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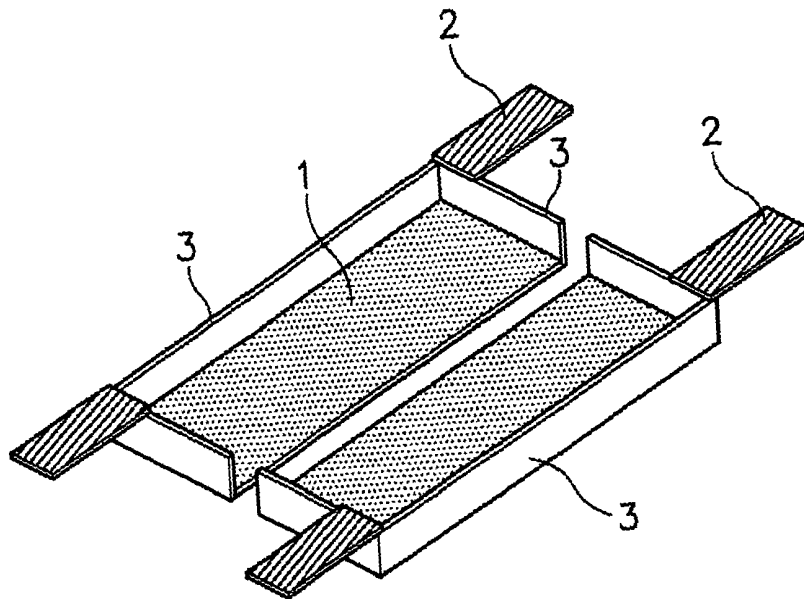
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(54) Title: PLASMA DISPLAY PANEL



(57) Abstract: A PDP improves discharge efficiency by reducing a discharge voltage and increasing a volume of a plasma. The PDP includes an opaque metal fence-type electrode electrically connected to first and second electrodes in each pixel of an upper substrate, and extended toward the second substrate. As a result, the discharge voltage is reduced by minimizing a loss of the plasma generated during the discharge in an individual unit pixel. As the electrode area is widened, a plasma formation space is increased and plasma energy loss is decreased, thereby performing stabilized space discharge. Moreover, interaction between adjacent pixels is prevented by individualizing the unit pixels by sidewalls. A size of the pixels is decreased to obtain a high quality screen.



WO 01/31675 A1

PLASMA DISPLAY PANEL**BACKGROUND OF THE INVENTION**5 Field of the Invention

The present invention relates to a plasma display panel (PDP), and more particularly, to a PDP having an improved structure of a sustain electrode which is formed on an upper substrate of the PDP used in various flat panel display
10 devices such as TV or monitors.

Discussion of the Related Art

Fig. 1 is a schematic view of a unit pixel formed on an upper substrate of a related art PDP.

15 Referring to Fig. 1, two transparent electrodes 1 are deposited on the upper substrate at regular intervals, and bus electrodes 2 for connection to a power source are deposited on both ends of the transparent electrode 1. A plasma is formed in a unit pixel in such a manner that a
20 power source is supplied through the bus electrodes 2 to maintain discharge between the transparent electrodes 1 having regular intervals.

Figs. 2a and 2b illustrate a related art PDP.

As shown in Fig. 2a, horizontal transparent and bus electrodes 1 and 2 are formed on a transparent upper
25 substrate 7. As shown in Fig. 2b, vertical signal electrodes 5 are formed on a lower substrate 6 at regular intervals, vertical sidewalls 4 are formed on the signal electrodes 5, and phosphors of R, G, and B are deposited between the
30 sidewalls 4. Then, the upper substrate 7 is attached to the lower substrate 6.

In the related art PDP having the above electrode structure, the discharge and sustain electrodes are flush with each other and the quantity of the plasma is proportional to an electrode area.

5 Since an area of the electrode is limited due to a limited size of the unit pixel, the plasma generating quantity is also limited. The energy of the plasma is continuously lost through an outer wall and the like. The energy of the plasma is much required to maintain discharge.

10 If the plasma generating quantity is small, much more energy is required to maintain discharge. For this reason, energy efficiency of the PDP is reduced. Also, in the related art PDP having the above electrode structure, efficiency is reduced if the size of the unit pixel is small.
15 In this case, it is difficult to obtain high picture quality.

SUMMARY OF THE INVENTION

20 Accordingly, the present invention is directed to a PDP that substantially obviates one or more of the problems due to limitations and disadvantages of the related art.

An object of the present invention is to provide a PDP which improves discharge efficiency by reducing a discharge voltage and increasing a volume of a plasma.

25 Additional features and advantages of the invention will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice of the invention. The objectives and other advantages of the invention will be realized and
30 attained by the scheme particularly pointed out in the written description and claims hereof as well as the

appended drawings.

To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described, in a PDP according to the present
5 invention, which is provided with upper and lower substrates aligned in parallel at regular intervals, first and second electrodes formed on the upper substrate in one unit pixel, third electrodes formed on a second substrate to correspond to the first and second electrodes, and bus lines which
10 connect the first and second electrodes with adjacent first and second electrodes, the PDP includes fence-type electrodes extended toward the second substrate in a corner portion of an adjacent pixel of the first and second electrodes.

15 In the preferred embodiment of the PDP according to the present invention, the fence-type electrodes are made of an opaque metal material and sidewalls are formed in a rectangular frame to divide the pixels on the upper substrate, the fence-type electrodes are formed on the
20 sidewalls, and the fence-type electrodes and transparent electrodes of the first and second electrodes are formed symmetrically in a diagonal direction within each unit pixel.

It is to be understood that both the foregoing general description and the following detailed description are
25 exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

30 The invention will be described in detail with reference to the following drawings in which like reference

numerals refer to like elements wherein:

Fig. 1 is a schematic view showing a unit pixel formed on an upper substrate of a related art PDP;

5 Fig. 2a is a schematic view showing an upper substrate of a related art PDP provided with an electrode of Fig. 1;

Fig. 2b is a schematic view of a lower substrate of a PDP corresponding to Fig. 2a;

10 Fig. 3 is a schematic view of an electrode of a unit pixel formed on an upper substrate of a PDP according to the first embodiment of the present invention;

Fig. 4 is a schematic view of an upper substrate of a PDP provided with an electrode of Fig. 3;

15 Fig. 5 is a schematic view of an upper substrate of a PDP according to the second embodiment of the present invention; and

Fig. 6 is a schematic view of an upper substrate of a PDP according to the third embodiment of the present invention.

20 **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

25 Fig. 3 is a schematic view of an electrode of a unit pixel formed on an upper substrate of a PDP according to the first embodiment of the present invention.

A lower substrate of a PDP according to the present invention has the same structure as that of the related art
30 PDP. Accordingly, the upper substrate of a PDP according to the present invention will be described below.

An electrode structure of one unit pixel is shown in Fig. 3. Referring to Fig. 3, the unit pixel includes two portions, wherein a left side portion is defined as a first electrode and a right side portion is defined as a second electrode.
5

A pair of transparent electrodes 1 are deposited on the bottom surface of the unit pixel at regular intervals. An opaque metal fence-type electrode 3 is partially formed in a corner portion of the unit pixel to be partially projected from a corner portion of an adjacent pixel to the lower substrate. A bus electrode 2 is connected to the fence-type electrode 3.
10

In other words, a discharge sustain electrode structure of a fence type having two portions is formed. In the present invention, a pair of the transparent electrodes 1 are referred to as a discharge sustain electrode.
15

Fig. 4 is a schematic view of the upper substrate of a PDP provided with the electrode of Fig. 3. The electrode of the upper substrate of Fig. 4 is orthogonal to the electrode(ex, signal electrode) of the lower substrate(not shown). In Fig. 4, an electrode structure of 6 unit pixels is exemplified.
20

A reference numeral 1 denotes a transparent electrode, a reference numeral 2 denotes a bus electrode, a reference numeral 3 denotes a fence-type electrode, a reference numeral 7 denotes an upper substrate, a reference numeral 8 denotes a horizontal sidewall, and a reference numeral 9 denotes a vertical sidewall.
25

Lattice shaped (matrix shaped) sidewalls 8 and 9 are formed in a rectangular frame on the upper substrate 7 in horizontal and vertical directions. Thus, an individual
30

discharge space is formed for a unit pixel.

The lattice shaped sidewalls 8 and 9 improve contrast. A pair of the transparent electrodes 1 are deposited on a bottom surface of the upper substrate 7 at regular intervals for a unit pixel in a horizontal direction. An opaque metal fence-type electrode 3 is deposited inside the sidewalls 8 and 9, so as to increase the plasma generating quantity of a corresponding pixel during individual discharge.

In Fig. 4, the bus electrode 2 is deposited on the horizontal sidewall 8 so that it is to be connected with the transparent electrodes 1 using the fence-type electrode 3 as a medium. The heights of the sidewalls 8 and 9 are lower than the height of a sidewall of the lower substrate.

Fig. 5 is a schematic view of an upper substrate of a PDP according to the second embodiment of the present invention. Referring to Fig. 5, transparent electrodes are aligned along a fence-type electrode to extend a discharge path of a sustain electrode, thereby improving discharge density.

In Fig. 5, an electrode structure of 6 unit pixels is exemplified. A reference numeral 1 denotes a transparent electrode, a reference numeral 2 denotes a bus electrode, a reference numeral 3 denotes a fence-type electrode, a reference numeral 7 denotes an upper glass substrate, a reference numeral 8 denotes a horizontal sidewall, and a reference numeral 9 denotes a vertical sidewall.

A pair of the transparent electrodes 1 are longitudinally formed in a vertical direction at regular intervals in one unit pixel. Each of the transparent electrodes 1 is slanted toward either upper or lower directions. An opaque metal fence-type electrode 3 is

deposited inside the sidewalls 8 and 9 surrounding the outer wall of the transparent electrodes 1 so as to increase the plasma generating quantity of a corresponding pixel during discharge of an individual pixel.

5 The fence-type electrodes 3 and the transparent electrodes 1 per unit pixel are symmetrically formed in a diagonal direction.

 The bus electrode 2 is deposited on the horizontal sidewall 8 to be connected with the transparent electrode 1
10 using the fence-type electrode 3 as a medium. The heights of the sidewalls 8 and 9 are lower than that of a sidewall of the lower substrate.

 Fig. 6 is a schematic view of an upper substrate of a PDP according to the third embodiment of the present
15 invention. Referring to Fig. 6, a fence-type electrode type upper substrate having a long corner electrode structure is formed orthogonally to the electrodes of Fig. 3. In Fig. 6, an electrode structure of 6 unit pixels is exemplified. A reference numeral 1 denotes a transparent electrode, a
20 reference numeral 2 denotes a bus electrode, a reference numeral 3 denotes a fence-type electrode, a reference numeral 7 denotes an upper glass substrate, a reference numeral 8 denotes a horizontal sidewall, and a reference numeral 9 denotes a vertical sidewall.

25 In Fig. 6, the bus electrode 2 is formed in the same direction (vertical direction) as that of a sidewall of a lower substrate (not shown), so that a pair of discharge sustain electrodes respectively correspond to respective phosphors. A signal electrode of the lower electrode is
30 formed in a horizontal direction perpendicular to the sidewall of the lower substrate.

A pair of the transparent electrodes 1 are deposited on the upper glass substrate 7 in a vertical direction at regular intervals in a unit pixel. The vertical sidewall 9 of the upper substrate is formed in the same direction as a vertical sidewall 4 (see Fig. 2) of the lower substrate. The horizontal sidewall 8 is additionally formed.

An opaque metal fence-type electrode 3 is deposited inside the sidewalls 8 and 9 of a rectangular frame so as to increase the plasma generating quantity of a corresponding pixel during discharge of an individual pixel.

The bus electrode 2 is deposited on the horizontal sidewall 8 to be connected with a power source in the vertical direction. The heights of the sidewalls 8 and 9 are lower than the height of a sidewall of the lower substrate.

Consequently, in Figs. 5 and 6, the length of a corner portion of the transparent electrode 1 is longer than that of a corner portion of the transparent electrode in the related art PDP.

In the aforementioned electrode structure of Fig. 6, a plasma is generated by discharge between two transparent electrodes 1 having a long corner portion between the sidewalls. Also, an electrode structure with high efficiency is provided, in which an area of the electrode is maximized and the plasma generating quantity is increased between the transparent electrodes having a long corner portion.

In the aforementioned PDP according to the first to third embodiments of the present invention, the opaque metal fence-type electrode 3 is deposited on the sidewalls 8 and 9 of the upper substrate to utilize the area of the electrode

to the utmost and thus reduce the discharge voltage. The fence-type electrode 3 minimizes loss of the plasma generated during discharge in an individual unit pixel to increase the plasma generating quantity.

5 As the electrode area is widened, a plasma formation space is increased and plasma energy loss is decreased, thereby performing stabilized space discharge. Moreover, interaction between adjacent pixels is prevented by individualizing the unit pixels by the side wall. The size
10 of the pixels is decreased to obtain a high quality screen.

Meanwhile, although the sidewalls 8 and 9 have been formed on the upper substrate in the present invention, the bus electrode and the fence-type electrode may only be formed without forming the sidewalls 8 and 9 on the upper
15 substrate. In such case, the same effect can be obtained but contrast may be reduced.

As aforementioned, the PDP according to the present invention has the following advantages.

20 Since the electrode of the upper substrate has a fence-type electrode structure, the discharge voltage is reduced and the volume of the plasma is increased, thereby improving discharge efficiency.

The foregoing embodiments are merely exemplary and are not to be construed as limiting the present invention. The
25 present teachings can be readily applied to other types of apparatuses. The description of the present invention is intended to be illustrative, and not to limit the scope of the claims. Many alternatives, modifications, and variations will be apparent to those skilled in the art.

What is claimed is:

1. In a plasma display panel (PDP) provided with upper and lower substrates aligned in parallel at regular intervals, first and second electrodes formed on the upper substrate in one unit pixel, third electrodes formed on a second substrate to correspond to the first and second electrodes, and bus lines which connect the first and second electrodes with adjacent first and second electrodes, the PDP comprising fence-type electrodes extended toward the second substrate in a corner portion of an adjacent pixel of the first and second electrodes.

2. The PDP of claim 1, wherein the fence-type electrodes are made of an opaque metal material.

3. The PDP of claim 1, wherein a sidewall is formed in a rectangular frame to divide the pixels on the upper substrate, and the fence-type electrodes are formed on the sidewall.

4. The PDP of claim 1, wherein the fence-type electrodes connected with the first and second electrodes are connected with the fence-type electrodes connected with the first and second electrodes of an adjacent pixel by a bus electrode formed on the sidewall.

5. The PDP of claim 1, wherein the first and second electrodes and the fence-type electrodes are formed symmetrically in a diagonal direction within each unit pixel.

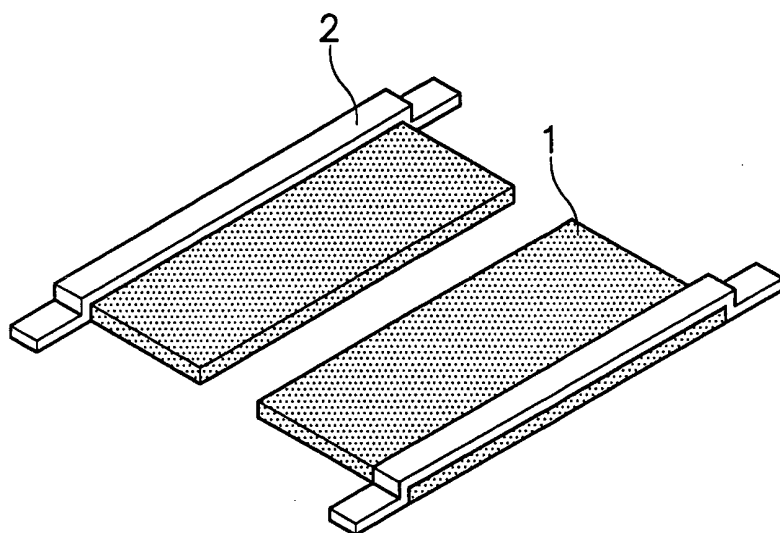


Fig. 1

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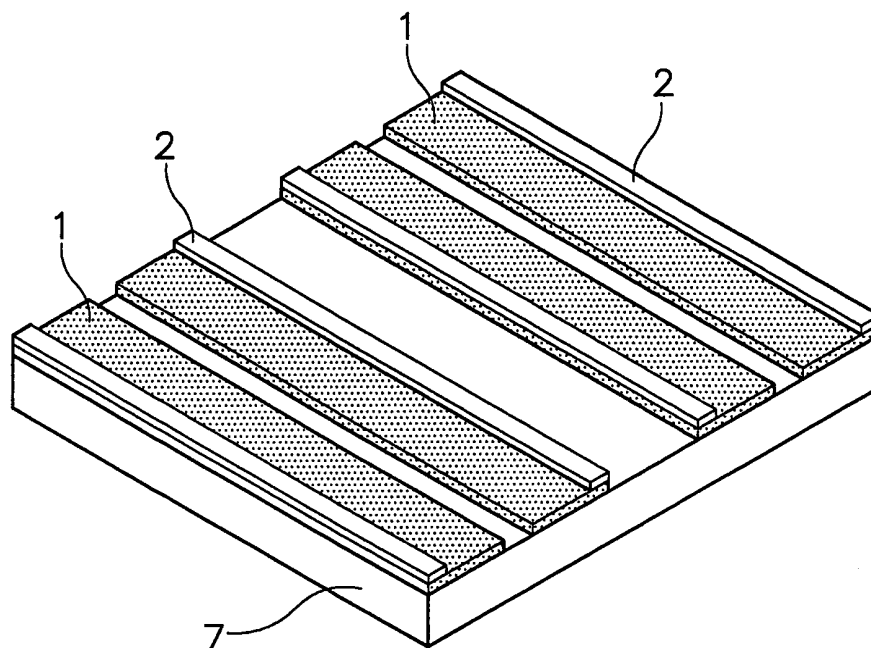


Fig. 2a

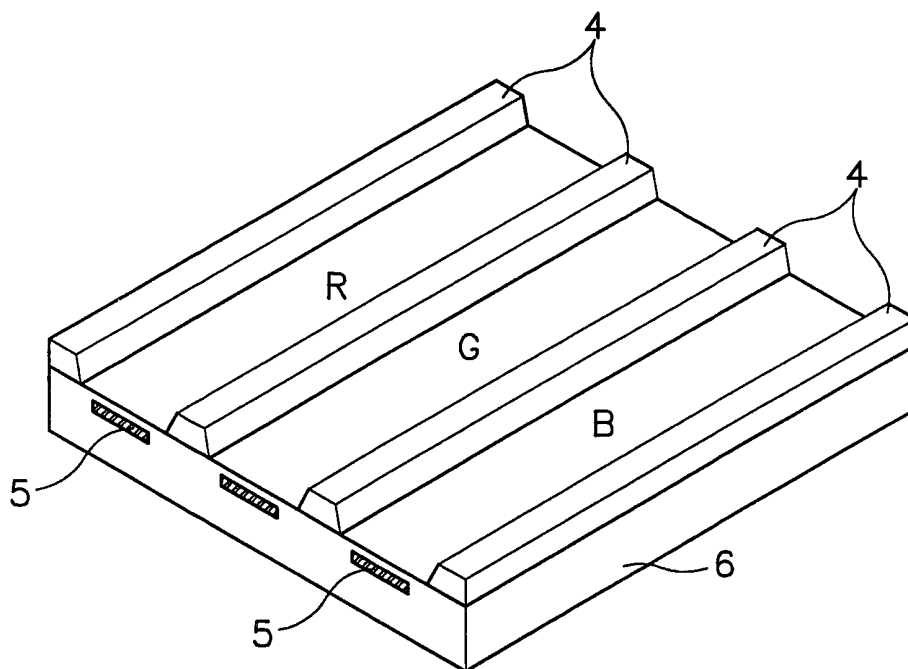


Fig. 2b

3/4

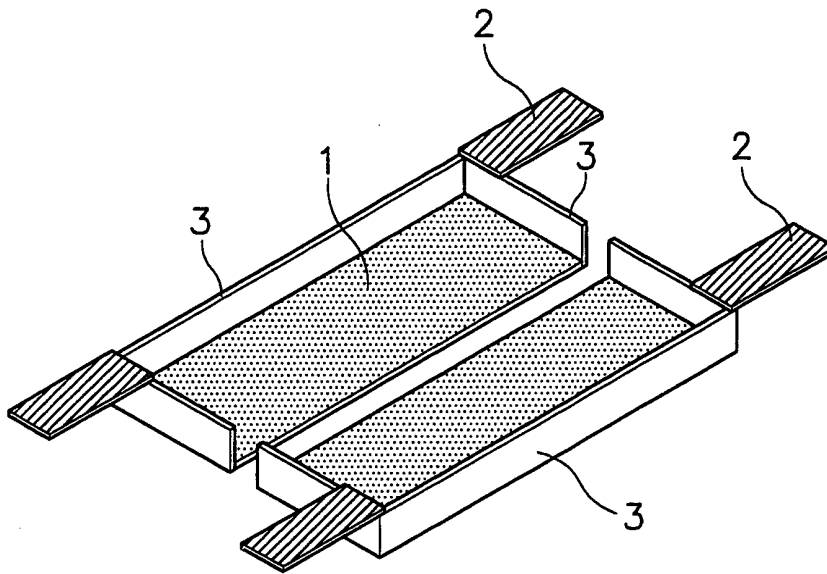


Fig.3

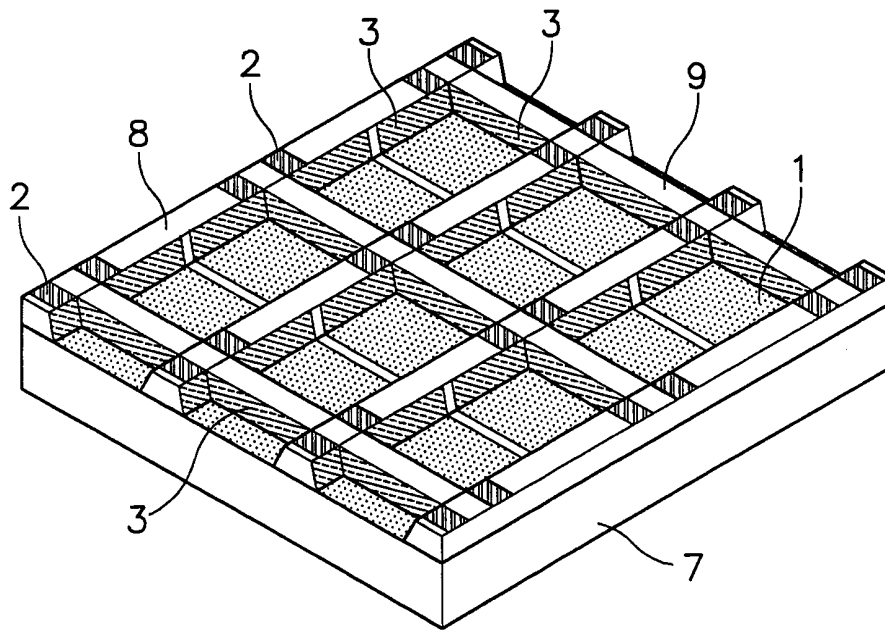


Fig.4

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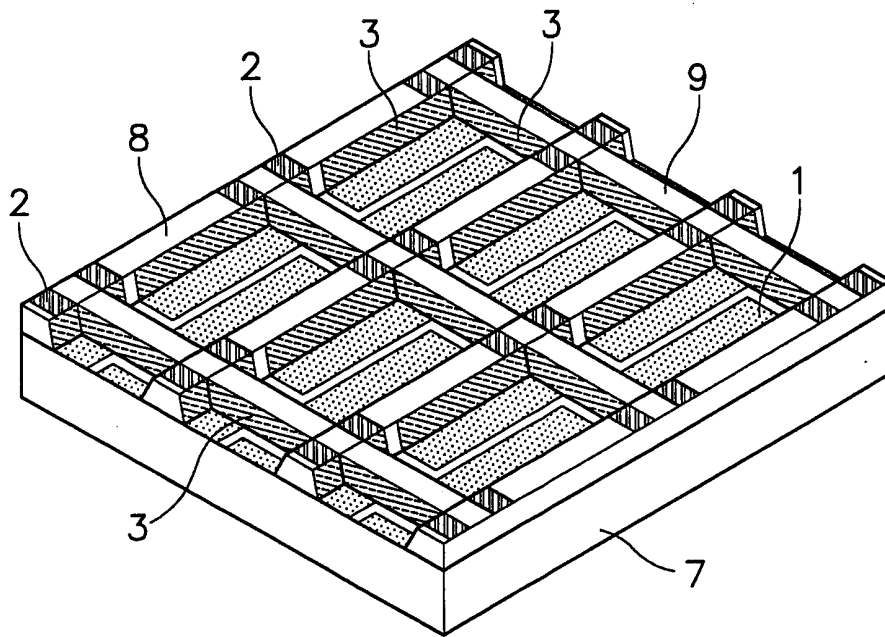


Fig.5

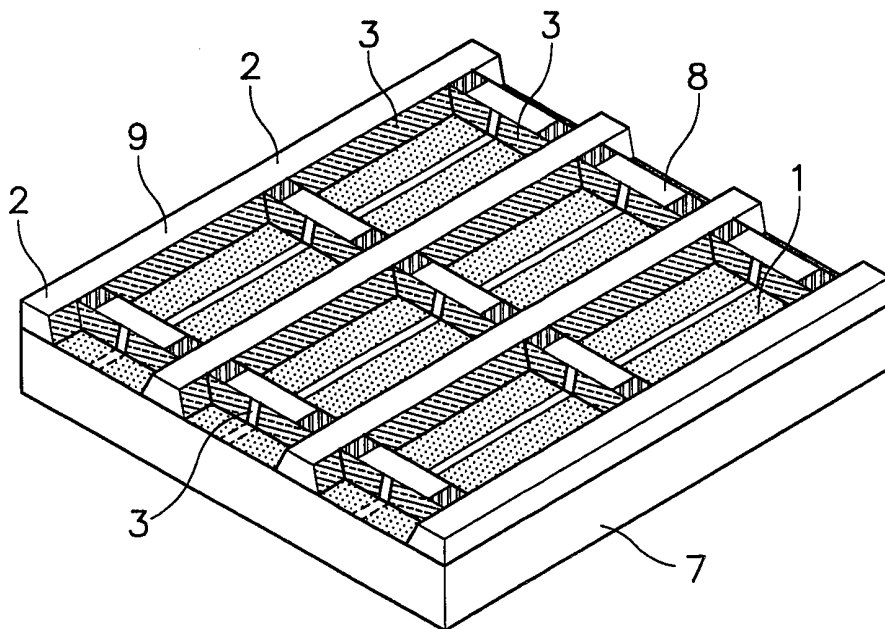


Fig.6

INTERNATIONAL SEARCH REPORT

international application No.

PCT/KR00/01225

A. CLASSIFICATION OF SUBJECT MATTER		
IPC7 H01J 17/49, H01J 11/02		
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) IPC7 H01J 17, H01J 11, H01J 9		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Korean Patents and applications for inventions since 1975. Korean 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)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 11-45663 A (TOPPAN PRINTING) 16 February 1999 claim 1; page 2, paragraphs [0007], [0013]-[0015]; Fig. 1	1-3
X	JP 6-283108 A (PIONEER) 7 October 1994 claim 1; page 3, paragraphs [0011], [0013], [0014]; Fig. 3	1-3
A	KR 1999-16640 A (LG ELECTRONICS) 15 March 1999 the whole document	1-3
A	KR 1998-52817 A (LG ELECTRONICS) 25 September 1998 the whole document	1-3
A	KR 1998-48662 A (LG ELECTRONICS) 15 September 1998 the whole document	1-3
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> 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 20 JANUARY 2001 (20.01.2001)		Date of mailing of the international search report 22 JANUARY 2001 (22.01.2001)
Name and mailing address of the ISA/KR Korean Industrial Property Office Government Complex-Taejon, Dunsan-dong, So-ku, Taejon Metropolitan City 302-701, Republic of Korea Facsimile No. 82-42-472-7140		Authorized officer LEE, Doo Hee Telephone No. 82-42-481-5747



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR00/01225

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.:4
because they relate to part of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
Claim 4, dependent upon Claim 1, refers to "the barrier", but Claim 1 does not include any mention of "the barrier".

3. Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Search Authority found multiple inventions in this international application, as follows:

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. As all searchable claims could be established without effort justifying an additional fee, this Authority did not invite payment of any addition fee.
3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- The additional search fees were accompanied by the applicant's protest.
- No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR00/01225

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 11-45663 A	16. 2. 1999	None	
JP 6-283108 A	7. 10. 1994	None	
KR 1999-16640 A	15. 3. 1999	None	
KR 1998-52817 A	25. 9. 1998	None	
KR 1998-48662 A	15. 9. 1998	None	