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(54) **ELECTROLUMINESCENCE LIGHT
EMITTING DISPLAY SYSTEM AND
ELECTROLUMINESCENCE LIGHT
EMITTING SHEET**

(52) **U.S. Cl. 313/501**

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(57) **ABSTRACT**

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An electroluminescence light emitting display system having: an electroluminescence light emitting sheet which comprises a light-emitting layer containing electroluminescence light-emitting elements therein, and an electrode section comprising a plurality of electrode pairs which are disposed with a predetermined arrangement, wherein each of the electrode pairs includes first and second electrodes which are electrically separated from each other with a spacing region and disposed in one surface side of the light-emitting layer with a predetermined arrangement; and a voltage application unit for applying a predetermined voltage between the first and second electrodes. Each width of the first and second electrodes is 0.2-0.5 mm and a width of the spacing region between the first and second electrodes is 0.2-0.3 mm. When an electrically conductive material is placed on the other surface side of the light-emitting layer and a voltage application between the first and second electrodes is performed by the voltage application unit, a portion of the light-emitting layer corresponding to the placed electrically conductive material emits light.

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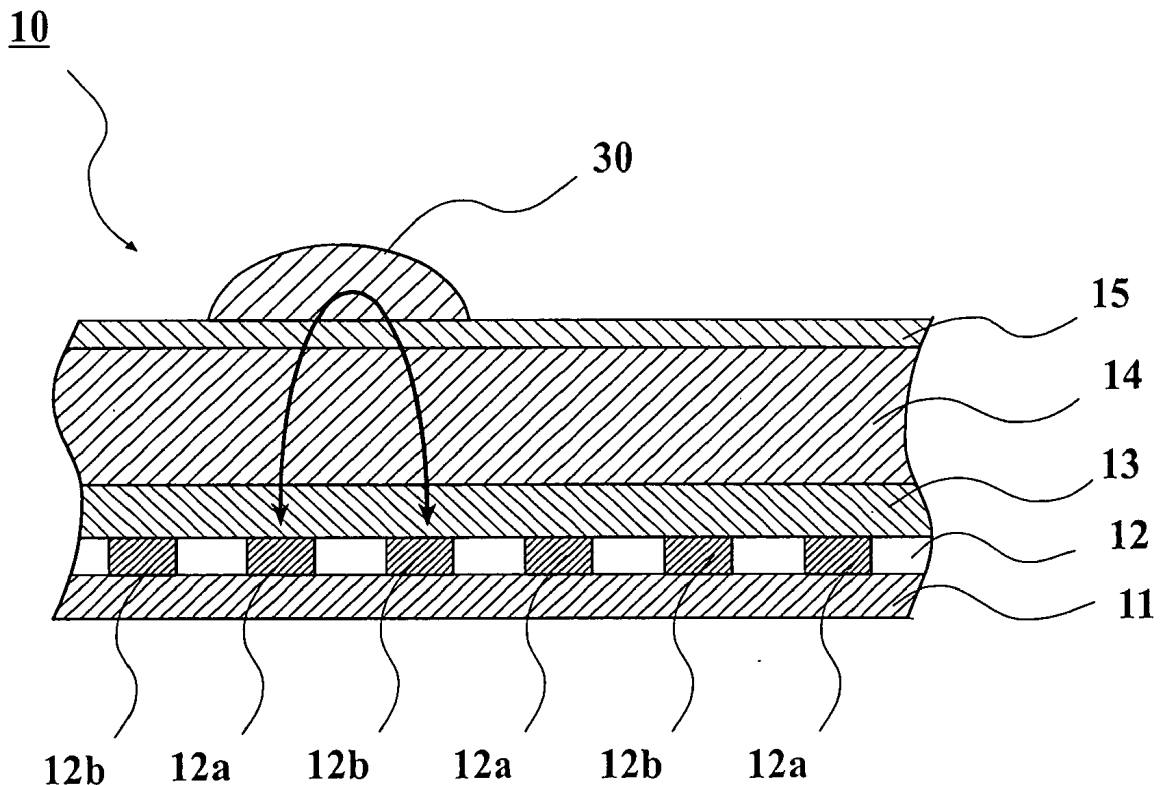


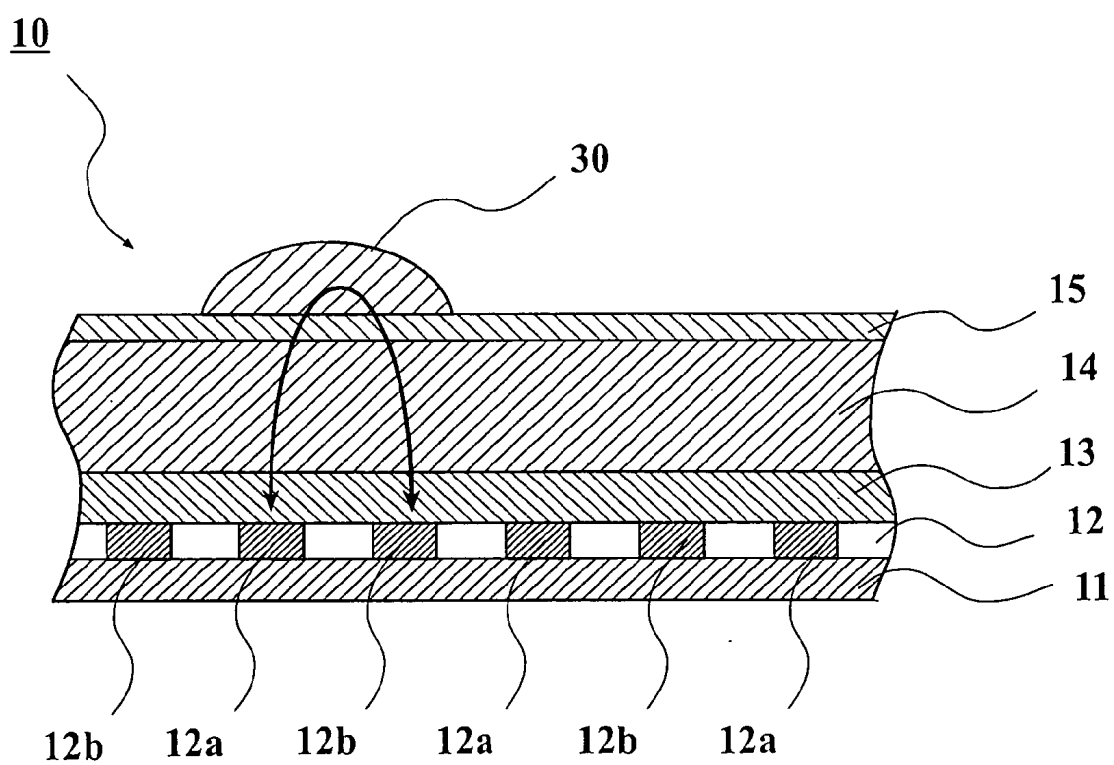
FIG. 1

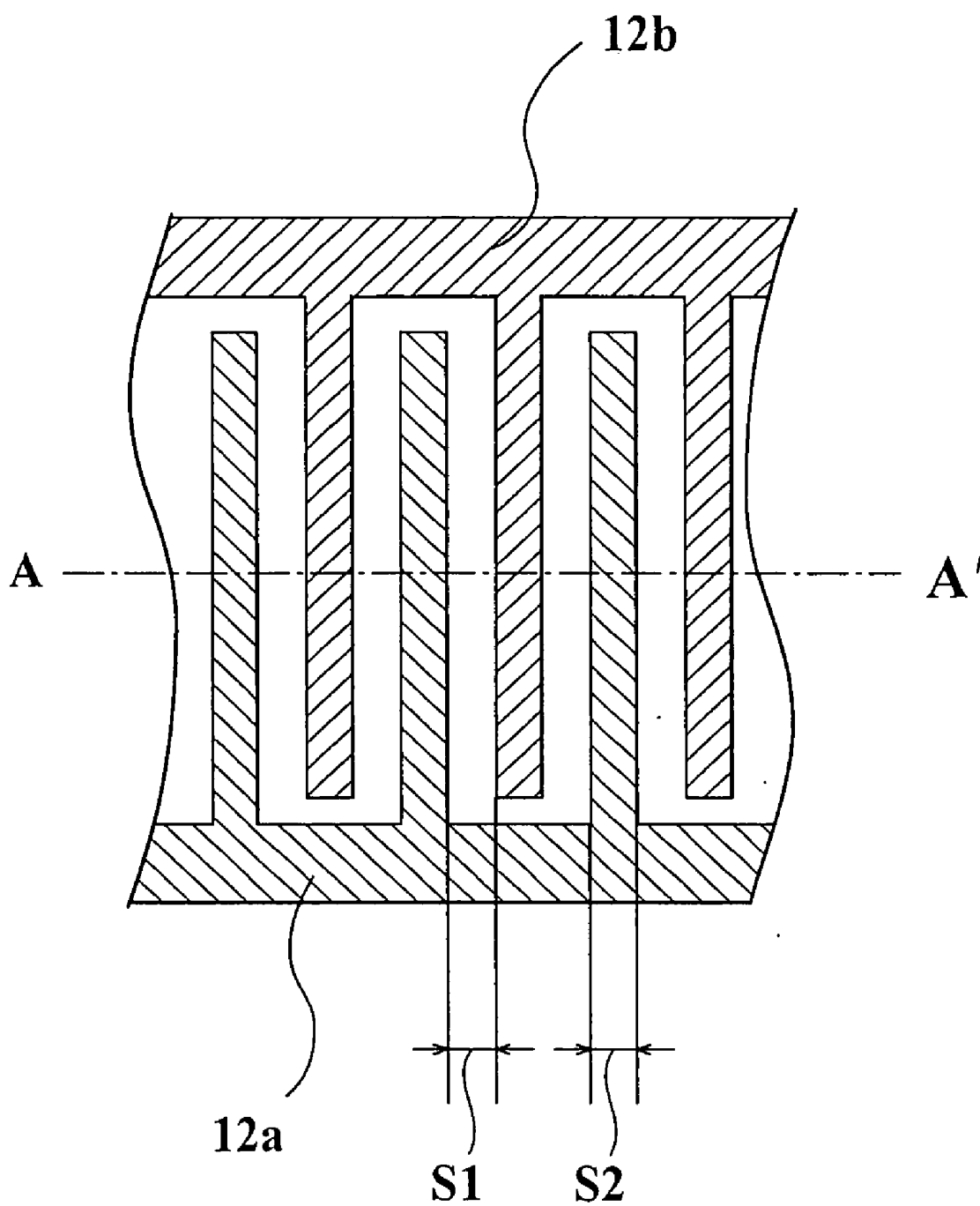
FIG. 2

FIG. 3

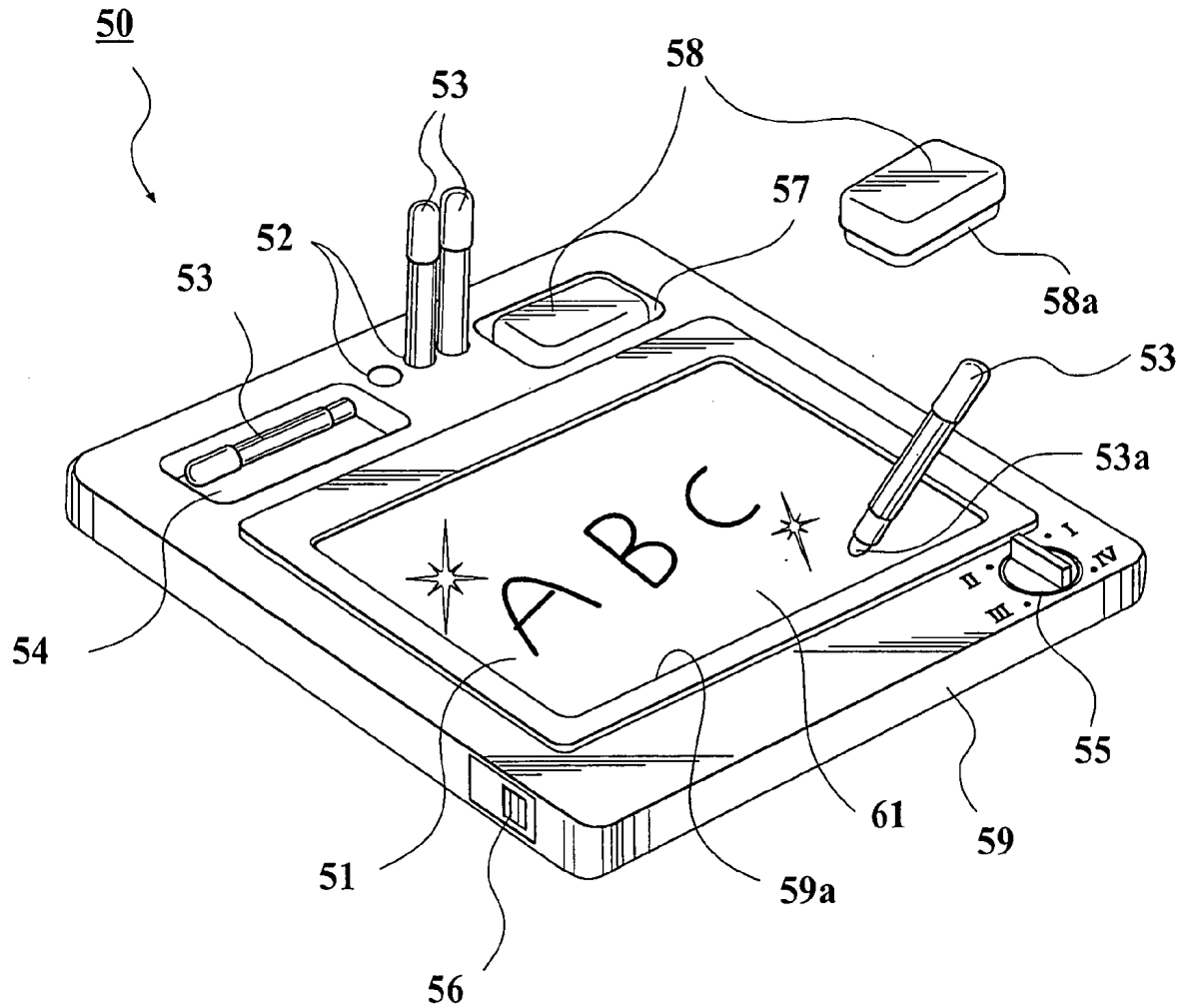


FIG. 4

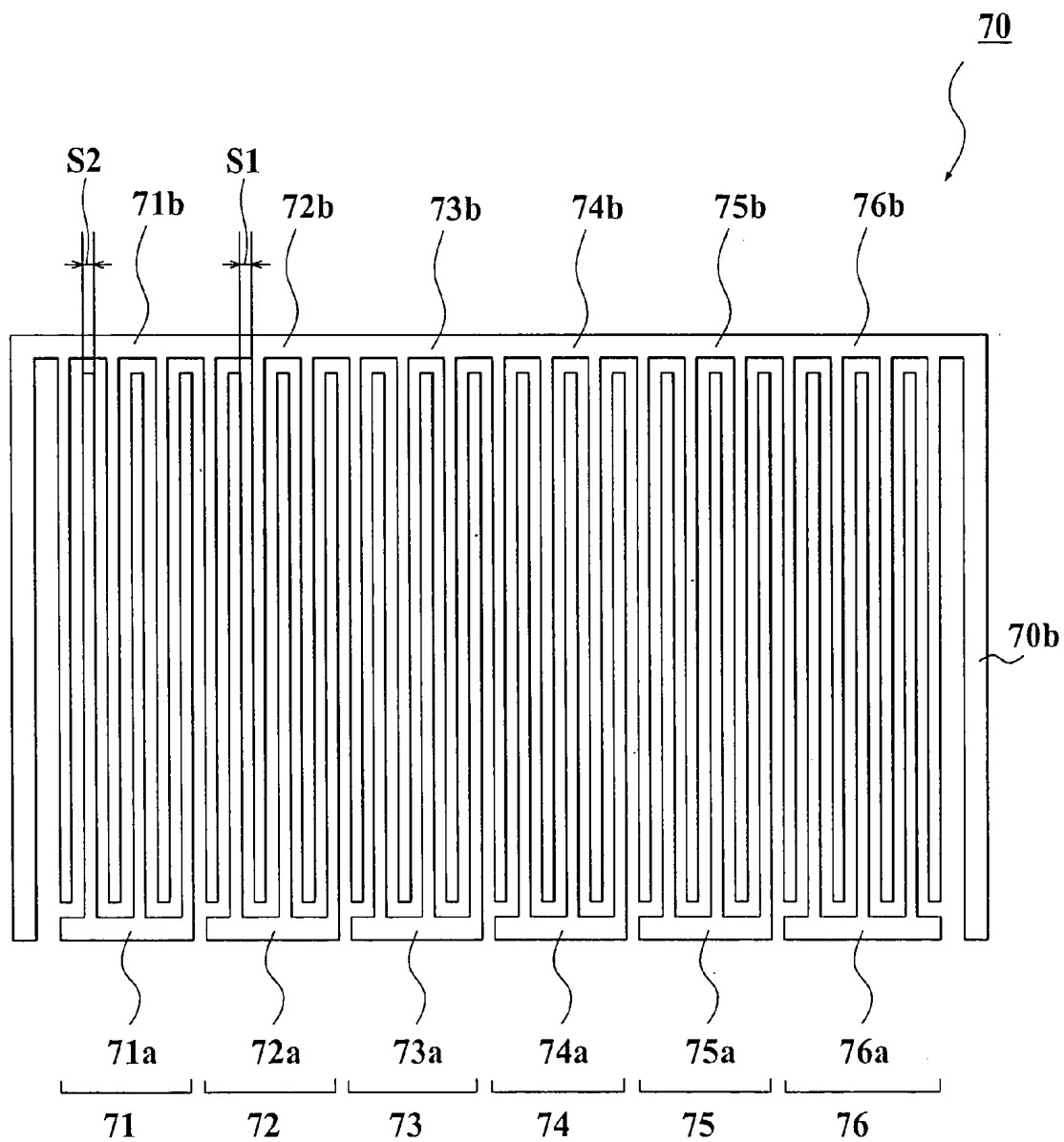


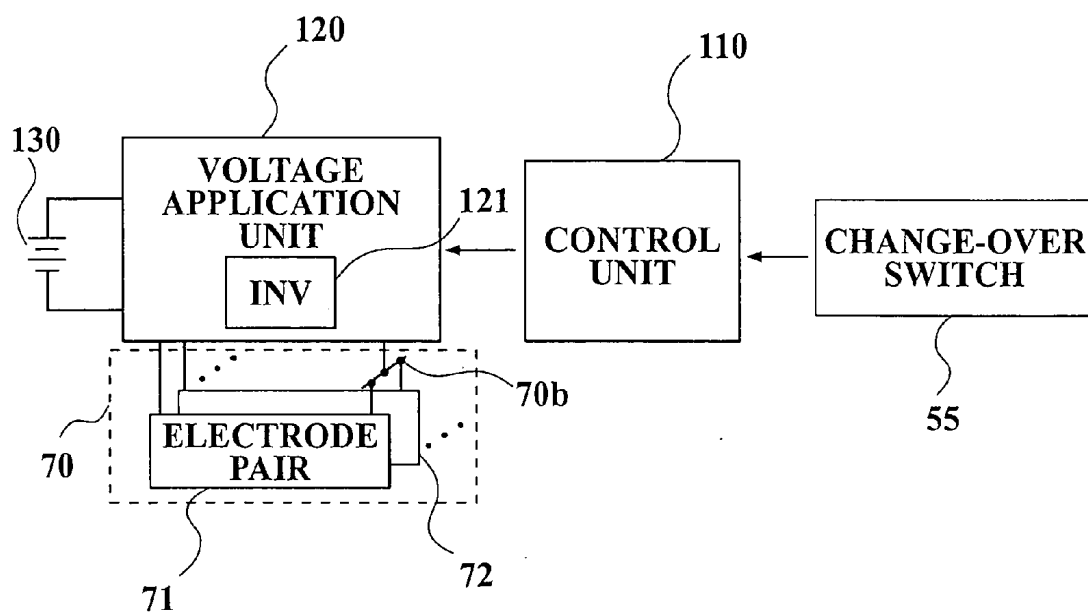
FIG. 5

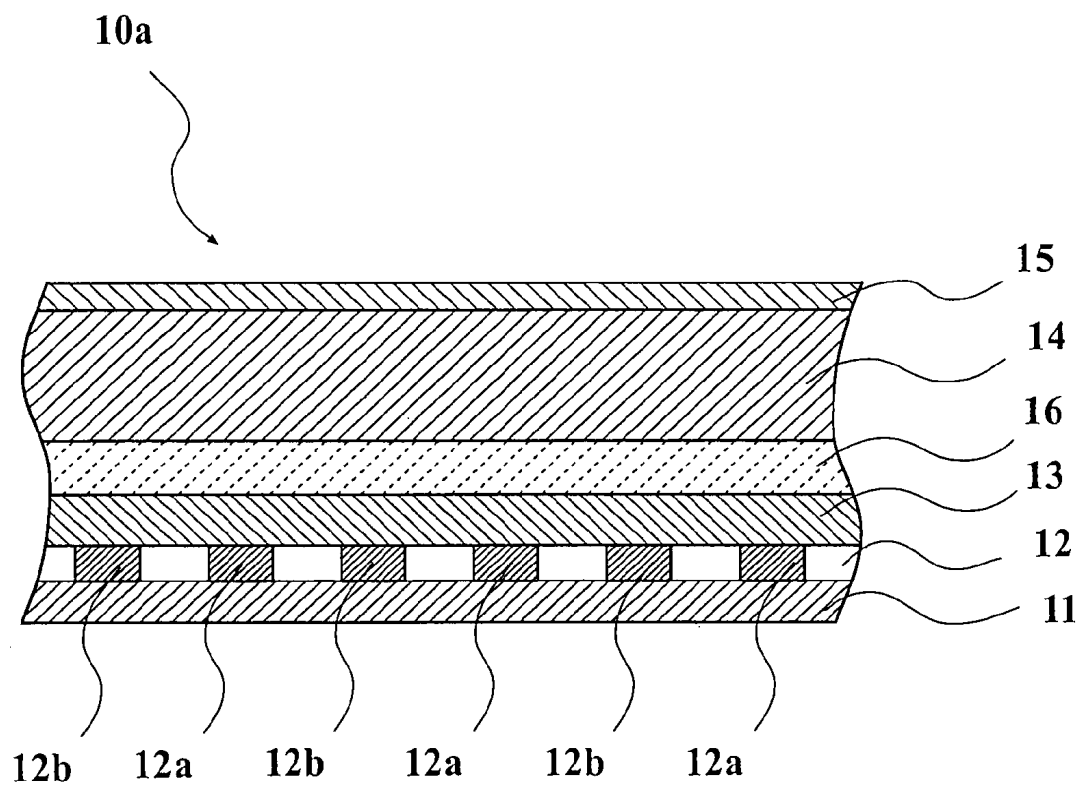
FIG. 6

FIG 7

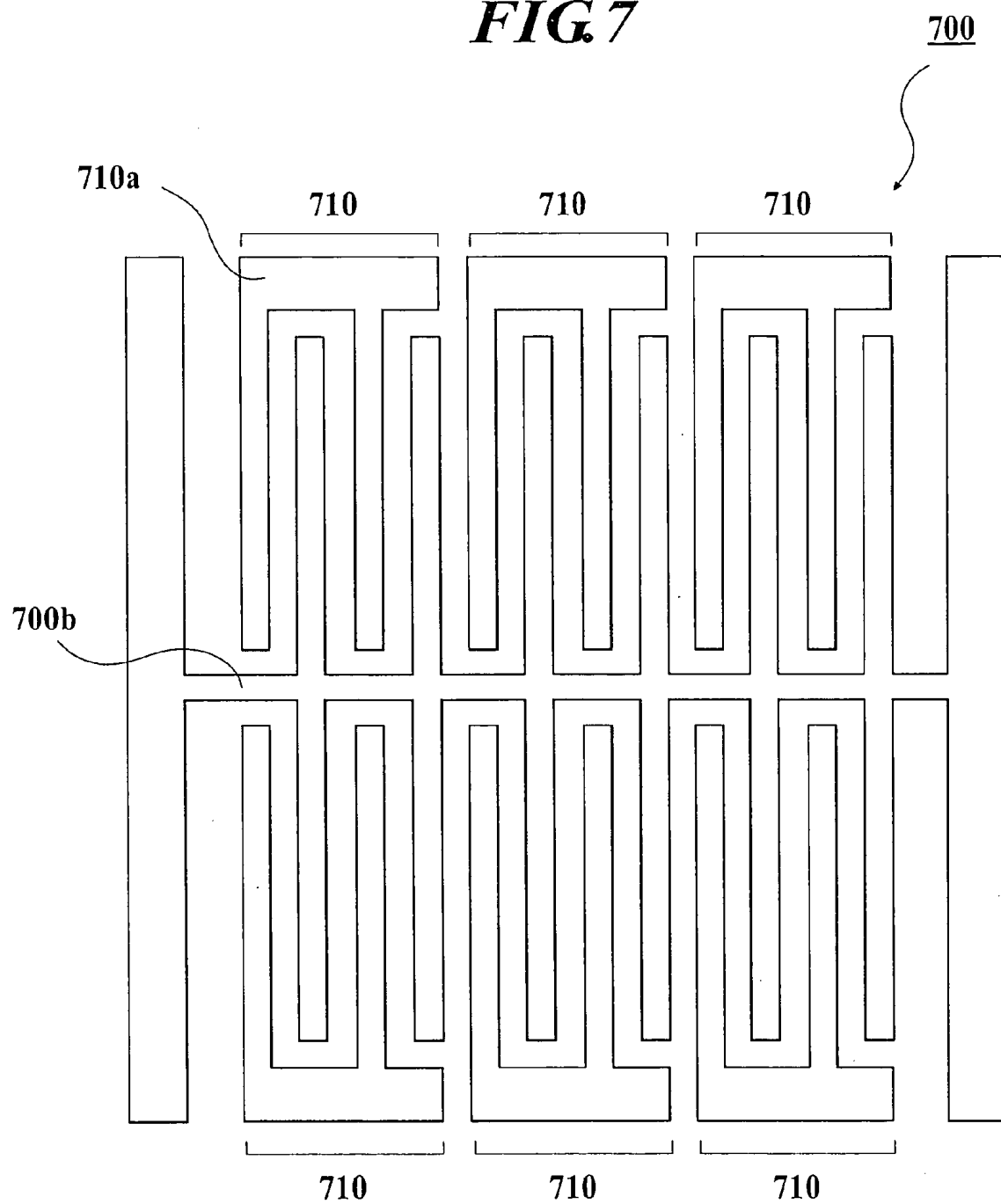


FIG. 8A

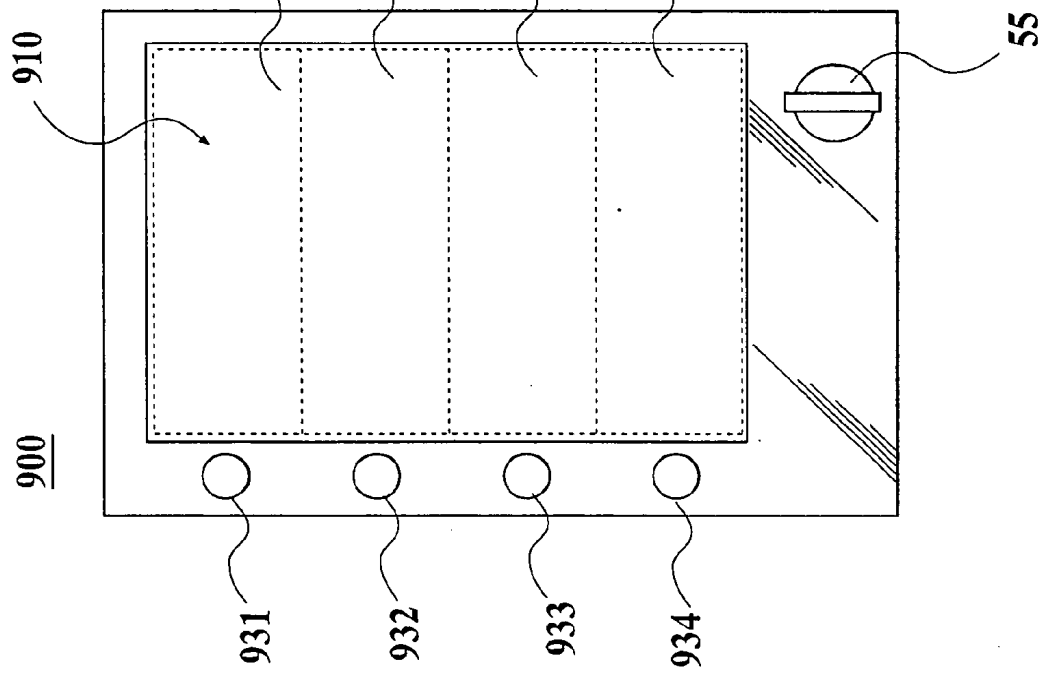


FIG. 8B

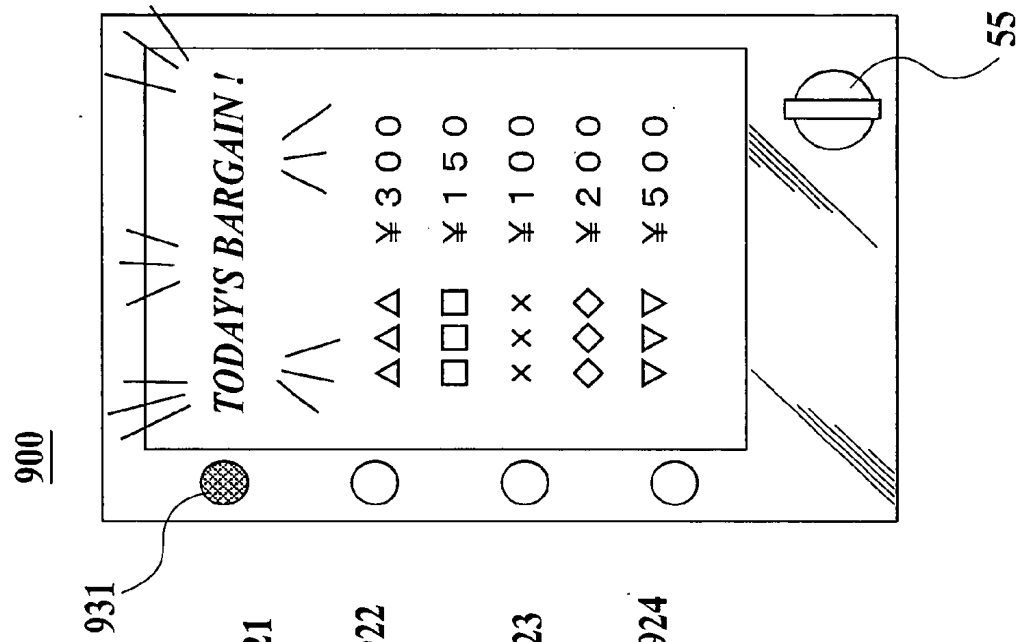


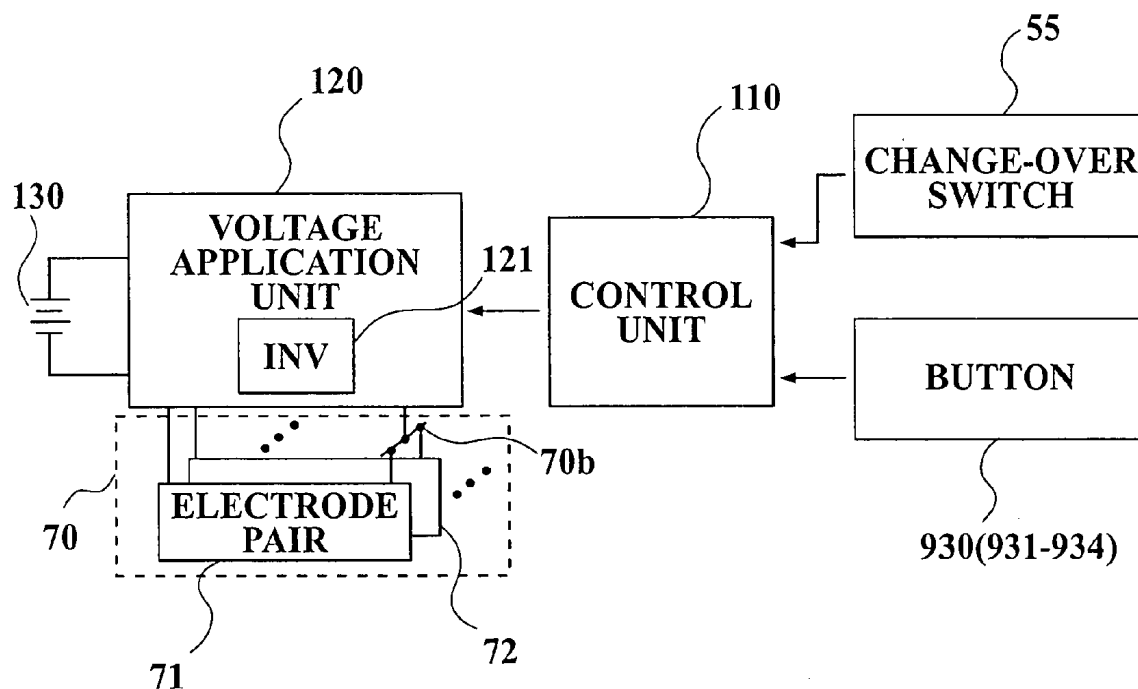
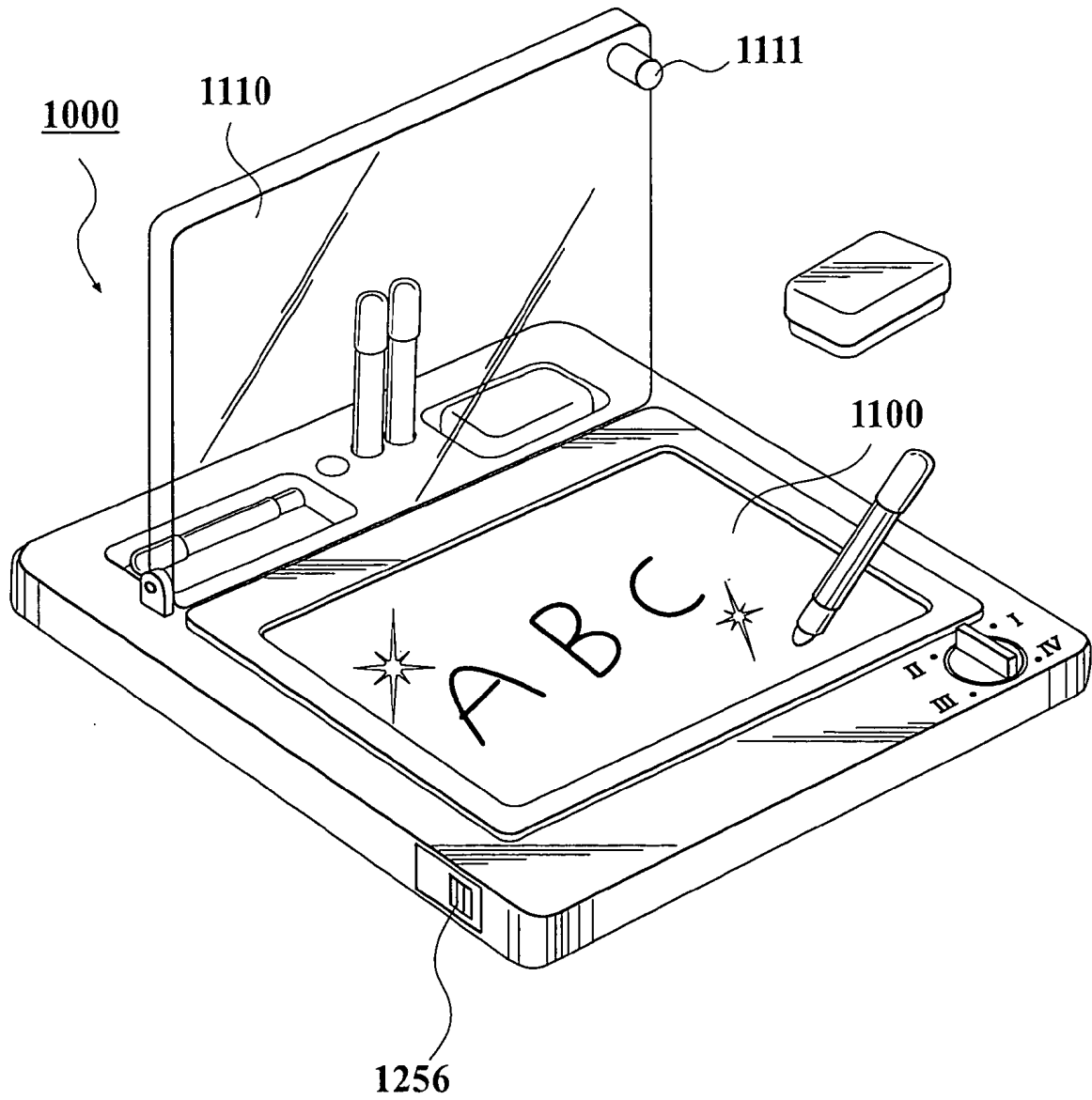
FIG. 9

FIG. 10



ELECTROLUMINESCENCE LIGHT EMITTING DISPLAY SYSTEM AND ELECTROLUMINESCENCE LIGHT EMITTING SHEET

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to an electroluminescence light emitting display system and an electroluminescence light emitting sheet.

[0003] 2. Description of Related Art

[0004] An electroluminescence, hereinafter, which may be referred to EL simply, material is known as one of light emitting materials. Various types of EL light emitting sheets have been developed and put to practical use. The EL light emitting sheet is generally formed by laminating a first electrode, a light-emitting layer, an insulating layer, i.e., a light reflecting layer, a second electrode and a protective layer, i.e., a top coating layer, in order. Generally, by applying an alternating voltage (AC voltage) between the first electrode and the second electrode, a fluorescent material, i.e., EL light emitting elements, in the light-emitting layer emits light.

[0005] As another type of EL light emitting sheet, one having peculiar operation and effects is known (see, for example, Patent Document 1: Japanese Patent Laid-Open Publication No. Hei-8-153582). The EL light emitting sheet is formed by laminating an electrode section, an insulating layer and a light-emitting layer in order. The electrode section includes a plurality of electrode pairs each of which have a first electrode and a second electrode, which are formed like a comb. Then, an electrically conductive material in arbitrary shape is formed on the light-emitting layer as a film and the film is dried to be formed as a display electrode. Thereby, the parts in the light-emitting layer on which the display electrode is formed as a film emit light. In the EL light emitting sheet, a display electrode having a shape corresponding to the taste of a user can be formed, and then a desired light emission shape can be obtained.

[0006] However, in the EL light emitting sheet according to such an earlier development, when a chart for light emission, of a thin line or a dot-shaped chart for light emission is placed thereon, the EL light-emitting layer often emits insufficient light or often creates flecks of light emission. The light emitting sheet according to the earlier development has a further problem that it is not possible to make the display electrode easily because deposition and drying of the electrically conductive material are required for making the display electrode.

SUMMARY OF THE INVENTION

[0007] The present invention has been developed in view of the above-described circumstances.

[0008] An object of the invention is mainly to provide an EL light emitting display system and an EL light emitting sheet, having a high probability of forming an AC electric field.

[0009] In accordance with a first aspect of the present invention, the electroluminescence light emitting display system comprises: an electroluminescence light emitting

sheet which comprises a light-emitting layer containing electroluminescence light-emitting elements therein, and an electrode section comprising a plurality of electrode pairs which are disposed with a predetermined arrangement, wherein each of the electrode pairs includes first and second electrodes which are electrically separated from each other with a spacing region and disposed in one surface side of the light-emitting layer with a predetermined arrangement; and a voltage application unit for applying a predetermined voltage between the first and second electrodes, wherein when an electrically conductive material is placed on the other surface side of the light-emitting layer and a voltage application between the first and second electrodes is performed by the voltage application unit, a portion of the light-emitting layer corresponding to the placed electrically conductive material emits light; and each width of the first and second electrodes is 0.2-0.5 mm and a width of the spacing region between the first and second electrodes is 0.2-0.3 mm.

[0010] The reason for the above-described definition of gap or width is as follows.

[0011] When the gap between the first electrode and the second electrode is less than 0.2 mm, there is a large possibility that a light emission (spontaneous emission) which is not negligible is created in also a region onto which no conductive material is placed. When the gap is more than 0.3 mm, particularly, in a case of placing a chart of a thin line, flecks of light emission stand up. Under conditions, that is, EL sheet with a light emitting region of 140 mm×92 mm, starting voltage of 250V to 270V and current of 100 mA to 130 mA, luminance of emitted lights from two EL light emitting sheets which have gaps of 0.2 mm and 0.15 mm, respectively, were compared. As a result, the luminance of emitted lights from the EL light emitting sheet having the gap of 0.2 mm was 3 ± 0.5 candela and that of 0.15 mm was 6 ± 0.5 candela which was approximately twice that of 0.2 mm gap case. Therefore, it is considered that when assuming a regular use condition in an ordinary room as an industrial product, the luminance of emitted light, of 3 ± 0.5 candela which is obtained by the gap of 0.2 mm is a lower limit. On the other hand, when the width sizes of the first electrode and the second electrode themselves are less than 0.2 mm, there are problems that the luminance of emitted lights may be lowered and the productivity may deteriorate by bridge or disconnection, occurred in mass production. When the width sizes are more than 0.5 mm, there is a problem that in a case of placing a dot-shaped chart for light emission by using a pen for drawing a thin line, probability of AC electric field formation with another electrode is lowered because the thin chart may be within the width of one electrode. When the width sizes are not more than 0.5 mm, the probability of AC electric field formation with another electrode is increased because the probability of the placed dot-shaped chart being out of the one electrode is much larger than that of the chart being placed at the center of the one electrode.

[0012] Thus, according to the EL light emitting display system, it is possible to emit light surely with maintaining a predetermined luminance, and to restrain occurrence of flecks of light emission, in comparison with the case of the earlier development, even when the electrically conductive material is a chart of a thin line or a dot-shaped chart.

[0013] Preferably, the electrically conductive material is attachable onto and detachable from the other surface side of the light-emitting layer.

[0014] According to the EL light emitting display system, it is possible to attach also a chart of a thin line or a dot-shaped chart thereon freely, to enable various change of light emission.

[0015] The electrode section may comprise a plurality of electrode pairs.

[0016] According to the EL light emitting display system, it is possible to perform various types of light emission with different light emission systems and/or different light emission ranges by controlling the voltage application to each of electrode pairs because of having a plurality of electrode pairs.

[0017] In accordance with a second aspect of the present invention, the electroluminescence light emitting sheet comprises: a light-emitting layer containing electroluminescence light-emitting elements therein; and an electrode section comprising a plurality of electrode pairs which are disposed with a predetermined arrangement, wherein each of the electrode pairs includes first and second electrodes which are electrically separated from each other with a spacing region and disposed in one surface side of the light-emitting layer with a predetermined arrangement, each width of the first and second electrodes is 0.2-0.5 mm and a width of the spacing region between the first and second electrodes is 0.2-0.3 mm.

[0018] According to the EL light emitting sheet, it is possible to emit light surely with maintaining a predetermined luminance, and to restrain occurrence of flecks of light emission, in comparison with the case of the earlier development, even when the electrically conductive material is a chart of a thin line or a dot-shaped chart.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] FIG. 1 is a partially enlarged sectional view of a principal part of an EL light emitting sheet according to an embodiment of the invention;

[0020] FIG. 2 is a schematic plan view showing a part of an electrode layer;

[0021] FIG. 3 is a perspective view of the external appearance of a drawing board;

[0022] FIG. 4 is a plan view showing an example of the external shape of the electrode pattern of the EL light emitting sheet built in the drawing board;

[0023] FIG. 5 is a functional block diagram of the drawing board;

[0024] FIG. 6 is a partially enlarged sectional view of a principal part according to variation 1 of the EL light emitting sheet;

[0025] FIG. 7 is a plan view showing the external shape of the electrode pattern according to variation 7 of the EL light emitting sheet;

[0026] FIGS. 8A and 8B are plan views of a signboard according to variation 1 of the EL light emitting display system;

[0027] FIG. 9 is a control block diagram for the signboard according to variation 1 of the EL light emitting display system; and

[0028] FIG. 10 is a perspective view of a drawing board according to variation 2 of the EL light emitting display system.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0029] Hereinafter, the preferred embodiments of the present invention will be described in detail by reference to the attached drawings.

[0030] A. EL Light Emitting Sheet

[0031] 1. Whole Configuration

[0032] FIG. 1 is an enlarged sectional view of a principal part of an EL light emitting sheet 10 to which the present invention is applied. In FIG. 1, the EL light emitting sheet 10 is formed by laminating a base layer 11, an electrode layer (electrode section) 12, a waterproof layer 13, an EL light-emitting layer 14 and a top coat layer 15 in this order.

[0033] 2. Detailed Configuration

[0034] (1) Base Layer 11

[0035] The base layer 11 is made of an insulating material such as polyethylene terephthalate (PET) or the like. The base layer 11 may be configured as a base film (substrate sheet). In this case, the base film is made of a transparent or opaque resin. As the resin in this case, for example, PET is used. The base layer 11 may be made of glass.

[0036] (2) Electrode Layer 12

[0037] The electrode layer 12 having a predetermined electrode pattern is formed by depositing a metal such as copper, aluminum or the like on the base layer 11, and thereafter by performing etching or the like to the deposited metal layer. Alternatively, the electrode layer 12 is formed by depositing, for example, a pasty silver paste including silver powder, a pasty copper paste including copper powder, another electrically conductive paste such as carbon, or the like on the base layer 11 in a predetermined pattern by the screen printing process, and thereafter by performing a heat drying process of the paste.

[0038] FIG. 2 is a schematic plan view showing a part of the electrode layer 12. The electrode layer 12 of FIG. 1 shows the cross section of the electrode layer 12, taken along the A-A' line of FIG. 2. As shown in FIG. 2, first electrodes 12a, 12a, . . . and second electrodes 12b, 12b, . . . are formed to have a comb-like pattern shape severally, and they are formed to be engaged with each other with a predetermined gap between their teeth with putting a spacing region between each tooth so that each tooth does not touch each other. Since each of first electrodes 12a, 12a, . . . is electrically connected with one another, each of them has the same electric potential. Since each of second electrodes 12b, 12b, . . . is also electrically connected with one another similarly, each of them has the same electric potential.

[0039] Preferably, a plurality of electrode pairs each of which has the first electrodes 12a, 12a, . . . and the second electrodes 12b, 12b, . . ., as described above, are disposed with a predetermined arrangement.

[0040] Incidentally, it is preferable to form the first electrodes **12a** and the second electrodes **12b** so that the spacing regions therebetween may substantially be the same per a unit area in a light emitting region.

[0041] The gap **S1** between the first electrode **12a** and the second electrode **12b** which are next to each other in the light emission region may be, for example, about 0.1-2.0 mm, and the width **S2** of the first electrode **12a** and the second electrode **12b** themselves may be, for example, about 0.1-5.0 mm, which are enough for light emission only.

[0042] However, when taking into account the case of placing a chart for light emission, of a thin line which is approximately parallel to the extending direction of comb-shaped pattern electrode, or a dot-shaped chart for light emission, the gap **S1** between the first electrode **12a** and the second electrode **12b** which are next to each other is preferably about 0.2-0.3 mm, and the widths **S2** of the first electrode **12a** and the second electrode **12b** themselves are preferably about 0.2-0.5 mm, by the above-described reason.

[0043] (3) Waterproof Layer **13**

[0044] The waterproof layer **13** is a layer for protecting the electrode layer **12** and is made of a resin. As the resin, the following resins can be used. That is, they are, for example, a fluorocarbon resin such as a 4-fluorinated ethylene resin, fluororubber and the like; a silicon resin such as silicon rubber and the like. Another resin having a high sealing property such as an epoxy resin, an acrylic resin, a urethane resin, a polyester resin, an ethylene-vinyl acetate copolymer or the like, can also be used. These resins are cured by a method such as ultraviolet (UV) curing, infrared (IR) curing, two-liquid curing, heat curing and the like.

[0045] (4) EL Light-Emitting Layer **14**

[0046] The EL light-emitting layer **14** is made of organic or inorganic EL light-emitting material elements (fluorescent material) sealed with a sealing resin. The EL light-emitting material elements are fixed with being dispersed in a transparent resin binder.

[0047] As the resin binder, a resin having a high dielectric constant such as a polyester resin or the like may suitably be selected. The EL light-emitting layer **14** has a thickness of about 30-40 μm , a withstanding voltage of about 50-150 V, and a dielectric constant of about 10-30. The thickness of the EL light-emitting layer **14** is preferably one and a half times as large as the diameter of an EL light emitting material element or more. With such a thickness, the surfaces of the EL light-emitting layer **14** is regarded as being smooth, and for example, their surface roughness is regarded as being 30 μm or less.

[0048] The EL light-emitting layer **14** configured as above emits the light of a predetermined luminescent color such as a bluish green color when an AC power supply voltage is applied between the first electrodes **12a** and the second electrodes **12b**.

[0049] (5) Top Coat Layer **15**

[0050] The top coat layer **15** is stuck or fixed, closely to the EL light-emitting layer **14** to protect the EL light-emitting layer **14**. The top coat layer **15** is laminated on the EL light-emitting layer **14** also for improving the smoothness of the EL light-emitting layer **14** and the removability

of an electrically conductive material **30**. When the EL light-emitting layer **14** itself can secure necessary smoothness and removability, it is unnecessary to provide the top coat layer **15** in particular.

[0051] As the top coat layer **15**, the following resins can be used. That is, they are, for example, a fluorocarbon resin such as a 4-fluorinated ethylene resin, fluororubber and the like; a silicon resin such as silicon rubber and the like; a polyester resin; an urethane resin and the like. Since the main object of providing the top coat layer **15** is, as described above, to smooth the surface of the EL light-emitting layer **14** and to improve the removability of conductive material out of the surface thereof, the thickness of the top coat layer **15** is enough to be a degree which makes it possible to attain the object. On the other hand, it is suitable that the top coat layer **15** is as thin as possible. The reason for this is that the more the thickness is, the more the luminous intensity of the EL light-emitting sheet **10** decreases. The thickness is practically preferable to be about 1-2 μm as the effective value. Hereupon, the "effective value" means the size of the thickness of the top coat layer **15** placed on the uppermost part of the EL light-emitting layer **14**. It is sufficient for obtaining the thickness of about 1-2 μm as the effective value to make the coating value of the thickness about 5-8 μm . Hereupon, the "coating value" means the thickness of the protection layer **15** when the coating is performed on a surface having no irregularities.

[0052] The top coat layer **15** may be formed by gluing a film-like or sheet-like member fixedly onto the EL light-emitting layer **14**, or by placing a flexible material member thereto closely.

[0053] (6) Electrically Conductive Material **30**

[0054] As the electrically conductive material **30**, the following known materials can be used. That is, the conductive material includes: a stick type painting material such as a well-known ink, a pencil, a crayon, a pastel and the like; a sheet material having electrical conductivity (hereinafter referred to as a conductor sheet) and the like. As the stick type painting material such as the ink, the pencil, the crayon, the pastel and the like, ones including an organic or an inorganic coloring pigment may be used.

[0055] As the ink, one having the following properties is preferable. The properties are, for example, to have a surface resistance value equal to or less than $10^6 \Omega/\square$ in the state of being coated, to have optical transparency, and to include at least one kind of powder of the electrically conductive materials such as indium oxide, tin oxide, antimony, zinc oxide and the like, in a solvent. Further, as the ink, an electrically conductive polymer such as polyethylene dioxi thiophene and the like or a mixture of the electrically conductive polymer with the powder of the electrically conductive material may be used. In this case, it is possible to make the ink emit light for a long period until removal of the ink by wiping or the like. Moreover, the electrically conductive material **30** may be composed of water or a solvent, which have a high dielectric constant. In this case, the electrically conductive material **30** can easily be removed by drying it with a dryer, or by wiping it with a tissue, a piece of gauze, a sponge and the like.

[0056] 3. Operation and Function

[0057] The electrically conductive material **30** is attached on the top coat layer **15** with a desired pattern. The attach-

ment of the electrically conductive material **30** is performed by drawing with a brush, a pencil, a pastel, a crayon or the like, by performing printing with an ink jet printer or screen printing, by sticking an electrically conductive sheet, or the like. In the state, an AC power supply voltage is applied between the first electrode **12a** and the second electrode **12b**. Incidentally, the electrically conductive material **30** may be attached on the top coat layer after the AC power supply voltage has previously been applied.

[0058] Then, by the attachment of the electrically conductive material **30** on the top coat layer, an AC electric field is formed in the EL light-emitting layer **14**, and only the portion thereof just under the attached electrically conductive material **30** emits light locally. That is, since the EL light-emitting layer **14** has a high dielectric constant, a circuit composed of the first electrode **12a**, the EL light-emitting layer **14**, the electrically conductive material **30**, the EL light-emitting layer **14**, the second electrode **12b** and the like is formed to create an AC electric field in the EL light-emitting layer **14**. Then, the portion of the EL light-emitting layer just under the attachment part of the electrically conductive material **30** emits light. On the other hand, the intensity of the AC electric field at the rest portion of the EL light-emitting layer **14** just under the part where the electrically conductive material **30** is not attached is insufficient for the EL light-emitting layer **14** to emit light, and consequently the rest portion does not emit light. The thickness and the dielectric constant of the EL light-emitting layer **14** or the like are set in order that the portion of the EL light-emitting layer just under the attached electrically conductive material **30** may emit light selectively.

[0059] When the electrically conductive material **30** is liquid, there is a case where the electrically conductive material **30** permeates the EL light-emitting layer **14** to reach the waterproof layer **13** through a scratch, a pinhole or the like. However, the waterproof layer **13** prevents the further permeation of the electrically conductive material **30**. Moreover, the waterproof layer **13** also prevents the permeation of moisture or humidity in the air.

[0060] 4. Advantageous Effects

[0061] According to the present embodiment, an AC electric field is formed at the portion of the EL light-emitting layer **14** just under the attached electrically conductive material **30**, and only the portion locally emits light. This thing indicates that, when the electrically conductive material **30** is attached to the top coat layer **15** in the same pattern as a desired pattern, a light emitting with the desired pattern can be obtained. Consequently, an EL light emitting sheet **10** with which a user can easily produce a desired light emitting pattern can be provided.

[0062] The electrode layer **12** of the EL light emitting sheet **10** is, as described above, formed by deposition of a metal. When it is intended to form the electrode layer **12** by, for example, deposition of aluminum, the thickness of the electrode layer **12** is preferably about 300-1,000 Å (10^{-10} m), more preferably about 400-800 Å. Since the electrode layer **12** is very thin and is formed by deposition of aluminum, if a user, for example, scratches the EL light emitting sheet with a cutter or strikes a nail, only a part of the electrode layer **12** contacting with the cutter or the nail, is melted almost simultaneously with the shortage. Conse-

quently, the worst case where the whole of the electrode layer **12** is shorted is not generated, and the user does not receive electric shock.

[0063] The luminescent color of the EL light emitting sheet **10** can be changed by forming the EL light-emitting layer **14** by sealing the EL light-emitting elements with a coloring pigment mixed therein, by disposing a color filter between the EL light-emitting layer **14** and the top coat layer **15**, by coloring the top coat layer **15**, or by mixing a coloring pigment with the electrically conductive material **30**.

[0064] B. EL Light Emitting Display System

[0065] FIG. 3 is a perspective view showing the external appearance of a drawing board **50** as an example of an EL light emitting display system incorporating the above-mentioned EL light emitting sheet therein.

[0066] 1. Whole Configuration

[0067] In the drawing board **50**, a main body **59** with a shape like a board having a predetermined thickness holds the EL light emitting sheet **51** which is provided in the inside of the main body **59**. The EL light emitting sheet **51** having the top coat layer **15** on the top surface thereof is exposed from an opening **59a**. The drawing board **50** is configured to be provided with a highlight pen **53** having a pen point **53a** made of an impregnating material impregnating the electrically conductive material **30** using electrically conductive ink which includes a fluorescent material, holders **52** for holding the highlight pens **53** in the state of standing up, a tray **54** having a shape of a recess capable of holding the highlight pens **53** in the state of lying on their sides in the inside of the tray **54**, a removal member **58** carrying a sponge **58a** which is superior in water absorbing property, for removing the electrically conductive member **30** from the top surface of the EL light emitting sheet **51**, a tray **57** for holding the removal member **58** to allow the removal member to be taken out thereof, a change-over switch **55** for switching the light-emitting modes, and a power supply switch **56**.

[0068] 2. How to Use

[0069] A user may take a pen **53** out of the tray **54**, and may draw an arbitrary light emitting chart by applying the electrically conductive material **30** on a drawing screen **61**, namely the top surface part of the top coat layer **15** exposed from the opening **59a**. In FIG. 3, a word "ABC" is drawn. When the power supply switch **56** is turned on, a closed circuit is formed with the electrically conductive material **30**, the electrodes **12a**, **12b**, and the like. As a result, the EL light-emitting layer **14** emits light, and the emitted light is transmitted through the electrically conductive material **30** to be radiated. That is, since the lower parts where the pen **53** has drawn emit light, the drawing acts as if the characters "A", "B" and "C" themselves were emitting light.

[0070] 3. Detailed Configuration

[0071] (1) Electrode Pattern

[0072] Next, an electrode pattern of the EL light emitting sheet **51** built in the drawing board **50** will be described. FIG. 4 is a plan view showing the outline of the electrode pattern **70** of the EL light emitting sheet **51** built in the drawing board **50**. The electrode pattern **70** means the shape of the electrode layer **12** formed on the base layer **11**. In the

figure, an electrode (first electrode) **71a** and an electrode (second electrode) **71b** constitute an electrode pair **71**, and the electrode **71a** and **71b** have substantially the same figures as the comb-like pattern shapes of the electrodes **12a** and **12b**. The electrode pattern **70** includes six electrode pairs **71-76** having substantially the same configuration as the electrode pair **71** severally. The electrode pairs **71-76** are aligned. The upper end parts of the electrodes **71b-76b** of respective electrode pairs **71-76** in the figure are connected with one another to form an electrode line (earth line) **70b** which is connected to the ground. On the other hand, the electrodes **71a-76a** are not connected with one another.

[0073] When a predetermined voltage (AC voltage) is applied to each of the electrodes **71a-76a**, each of the electrode pairs **71-76** takes the state capable of forming a closed circuit. To put it more concretely, when the electrically conductive material **30** is coated on the drawing screen **61** while the voltage is applied to all of the electrodes **71a-76a**, a closed circuit is formed between the electrically conductive material **30** and an electrode pair at any place on the drawing screen **61** through the EL light-emitting layer **14** and the like. However, when the voltage is applied to only a part of the electrodes **71a-76a**, only the part of the electrode pair corresponding to the electrode to which the voltage is applied can form a closed circuit (the state may be referred to as a "closed circuit formation possible state", and a state other than the above-mentioned state may be referred to as a "closed circuit formation impossible state" in the present specification).

[0074] When taking into account the case of placing a chart for light emission, of a thin line which is approximately parallel to the extending direction of comb-shaped pattern electrode, or a dot-shaped chart for light emission, the gap **S1** between the first electrode **12a** and the second electrode **12b** which are next to each other is preferably about 0.2-0.3 mm, and the widths **S2** of the first electrode **12a** and the second electrode **12b** themselves are preferably about 0.2-0.5 mm, according to the same reason as the above-described one.

[0075] (2) Internal Circuits

[0076] FIG. 5 is a functional block diagram of the drawing board **50**. In the figure, the drawing board **50** is provided with a control unit **110** composed of a central processing unit (CPU), a random access memory (RAM), a read only memory (ROM) and the like, a battery **130** composed of dry cells, and a voltage application unit **120**. The voltage application unit **120** includes an inverter circuit **121** for converting a direct-current (DC) voltage supplied from the battery **130** to an AC voltage, and a booster circuit (not shown). The voltage application unit **120** applies an effective AC voltage of about 100-300 V between the earth line **70b** of the electrode pattern **70** and each of the electrode pair **71-76** according to a control signal input from the control unit **110**.

[0077] The control unit **110** stores programs instructing the procedures of applying the voltage to the electrode pattern **70** into the ROM at every light emitting mode. The control unit **110** reads a corresponding program according to a mode selection signal which is input from the change-over switch **55**, and outputs a control signal to the voltage application unit **120**.

[0078] Then, various light emitting modes can be realized by controlling the voltage application to the electrode pairs

71-76. In the drawing board **50**, an entirely light-emitting mode (mode I), an entirely blinking mode (mode II), a sequentially light-emitting mode (mode III) and a wavy light-emitting mode (mode IV) are executed by the switching of the change-over switch **55**.

[0079] (3) Light-Emitting Modes

[0080] (a) Entirely Light-Emitting Mode

[0081] The entirely light-emitting mode is a mode in which an voltage is applied to all of the electrode pair **71-76** simultaneously and continuously. In other words, the mode is one in which all of the electrode pairs **71-76** are in the closed circuit formation possible state. If the electrically conductive material **30** is coated on all over the drawing screen **61**, the whole surface of the drawing screen **61** continuously emits light.

[0082] (b) Entirely Blinking Mode

[0083] The entirely blinking mode is a mode in which a voltage is applied to all of the electrode pairs **71-76** simultaneously and intermittently. In other words, the mode is one in which all of the electrode pairs **71-76** simultaneously take the closed circuit formation possible state or the closed circuit formation impossible state alternately at predetermined time gaps. If the electrically conductive material **30** is coated on all over the drawing screen **61**, the whole surface of the drawing screen **61** intermittently emits light.

[0084] (c) Sequentially Light-Emitting Mode

[0085] The sequentially light-emitting mode is a mode in which a voltage is accumulatively applied to the electrode pairs **71-76** in the order of their arrangement. In other words, the mode is one in which the electrode pairs **71-76** which have been in the closed circuit formation impossible state sequentially become the closed circuit formation possible state at predetermined time gaps. If the electrically conductive material **30** is coated on all over the drawing screen **61**, an area part of one sixth of the whole area of the drawing screen **61** sequentially emits light (since there are six electrode pairs), and the area emitting light gradually increases. Incidentally, after all of the electrode pairs have become the closed circuit formation possible state, the application of the voltage to all of the electrode pairs **71-76** is stopped after a predetermined time to make all of the electrode pairs **71-76** be in the closed circuit formation impossible state. Thereby, the electrode pairs **71-76** return to the initial state, and the execution of the sequential light-emitting is repeated.

[0086] (d) Wavy Light-Emitting Mode

[0087] The wavy light-emitting mode is a mode in which a voltage is intermittently applied to the electrode pairs **71-76** in the order of their arrangement. In other words, the mode is one in which each of the electrode pairs **71-76** repeatedly transits the closed circuit formation possible state and the closed circuit formation impossible state with a predetermined time lag. If the electrically conductive material **30** is coated on all over the drawing screen **61**, each area part of one sixth of the whole area of the drawing screen **61** sequentially emits light and does not emit light, and consequently the parts emitting light operates to appear as if they were moving while waving.

[0088] 4. Advantageous Effects

[0089] As described above, in the drawing board **50**, it is possible to draw a light emitting chart by applying the electrically conductive material **30** easily with the highlight pen **53**. Moreover, it is also possible to remove the coated electrically conductive material **30** easily. Consequently, the repeating drawing of charts for light emitting can easily be realized.

[0090] Furthermore, a plurality of electrode pairs are formed in the EL light emitting sheet, and the control unit **110** controls the execution of the voltage application to each electrode pair. Thereby, light-emitting modes for light emitting charts can variously be changed, which makes it possible to realize interesting light emission together with the aid of the variation of the places where the electrically conductive material **30** is coated.

[0091] Incidentally, it is needless to say that the EL light emitting display system may be applied to other toys. In that case, the toys are not limited to the ones aiming to draw the light emitting charts like the EL light emitting display toys (for example, the drawing board **50**), but the toys may be ones incorporating the EL light emitting display system as a part of them.

[0092] C. Variations of EL Light Emitting Sheet**[0093]** 1. Variation 1 of EL Light Emitting Sheet**[0094]** (1) Whole Configuration

[0095] As shown in **FIG. 6**, the EL light emitting sheet **10a** according to the variation **1** has a configuration in which a base layer **11**, an electrode layer **12**, a waterproof layer **13**, a light reflecting layer **16**, an EL light emitting layer **14** and a top coat layer **15** are laminated in this order. Since each structure of the base layer **11**, the electrode layer **12**, the waterproof layer **13**, the EL light-emitting layer **14** and the top coat layer **15** is substantially the same as that of the EL light emitting sheet **10** in the embodiment of the present invention, the same reference numeral as that of the sheet **10** is attached to each element and the description for them are omitted. Mainly, the light-reflecting layer **16** will be described in the following.

[0096] (2) Detailed Configuration

[0097] The light-reflecting layer **16** is arranged between the waterproof layer **13** and the EL light-emitting layer **14**. The light-reflecting layer **16** adheres to the EL light-emitting layer **14**. The light-reflecting layer **16** has a thickness of about 10-30 μm , a withstanding voltage of about 200-300 V, and a dielectric constant of about 30-100, preferably about 60-100.

[0098] The light-reflecting layer **16** is made by dispersing inorganic powder which is ferroelectric powder such as barium titanate or Rochelle salt, into a resin functioning as a bonding agent such as an acrylic resin or the like. Since the inorganic powder such as the ferroelectric powder is a pigment showing white, the light-reflecting layer **16** becomes white, and therefore the light-reflecting layer **16** exhibits the light-reflecting function effectively.

[0099] 2. Variation 2 of EL Light Emitting Sheet

[0100] Although in the variation **1**, the waterproof layer **13** is arranged between the electrode layer **12** and the light-

reflecting layer **16**, in the variation **2**, the waterproof layer **13** is arranged between the light-reflecting layer **16** and the EL light-emitting layer **14**. In this case, the top coat layer **15** are not necessarily required.

[0101] 3. Variation 3 of EL Light Emitting Sheet

[0102] Variation **3** is one that a further change is given to variation **1**. The EL light emitting sheet according to the variation **3** has a structure in which a base layer **11**, one of first and second electrodes **12a** and **12b**, a waterproof layer **13**, the other of first and second electrodes **12a** and **12b**, a light reflecting layer **16**, and an EL light-emitting layer **14** are laminated in this order. In this case, the top coat layer **15** are not necessarily required, and the light reflecting layer **16** may be omitted.

[0103] 4. Variation 4 of EL Light Emitting Sheet

[0104] Variation **4** is one that a further change is given to variation **1**. The EL light emitting sheet according to the variation **4** has a structure in which a base layer **11**, one of first and second electrodes **12a** and **12b**, a light reflecting layer **16**, a waterproof layer **13**, the other of first and second electrodes **12a** and **12b**, and an EL light-emitting layer **14** are laminated in this order. In this case, the top coat layer **15** are not necessarily required.

[0105] 5. Variation 5 of EL Light Emitting Sheet

[0106] Variation **5** is one that a further change is given to the EL light emitting sheet **10**, **10a** or **51** according to the embodiment, or one of variations **1-4**. The EL light emitting sheet according to the variation **5** has a structure in which the EL light-emitting layer **14** and/or the light reflecting layer **16** has a permeation prevention function to water or the like, instead of or in addition to the waterproof layer **13**. In this case, the top coat layer **15** are not necessarily required.

[0107] The EL light-emitting layer **14** with the permeation prevention function is composed of, for example, an organic or inorganic EL light-emitting elements being phosphor particles or phosphorescent particles, and a transparent resin binder for fixing the EL light-emitting elements in the state of being dispersed. The variation **5** uses a resin having a waterproof property or a moisture-proof property as the resin binder. The following resins are used. That is, the resins are, for example, for example, a fluorocarbon resin such as a 4-fluorinated ethylene resin, fluororubber and the like; a silicon resin such as silicon rubber and the like; the other epoxy resins; an acrylic resin; a urethane resin; a polyester resin; and a resin having a high sealing property such as an ethylene-vinyl acetate copolymer and the like. These resins are cured by a method such as the UV curing, the IR curing, the two-liquid curing, the heat curing and the like.

[0108] Further, as the resins constituting the light-reflecting layer **16** having the permeation prevention function, the following resins having the waterproof property or the moisture-proof property are used. The resins are, for example, a fluorocarbon resin such as a 4-fluorinated ethylene resin, fluororubber and the like; a silicon resin such as silicon rubber and the like; the other epoxy resins; an acrylic resin; a urethane resin; a polyester resin; and a resin having a high sealing property such as an ethylene-vinyl acetate copolymer and the like. These resins are cured by a method such as the UV curing, the IR curing, the two-liquid curing, the heat curing and the like.

[0109] According to the variation 4, since the light-reflecting layer 16 prevents the permeation of water and the like, the generation of electrolysis between the first electrode 12a and the second electrode 12b can be prevented. Moreover, the snapping (damage) of a wire caused by the oxidation of the first electrode 12a and the second electrode 12b can be prevented.

[0110] 6. Variation 6 of EL Light Emitting Sheet

[0111] In the variation 6, the first electrode 12a and the second electrode 12b are formed on the back surface of a base film or a sheet of glass (base layer 11) which have a permeation prevention function. As the base film in this case, one made of, for example, polyethylene terephthalate (PET) is used.

[0112] According to the variation 6, since the base film or the sheet of glass prevents the permeation of water and the like from the front side, the generation of electrolysis between the first electrode 12a and the second electrode 12b can be prevented. Moreover, the snapping (damage) of a wire caused by the oxidation of the first electrode 12a and the second electrode 12b can be prevented.

[0113] Incidentally, the configuration is used in the case where the EL light emitting sheet is incorporated in a case body or the like. In the case where the EL light emitting sheet is incorporated in the case body as described above, the back surface side is generally sealed not to be exposed. Consequently, it is needless to consider the attachment of water and the like from the back surface side. If necessary, it is enough to coat the exposing electrodes with a resin having the permeation prevention function, or to perform the alumite processing of the exposing electrodes.

[0114] Incidentally, although the first electrode 12a and the second electrode 12b are provided on the back surface of the substrate sheet in the variation 6, the first electrode 12a and the second electrode 12b may be provided with putting the substrate sheet between them.

[0115] 7. Variation 7 of EL Light Emitting Sheet

[0116] FIG. 7 shows the outline of the electrode pattern of the variation 7. In the figure, the electrode pattern 700 is a two dimensional arrangement composed of six comb-shaped electrode pairs 710 in all, three of which are arranged at the upper row in the right and left direction in the figure, and the other three of which are arranged at the lower row in the right and left direction in the figure. Moreover, the electrode pairs 710 are arranged so that the electrodes of each electrode pair are engaged in the upper and lower direction in the figure. Then, the electrode end of the earth side electrode of each electrode pair is integrally formed as an earth line 700b between the upper row electrode pairs and the lower electrode pairs of the two rows. In a case of adhering a chart for light emission, of a thin line, or in a case of adhering a dot-shaped chart for light emission, the gap of about 0.2-0.3 mm, between the first electrode 12a and the second electrode 12b which are next to each other is preferable, and the width sizes of the first electrode 12a and the second electrode 12b themselves, of about 0.2-0.5 mm, are preferable.

[0117] By means of the electrode pattern 700, a wide variety of light emitting patterns can be formed with the six electrode pairs in all.

[0118] Furthermore, owing to the arrangement of the earth line 700b between the upper row electrode pairs and the lower row electrode pairs of the two rows, the gap of the upper row electrode pairs and the lower row electrode pairs can be narrowed. That is, if a displacement side electrode 710a is arranged between the upper row electrode pairs and the lower row electrode pairs of the two rows, it is impossible to connect the upper row electrode 710a and the lower row electrode 710a cannot connected with each other, and then it is necessary to arrange them with a predetermined space between them. Consequently, the gap between the upper row and the lower row of the two rows becomes wide, and the gap becomes clear in some light emission patterns. On the other hand, if the earth line 700b is arranged at the center, it becomes possible to remove, or at least to reduce, the defect as above.

[0119] D. Variations of EL Light Emitting Display System

[0120] 1. Variation 1 of EL Light Emitting Display System

[0121] A signboard 900 according to a variation of the EL light emitting system is shown in FIGS. 8A and 8B. The signboard 900 is provided with an EL light emitting sheet 910 therein. The EL light emitting sheet 910 includes rectilinearly arranged four electrode pairs formed by depositing aluminum on a base layer 11. Buttons 931, 932, 933 and 934 (hereinafter referred to as buttons 930 comprehensively) corresponding to each of the electrode pairs 921, 922, 923 and 924 (hereinafter referred to as electrode pairs 920 comprehensively) are arranged on one side of a drawing screen, i.e., the top surface of the top coat layer of the EL light emitting sheet. The EL light emitting sheet 910 and the signboard 900 have the same configuration as those of the EL light emitting sheet 10 and the drawing board 50 except the arrangement configuration of the electrode pairs. The buttons 930 are made to be toggle switches. The buttons 930 are configured to output pushed signals when the buttons 930 are pushed down.

[0122] FIG. 9 is a control block diagram of the signboard 900. The configuration of the signboard is substantially the same as that of the drawing board 50 shown in FIG. 3. The configuration of the signboard is provided with the buttons 930. In FIG. 10, the control unit 110 selects and decides a region where light is to be emitted, that is, an electrode pair to which a predetermined voltage is applied on the basis of the pushed signal inputted from the buttons 930. For example, when the buttons 931 and 932 are pushed down, the control unit 110 selects and decides the electrode pairs 921 and 922. Then, the control unit 110 performs voltage application to the selected and decided electrode pairs 921 and 922 on the basis of the light emitting mode selected with the change-over switch 55.

[0123] FIG. 8B is a view showing an embodiment of the signboard 900 in the state in which the button 931 is pushed down. Since the electrode pair 921 is in the state of closed circuit formation possible state, the portion of the characters indicating "TODAY'S BARGAIN!", which have been drawn with the electrically conductive material 30, emit light in the region of the drawing screen where the electrode pair 921 is arranged.

[0124] Incidentally, the buttons 930 may be composed of change-over switches to make it possible to select light emitting modes in addition to the turning on and off, of the

electrode pairs. In this case, for example, a light emitting form in which light emission is blinked in the region drawn as "TODAY'S BARGAIN!" in FIG. 8B, while a continuous light emission is given in the other regions, can be realized.

[0125] 2. Variation 2 of EL Light Emitting Display System

[0126] (1) Schematic Configuration

[0127] FIG. 10 is a perspective view showing an external appearance of a drawing board 1000 as an embodiment of the EL light emitting display system incorporating the above-mentioned EL light emitting sheets.

[0128] As shown in FIG. 11, the drawing board 1000 is provided with a transparent cover 1110 on an EL light emitting sheet 1100. The cover 1110 is configured to be capable of being opened and closed. On the back side of the cover 1110, a projection 1111 is annexed. The projection 1110 is provided to turn on a power supply control switch (not shown in the figure) which is arranged on the inside of the drawing board 1000 when the cover 1110 is closed. Other configurations and the like of the EL light emitting sheet 1100 are substantially the same as those of the drawing board 50.

[0129] (2) Function and Advantageous Effect

[0130] The EL light emitting display system does not work only by turning the power supply switch 1256 on. Only when both the power supply switch 1256 and the power supply control switch are turned on, the system does work to become in a closed circuit formation possible state. Therefore, even if the liquid electrically conductive material 30 penetrates into the EL light emitting sheet 1100 to short-circuit the electrode pair, no AC current are applied to the electrode pair unless the cover 1110 is closed. Accordingly, it is possible to enhance the safety.

[0131] E. Another Variation of the Invention

[0132] (1) It is preferable to contain organic or inorganic colored pigment in the waterproof layer 13 of the EL light emitting sheet, to make the electrode pattern invisible from the front side by coloring. Such coloring enables not only making the electrode pattern invisible from the front side but also widening the range of choice for design from the front side. In a case of providing a light reflecting layer 16, it is required to arrange the light reflecting layer 16 near the EL light emitting layer in comparison with the waterproof layer 13.

[0133] (2) In the variation 2 of EL light emitting display system, a projection 1111 is annexed on the back side of the cover 1110, and when the cover 1110 is closed, the system works to become in a closed circuit formation possible state. However, opening and closing of the cover 1110 may be detected by any one of appropriate mechanical, electrical and optical manners, to become in a closed circuit formation possible state only when the cover 1110 is closed. Alternatively, a structure in which the power supply switch 1256 is locked during the cover 1110 is opened, may also be used.

[0134] According to the invention, it is possible to obtain an EL light emitting display system and an EL light emitting sheet, having an improved probability of light emission and to restrain occurrence of flecks of light emission when placing an electrically conductive material thereon.

[0135] The entire disclosure of Japanese Patent Application No. Tokugan 2002-254617 which was filed on Aug. 30, 2002, and Japanese Patent Application No. Tokugan 2003-122787 which was filed on Apr. 25, 2003, including specification, claims, drawings and summary are incorporated herein by reference in its entirety.

What is claimed is:

1. An electroluminescence light emitting display system comprising:

an electroluminescence light emitting sheet which comprises a light-emitting layer containing electroluminescence light-emitting elements therein, and an electrode section comprising a plurality of electrode pairs which are disposed with a predetermined arrangement, wherein each of the electrode pairs includes first and second electrodes which are electrically separated from each other with a spacing region and disposed in one surface side of the light-emitting layer with a predetermined arrangement; and

a voltage application unit for applying a predetermined voltage between the first and second electrodes,

wherein when an electrically conductive material is placed on the other surface side of the light-emitting layer and a voltage application between the first and second electrodes is performed by the voltage application unit, a portion of the light-emitting layer corresponding to the placed electrically conductive material emits light; and each width of the first and second electrodes is 0.2-0.5 mm and a width of the spacing region between the first and second electrodes is 0.2-0.3 mm.

2. The electroluminescence light emitting display system as claimed in claim 1, wherein the electrically conductive material is attachable onto and detachable from the other surface side of the light-emitting layer.

3. The electroluminescence light emitting display system as claimed in claim 1, wherein the electrode section comprises a plurality of electrode pairs.

4. The electroluminescence light emitting display system as claimed in claim 2, wherein the electrode section comprises a plurality of electrode pairs.

5. An electroluminescence light emitting sheet comprising:

a light-emitting layer containing electroluminescence light-emitting elements therein; and

an electrode section comprising a plurality of electrode pairs which are disposed with a predetermined arrangement, wherein each of the electrode pairs includes first and second electrodes which are electrically separated from each other with a spacing region and disposed in one surface side of the light-emitting layer with a predetermined arrangement, each width of the first and second electrodes is 0.2-0.5 mm and a width of the spacing region between the first and second electrodes is 0.2-0.3 mm.

6. The electroluminescence light emitting sheet as claimed in claim 5, wherein the electrode section comprises a plurality of electrode pairs.

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摘要(译)

一种电致发光发光显示系统，具有：电致发光发光片，其包括其中包含电致发光元件的发光层，和电极部分，所述电极部分包括以预定排列设置的多个电极对，其中每个电极对电极对包括第一和第二电极，它们以间隔区域彼此电隔离，并以预定的排列设置在发光层的一个表面侧；电压施加单元，用于在第一和第二电极之间施加预定电压。第一和第二电极的每个宽度为0.2-0.5mm，第一和第二电极之间的间隔区域的宽度为0.2-0.3mm。当导电材料放置在发光层的另一表面侧上并且通过电压施加单元执行第一和第二电极之间的电压施加时，发光层的一部分对应于放置的导电层材料发光。

