shielding sheet. In general, external light, which is incident on the panel to affect lowering in the bright and dark room contrast of the panel, is mainly located at a location higher than the panel. Thus, in order to effectively shield external light incident on the panel, it is preferred that the height "h" of the pattern unit have a given value range with respect to the thickness T of the external light shielding sheet.

[65] Referring to FIG. 9, as the height "h" of the pattern unit increases, the thickness of the base unit at the top portion of the pattern unit becomes thin, resulting in insulating breakdown. As the height "h" of the pattern unit decreases, external light having a given angle range is incident on the panel, thus hindering proper shielding of the external light.

[66] The following Table 2 is an experimental result on insulating breakdown of the external light shielding sheet and the external light shielding effect depending on the thickness T of the external light shielding sheet and the height "h" of the pattern unit.

[67] Table 2

Sheet Thicknes (T)	Height of Pattern Unit	Insulating Breakdown	External Light Shielding Effect
120 ㎛	120 ㎛	○	○

120 ㎛	115 ㎛	△	○
120 ㎛	110 ㎛	x	○
120 ㎛	105 ㎛	x	○
120 ㎛	100 ㎛	x	○
120 ㎛	95 ㎛	x	○
120 ㎛	90 ㎛	x	○
120 ㎛	85 ㎛	x	○
120 ㎛	80 ㎛	x	○
120 ㎛	75 ㎛	x	△
120 ㎛	70 ㎛	x	△
120 ㎛	65 ㎛	x	△
120 ㎛	60 ㎛	x	△
120 ㎛	55 ㎛	x	△
120 ㎛	50 ㎛	x	x

[68] Referring to Table 2, when the thickness T of the external light shielding sheet is 120 ㎛, if the height "h" of the pattern unit becomes 120 ㎛ or more, the failure rate of a product may increase since there is a danger that the pattern unit may experience insulating breakdown. If the height "h" of the pattern unit becomes 115 ㎛ or less, the failure rate of the external light shielding sheet may decrease since there is no danger that the pattern unit may experience insulating breakdown. However, when the height of the pattern unit is set to 75 ㎛ or less, an efficiency in which external light is blocked by the pattern unit may decrease. When the height of the pattern unit is set to 50 ㎛ or less, external light can be incident on the panel.

[69] When the thickness T of the external light shielding sheet is 1.01 to 2.25 times greater than the height "h" of the pattern unit, insulating breakdown at the top portion of the pattern unit can be prevented, and external light can be prevented from being incident on the panel. Furthermore, in order to increase the reflectance of light emitted from the panel and to secure a sufficient viewing angle while preventing insulating breakdown and external light from being incident on the panel, the thickness T of the external light shielding sheet may be 1.01 to 1.5 times greater than the height "h" of the pattern unit.

[70] Referring to FIG. 9, in order to secure the aperture ratio of the external light shielding sheet including the pattern units, and maximize the external light shielding effect and the reflection efficiency of the panel interior light, it is preferred that a

bottom width P1 of the pattern unit be set in the range of 18 to 35 □ by taking the convenience of fabrication into consideration.

[71] In order for the panel light to be radiated to a user side, thus to secure the aperture ratio for displaying a display image of an adequate luminance, and to secure an optimal inclined surface gradient of the pattern units 120 for increasing the external light shielding effect and the panel light reflection efficiency, the shortest distance P2 between neighboring pattern units may be set in the range of 40 to 90 □, and a distance P3 between tops of neighboring pattern units may be set in the range of 60 to 130 □.

[72] For the above reasons, when the shortest distance P2 between two neighboring pattern units is 1.1 to 5 times greater than the bottom width of the pattern unit 120, an adequate aperture ratio for display can be secured. Furthermore, in order to optimize the external light shielding effect and the panel light reflection efficiency while securing the aperture ratio, the shortest distance P2 between two neighboring pattern units may be 1.5 to 3.5 times greater than the bottom width of the pattern unit 120.

[73] The following Table 3 is an experimental result on the aperture ratio and the external light shielding effect of the external light shielding sheet depending on the bottom width P1 of the pattern unit of the external light shielding sheet 100 and a width at the center (h/2) of the height of the pattern unit. In this case, the bottom width of the pattern unit was set to 23 □.

[74] Table 3

Bottom Widht (□) of Pattern Unit	Center Width (□) of Pattern Unit	Aperture Ratio (%)	External Light Shielding Effect
23.0	23.0	50	○
23.0	22.0	55	○
23.0	20.0	60	○
23.0	18.0	65	○
23.0	16.0	70	○
23.0	14.0	72	○
23.0	12.0	75	○
23.0	10.0	78	○
23.0	9.0	80	○
23.0	8.0	83	△
23.0	6.0	85	△
23.0	5.0	90	X

[75] Referring to Table 3, in the case where the bottom width P1 of the pattern unit of the external light shielding sheet 100 is 23.0 □, if the width at the center (h/2) of the pattern unit is set to 23 □, light emitted from the interior of the panel can pass through the user side, so that the aperture ratio of 50 % or more in which an image is displayed can be secured. However, if the width at the center (h/2) of the pattern unit is 8 □ or less, an efficiency in which external light is shielded can be decreased. If the width at the center (h/2) of the pattern unit is 5 □ or less, external light can be incident on the panel.

[76] Thus, when the width at the center (h/2) of the pattern unit of the external light shielding sheet is 1 to 3.5 or 1.5 to 2.5 times greater than the bottom width P2, external light can be prevented from being incident on the panel, and an adequate aperture ratio can be secured.

[77] The height "h" of the pattern unit is set to 0.89 to 4.25 times greater than the shortest distance between neighboring pattern units by taking an angle in which external light is incident on the panel into consideration. In this case, the reflection efficiency of light emitted from the interior of the panel and the external light shielding efficiency can be maximized, and the upper and lower viewing angles depending on the height "h" of the pattern unit can be secured sufficiently.

[78] Incidentally, in order to secure the highest aperture ratio of the external light shielding sheet, the distance between the tops of neighboring pattern units may be 1 to 3.25 times greater than the shortest distance between neighboring pattern units. It is therefore possible to maximize the external light shielding efficiency while securing the aperture ratio.

[79] FIG. 10 is a front view of the external light shielding sheet according to an embodiment of the present invention.

[80] As illustrated in FIG. 10, it is preferred that the pattern units 120 be arranged on the base unit 110 in a row at given intervals. There is shown in FIG. 10 that the pattern units 120 are parallel to the top or bottom of the external light shielding sheet 100. However, the pattern units 120 may be formed at a given tilt angle from the top or bottom of the external light shielding sheet. In this case, it is possible to prevent the Moire phenomenon generated by the black matrices, the black layer, the barrier ribs, the bus electrodes, etc. within the panel.

[81] The Moire phenomenon refers to patterns of a low frequency, which occur as patterns of a similar lattice shape are overlapped. For example, the Moire phenomenon may refer to wave patterns appearing when mosquito nets are overlapped. The Moire phenomenon is associated with not only the angles formed by the top or bottom of the external light shielding sheet and the pattern units, but also the bottom width of the pattern unit, having substantially the same width as that of the pattern unit, the width of

the bus electrode formed within the panel, and the width of the longitudinal barrier rib.

[82] The following Table 4 is an experimental result on whether the Moire phenomenon has occurred and the external light shielding effect, depending on the ratio of the bottom width of the pattern unit of the external light shielding sheet and the width of the bus electrode formed in the front substrate of the panel. In this case, the width of the bus electrode was set to 90 □.

[83] Table 4

Bottom Width of Pattern Unit/ Width of Bus Electrode	MoirePhenomenon	External Light Shielding Effect
0.10	△	X
0.15	△	X
0.20	X	△
0.25	X	○
0.30	X	○
0.35	X	○
0.40	X	○
0.45	△	○
0.50	△	○
0.55	○	○
0.60	○	○

[84] From Table 4, it can be seen that when the bottom width of the pattern unit is 0.2 to 0.5 times the width of the bus electrode, the Moire phenomenon can be reduced, and external light incident on the panel can also be reduced. In order to prevent the Moire phenomenon and effectively shield external light while securing the aperture ratio for discharging the panel light, it is preferred that the bottom width of the pattern unit be 0.25 to 0.4 times greater than the width of the bus electrode.

[85] The following Table 5 is an experimental result on whether the Moire phenomenon has occurred and the external light shielding effect, depending on the ratio of the bottom width of the pattern unit of the external light shielding sheet and the width of the longitudinal barrier rib formed in the rear substrate of the panel. In this case, the width of the longitudinal barrier rib was set to 50 □.

[86] Table 5

Bottom Width of Pattern Unit/Top Width of Longitudinal Barrier Rib	MoirePhenomeno n	External Light-Shielding Effect

0.10	○	X
0.15	△	X
0.20	△	X
0.25	△	X
0.30	X	△
0.35	X	△
0.40	X	○
0.45	X	○
0.50	X	○
0.55	X	○
0.60	X	○
0.65	X	○
0.70	△	○
0.75	△	○
0.80	△	○
0.85	○	○
0.90	○	○

[87] From Table 5, it can be seen that when the width D1 of the bottom of the pattern unit is 0.3 to 0.8 times greater than the width of the longitudinal barrier rib, the Moire phenomenon can be reduced, and external light incident on the panel can also be decreased. In order to prevent the Moire phenomenon and also effectively shield external light while securing the aperture ratio for discharging the panel light, it is preferred that the bottom width of the pattern unit be 0.4 to 0.65 times greater than the width of the longitudinal barrier rib.

[88] FIGS. 11 to 14 are cross-sectional views illustrating embodiments of a lamination structure of a filter according to an embodiment of the present invention. The filter formed at the front of the PDP may include an AR/NIR sheet, an EMI shielding sheet, an external light shielding sheet, an optical characteristic sheet, and so on.

[89] Referring to FIGS. 11 to 14, an AR/NIR sheet 210 includes an AR layer 211 disposed at the front of a base sheet 213 made of a transparent plastic material, and a NIR shielding layer 212 disposed at the rear of the base sheet 213. The AR layer 211 serves to prevent externally incident light from reflecting therefrom, thus decreasing a glairing phenomenon. The NIR shielding layer 212 serves to shield NIR radiated from

the panel, so that signals transferred using infrared rays, such as a remote controller, can be transferred normally.

[90] At this time, the base sheet 213 may be formed using a variety of materials by taking use conditions or transparency, an insulating property, a heat-resistance property, mechanical strength, etc. into consideration. For example, the materials of the base sheet 213 may include poly polyester-based resin, polyamid-based resin, polyolefin-based resin, vinyl-based resin, acryl-based resin, cellulose-based resin, and so on. In general, it is preferred that the base sheet 213 be formed using a polyester-based material, such as polyethylene tereophthalate (PET) and polyethylene naphthalate (PEN) having a good transparency and transmittance of a visible ray of 80 % or more. The thickness of the base sheet 213 may be preferably set in the range of 50 to 500 □ considering that it can prevent damage to the sheet by overcoming weak mechanical strength and it can save cost by having an necessary thickness.

[91] The AR layer 211 may generally include an anti-reflection layer. The NIR shielding layer 212 is formed using an NIR absorbent which can be utilized and in which NIR transmittance of a wavelength band of 800 to 1100 □, emitted from the PDP, is 20 % or less, preferably, 10 % or less. The NIR absorbent may be formed using materials, such as NIR absorbent pigments having a high optical transmittance of a visible ray region, such as polymethine-base, cyanine-based compound, phthalocyanine-based compound, naPhthalocyanine-based compound, buthalocyanine-based compound, anthraquinone-based compound, dithiol-based compound, imonium-based compound, diimmonium-based compound.

[92] The EMI shielding sheet 220 includes an EMI shielding layer 221 disposed at the front of a base sheet 222 made of a transparent plastic material. The EMI shielding layer 221 functions to shield EMI, thereby preventing EMI, radiated from the panel, from being emitting externally. In general, the EMI shielding layer 221 is formed to have a mesh structure using a conductive material.

[93] In order to ground the EMI shielding layer, a conductive material is entirely coated on the outside of the pattern, i.e., an invalid region of the EMI shielding sheet 220 on which an image is not displayed. Materials of the metal layer forming the pattern of the EMI shielding sheet may include metal with an enough conductivity to shield electronic waves, such as gold, silver, iron, nickel, chrome and aluminum. The materials may be used as a single material, an alloy or multiple layers.

[94] If a black oxidization process is performed on the bottom of the pattern, the bright and dark room contrast of a panel, such as the black matrix formed within the panel, can be improved. The black oxidization process is performed on at least one side of the outer circumference of the pattern so that it has a color darker than the base unit. In this case, when external light such as sunlight or electrical light is incident on the panel, the

blackened portion can prohibit and absorb reflection, thus improving a display image of the PDP with a high contrast.

[95] The black oxidization process may include a plating method. In this case, the black oxidization process can be easily performed on all the surfaces of the pattern since adherence force of the plating method is excellent. The plating materials may include one or more compounds selected from copper, cobalt, nickel, zinc, tin and chrome, for example, oxide compounds such as copper oxide, copper dioxide and oxidized steel.

[96] It is preferred that the pattern width of the EMI shielding layer be set to 10 to 30 □. In this case, a sufficient electrical resistance value for EMI shielding can be obtained, and the aperture ratio for an adequate optical transmittance can be secured.

[97] In general, an external light source exists in a room, outside the room or over the head of a user. The external light shielding sheet 230 is used to represent a black image of the PDP as dark by effectively shielding the external light.

[98] An adhesive 240 is formed between the AR/NIR sheet 210, the EMI shielding sheet 220, and the external light shielding sheet 1030, so that each of the sheets and the filter can be firmly adhered at the front of the panel. It is preferred that the base sheets included between the respective sheets be formed using substantially the same material by taking the convenience of fabrication of the filter into consideration.

[99] Meanwhile, it has been shown in FIG. 11 that the AR/NIR sheet 210, the EMI shielding sheet 220 and the external light shielding sheet 1030 are sequentially laminated. However, as illustrated in FIG. 12, the AR/NIR sheet 210, the external light shielding layer 1030, and the EMI shielding sheet 220 may be sequentially laminated. Furthermore, the lamination sequence of the respective sheets may be changed by those skilled in the art. Incidentally, at least one of the sheets may be omitted.

[100] Referring to FIGS. 13 and 14, a filter 300 disposed at the front of a panel may further include an optical characteristic sheet 320 in addition to the AR/NIR sheet 310, the EMI shielding sheet 330 and the external light shielding sheet 340 as illustrated in FIGS. 11 and 12. The optical characteristic sheet 320 functions to improve a color temperature and a luminance characteristic of light incident from the panel and. The optical characteristic sheet 320 includes a base sheet 322 made of a transparent plastic material, and an optical characteristic layer 321 made of dyes and an adhesive and laminated at the front or rear of the base sheet 322.

[101] At least one of the base sheets included each of the sheets illustrated in FIGS. 11 to 14 may be omitted. One of the base sheets may be formed using glass not a plastic material in order to improve the function of protecting the panel. It is preferred that the glass be spaced apart from the panel at a given distance.

[102] FIG. 15 is a perspective view showing the construction of a plasma display apparatus according to an embodiment of the present invention.

[103] Referring to FIG. 15, a filter 100 is preferably formed at the front of the PDP according to an embodiment of the present invention. The filter 100 may include an external light shielding sheet, an AR sheet, a NIR shielding sheet, an EMI shielding sheet, an optical characteristic sheet, and so on.

[104] An adhesive layer of 10 to 30 □ in thickness is layered between the filter 100 and the panel, thus facilitating the attachment of the panel and the filter 100 and increasing the adhesive property. In order to protect the panel from external pressure, etc., an adhesive layer having a thickness of 30 to 120 □ may be formed between the filter 100 and the panel.

[105] As descried above, the plasma display apparatus according to the present invention has been described with reference to the accompanying drawings. It is to be appreciated that the present invention is not limited to the disclosed embodiments and drawings, and those skilled in the art can change or modify the embodiments without departing from the scope and spirit of the present invention.

Industrial Applicability

[106] As described above, in accordance with the plasma display apparatus according to the present invention, external light incident on the inetrior of a panel can be shielded, and the bright and dark room contrast can be improved accordingly. Furthermore, in order to improve the bright and dark room contrast of a PDP, a black matrix, an anti-reflection layer attached to a conventional filter, and so on have been used. In the present invention, however, external light incident on the interior of discharge cells of a panel can be effectively blocked. Accordingly, it is expected that the bright and dark room contrast of a panel can be improved significantly.

[107] While the present invention has been described with reference to the particular illustrative embodiments, it is not to be restricted by the embodiments but only by the appended claims. It is to be appreciated that those skilled in the art can change or modify the embodiments without departing from the scope and spirit of the present invention.

Claims

[1] A plasma display apparatus, comprising:
a Plasma Display Panel (PDP); and
a filter disposed at the front of the PDP,
wherein the filter comprises an external light shielding sheet including a base unit, and a plurality of pattern units formed on the base unit,
a thickness of the external light shielding sheet is set in the range of 1.01 to 2.25 times greater than a height of each of the pattern units, and
a first interior angle formed by an upper-side inclined surface of the pattern unit and a bottom of the pattern unit differs from a second interior angle formed by a lower-side inclined surface of the pattern unit and the bottom of the pattern unit.

[2] The plasma display apparatus of claim 1, wherein the first interior angle formed by the upper-side inclined surface of the pattern unit and the bottom of the pattern unit is smaller than the second interior angle formed by the lower-side inclined surface of the pattern unit and the bottom of the pattern unit.

[3] The plasma display apparatus of claim 2, wherein the second interior angle of the pattern unit is 1.01 to 1.45 times greater than the first interior angle.

[4] The plasma display apparatus of claim 2, wherein the second interior angle of the pattern unit is 1.02 to 1.32 times greater than the first interior angle.

[5] The plasma display apparatus of claim 2, wherein the second interior angle of the pattern unit is 81 to 115 degrees.

[6] The plasma display apparatus of claim 1, wherein a bottom width of the pattern unit is 1 to 3.5 times greater than a width at the center of a height of the pattern unit.

[7] The plasma display apparatus of claim 1, wherein the shortest distance between neighboring pattern units is 1.1 to 5 times greater than a bottom width of the pattern unit.

[8] The plasma display apparatus of claim 1, wherein a height of the pattern unit is 0.89 to 4.25 times greater than the shortest distance between neighboring pattern units.

[9] The plasma display apparatus of claim 1, wherein a distance between tops of neighboring pattern units is 1 to 3.25 times greater than the shortest distance between the pattern units.

[10] The plasma display apparatus of claim 1, wherein a refractive index of the pattern unit is smaller than that of the base unit.

[11] The plasma display apparatus of claim 1, wherein a refractive index of the pattern unit is 0.300 to 0.999 times greater than that of the base unit.

[12] The plasma display apparatus of claim 1, wherein the filter comprises at least one of an anti-reflection layer configured to prevent reflection of external light, an NIR shielding layer configured to shield NIR radiated from the PDP, and an EMI shielding layer configured to shield EMI.

[13] The plasma display apparatus of claim 1, wherein a bottom width of the pattern unit is set in the range of 18 to 35 ㎛.

[14] The plasma display apparatus of claim 1, wherein a height of the pattern unit is set in the range of 80 to 170 ㎛.

[15] The plasma display apparatus of claim 1, wherein a distance between neighboring pattern units is set in the range of 40 to 90 ㎛.

[16] A filter, comprising:
an external light shielding sheet including a base unit and a plurality of pattern units formed on the base unit,
wherein a thickness of the external light shielding sheet is set in the range of 1.01 to 2.25 times greater than a height of each of the pattern units, and
a first interior angle formed by an upper-side inclined surface of the pattern unit and a bottom of the pattern unit differs from a second interior angle formed by a lower-side inclined surface of the pattern unit and the bottom of the pattern unit.

[17] The filter of claim 16, wherein the first interior angle formed by the upper-side inclined surface of the pattern unit and the bottom of the pattern unit is smaller than the second interior angle formed by the lower-side inclined surface of the pattern unit and the bottom of the pattern unit.

[18] The filter of claim 16, wherein the second interior angle of the pattern unit is 1.01 to 1.45 times greater than the first interior angle.

[19] The filter of claim 16, wherein the second interior angle of the pattern unit is 1.02 to 1.32 times greater than the first interior angle.

[20] The filter of claim 16, wherein the second interior angle of the pattern unit is 81 to 115 degrees.

[21] The filter of claim 16, wherein a bottom width of the pattern unit is 1 to 3.5 times greater than a width at the center of a height of the pattern unit.

[22] The filter of claim 16, wherein the shortest distance between neighboring pattern units is 1.1 to 5 times greater than a bottom width of the pattern unit.

[23] The filter of claim 16, wherein a height of the pattern unit is 0.89 to 4.25 times greater than the shortest distance between neighboring pattern units.

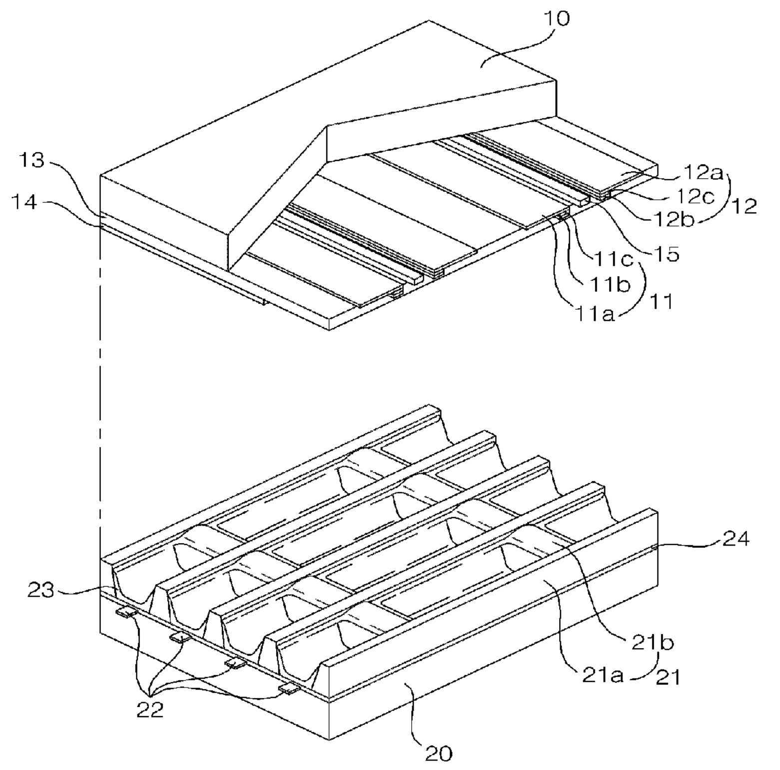
[24] The filter of claim 16, wherein a distance between tops of neighboring pattern units is 1 to 3.25 times greater than the shortest distance between the pattern units.

[25] The filter of claim 16, wherein the filter comprises at least one of an anti-

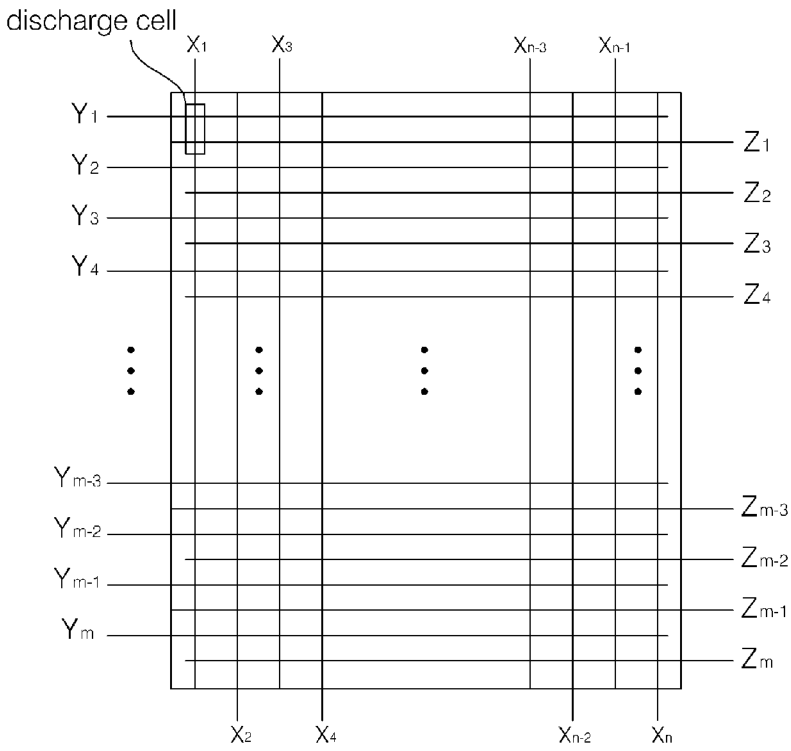
reflection layer configured to prevent reflection of external light, an NIR shielding layer configured to shield NIR radiated from the PDP, and an EMI shielding layer configurd to shield EMI.

[26] The filter of claim 16, wherein a refractive index of the pattern unit is 0.300 to 0.999 times greater than that of the base unit.

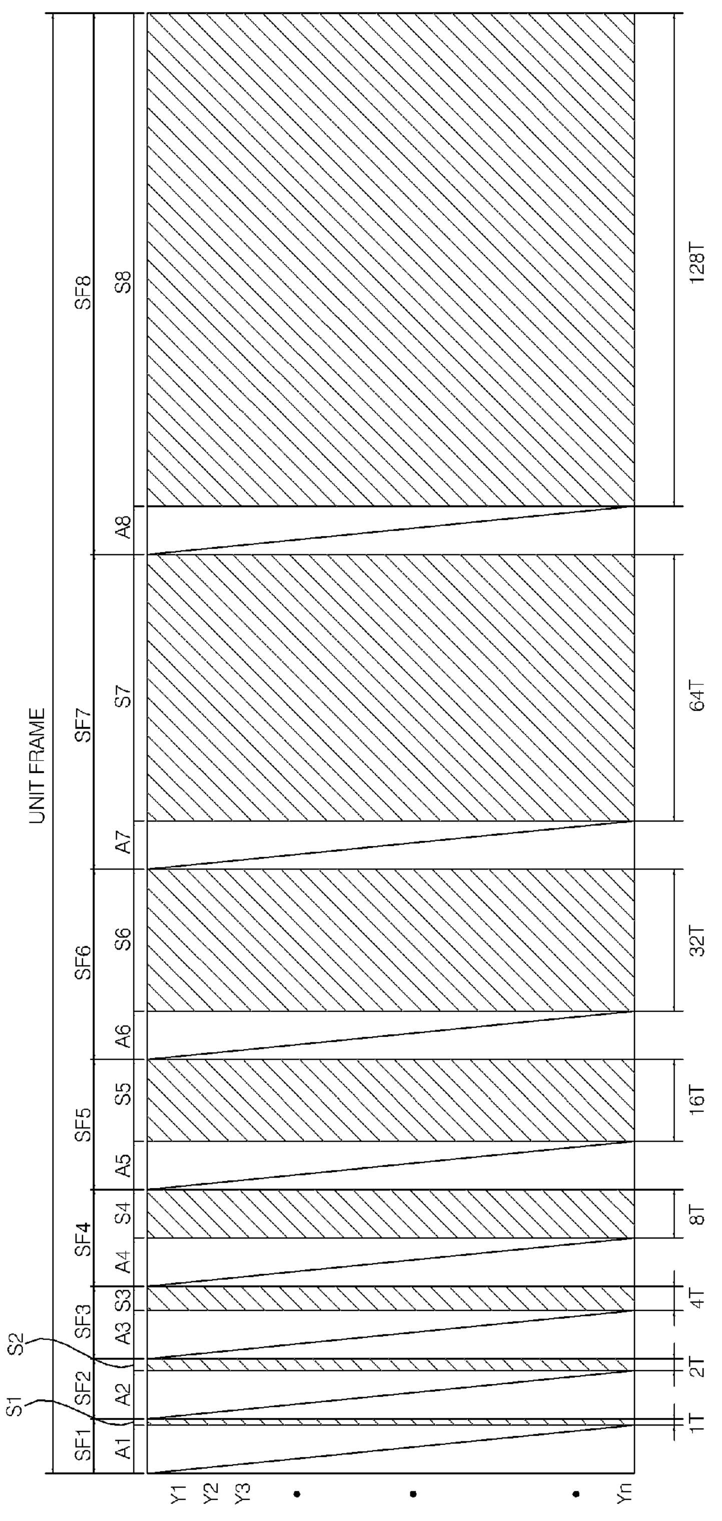
[Fig. 1]


10
13
14
12a
12c
12
12b
15
11c
11b
11
11a
24
23
21b
21a
21
22
20

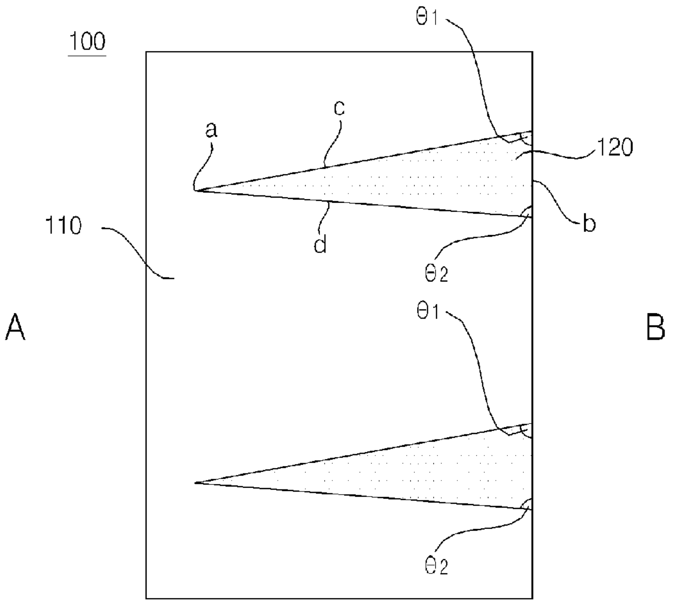
[Fig. 2]


discharge cell
X1
X3
Xn-3
Xn-1
Y1
Y2
Y3
Y4
Ym-3
Ym-2
Ym-1
Ym
Z1
Z2
Z3
Z4
Zm-3
Zm-2
Zm-1
Zm
X2
X4
Xn-2
Xn

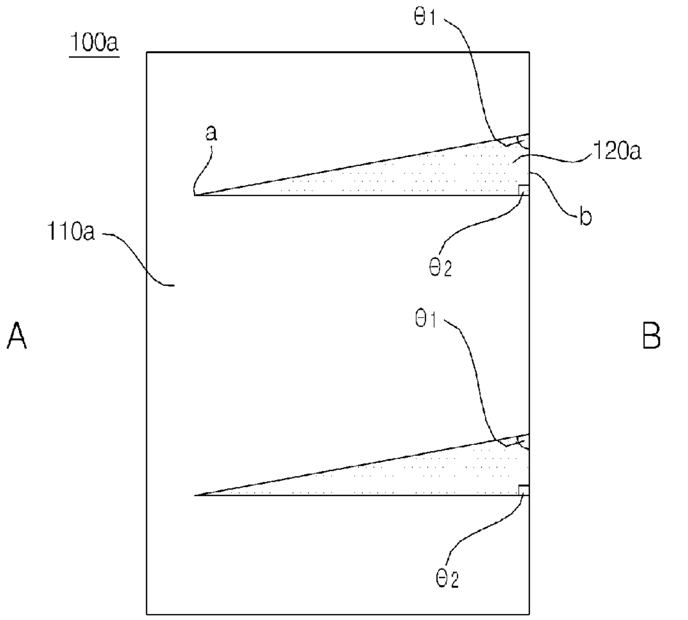
[Fig. 3]


UNIT FRAME
SF1
SF2
SF3
SF4
SF5
SF6
SF7
SF8
A1
A2
A3
A4
A5
A6
A7
A8
S1
S2
S3
S4
S5
S6
S7
S8
1T
2T
4T
8T
16T
32T
64T
128T
Y1
Y2
Y3
Yn

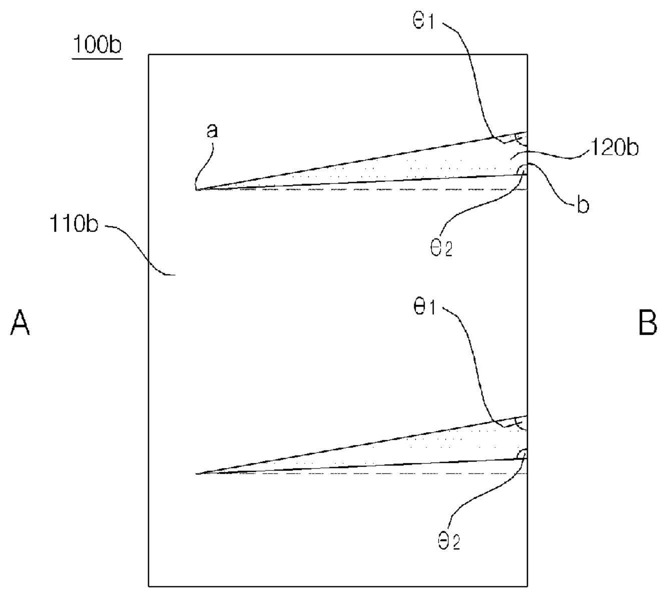
[Fig. 4]



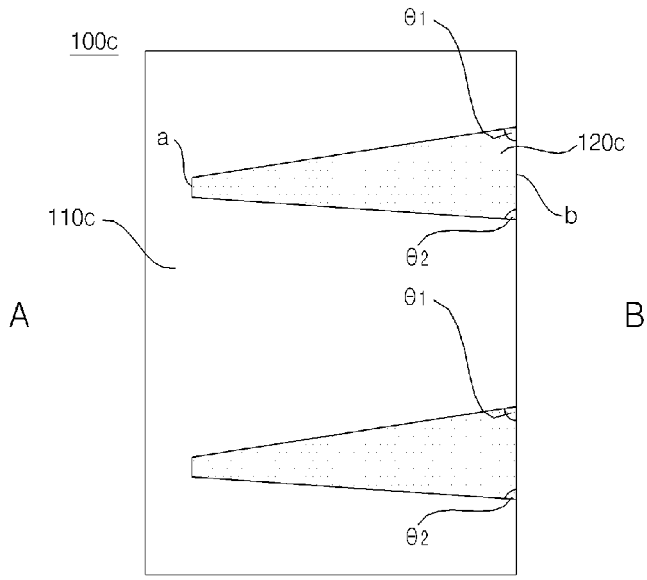
[Fig. 5]



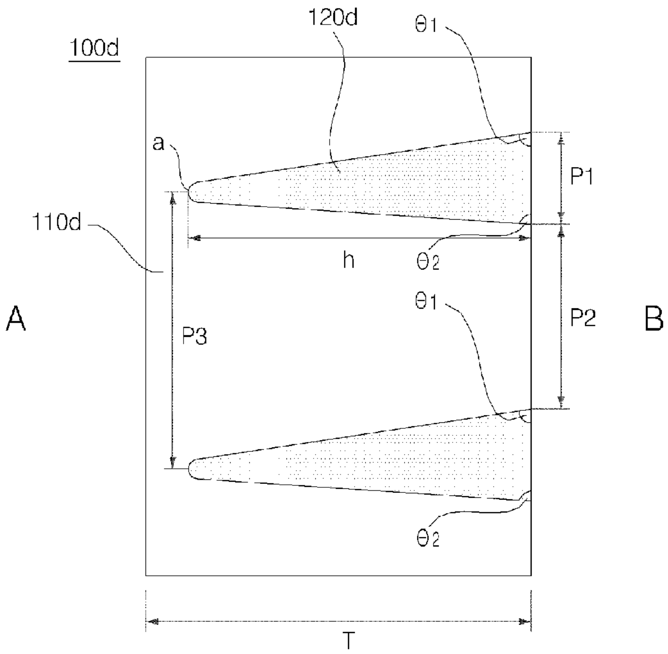
[Fig. 6]



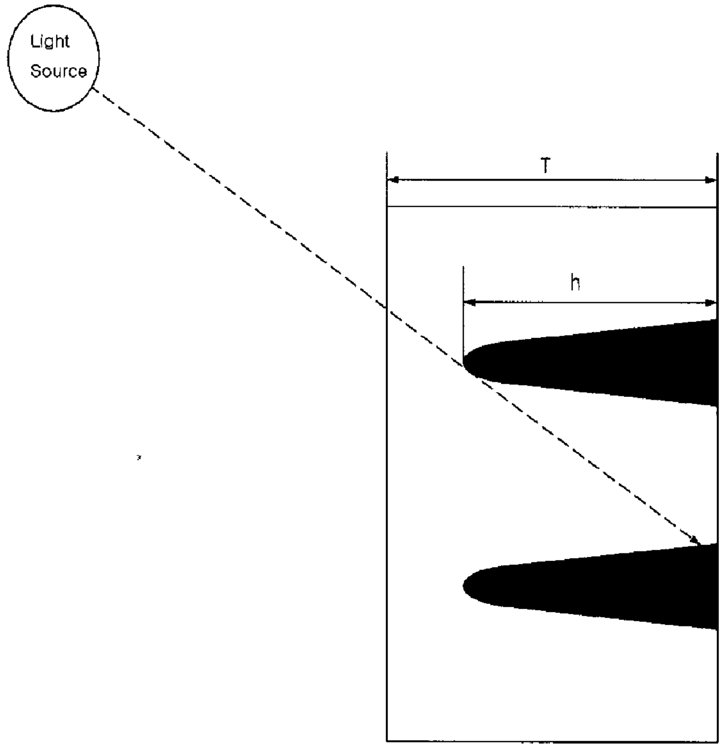
[Fig. 7]



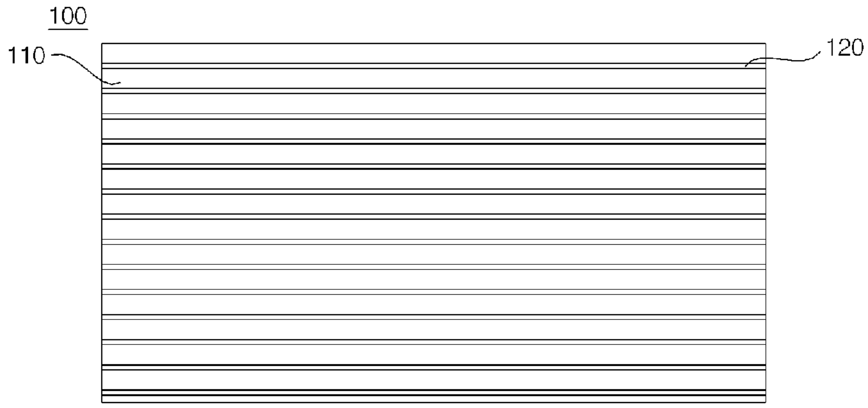
[Fig. 8]



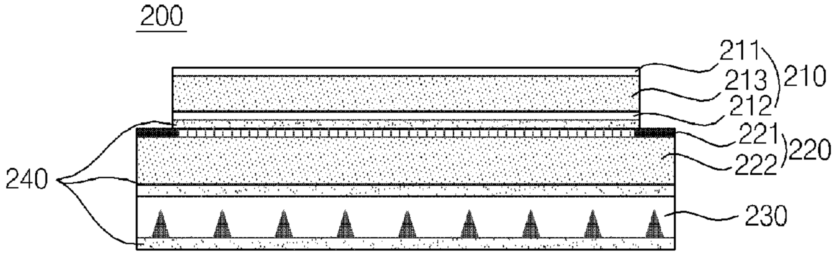
[Fig. 9]



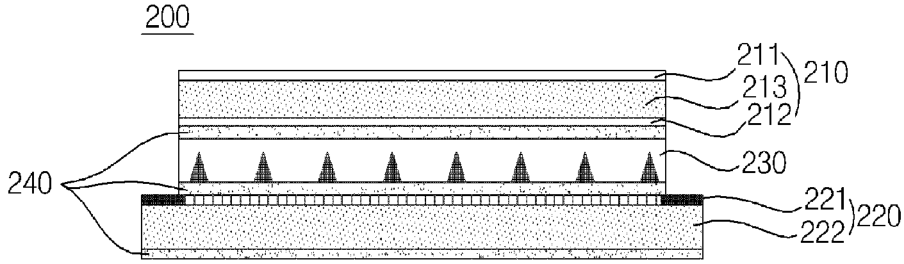
[Fig. 10]



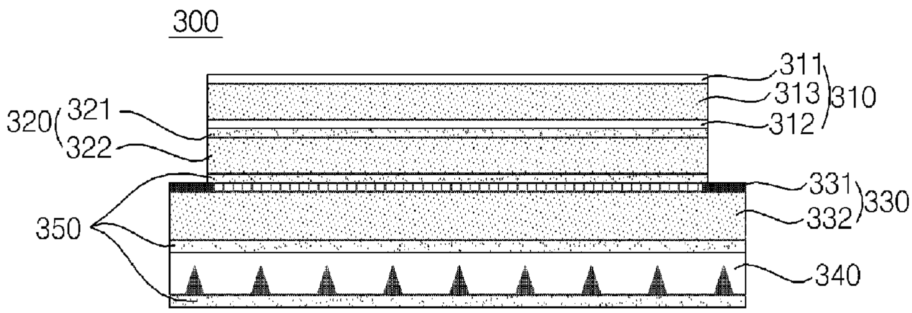
[Fig. 11]



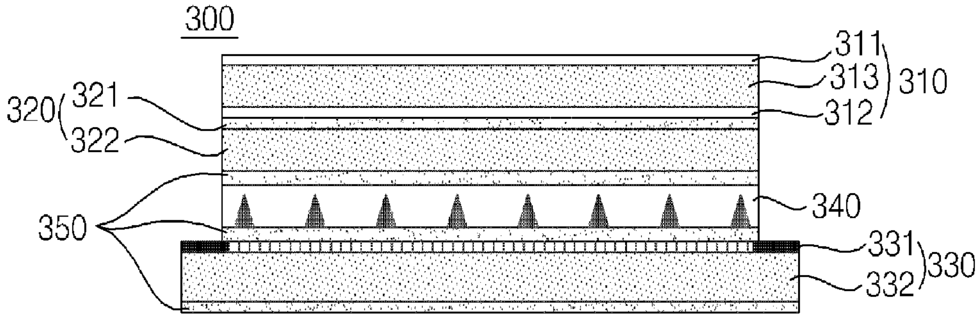
[Fig. 12]



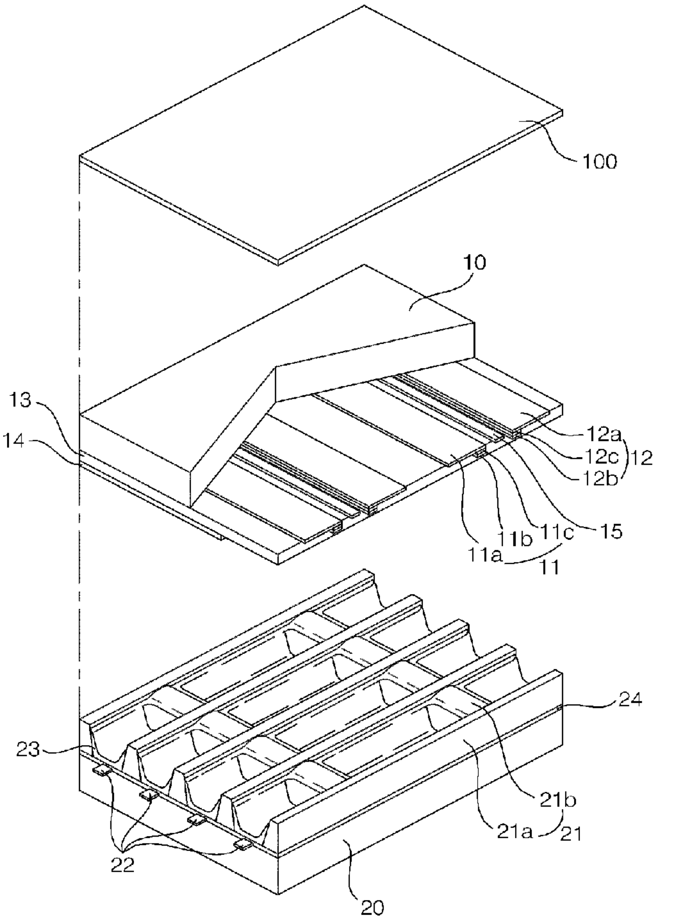
[Fig. 13]



[Fig. 14]


300
311
313
310
312
320
321
322
340
350
331
330
332

[Fig. 15]


100
10
13
14
12a
12c
12
12b
15
11c
11b
11a
11
24
23
21b
21a
21
22
20

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2006/003904

A. CLASSIFICATION OF SUBJECT MATTER

H01J 17/49(2006.01)i, G02B 5/20(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC8: H01J 17/49, G03B 21/00, G09F 9/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Utility models and applications for Utility models since 1975
Japanese Utility models and applications for Utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKIPASS(KIPO internal) "Keyword: plasma, filter, light, shield, and similar terms"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2004-286996 A (DAINIPPON PRINTING CO. LTD)14 October 2004 see paragraphs [0028]~[0046], [0053]~[0061], figures 3, 7, 9	1-26
Y	JP 2001-034183 A (MITSUBISHI ELECTRIC CORP.)9 February 2001 see paragraphs [0029]~[0044], [0048]~[0050], figures 1, 9, 10	1-26
Y	WO 01/04701 A1 (3M INNOVATIVE PROPERTIES COMPANY) 18 January 2001 see pages 7~9, 24~29, figures 13, 15, 18	1-26

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 APRIL 2007 (12.04.2007)	**12 APRIL 2007 (12.04.2007)**

Name and mailing address of the ISA/KR	Authorized officer
Korean Intellectual Property Office 920 Dunsan-dong, Seo-gu, Daejeon 302-701, Republic of Korea	LEE, Beaung Woo
Facsimile No. 82-42-472-7140	Telephone No. 82-42-481-8227

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2006/003904

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP16286996 A	14.10.2004	CN1701276A	23.11.2005
		JP16286996	14.10.2004
		JP2004286996A2	14.10.2004
		KR1020050035196	15.04.2005
		KR2005035196A	15.04.2005
		US2005237611AA	27.10.2005
		WO2004083955A1	30.09.2004
JP13034183 A	09.02.2001	JP13034183	09.02.2001
		JP2001034183A2	09.02.2001
WO 01/04701 A1	18.01.2001	AU200017317A1	30.01.2001
		AU200017317A5	30.01.2001
		CA2376812AA	18.01.2001
		CA2376812C	17.05.2005
		CA2376812A1	18.01.2001
		CA2376812C	18.01.2001
		CN1207623C	22.06.2005
		CN1378660	06.11.2002
		CN1378660A	06.11.2002
		EP01200875A1	02.05.2002
		EP1200875A1	02.05.2002
		JP15504691	04.02.2003
		JP2003504691T2	04.02.2003
		KR1020020029071	17.04.2002
		MXPA01013459A	22.07.2002
		US06417966	09.07.2002
		US6417966B1	09.07.2002
		US6417966BA	09.07.2002
		WO0104701A1	18.01.2001
		WO200104701A1	18.01.2001