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(54) Title: FILTER FOR SHIELDING ELECTROMAGNETIC INTERFERENCE AND DISPLAY DEVICE PROVIDED WITH THE SAME

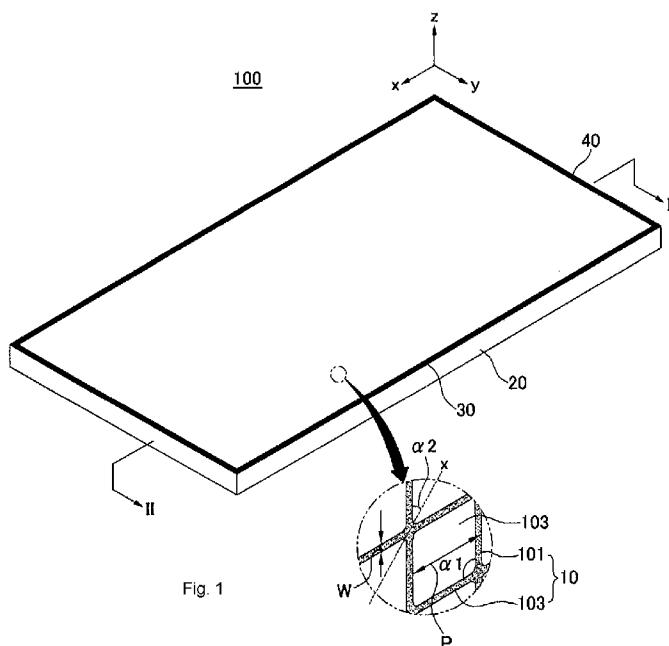


Fig. 1

(57) Abstract: The present invention relates to a filter for shielding electromagnetic interference using an offset printing method and a display device provided with the same. The filter for shielding electromagnetic interference includes i) a glass substrate, and ii) a shielding member that is formed on the glass substrate with a mesh shape. The shielding member is configured to shield electromagnetic interference.

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FILTER FOR SHIELDING ELECTROMAGNETIC INTERFERENCE AND DISPLAY DEVICE PROVIDED WITH THE SAME

Technical Field

5 The present invention relates to a filter for shielding electromagnetic interference using an offset printing method and a display device provided with the same.

Background Art

10 Recently, various kinds of display devices have been developed. For example, a plasma display device (PDP), a liquid crystal display device (LCD), an organic light emission display device (OLED), etc. have been developed. Since these display devices have a small thickness and a low weight, they are used in many products that are necessary for displaying images.

15 Meanwhile, electromagnetic interference (EMI) is emitted from many electric elements included in the display device. The electromagnetic interference causes malfunction of the display device and harm to a human body. Therefore, a filter for shielding electromagnetic interference is attached to the display device for shielding electromagnetic interference.

DISCLOSURE

20 Technical Problem

 A filter for shielding electromagnetic interference that is manufactured by using an offset printing method is provided. In addition, a display device provided with the above filter for shielding electromagnetic interference is provided.

25 Technical Solution

30 A filter for shielding electromagnetic interference according to an embodiment of the present invention includes i) a glass substrate, and ii) a shielding member that is formed on the glass substrate with a mesh shape, has a chamfered opening, and is formed of a single layer. The shielding member is configured to shield electromagnetic interference.

 The shielding member may be manufactured by using an offset printing method and a plasticizing method. The shielding member may include i) at least one first shielding portion that extends along one direction, and ii) at least one second shielding portion that crosses the first shielding portion. A width of the first shielding portion may be over 0 and is not more than 50 μ m. The width of the first shielding portion may be in a range of 15 μ m to 30 μ m. The at least one first shielding portion may include a plurality of first shielding

portions, and an average pitch of the plurality of first shielding portions may be over 0 and is not more than 500 μ m. The average pitch of the plurality of first shielding portions may be in a range of 200 μ m to 400 μ m.

5 An angle formed when the first shielding portion crosses the second shielding portion may be in a range of 60 degrees to 120 degrees. The angle may be in a range of 80 degrees to 100 degrees. The angle may be substantially 90 degrees.

10 An angle formed between the first shielding portion and an edge of the glass substrate may be in a range of 20 degrees to 70 degrees. The angle may be in a range of 35 degrees to 55 degrees.

The opening may have a polygon shape. Lengths of all of edges forming the polygon may be substantially the same. The polygon may be substantially a square.

15 The shielding member may include a conductive metal. The conductive metal may be at least one element selected from a group consisting of silver, copper, and nickel.

20 A filter for shielding electromagnetic interference according to an embodiment of the present invention may further include an edge layer formed along an edge of the glass substrate. The shielding member may be formed on the edge layer. A filter for shielding electromagnetic interference according to an embodiment of the present invention may further include a ground member that is connected to an end of the shielding member to ground the shielding member.

25 A display device according to an embodiment of the present invention includes i) a glass substrate; ii) a shielding member that is formed on the glass substrate with a mesh shape, has a chamfered opening, and is formed of an single layer; and iii) a display panel that displays image and is opposed to the glass substrate. The shielding member is configured to shield electromagnetic interference emitted from the display panel.

30 The display panel may include i) first and second substrates that are opposed to each other, and ii) a black layer that is located between the first and second substrates. A direction along which the shielding member extends may cross a direction along which the black layer extends. The shielding member may contact the second substrate. A thickness of the glass substrate may be not less than a thickness of the first substrate. The shielding member
35 may have a polygon-shaped opening. The opening may be chamfered. Lengths of all of edges forming the polygon may be substantially the same.

The polygon may be substantially a square.

The shielding member may be manufactured by using an offset printing method and a plasticizing method.

5 The shielding member may include i) at least one first shielding portion that extends along one direction, and ii) at least one second shielding portion that crosses the first shielding portion. A width of the first shielding portion may be over 0 and is not more than $50\mu\text{m}$. The width of the first shielding portion may be in a range of $15\mu\text{m}$ to $30\mu\text{m}$.

10 The at least one first shielding portion may include a plurality of first shielding portions, and an average pitch of the plurality of first shielding portions may be over 0 and is not more than $500\mu\text{m}$. The average pitch of the plurality of first shielding portions may be in a range of $200\mu\text{m}$ to $400\mu\text{m}$.

15 An angle formed when the first shielding portion crosses the second shielding portion may be in a range of 60 degrees to 120 degrees. The angle may be in a range of 80 degrees to 100 degrees. The angle may be substantially 90 degrees.

An angle formed between the first shielding portion and an edge of the glass substrate may be in a range of 20 degrees to 70 degrees. The angle may be in a range of 35 degrees to 55 degrees.

20 The display panel may be a plasma display panel.

Advantageous Effects

As described above, a filter for shielding electromagnetic interference can be manufactured by using an offset printing method that has a simpler manufacturing process than other processes and a low cost.

25 In addition, an effect for shielding electromagnetic interference of the display device can be maximized when the display device provided with the above-described filter for shielding electromagnetic interference is manufactured.

DESCRIPTION OF DRAWINGS

30 FIG. 1 is a schematic perspective view of a filter for shielding electromagnetic interference according to an embodiment of the present invention.

FIG. 2 is a partial cross-section view along a line II-II of FIG. 1.

35 FIG. 3 is a schematic view illustrating a manufacturing method of the filter for shielding electromagnetic interference of FIG. 1.

FIG. 4 is a schematic perspective view of the display device provided with the filter for shielding electromagnetic interference of FIG. 1.

FIG. 5 is a partial cross-sectional view along a line V-V of FIG. 4.

FIG. 6 is an enlarged photograph of a glass substrate that is offset printed according to a first exemplary example of the present invention.

FIG. 7 is an enlarged photograph of a manufactured filter for shielding
5 electromagnetic interference according to a first exemplary example of the present invention.

BEST MODE

Exemplary embodiments of the present invention will be explained in detail below with reference to the attached drawings in order for those skilled
10 in the art in a field of the present invention to easily perform the present invention. However, the present invention can be realized in various forms and is not limited to the embodiments explained below. In addition, like reference numerals refer to like elements in the present specification and drawings.

15 All terms including technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and the present disclosure, and will not be interpreted in an idealized or overly
20 formal sense unless expressly so defined herein.

It will be understood that, although the terms first, second, third, etc., may be used herein to describe various elements, components, regions, layers, and/or sections, these elements, components, regions, layers, and/or sections
25 should not be limited by these terms. These terms are only used to distinguish one element, component, region, layer, or section from another element, component, region, layer, or section. Thus, a first element, component, region, layer, or section discussed below could be termed a second element, component, region, layer, or section without departing from the teachings of the present
30 invention.

A "chamfer" means that a corner is removed by cutting it. Here, the corner may be a substantial object with a polygonal shape or an opening. If the polygon is an opening, lines can meet with each other as widths thereof forming the opening become slightly large. In this case, the corner of the
35 opening is surrounded by the lines with a slightly increased width, and thereby it can be referred to as a chamfered opening.

FIG. 1 schematically shows a filter 100 for shielding electromagnetic

interference according to an embodiment of the present invention. An enlarged circle of FIG. 1 shows a magnified inner portion of the filter 100 for shielding electromagnetic interference.

As shown in FIG. 1, the filter 100 for shielding electromagnetic interference includes a glass substrate 20, a shielding member 10, an edge layer 30, and a ground member 40. The glass substrate 20 is used for forming the shielding member 10 by using an offset printing method. A long edge of the glass substrate 20 is parallel to an x-axis, while a short edge thereof is parallel to a y-axis.

The shielding member 10 is grounded to be connected to the ground member 40. Therefore, the shielding member 10 can absorb and remove electromagnetic interference. As a result, the shielding member 10 functions as a filter for shielding the electromagnetic interference. The edge layer 30 is formed along an edge of the glass substrate 20, and the ground member 40 is located at both ends of the glass substrate 20 along an x-axis direction in order to ground the shielding member 10.

As shown in an enlarged circle of FIG. 1, the shielding member 10 is formed with a mesh shape. The filter 100 for shielding electromagnetic interference is mainly used in a display device. Therefore, the shielding member 10 is formed with a mesh shape in order to display an image projected from the display device to the outside. Since the shielding member 10 has an opening 109, the image can be seen through the opening 109 while the electromagnetic interference is blocked.

The shielding member 10 includes first and second shielding portions 101 and 103. The first shielding portion 101 extends along an x-axis direction to cross the second shielding portion 103. That is, as shown in the enlarged circle of FIG. 1, the first and second shielding portions 101 and 103 form an angle α_1 while meeting each other. The angle α_1 may be in a range of 60 degrees to 120 degrees. If the angle α_1 is too large or too small, a distance between the first and second shielding portions 101 and 103 becomes too small, and thereby an opening ratio may become too small. More preferably, the angle α_1 may be in a range of 80 degrees to 100 degrees. In this case, a distance between the first and second shielding portions 101 and 103 can be suitably maintained. In addition, most preferably, the angle may be substantially 90 degrees.

In the embodiment of the present invention, a gravure roll 55 (shown in FIG. 3) in which grooves 551 (shown in FIG. 3) with a mesh shape are formed

along oblique line directions is used for forming the shielding member 10 with a mesh shape. If the grooves 551 are not formed along oblique line directions but are perpendicular to a rotating direction of the gravure roll 55, a conductive paste 10a (shown in FIG. 3) as a resource of the shielding member 10 received in the groove 551 is not removed well from the groove 551. That is, since the conductive paste 10a is not influenced by a rotating force of the gravure roll 55, it is not easy to remove the conductive paste 10a from the gravure roll 55.

On the contrary, when a rotating direction of the gravure roll 55 corresponds to a direction along which the groove 551 extends, the conductive paste 10a can be removed well from the groove 551 by a rotating force of the gravure roll 55. Therefore, when the groove 551 is formed to correspond to the rotating direction of the gravure roll 55, the shielding member 10 with an opening 109 having a uniform size can be formed.

More specifically, when the groove is only formed to correspond to the rotating direction of the gravure roll, it is impossible to form a shielding member with a mesh shape as in the embodiment of the present invention. That is, when the mesh shape is a rectangle shape, it is difficult to transfer the conductive paste to a blanket roll since another groove should also be formed along a direction to be perpendicular to the rotating direction of the gravure roll.

As shown in the enlarged circle of FIG. 1, when the shielding member 10 is formed on the glass substrate 20 using the above-described method, the first shielding portion 101 forms a certain angle α_2 with the x-axis direction. Here, the angle α_2 may be in a range of 20 degrees to 70 degrees. If the angle α_2 is too small or too large, the first and second shielding portions 10 and 20 are dense, and thereby an effect of shielding electromagnetic interference can be deteriorated. In addition, when the filter 100 for shielding electromagnetic interference is used in the display device 200 (shown in FIG. 4), it is overlapped with a black layer 651 of the display device 200, and thereby a moiré phenomenon can occur. More specifically, the angle α_2 may be in a range of 35 degrees to 55 degrees.

As shown in the enlarged circle of FIG. 1, resolution of the image can be enhanced by maximizing the area of the opening 109 while forming a width W of the shielding member 10 to be smaller. For this, the width W of the shielding member 10 may be over 0 and may not be more than $50\mu\text{m}$. In this case, the shielding member 10 cannot be recognized with the naked eye. When the width W of the shielding member 10 is too large, the resolution of the image is deteriorated as the size of the opening 109 becomes small. More

specifically, the width W of the shielding member 10 is preferably in a range of $15\mu\text{m}$ to $30\mu\text{m}$.

Meanwhile, an average pitch P of the shielding member 10 may be over 0 and be not more than $500\mu\text{m}$. When the average pitch P of the shielding member 10 is too large, the electromagnetic interference can be discharged to the outside without being absorbed since the shielding member 10 is not densely formed. As a result, an effect of shielding an electromagnetic interference is deteriorated. More specifically, it is preferable that the average pitch P of the shielding member 10 may be in a range of $200\mu\text{m}$ to $400\mu\text{m}$.

The shielding member 10 can include a conductive metal to maximize an effect of shielding electromagnetic interference. The conductive metal has a good effect of shielding electromagnetic interference since it can collect the electromagnetic interference passing through the filter 100 for shielding electromagnetic interference. Silver, copper, nickel, or alloys thereof can be used as the conductive metal. Since the conductive metal has good electrical conductivity, it can effectively shield the electromagnetic interference.

FIG. 2 partially shows a cross-sectional structure of the filter 100 for shielding electromagnetic interference, cutting along a line II-II of FIG. 1.

As shown in FIG. 2, the shielding member 10 is formed on an edge layer 30 formed on the glass substrate 20. Since the edge layer 30 contains black ceramics, it can improve appearance of the filter 100 for shielding electromagnetic interference. In addition, the edge layer 30 can effectively connect the ground member 40 to the shielding member 10. A thickness of the edge layer 30 may be in a range of about $15\mu\text{m}$ to about $20\mu\text{m}$. After the shielding member 10 is formed on the edge layer 30 formed on the glass substrate 20 by coating a conductive paste using the offset printing method, the ground member 40 is formed thereon. A conductive film tape can be used as the ground member 40.

FIG. 3 schematically shows a manufacturing process of the filter 100 for shielding electromagnetic interference of FIG. 1. The filter 100 for shielding electromagnetic interference can be manufactured by using an offset printing device 500. The offset printing method will be explained in detail below.

As shown in FIG. 3, the offset printing device 500 includes a dispenser 51, a doctor blade 53, a gravure roll 55, and a blanket roll 57. In the offset printing method, the offset printing device 500 is used. The offset printing method includes an off process and a set process. In the off process, the conductive paste 10a is removed from the gravure roll 55. The removed

conductive paste 10a is coated on the glass substrate 20 in the set process. The dispenser 51 discharges the conductive paste 10a at a predetermined time interval. The conductive paste 10a discharged from the dispenser 51 is received in the grooves 551 formed in the gravure roll 55. The conductive
5 paste 10a may contain elastic organic materials, conductive metals, a flux, a binder, etc. A material having a boiling point of 200°C or more may be used as the flux and a glass frit may be used as a binder. The organic material may include acrylate resin, acryl resin, polyster, polyurethane, an oligomer, etc. The organic materials are removed in a process of plasticizing the glass
10 substrate 20. The conductive paste 10a may further include black pitch.

Since an amount of the conductive paste 10a received in the groove 551 is large, the conductive paste 10a may overflow outside of the groove 551. Therefore, overflowed conductive paste 10a is removed by the doctor blade 53 while the gravure roll 55 rotates along a direction indicated by an arrow
15 (counter-clockwise direction). Since the doctor blade 53 contacts an outer surface of the gravure roll 55, the overflowed conductive paste to the outside of the groove 551 can be effectively removed. Therefore, the groove 551 of the gravure roll 55 can be suitably filled with the conductive paste 10a without overflowing it.

20 The blanket roll 57 is located to oppose the gravure roll 55. The blanket roll 57 rotates in a direction (clockwise direction) that is opposite to a rotating direction of the gravure roll 55. As a result, the conductive paste 10a received in the grooves 551 is transferred to the blanket roll 57 while the gravure roll 55 meets the blanket roll 57. Therefore, the conductive paste 10a is attached to an
25 outer surface of the blanket roll 57.

The blanket roll 57 coats the conductive paste 10a on the glass substrate 20 while moving on the glass substrate 20 along a direction indicated by an arrow. The glass substrate 20 is prepared by being washed. The conductive
30 paste 10a with a mesh shape is formed on the glass substrate 20 in order to form the shielding member 10 (shown in FIG. 1).

Next, organic materials contained in the conductive paste 10a are removed by loading the glass substrate 20 into a heating furnace (not shown) to heat it. The conductive paste 10a may be dried before a plasticizing process. Since the shielding member 10 of a single layer is formed by removing the
35 organic materials, the glass substrate 20 can be plasticized at a relative low temperature and shock resistance of the glass substrate 20 can be maintained by preventing reinforcement of the glass substrate 20 from being reduced.

The shielding member can be directly formed by heating the glass substrate 20 and removing the organic materials. That is, the filter for shielding electromagnetic interference is directly manufactured without performing other processes such as etching of the conductive paste 10a. Therefore, the process is simple, and thereby manufacturing cost of the filter for shielding electromagnetic interference can be reduced.

The offset printing method used during manufacturing of the filter for shielding electromagnetic interference according to an embodiment of the present invention includes a plasticizing process, and thereby a resin substrate, which is weak with respect to heat, cannot be used in the offset printing method. Therefore, a glass substrate 20 is used instead of a resin substrate. Since other contents of the offset printing method can be understood by those skilled in the arts in the technical field of the present invention, detailed description thereof is omitted.

A copper film is firstly attached to a resin film when the filter for shielding electromagnetic interference is manufactured by using a photolithography method instead of an offset printing method. Then, a dry film resist is laminated on the copper film and an exposing process, a developing process, an etching process, and an exfoliation process are performed to form a pattern. Therefore, the manufacturing process is complicated, and thereby productivity is not good.

In addition, when the filter for shielding electromagnetic interference is manufactured by using a plating method, desired electrical conductivity should be obtained by forming a pattern on a resin film and plating a copper thereon. However, wasted liquid from the plating process causes environmental pollution and a structure of the filter for shielding electromagnetic interference is complicated since it does not have a single structure but has a multi-layered structure.

A pattern cannot be directly formed on the glass substrate in the above-described photography method or the plating method. For example, a mother substrate is wound in a form of a roll and is then submerged in a plating bath in the plating method. However, the glass substrate cannot be wound in a form of a roll, and thereby it is impossible to plate the glass substrate to form a shielding member. In addition, when the glass substrate is used, the process is complicated because the pattern should be attached to the glass substrate. The offset printing method can solve the above problems. That is, since the shielding member 10 of a single layer is directly formed on the glass substrate

20, the process is simplified and so manufacturing cost is reduced. On the contrary, a shielding member with a plurality of layers is formed in a non-electrolytic plating method and so on, and thereby manufacturing cost is high. Meanwhile, harmful materials are not discharged in the offset printing method, and thereby pollution does not occur.

FIG. 4 schematically shows a display device 200 provided with the filter 100 for shielding electromagnetic interference of FIG. 1. An enlarged circle of FIG. 4 shows a magnified display device 200 to be seen from a z-axis direction.

As shown in FIG. 4, the filter 100 for shielding electromagnetic interference is fixed on a display panel 600 (shown in FIG. 5) using a supporting member 110. Therefore, the filter 100 for shielding electromagnetic interference can be stably received in the display device 200.

As illustrated in the enlarged circle of FIG. 4, the shielding member 10 is located on a black layer 651 included in the display panel 600 (shown in FIG. 5). Although not shown in the enlarged circle of FIG. 4, a glass substrate 20 (shown in FIG. 5) and a second substrate (620) (shown in FIG. 5) are located between the shielding member 10 and the black layer 651. The shielding member 10 shields electromagnetic interference emitted from the display panel 600.

As shown in the enlarged circle of FIG. 4, the shielding member 10 has an opening 109 with a lozenge shape. Although not shown in FIG. 4, the shielding member 10 preferably has a square shape. In this case, the shape of the shielding member 10 is optimized, and thereby the effect of shielding electromagnetic interference can be maximized.

Lengths of the four edges forming the opening 109 are substantially the same. Since lengths of the four edges are substantially the same, the shape of the shielding member 10 is regular. As a result, intensity of light emitted from the opening 109 is uniform, and thereby a uniform image can be displayed. Meanwhile, although the opening 109 is shown to have a lozenge shape in the enlarged circle of FIG. 4, this is merely to illustrate the present invention and the present invention is not limited thereto. Therefore, the opening 109 may have a polygonal shape.

The shielding members 10 are formed with the shielding portions crossing with each other by the offset printing method and are then plasticized. Therefore, the width of the shielding members 10 formed of a single layer becomes a little larger at a crossing point where the shielding members 10 meet each other. As a result, the opening 109 has a chamfered shape. That is, since the width of the shielding members 10 becomes a little larger at a crossing point

of the shielding members 10, the opening 109 has a shape in which corners are removed. The shielding member 10 is continuously formed without being cut due to the above-described shape of the opening 109, and thereby electromagnetic interference can be shielded by an entire surface of the shielding member 10.

As shown in the enlarged circle of FIG. 4, the shielding members 10 are formed in such a way that a direction along which shielding members 10 extend crosses a direction in which the black layer 651 extends. Therefore, it is possible to prevent a phenomenon in which an image becomes blurred. Furthermore, since the shielding member 10 has a fine width that cannot be recognized with the naked eye, there is almost no influence on the quality of the image. Therefore, as shown in the enlarged circle of FIG. 4, an image with a high resolution can be displayed even if the shielding member 10 is located on the black layer 651.

FIG. 5 partially shows a cross-section cut along a line V-V of FIG. 4.

FIG. 5 shows a plasma display panel as a display panel 600. The plasma display panel shown in FIG. 5 is merely to illustrate the present invention and the present invention is not limited thereto. Therefore, the filter for shielding electromagnetic interference can be used in another display panel.

The display panel 600 includes first and second substrates 610 and 620, display electrodes 680, address electrodes 640, sidewalls 660, a phosphor layer 670, a dielectric layer 630, a protective layer 635, and a black layer 651. An internal space of the display panel 600 is filled with a discharge gas. The first and second substrates 610 and 620 are opposed to each other. The sidewalls 660 form a plurality of discharge cells and a phosphor layer is formed in the discharge cells. The dielectric layer 630 protects the address electrodes 640 and the display electrodes 680 from electrons. The protective layer 635 protects the dielectric layer 630 located thereon.

When a voltage is applied to the address electrodes 640 and the display electrodes 680, a discharge occurs between the address electrodes 640 and the display electrodes 680. Ultraviolet rays generated by the discharge collide with the phosphor layer 670 and then visible rays are emitted therefrom. Meanwhile, the black layer 651 is formed on the sidewalls 660 to improve the contrast ratio. The black layer 651 is located between the first and second substrates 610 and 620. Since the black layer 651 is located on the sidewall 660 that does not emit light, it can reduce a loss of light emitted from the phosphor layer 670.

As shown in FIG. 5, the filter 100 for shielding electromagnetic interference is located on the display panel 600. Therefore, the filter 100 for shielding electromagnetic interference can shield electromagnetic interference emitted from the display panel 600. Since the shielding member 10 contacts the second substrate 620, it is not exposed to the outside. Therefore, the shielding member 10 can be prevented from being harmed and the appearance is prevented from being deteriorated due to the shielding member 10.

Meanwhile, if respective thicknesses of the first and second substrates 610 and 620 are small, the display panel 600 is weak against an external shock. Therefore, strength of the display device 200 is reinforced by using the filter 100 for shielding electromagnetic interference including the glass substrate 20. That is, since the thickness of the filter 100 for shielding electromagnetic interference is included in the thickness of the display device 200 so that the display device 200 becomes thick, it is strong against an external shock. For example, the thickness 20t of the glass substrate 20 is formed to be greater than the thickness 620t of the second substrate 620, and thereby durability of the display device 200 can be improved by the filter 100 for shielding electromagnetic interference.

The present invention will be explained in detail with reference to the exemplary examples below. The exemplary examples are merely to illustrate the present invention and the present invention is not limited thereto.

Exemplary Example 1

A conductive paste containing a high molecule resin at 7wt%, butylcarbitol acetate (BCA) at 7wt%, glass powder at 4wt%, silver at 80wt%, and a dispersion agent at 2wt% was manufactured. Here, the molecular weight of the high molecule resin was 25,000, where a ratio of weight of methyl acrylate (MA), butyl methacrylate (BM), hydroxyethyl methacrylate (HEMA), and methyl methacrylate (MMA) was 30:20:10:40. The glass powder was a Bi-based glass powder and an average particle size thereof was 1.5 μ m. The silver had a sphere shape and the average particle size thereof was 1.0 μ m. An organic dispersion agent containing an amine group was used as the dispersion agent.

Exemplary Example 2

A conductive paste was manufactured by using a black pigment as a mixture thereof without using a dispersion agent. The conductive paste contained glass powder at 3wt%, silver at 78wt%, and black pigment at 5wt%. A Co-based black pigment was used as the black pigment. The remaining experimental conditions were the same as those of the above described

Exemplary Example 1.

Exemplary Example 3

A conductive paste was manufactured without using a black pigment. The remaining experimental conditions were the same as those of the above described Exemplary Example 2 except for using BCA at 12wt%.

Experimental Results

The conductive paste with a mesh shape was formed on the glass substrate by using an offset printing device that is the same as that shown in FIG. 3.

FIG. 6 is a photograph showing a state in which the above-described conductive paste was formed on the glass substrate. The left photograph of FIG. 6 shows a 200X enlarged conductive paste, while the right photograph of FIG. 6 shows a 1200X enlarged conductive paste. The width of the conductive paste was $20\mu\text{m}$ and the pitch thereof was $300\mu\text{m}$. Next, the conductive paste formed on the glass substrate was maintained at 500°C for 15 minutes during a plasticizing process, and thereby organic materials were vaporized.

FIG. 7 is a photograph showing a state in which a shielding member having undergone the plasticizing process was formed on the glass substrate. The left photograph of FIG. 7 shows a 200X enlarged shielding member, while the right photograph of FIG. 6 shows a 1400X enlarged shielding member. The width of the conductive paste was reduced to $15\mu\text{m}$ after the conductive paste had undergone the plasticizing process, and the pitch of $300\mu\text{m}$ was maintained without a change.

Performance of the filters for shielding electromagnetic interference that were manufactured according to the above-described first to third exemplary examples was estimated. The estimations are shown in Table 1 below.

[Table 1]

NO	Classification	Estimated item	Exemplary Example 1	Exemplary Example 2	Exemplary Example 3
1	Light characteristics	Transmissivity	86.4%	86.4%	86.8%
		haze	1.5	1.5	1.6
2	Electric characteristics	Electric resistance	$0.2\sim 0.6\Omega/\square$	$0.6\Omega/\square$	$0.6\Omega/\square$
3	Mechanical characteristics	Pencil hardness	7H or more	6H or more	6H or more

4	Chemical resistance	Alcohol resistance	Excellent	Excellent	Excellent
		Acetone resistance	Excellent	Excellent	Excellent
5	Black degree	L value	N/A	31	55

As shown in the above Table 1, light characteristics, electrical characteristics, mechanical characteristics, chemical characteristics, and black degree of the filter for shielding electromagnetic interference according to the first to third exemplary examples were all excellent. Therefore, the filter for shielding electromagnetic interference with a simple manufacturing method can be provided by using the offset printing method.

While the present invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

CLAIMS

1. A filter for shielding electromagnetic interference, the filter comprising:
a glass substrate; and
5 a shielding member that is formed on the glass substrate with a mesh shape, that has a chamfered opening, and is formed of a single layer, wherein the shielding member is configured to shield electromagnetic interference.
- 10 2. The filter of Claim 1, wherein the shielding member is manufactured by using an offset printing method and a plasticizing method.
3. The filter of Claim 2, wherein the shielding member comprises:
at least one first shielding portion that extends along one direction; and
15 at least one second shielding portion that crosses the first shielding portion.
4. The filter of Claim 3, wherein a width of the first shielding portion is over 0 and is not more than $50\mu\text{m}$.
- 20 5. The filter of Claim 4, wherein the width of the first shielding portion is in a range of $15\mu\text{m}$ to $30\mu\text{m}$.
6. The filter of Claim 3, wherein the at least one first shielding portion
25 comprises a plurality of first shielding portions, wherein an average pitch of the plurality of first shielding portions is over 0 and is not more than $500\mu\text{m}$.
7. The filter of Claim 6, wherein the average pitch of the plurality of first shielding portions is in a range of $200\mu\text{m}$ to $400\mu\text{m}$.
- 30 8. The filter of Claim 3, wherein an angle formed when the first shielding portion crosses with the second shielding portion is in a range of 60 degrees to 120 degrees.
- 35 9. The filter of Claim 8, wherein the angle is in a range of 80 degrees to 100 degrees.

10. The filter of Claim 9, wherein the angle is substantially 90 degrees.
11. The filter of Claim 3, wherein an angle formed between the first shielding portion and an edge of the glass substrate is in a range of 20 degrees to 70 degrees.
12. The filter of Claim 11, wherein the angle is in a range of 35 degrees to 55 degrees.
13. The filter of Claim 1, wherein the opening has a polygonal shape.
14. The filter of Claim 13, wherein lengths of all of edges forming the polygon are substantially the same.
15. The filter of Claim 14, wherein the polygon is substantially a square.
16. The filter of Claim 1, wherein the shielding member comprises a conductive metal.
17. The filter of Claim 16, wherein the conductive metal is at least one element selected from a group consisting of silver, copper, and nickel.
18. The filter of Claim 1, further comprising an edge layer formed along an edge of the glass substrate and wherein the shielding member is formed on the edge layer.
19. The filter of Claim 18 further comprising a ground member that is connected to an end of the shielding member to ground the shielding member.
20. A display device comprising:
a glass substrate;
a shielding member that is formed on the glass substrate with a mesh shape, has a chamfered opening, and is formed of an single layer; and
a display panel that displays an image and is opposed to the glass substrate,
wherein the shielding member is configured to shield electromagnetic interference emitted from the display panel.

21. The device of Claim 20, wherein the display panel comprises:
first and second substrates that are opposed to each other; and
a black layer that is located between the first and second substrates, and
5 wherein a direction along which the shielding member extends crosses a
direction along which the black layer extends.
22. The device of Claim 21, wherein the shielding member contacts the
second substrate.
- 10 23. The device of Claim 21, wherein a thickness of the glass substrate is not
less than a thickness of the first substrate.
24. The device of Claim 20, wherein the opening has a polygonal shape.
- 15 25. The device of Claim 24, wherein lengths of all of edges forming the
polygon are substantially the same.
26. The device of Claim 25, wherein the polygon is substantially a square.
- 20 27. The device of Claim 20, wherein the shielding member is manufactured
by using an offset printing method and a plasticizing method.
28. The device of Claim 20, wherein the shielding member comprises:
25 at least one first shielding portion that extends along one direction; and
at least one second shielding portion that crosses the first shielding
portion.
29. The device of Claim 28, wherein a width of the first shielding portion is
30 over 0 and is not more than $50\mu\text{m}$.
30. The device of Claim 29, wherein the width of the first shielding portion
is in a range of $15\mu\text{m}$ to $30\mu\text{m}$.
- 35 31. The device of Claim 28, wherein the at least one first shielding portion
comprises a plurality of first shielding portions, and wherein an average pitch
of the plurality of first shielding portions is over 0 and is not more than $500\mu\text{m}$.

32. The device of Claim 31, wherein an average pitch of the plurality of first shielding portions is in a range of 200 μ m to 400 μ m.

5 33. The device of Claim 32, wherein an angle formed when the first shielding portion crosses with the second shielding portion is in a range of 60 degrees to 120 degrees.

10 34. The device of Claim 33, wherein the angle is in a range of 80 degrees to 100 degrees.

35. The device of Claim 34, wherein the angle is substantially 90 degrees.

15 36. The device of Claim 28, wherein an angle formed between the first shielding portion and an edge of the glass substrate is in a range of 20 degrees to 70 degrees.

20 37. The device of Claim 36, wherein the angle is in a range of 35 degrees to 55 degrees.

38. The device of Claim 20, wherein the display panel is a plasma display panel.

FIG. 1

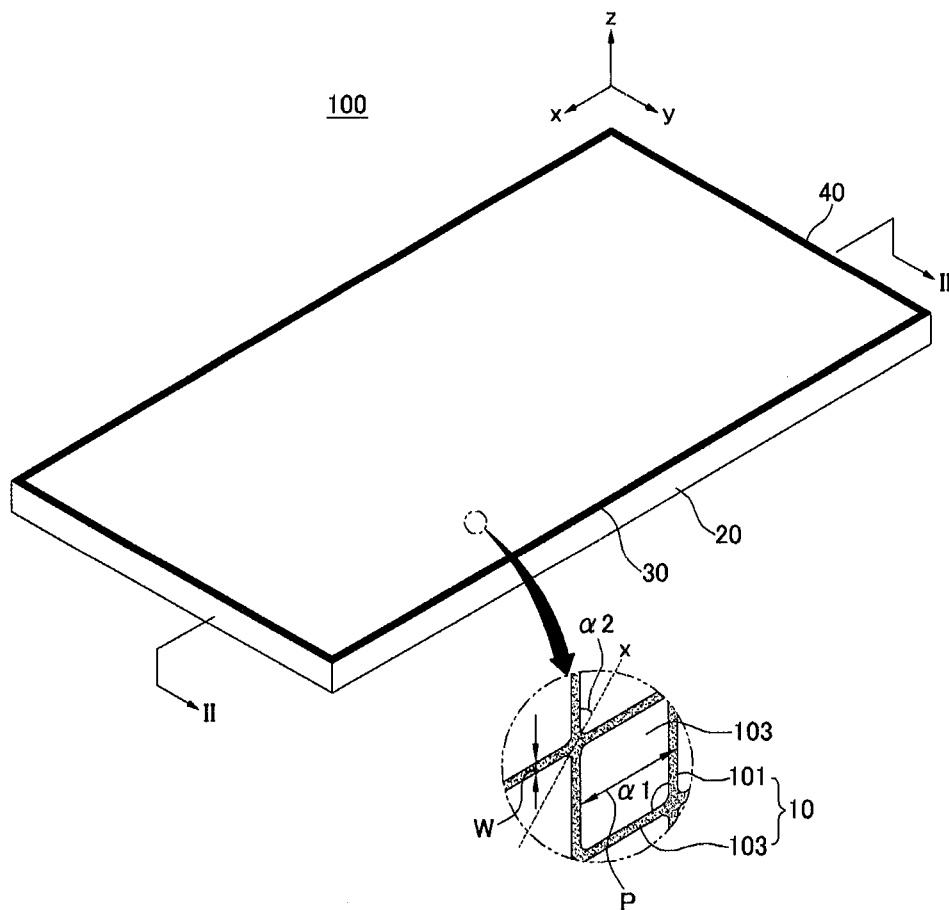


FIG. 2

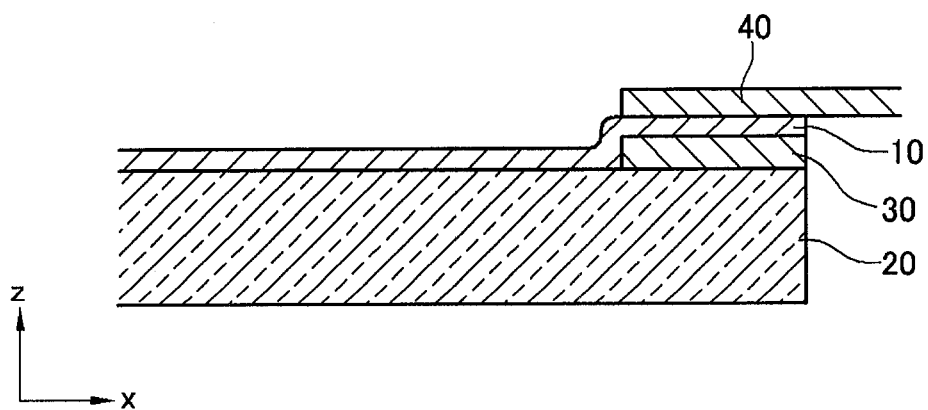


FIG. 3

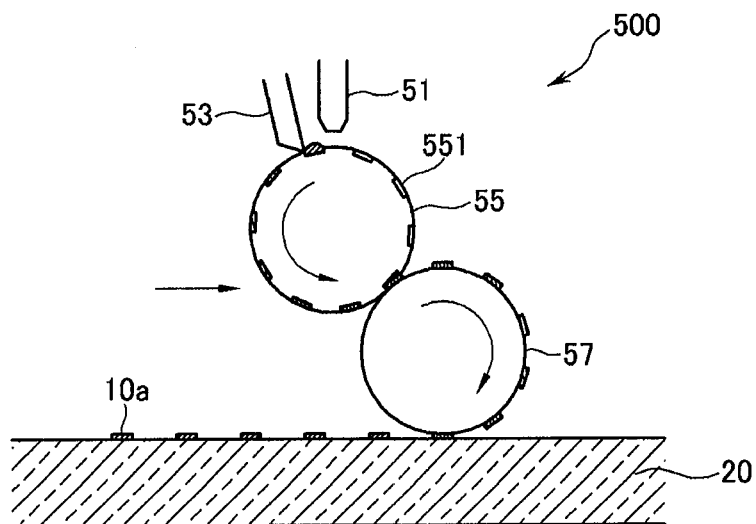


FIG. 4

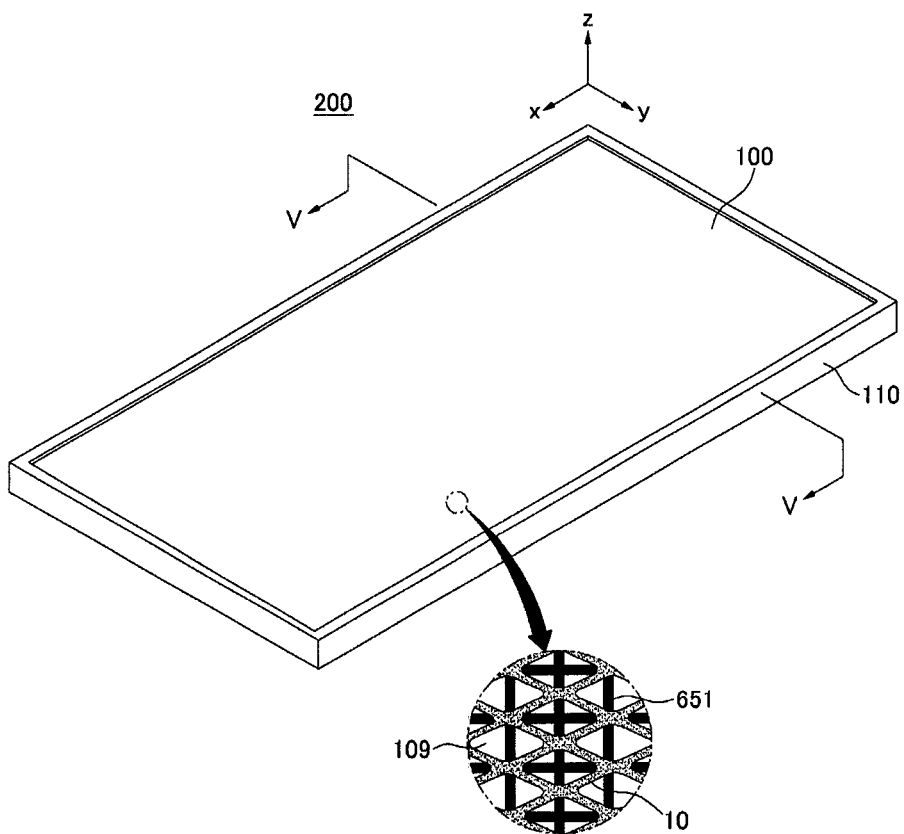


FIG. 5

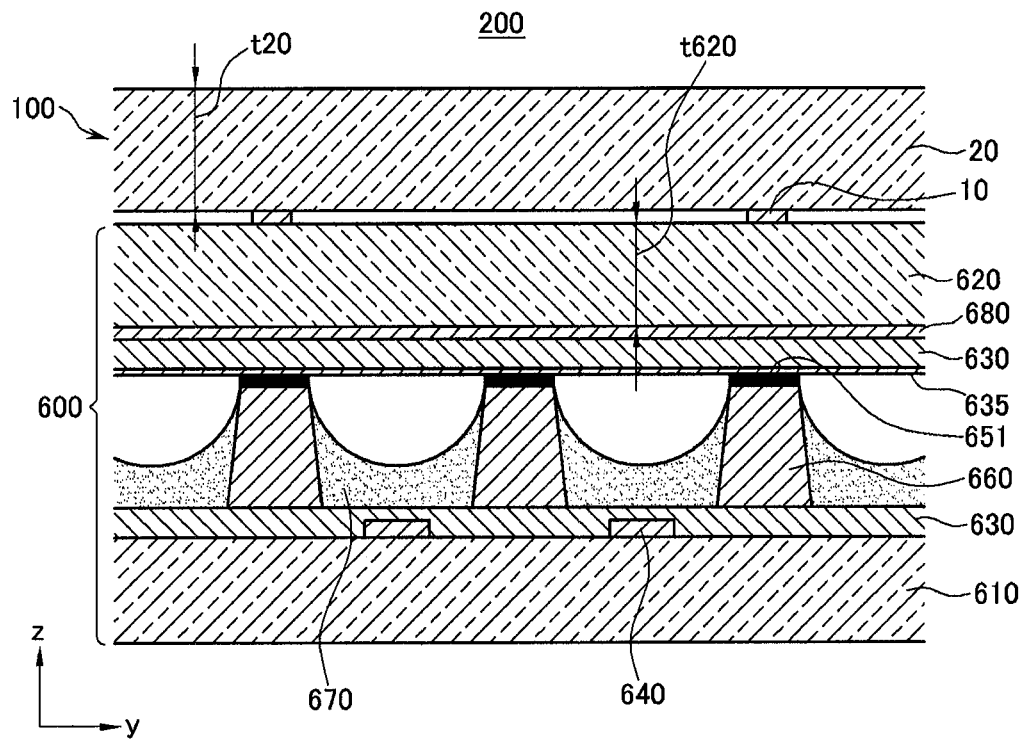


FIG. 6

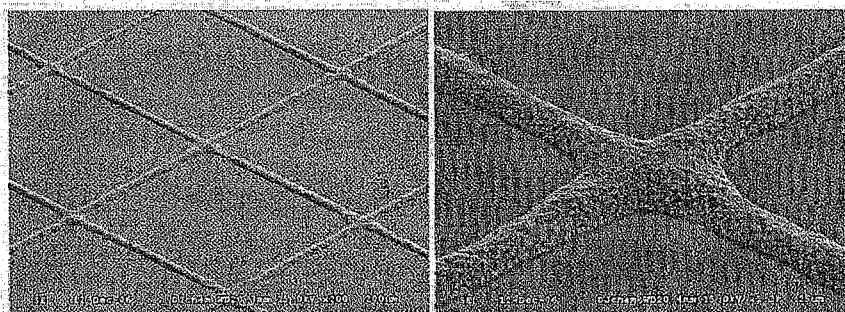
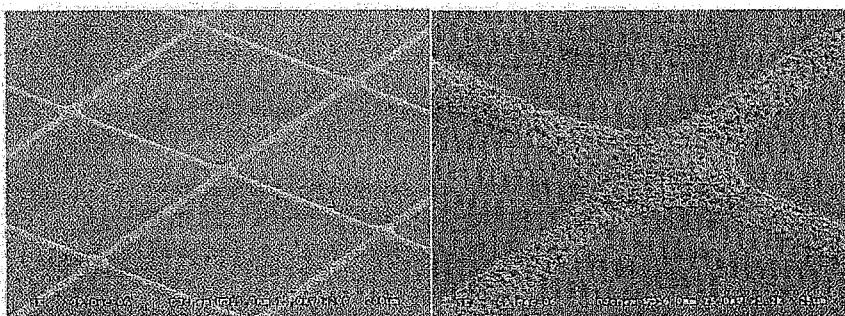


FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2008/000899**A. CLASSIFICATION OF SUBJECT MATTER****H05K 9/00(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)

IPC 8 : H05K

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: "electromagnetic, shield, display, mesh and the similar terms")

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2003-0152787 A1(Arakawa et al.) 14 August 2003 See abstract, Figs 2-4; [0176]-[0194]	1-38
A	WO 2005-083157 A1(MITSUI MINING & SMELTING CO., Ltd) 9 September 2005 See abstract, Figs 1-2; [0007]-[0013]	1-38
A	JP 2005-317888 A(ILJIN COPPER FOIL CO., LTD) 10 November 2005 See abstract, Figs 2-3; <17>-<29>	1-38
A	JP 2000-114772 A(NIPPON SHEET GLASS CO., LTD) 21 April 2000 See abstract, Figs 1-2; [0008]-[0026]	1-38



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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"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

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"&" document member of the same patent family

Date of the actual completion of the international search

09 JUNE 2008 (09.06.2008)

Date of mailing of the international search report

09 JUNE 2008 (09.06.2008)

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2008/000899

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