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(54) METHOD FOR FORMING FLUORESCENT FILM, AND TRANSFER MATERIAL FOR FORMATION OF THE FLUORESCENT FILM.

(57) This method makes it possible to form a fluorescent film (10) easily and efficiently on a glass plate (18), particularly on the face plate (8) of a cathode ray tube. A transfer material for its use is also

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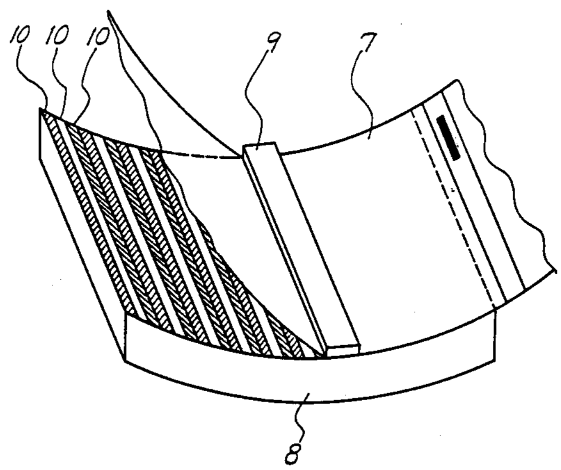
provided. The method comprises the steps of, by use of the transfer material (7) in which at least thermally transferable phospher layers (11, 12 and 13) containing phosphers and thermally fusible binder are formed on a base film (3), transferring the patterns of the thermally transferrable phospher layers (11, 12 and 13) to the glass plate (8) one after another; and baking the glass plate (8) to remove the binder from the fluorescent film (10) and to form the fluorescence film on the glass plate. The transfer material has a thermally transferable phosphor layer (4) containing at least phosphs (1) and thermally fusible binder (2) on the base film (3).

Fig. 6



Field of the Invention

The present invention relates to a method for easily and efficiently forming a fluorescent film on a glass substrate, in particular, on a face plate of a cathode ray tube, and to a transfer material used for such a method.

Background of the Invention

The slurry application and exposure method and the sedimentation method have been used as methods for forming the fluorescent film on the face plate of the cathode ray tube.

In the above-mentioned slurry application and exposure method, a slurry in which a fluorescent material is dispersed in a photosensitive resin consisting, for example, of polyvinyl alcohol and ammonium bichromate is spin-coated on the face plate, dried, and exposed to ultraviolet rays to form desired patterns. The film is developed using water for removing unexposed portions to form a fluorescent film.

The slurry application and exposure method for forming the fluorescent film has disadvantages such as a large number of steps, complicated equipment, and low productivity.

In the above-mentioned sedimentation method, the fluorescent film is formed by allowing a fluorescent material to be deposited on the face plate from a suspension containing the fluorescent material and a binder, such as water glass, and allowing a supernatant to flow slowly.

The sedimentation method also has disadvantages because it takes a long time for allowing the fluorescent material to be deposited, and it is difficult to form a desired pattern.

It is an object of the present invention to eliminate such problems and to provide a method for easily and efficiently forming the fluorescent film on the glass substrate, in particular, on the face plate of the cathode ray tube, and to provide a transfer material used for such a method.

SUMMARY OF THE INVENTION

The inventors studied the solution of the above problems and found that the fluorescent film may be formed on the face plate of the cathode ray tube easily and efficiently by the heat transfer method. The heat transfer method is widely used in personal word processors, color printers and the like, and is a method for heating an ink and transferring the ink onto recording paper in a desired pattern, for example, by heaing and pressing an ink ribbon consisting of a thermally fusible ink on a base material, from the back of the ink layer with a heating element such as a thermal head.

An aspect of the present invention is a method for forming the fluorescent film on the glass substrate, comprising using a transfer material consisting of a thermally transferable fluorescent layer containing at least a fluorescent material and a thermally fusible binder formed on a base film, sequentially transferring the thermally transferable fluorescent layer in desired patterns onto the glass substrate by the heat transfer method, and baking the substrate for removing the binder in the fluorescent layer. The heat source includes laser and thermal heads.

Another aspect of the present invention is a transfer material used for the above method which consists of the thermally transferable fluorescent layer containing at least the fluorescent material and the thermally fusible binder formed on the base film.

DETAILED DESCRIPTION OF THE INVENTION

The present invention will be described in detail referring to the case where the fluorescent film is formed on the face plate of the cathode ray tube.

Known materials suited for base films such as films and paper may be used as the base film. Such materials include, for example, polymer films having a relatively high heat-resistance, such as polyesters, polypropylene, polyamides, polycarbonates, polyimides, and cellophane; and paper such as glassine paper and condenser paper. The thickness of these films is preferably 1-200 microns. These base films may have a heat-resistant slidable layer such as a silicone layer on the side contacting the thermal head for improving the heat-resistance and the running property of the thermal head.

The examples of fluorescent materials used in the present invention are fluorescent materials conventionally used in the cathode ray tubes, including at least one of silver-activated zinc sulfides such as ZnS:Ag and ZnS:Ag, Al as blue fluorescent materials; at least one of copper-activated zinc sulfides such as the mixed fluorescent material of ZnS:Cu, Al and ZnS:Au, Al, and a ZnS:Cu, Al, gold, copper, and aluminum-activated zinc sulfides (ZnS:Au, Cu, Al), copper and aluminum-activated zinc cadmium sulfide [(Zn, Cd)S:Cu, Al] as green fluorescent materials; and at least one of europium-activated rare earth oxides such as europium-activated yttrium oxysulfide (Y_2O_2S:Eu) and europium-activated yttrium oxide (Y_2O_3:Eu) as red fluorescent materials. A pigment having a filter action may be adhered to these fluorescent materials. The pigment includes a blue pigment such as cobalt aluminate and ultramarine for the blue fluorescent material, a green pigment such as TiO_2-ZnO-CoO-NiO for the green fluorescent material, and a red pigment such as red oxide and cadmium sulfoselenide for the red fluorescent material. The particle size of the fluorescent material is preferably 1-20 microns, and more preferably 2-8 microns.

Suitable thermally fusible binders include waxes such as paraffin wax, microcrystalline wax, carnauba wax, and various synthetic waxes; and thermoplastic resins such as ethylene-vinyl acetate copolymer, ethylene-ethyl acrylate copolymer, polyesters, and polyamides. Softening agents such as petroleum resins, rosin derivatives, various plasticizers, and fluid paraffin, or dispersing agents for dispersing fluorescent materials may be used as required.

The preferable ratio of the fluorescent material and the thermally fusible binder is 20-90 % by weight of the fluorescent material and 80-10 % by weight of the thermally fusible binder. In the present invention, it is preferable to use the transfer material having fluorescent layers corresponding to red, green, and blue adjacently in the desired pattern on the same base film, because no replacement of the transfer material and the head is required, and red, green, and blue fluorescent layers can be transferred very efficiently.

Furthermore, the use of the transfer material having the thermally transferable fluorescent layer and the thermally transferable pigment layer laminated on the same base film with the thermally transferable pigment layer up or in parallel is preferred, because fluorescent colors superior to those obtained by the method in which the pigments are adhered to the fluorescent material is obtained since the pigments do not peel off or do not adhere to fluorescent materials of other colors to form mixed colors. In this case, the transfer material used has the thermally transferable fluorescent layer containing at least the fluorescent material and the thermally fusible binder, and the thermally transferable pigment layer containing at least the pigment and the thermally fusible binder laminated for each color on the base film. Alternatively, all of the thermally transferable fluorescent layers for each color and the thermally transferable pigment layers for each color may be arranged in parallel on the base film. Every region of fluorescent layers or pigment layers corresponding to red, green, and blue have almost the same area, and are arranged on the same base film adjacent to each other. If the area of each region is large enough to correspond to the amount transferred to the glass substrate, a transferring to the glass substrate is made by a region without excess or shortage, enabling the waste of transferring operation or materials to be eliminated. The pigments used include those mentioned above. The preferable particle size of the pigments is in the range of 0.01-0.5 microns.

The weight ratio of the pigment and the thermally fusible binder is preferably 20-90 % by weight of the pigment and 80-10 % by weight of the thermally fusible binder.

Methods for providing the above thermally transferable fluorescent layer or the above thermally transferable pigment layer on the base film include the hot-melt coating, solvent coating, and emulsion coating of the thermally fusible binder in which the fluorescent materials and optionally the pigments are dispersed. Providing the fluorescent and pigment layers corresponding to red, green, and blue or laminating the pigment layers and the fluorescent layers adjacently on the same base film may easily be performed by the use of a printing machine. The thickness of the thermally transferable fluorescent layer is preferably in the range of 3-60 microns, and more preferably in the range of 5-30 microns. If the layer is too thin, the amount of the fluorescent material in the fluorescent layer formed on the glass substrate is insufficient, and, if the layer is too thick, the thermal conduction to the thermally transferable fluorescent layer is insufficient and the formation of the desired pattern is difficult. The thickness of the thermally transferable pigment layer is preferably in the range of 1-10 microns.

If desired, the above transfer material may have an adhesion layer or a separation layer between the base film and the thermally transferable fluorescent layer and between the base film and the thermally transferable pigment layer for improving the adhesion of the thermally transferable fluorescent layer and the thermally transferable pigment layer to the base film, and the separation of these layers from the base film. The thickness of the adhesion layer or the separation layer is preferably in the range of 0.1-2 microns. It is also possible to provide an additional adhesion layer on the thermally transferable fluorescent layer and the thermally transferable pigment layer on the opposite side of the base film, or to provide an adhesion layer on the face plate for improving the adhesion of these layers to the face plate. The thickness of this adhesion layer is preferably in the range of 0.1-2 microns.

An embodiment of the transfer material of the present invention is shown referring to FIGS. 1-3. In these drawings, the numeral 1 represents a fluorescent material, and 2 represents a thermally fusible binder. FIG. 1 shows an embodiment in which a thermally fluorescent layer 4 is provided on a base film 3. FIG. 2 shows an embodiment in which an adhesion/separation layer 5 is provided between the base film 3 and the thermally transferable fluorescent layer 4. FIG. 3 shows an embodiment of FIG. 1 on which an additional adhesion layer 6 is provided.

The fluorescent film is formed on the face plate of the cathode ray tube using the transfer material mentioned above. First, a sensing device such as a photosensor is made to run on the face plate in the direction of driving of the thermal head, and the location and distance of the black matrix are sensed.

As FIG. 4 shows, the transfer material 7 is overlaid on the face plate 8, and pressed and made to run by the thermal head 9. When the transfer material is peeled off, the thermally transferable layer 10 having the desired pattern is transferred. The surface of the fluorescent layer excels in flatness. To obtain a color cathode ray tube having blue, green, and red as stripes or dots, the transfer materials 7 containing each fluorescent material may be transferred once or several times for each color repeatedly.

Next, the face plate, together with the transferred fluorescent layers, is baked. The main purpose of this baking is to remove organic components other than fluorescent materials and pigments. Therefore, unless the baking gives a negative effect to the fluorescent materials and the pigments a temperature suitable for the above purpose may be selected, and it is normally in the range of 400-500 °C. The fluorescent film is thus formed.

FIG. 5 shows an embodiment of the transfer material of the present invention. Red, green, and blue thermally transferable fluorescent layers 11, 12, and 13, adjacent to each other, are provided on the base film 3. Detection patterns 23 for detecting each color are normally provided between painted parts.

The fluorescent film is formed on the face plate of the cathode ray tube using the above transfer material. First, the sensing device such as the photosensor is made to run on the face plate in the direction of driving of the thermal head for sensing the location and distance of the black matrix, and film-forming locations corresponding to red, green, and blue are regularly located. Next, as FIG. 6 shows, the red painted part 11 of the transfer material 7 is overlaid on the face plate 8, and pressed and made to run by the line thermal head 9. When the transfer material is peeled off, a red fluorescent layer is transferred. Then, the green painted part 12 is overlaid on the face plate, and pressed and made to run by the line thermal head as before. When the transfer material is peeled off, a green fluorescent layer is transferred. This is done at a timing different from the first red part. The same process is repeated for the blue painted part 13 , and red, green and blue fluorescent layers 10 are formed on the face plate as stripes. The surface of the fluorescent layers excels in flatness.

Next, the face plate is baked and organic components other than the fluorescent materials are removed to form red, green, and blue fluorescent films sequentially as stripes.

FIGS. 7 and 8 show a further embodiment of the transfer material of the present invention. FIG. 7 shows an embodiment in which laminating materials consisting of red, green, and blue thermally transferable fluorescent layers and thermally transferable pigment layers are adjacently painted on the base film 3; and FIG. 8 shows another embodiment in which red, green, and blue thermally transferable fluorescent layers and thermally transferable pigment layers are painted in parallel. FIG. 9 shows a cross-sectional view of the laminating materials in FIG. 7 consisting of the thermally transferable fluorescent layers and the thermally transferable pigment layers; and FIG. 10 shows a cross-sectional view of the thermally transferable pigment layers and FIG. 11 shows that of the thermally transferable fluorescent layers in FIG. 8. In FIGS. 9 to 11, the numeral 1 represents the fluorescent material, 17 is the pigment, and 2 is the thermally fusible binder. Numerals 11, 12, and 13 are the thermally transferable fluorescent layers and 14, 15, and 16 are the thermally transferable pigment layers.

The fluorescent film is formed on the face plate of the cathode ray tube using the transfer material.

For example, when the red painted part of the transfer material consisting of laminated fluorescent layer and pigment layer is overlaid on the face plate, pressed and made to run by the line thermal head, and peeled off, a layer consisting of laminated red pigment/fluorescent layers is transferred. Next, the green painted part of the transfer material consisting of laminated fluorescent layer and pigment layer is overlaid on the face plate, the line thermal head is returned to the original position, and the transfer material is pressed and made to run by the line thermal head, and peeled off to form a layer consisting of laminated green pigment/fluorescent layers which is transferred. At this time, the electric power is applied at a timing different from that for the red part. The same process is repeated for the blue painted part to form the laminated red, green, and blue pigment layers 18 and fluorescent layers 10 sequentially on the face plate as stripes, as FIG. 12 shows. When the transfer material in which the fluorescent layers and the pigment layers are arranged in parallel as FIG. 8 shows is used, red, green, and blue pigment layers are transferred, then red, green, and blue fluorescent layers are transferred so that they are overlaid on the pigment layers of the same colors.

The sequence for transferring the three colors is not limited to the above red, green and blue, but other sequences may be used. When the transfer material in which the fluorescent layers and the pigment layers are arranged in parallel is used, the fluorescent layer and the pigment layer of the same color may be arranged adjacently so that the pigment layer is transferred before the fluorescent layer is transferred. The surface of the fluorescent layer thus obtained excels in flatness.

Next, the face plate is baked with the transferred fluorescent layer and organic components other than the fluorescent materials and the pigments are removed to form red, green, and blue fluorescent films sequentially as stripes.

If a laser is used as the heat source, the following additional advantages are obtained over the use of the thermal head:

(1) Although scanning with the thermal head cannot be so fast due to the accumulation of heat, the scanning with the laser can be performed very fast, enabling transfer in a shorter time than with the thermal head.

(2) Although the diameter of thermal dots produced by the thermal head is about 50 to 200 microns, the laser can produce thermal dots of as small as 10 microns, much improving the tracking of the patterns formed.

The transfer material for forming the fluorescent films used with the laser consists of the thermally transferable fluorescent layers containing at least the fluorescent material and the thermally fusible binder formed on the base film, and it is preferable that the transfer material contains an infrared absorber in at least one of the thermally transferable fluorescent layer, the base film or the intermediate layer between the thermally transferable layer and the base film. The reason is that the optothermal conversion efficiency of the laser increases due to the use of the infrared absorber, and a semiconductor laser, which has a relatively weak output but is easy to handle, can be used.

The infrared absorbers used in the present invention include, for example, carbon black, and well-known infrared absorbers such as cyanine pigments described in JP-B-88319191, squalium pigments, naphthoquinone pigments, anthraquinone pigments, azulenium pigments, and phthalocyanine pigments.

To make the infrared absorber be contained in the thermally transferable fluorescent layer, the infrared absorber is dispersed in the thermally fusible binder together with the fluorescent material and painted. To make the infrared absorber be dispersed in the base film, the infrared absorber is kneaded with the resin before extruding the film. When the infrared absorber is contained in the intermediate layer, a solution of the infrared absorber and the resin binder is prepared and painted similarly before painting the thermally transferable fluorescent layer. When the thermally transferable fluorescent layer or the intermediate layer is exothernic, it is preferable that the base film transmits laser beams.

FIGS. 13 to 15 show an embodiment of the transfer material of the present invention.

In these drawings, the numeral 1 represents the fluorescent material, 2 is the thermally fusible binder, and 19 is the infrared absorber. FIG. 13 shows an embodiment in which the thermally transferable fluorescent layer 4 containing the infrared absorber 19 is formed on a base film 3. FIG. 14 shows an embodiment in which the adhesion or separation layer 5 containing an infrared absorber 19 is formed between the base film 3 and the thermally transferable fluorescent layer 4. FIG. 15 shows an embodiment in which the adhesion layer 6 is added to the structure in FIG. 13, and the base film 3 contains the infrared absorber 19.

A variety of lasers can be used for transferring the thermally transferable fluorescent layer from the above transfer material. Such lasers include, for example, an ion gas laser such as argon and krypton; a metal vapor laser such as copper, gold and cadmium; a solid laser such as ruby and YAG; and a diode laser such as gallium arsenide radiation in the infrared region between 750 and 870 nm. Practically speaking, the use of a YAG or diode laser is preferable because of the small size, low cost, stability, reliability, and ease of control.

The fluorescent film is formed on the face plate of the cathode ray tube using the above transfer material.

The above transfer material is overlaid in contact with the face plate, and pressed with a transparent glass plate 20, or made to contact closely by reducing pressure between the transfer material and the face place. For example, the transfer material is scanned with a laser using the equipment as shown in FIG. 16, and peeled off to transfer the thermally transferable fluorescent layer. The surface of the fluorescent layer excels in flatness. Then, the face plate is baked together with the fluorescent layer which has been transferred.

The inventors of the present invention found that heat from the thermal head or laser does not dissipate onto the face plate if the face plate is preheated before heating the thermally transferable fluorescent layer or the thermally transferable pigment layer with a thermal head or laser, and the fluorescent layer or the pigment layer can be transferred on the face plate without any need for the application of excessive heat.

The preheating temperature is the blocking temperature of the thermally transferable fluorescent layer or the thermally transferable pigment layer or less, and room temperature or more. Especially when the fluorescent film having a plurality of light-emission colors is to be formed on the same glass substrate, the use of a temperature 5°C lower and preferably 10°C lower than the blocking temperature is recommended. In general, the preferred preheating temperature in the present invention is in the range between 40 and 100°C. In the thermal transfer system using the thermal head or laser, if the thermally transferable fluorescent layer or the thermally transferable pigment layer is transferred on the face plate without preheating, heat from the thermal head or the laser dissipates on the face plate because the face plate is thick and has a large heat capacity, and excessive heat must be applied to the thermally transferable fluorescent layer for transfer.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a cross-sectional view of an embodiment of the transfer material for forming fluorescent films of the present invention;
FIG. 2 shows a cross-sectional view of an embodiment of the transfer material for forming fluorescent films of the present invention;
FIG. 3 shows a cross-sectional view of an embodiment of the transfer material for forming fluorescent films of the present invention;
FIG. 4 shows a diagram illustrating an embodiment of the heat transfer method of the present invention;
FIG. 5 is a diagram showing an embodiment of the transfer material of the present invention;
FIG. 6 shows a diagram illustrating an embodiment of the heat transfer method of the present invention;
FIG. 7 shows a diagram of an embodiment of the transfer material for forming fluorescent films of the present invention:
FIG. 8 shows a diagram of an embodiment of the transfer material for forming fluorescent films of the present invention;
FIG. 9 shows a cross-sectional view of the transfer material for forming fluorescent films of FIG. 7;
FIG. 10 shows a cross-sectional view of the pigment layer in the transfer material for forming fluorescent films of FIG. 8;
FIG. 11 shows a cross-sectional view of the fluorescent layer in the transfer material for forming fluorescent films of FIG. 8;
FIG. 12 shows a diagram illustrating an embodiment of the heat transfer method of the present invention;
FIG. 13 shows a cross-sectional view of an embodiment of the transfer material for forming fluorescent films of the present invention;
FIG. 14 shows a cross-sectional view of an embodiment of the transfer material for forming fluorescent films of the present invention;
FIG. 15 shows a cross-sectional view of an embodiment of the transfer material for forming fluorescent films of the present invention; and
FIG. 16 shows a diagram illustrating an embodiment of the heat transfer method of the present invention.

In these drawings, numeral 1 is a fluorescent material, 2 is a thermally fusible binder, 3 is a base film, 4 is a thermally transferable fluorescent layer, 5 is an adhesion layer or a separation layer, 6 is an adhesion layer, 7 is a transfer material, 8 is a face plate, 9 is a thermal head, 10 is a transferred fluorescent layer, 11 is a red thermally transferable fluorescent layer, 12 is a green thermally transferable fluorescent layer, 13 is a blue thermally transferable fluorescent layer, 14 is a red thermally transferable pigment layer, 15 is a green thermally transferable pigment layer, 16 is a blue thermally transferable pigment layer, 17 is a pigment, 18 is a transferred pigment layer, 19 is an infrared absorber, 20 is a glass plate, 21 is a lens, 22 is a laser beam source, and 23 is a detection pattern.

EXAMPLES

The present invention will be described further in detail referring to the preferred examples. However, the present invention is not limited to these examples. In these examples, "part(s)" means "part(s) by weight".

Example 1:

A fluorescent ink of the following composition was applied on a polyethylene terephthalate film (6 microns thick), of which the back opposite to the ink application surface was treated to have heat-resistance and slidability, by the microphotogravure method to have a layer thickness after drying of 15 microns, thereby a transfer material was obtained.

Composition:

Ethylene-vinyl acetate emulsion (40% solid): 10 parts
Paraffin wax emulsion (40% solid): 20 parts
Fluorescent material powder (ZnS:Cu, Al): 24 parts
Water: 30 parts

The above transfer material was overlaid on a face plate, compressed with a line thermal head having a heating unit of 6 dots/mm under the conditions below, and peeled off to form fluorescent layers in clear stripes on the face plate.

Conditions:

Recording line density: 6 dots/mm

Electric power applied to the thermal head: 0.2 W/dot

Pulse width applied to the thermal head: 12 ms

Application pattern: Repeating pattern of 1 line with application and 2 lines without application

The above face plate was baked at 450 ° C for 30 minutes to remove organic components, thereby a fluorescent film was formed.

Example 2:

A fluorescent ink of the following composition was applied on a polyethylene terephthalate film (6 microns thick), of which the back opposite to the ink application surface was treated to have heat-resistance and slidability, by the hot melt micro-photogravure method to have a layer thickness after drying of 15 microns, thereby a transfer material was obtained.

Composition:

Ethylene-vinyl acetate: 1 part

Paraffin wax: 8 parts

Synthetic wax: 1 part

Fluorescent material powder (ZnS:Cu, Al): 40 parts

The above transfer material was overlaid on a face plate, and processed in the same manner as Example 1 to form fluorescent layers in clear stripes on the face plate.

The above face plate was baked at 450 ° C for 30 minutes to remove organic components, thereby a fluorescent film was formed.

Example 3:

Fluorescent inks of the following compositions were applied on a polyethylene terephthalate film (6 microns thick), of which the back opposite to the ink application surface was treated to have heat-resistance and slidability, using a printer to have a layer thickness after drying of 15 microns, thereby a transfer material in which red, green, and blue fluorescent layers were sequentially and adjacently arranged was obtained.

Composition (red fluorescent ink):

Ethylene-vinyl acetate emulsion (40% solid): 10 parts

Paraffin wax emulsion (40% solid): 20 parts

Fluorescent material powder (Y_2O_2S:Eu) (particle size: 4.5 microns): 24 parts

Water: 30 parts

Composition (green fluorescent ink):

Ethylene-vinyl acetate emulsion (40% solid): 10 parts

Paraffin wax emulsion (40% solid): 20 parts

Fluorescent material powder (ZnS:Cu, Al) (particle size: 4.5 microns): 24 parts

Water: 30 parts

Composition (blue fluorescent ink):

Ethylene-vinyl acetate emulsion (40% solid): 10 parts

Paraffin wax emulsion (40% solid): 20 parts

Fluorescent material powder (ZnS:Ag) (particle size: 4.5 microns): 24 parts

Water: 30 parts

The red painted part of the transfer material was overlaid on a face plate, and peeled off in the same manner as in Example 1 to form the transferred red fluorescent layer.

Next, the green painted part of the transfer material was overlaid on the face plate, the line thermal head was returned to its original position, and the transfer material was compressed by a running line thermal head as described above, and peeled off to transfer a green fluorescent layer. In this time, the electric power was applied at a different timing from that for the red part. The same process was repeated for the blue painted part to form the laminated red, green, and blue fluorescent layers sequentially on the face plate as stripes. The surface of the fluorescent layer excelled in flatness.

The above face plate was baked at 450 ° C for 30 minutes to remove organic components, thereby red, green, and blue fluorescent films in stripes were formed.

Example 4:

The fluorescent inks of the following compositions were applied on a polyethylene terephthalate film (6 microns thick), of which the back opposite to the ink application surface was treated to have heat-resistance and slidability, using a printer by the hot-melt method to have a layer thickness of 15 microns after drying, thereby a transfer material in which red, green, and blue fluorescent layers were sequentially and adjacently arranged was obtained.

Composition (red fluorescent ink):

Ethylene-vinyl acetate: 1 part

Paraffin wax: 8 parts

Synthetic wax: 1 part

Fluorescent material powder (Y_2O_2S:Eu) (particle size: 4.5 microns): 40 parts

Composition (green fluorescent ink):

Ethylene-vinyl acetate: 1 part
Paraffin wax: 8 parts
Synthetic wax: 1 part
Fluorescent material powder (ZnS:Cu, Al) (particle size: 4.5 microns): 40 parts

Composition (blue fluorescent ink):

Ethylene-vinyl acetate: 1 part
Paraffin wax: 8 parts
Synthetic wax: 1 part
Fluorescent material powder (ZnS:Ag) (particle size: 4.5 microns): 40 parts

The above transfer material was compressed by a running thermal head in the order of red, green, and blue, and peeled off in the same manner as in Example 3, thereby fluorescent layers of three colors were obtained on a face plate in stripes.

The above face plate was baked at 450 °C for 30 minutes to remove organic components, thereby red, green, and blue fluorescent films in stripes were formed.

Example 5:

The pigment inks of the following composition were applied on a polyethylene terephthalate film (6 microns thick), of which the back opposite to the ink application surface was treated to have heat-resistance and slidability, to have a layer thickness of 3 microns after drying, on which the fluorescent ink of the same composition as in Example 3 was applied using a printer to have a layer thickness of 15 microns, thereby a transfer material consisting of red, green, and blue pigment layers and red, green, and blue fluorescent layers sequentially and adjacently arranged was obtained.

Composition (red pigment ink):

Ethylene-vinyl acetate emulsion (40% solid): 10 parts
Paraffin wax emulsion (40% solid): 20 parts
Iron oxide powder: 24 parts
Water: 30 parts

Composition (green pigment ink):

Ethylene-vinyl acetate emulsion (40% solid): 10 parts
Paraffin wax emulsion (40% solid): 20 parts
Composite oxides green pigment: 24 parts
Water: 30 parts

Composition (blue pigment ink):

Ethylene-vinyl acetate emulsion (40% solid): 10 parts
Paraffin wax emulsion (40% solid): 20 parts
Cobalt aluminate blue pigment: 24 parts
Water: 30 parts

The above transfer material was compressed by a running thermal head in the order of red, green, and blue, and peeled off in the same manner as in Example 3 to form the laminated films consisting of pigment and fluorescent layers of three colors sequentially on a face plate in stripes. The surface of the fluorescent layer excelled in flatness.

The above face plate was baked at 450 °C for 30 minutes to remove organic components, thereby red, green, and blue fluorescent films in stripes were formed.

Example 6:

The pigment inks of the following composition were applied on a polyethylene terephthalate film (6 microns thick), of which the back opposite to the ink application surface was treated to have heat-resistance and slidability, to have a layer thickness of 3 microns after drying, on which a fluorescent ink of the same composition as in Example 4 was applied using a printer by the hot-melt method to have a layer thickness of 15 microns, thereby a transfer material consisting of red, green, and blue pigment layers and red, green, and blue fluorescent layers sequentially and adjacently arranged was obtained.

Composition (red pigment ink):

Ethylene-vinyl acetate: 1 part
Paraffin wax: 8 parts
Synthetic wax: 1 part
Iron oxide powder: 40 parts

Composition (green pigment ink):

Ethylene-vinyl acetate: 1 part
Paraffin wax: 8 parts
Synthetic wax: 1 part
Composite oxide green pigment: 40 parts

Composition (blue pigment ink):

Ethylene-vinyl acetate: 1 part
Paraffin wax: 8 parts
Synthetic wax: 1 part
Cobalt aluminate blue pigment: 40 parts

The above transfer material was compressed by a running thermal head in the order of red, green, and blue pigment layers, and peeled off in the same manner as in Example 3 to form pigment layers of three colors on a face plate in stripes. Next, red, green, and blue fluorescent layers were overlaid on the same colors of the pigment layers, compressed, and peeled off to form a laminated pigment and fluorescent layers on the face plate.

The above face plate was baked at 450 °C for 30 minutes to remove organic components, thereby red, green and blue fluorescent films in stripes were formed.

Example 7:

The transfer material the same as that in Example 1 except that a transparent polyethylene terephthalate film was used instead of the polyethylene terephthalate film treated to have heat-resistance and slidability was overlaid on the face plate, pressed with a transparent glass plate, and scan-exposed in stripes using a laser beam (YAG laser, output: 0.5 W, beam diameter: 20 microns). When the transfer material was peeled off, clear fluorescent layers were obtained in stripes on the face plate. The above face plate was baked at 450 °C for 30 minutes to remove organic components, thereby fluorescent films were formed.

Example 8:

An ink having the following composition was applied on a transparent polyethylene terephthalate film (6 microns thick) to have a layer thickness after drying of 15 microns by the hot-melt microphotogravure method, thereby a transfer material were formed.

Composition:

Ethylene-vinyl acetate: 1 part
Paraffin wax: 8 parts
Synthetic wax: 1 part
Fluorescent material powder (ZnS:Cu, Al) (particle diameter: 4.5 microns): 40 parts
Infrared absorbtion pigment: 2 parts

A scan-exposure the same as in Example 7 was performed except the above transfer material and a laser beam (diode laser, 830 nm, output: 0.1 W, beam diameter: 15 microns) were used. When the transfer material was peeled off, clear fluorescent layers were obtained in stripes on the face plate.

The above face plate was baked at 450 °C for 30 minutes to remove organic components, thereby fluorescent films were formed.

Example 9:

A fluorescent film was formed in the same manner as Example 1 except for using a face plate which had been preheated to 50 °C, and a very clear fluorescent film was obtained on the face plate.

Example 10:

A fluorescent film was formed in the same manner as Example 2 except for using a face plate which had been preheated to 40 °C, and a very clear fluorescent film was obtained on the face plate.

According to the present invention, a fluorescent film is formed easily on a glass substrate by using a thermally transferable fluorescent layer, and the productivity for the manufacture of fluorescent films is significantly improved. Since the fluorescent layer can be transferred in any pattern using a thermal head or a laser, fluorescent films can be manufactured in a highly efficient manner by using a transfer material having a thermally transferable fluorescent layer.

Claims

1. A method for forming a fluorescent film comprising using a transfer material in which a thermally transferable fluorescent layer containing at least a fluorescent material and a thermally fusible binder is formed on a base film, sequentially transferring the thermally transferable fluorescent layer in predetermined patterns onto a glass substrate by a heat transfer method, and baking the glass substrate to remove the binder in the fluorescent layer to form a fluorescent film on the glass substrate.

2. A method for forming a fluorescent film as set forth in Claim 1, in which a transfer material consisting of fluorescent layers corresponding to red, green, and blue formed on the same base film is used.

3. A method for forming a fluorescent film as set forth in Claim 1, in which the glass substrate is preheated before transferring the fluorescent layers onto the glass substrate.

4. A method for forming a fluorescent film as set forth in Claim 1, in which a transfer material consisting of thermally transferable fluorescent layers each of which contains at least a fluorescent material and a thermally fusible binder, and thermally transferable pigment layers each of which contains at least a pigment and

a thermally fusible binder, laminated in this order on a base film is used; the laminated thermally transferable fluorescent layers and thermally transferable pigment layers are transferred onto a glass substrate by a heat transfer method; the substrate is baked to remove binders in the fluorescent layers and the pigment layers to form a laminated film consisting of pigment and fluorescent layers on the glass substrate.

5. A method for forming a fluorescent film as set forth in Claim 1, in which a transfer material consisting of thermally transferable fluorescent layers each of which contains at least a fluorescent material and a thermally fusible binder, and thermally transferable pigment layers each of which contains at least a pigment and a thermally fusible binder, formed in parallel on a base film is used; the thermally transferable fluorescent layers and the thermally transferable pigment layers are transferred onto the glass substrate in the order of the pigment layers and the fluorescent layers by using a heat transfer method; the substrate is baked to remove binders in the pigment layers and the fluorescent layers to form a laminated film consisting of pigment and fluorescent layers on the glass substrate.

6. A method for forming a fluorescent film as set forth in Claim 1, in which a thermal head is used as a heat source for transfer.

7. A method for forming a fluorescent film as set forth in Claim 1, in which at least one of the thermally transferable fluorescent layers, base film, and an intermediate layer between the thermally transferable fluorescent layer and the base film contains an infrared absorber.

8. A method for forming a fluorescent film as set forth in Claim 1, in which a laser is used as a heat source for transfer.

9. A transfer material for forming a fluorescent film, comprising a thermally transferable fluorescent layer containing at least a fluorescent material and a thermally fusible binder formed on a base film.

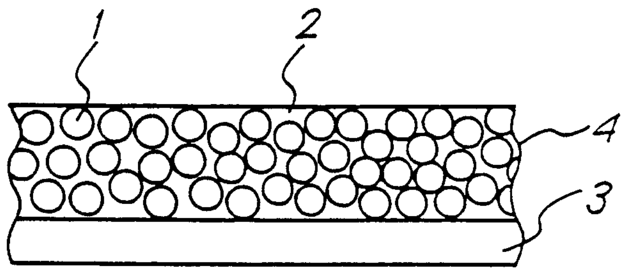
10. A transfer material for forming a fluorescent film as set forth in Claim 9, in which fluorescent layers corresponding to red, green, and blue are formed on the same base film.

11. A transfer material for forming a fluorescent film as set forth in Claim 9, in which thermally transferable fluorescent layers each of which contains at least a fluorescent material and a thermally fusible binder, and thermally transferable pigment layers each of which contains at least a pigment and a thermally fusible binder are laminated in this order on a base film, the transfer material has regions for red, green, and blue on the same base film; and the fluorescent layers and the pigment layers of the same color are laminated on the regions.

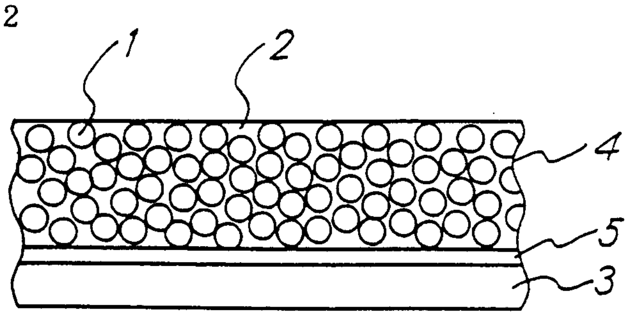
12. A transfer material for forming a fluorescent film as set forth in Claim 9, in which thermally transferable fluorescent layers each of which contains at least a fluorescent material and a thermally fusible binder, and thermally transferable pigment layers each of which contains at least a pigment and a thermally fusible binder are formed in parallel on a base film; and thermally transferable pigment layers and thermally transferable pigment layers each corresponding to red, green, and blue are formed in parallel on the same base film.

13. A transfer material for forming a fluorescent film as set forth in Claim 9, in which at least one of the thermally transferable fluorescent layers, base film, and an intermediate layer between the thermally transferable fluorescent layer and the base film contains an infrared absorber.

F i g. 1



F i g. 2



F i g. 3

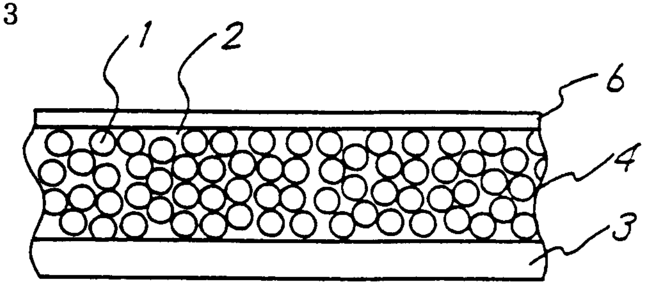


Fig. 4

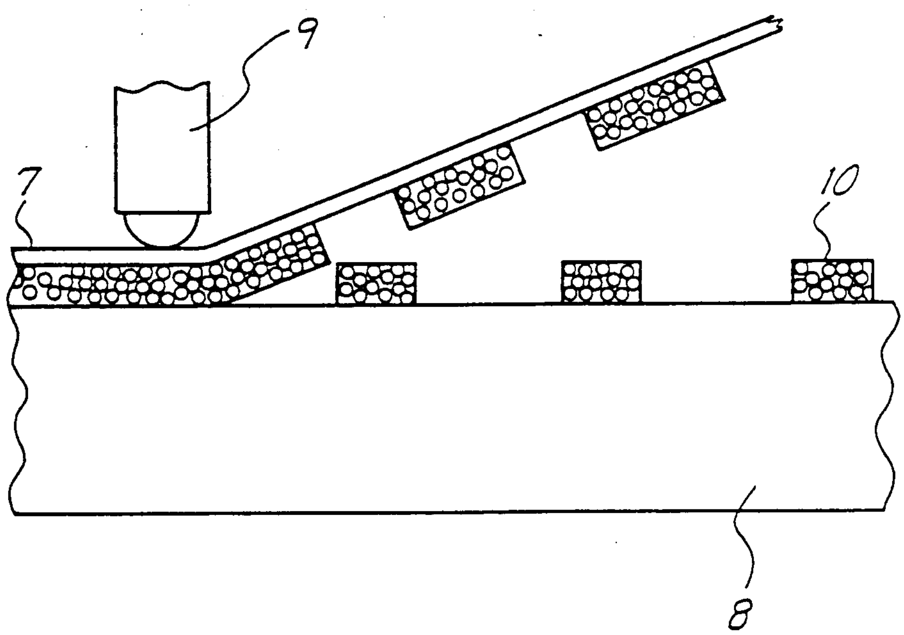


Fig. 5

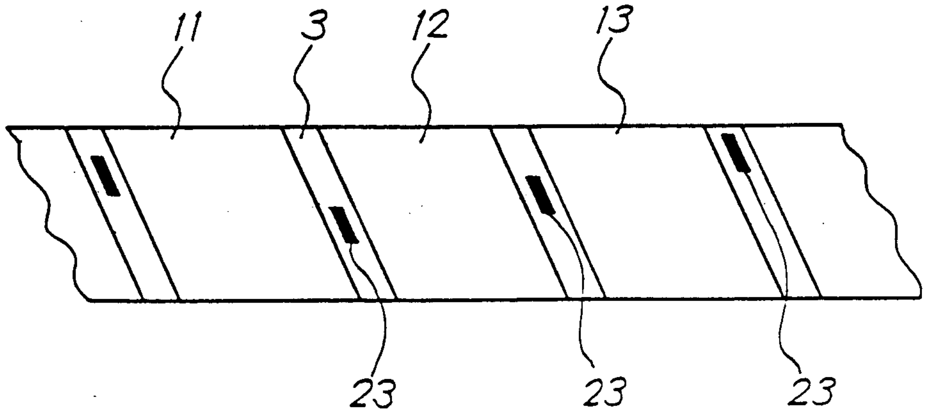


Fig. 6

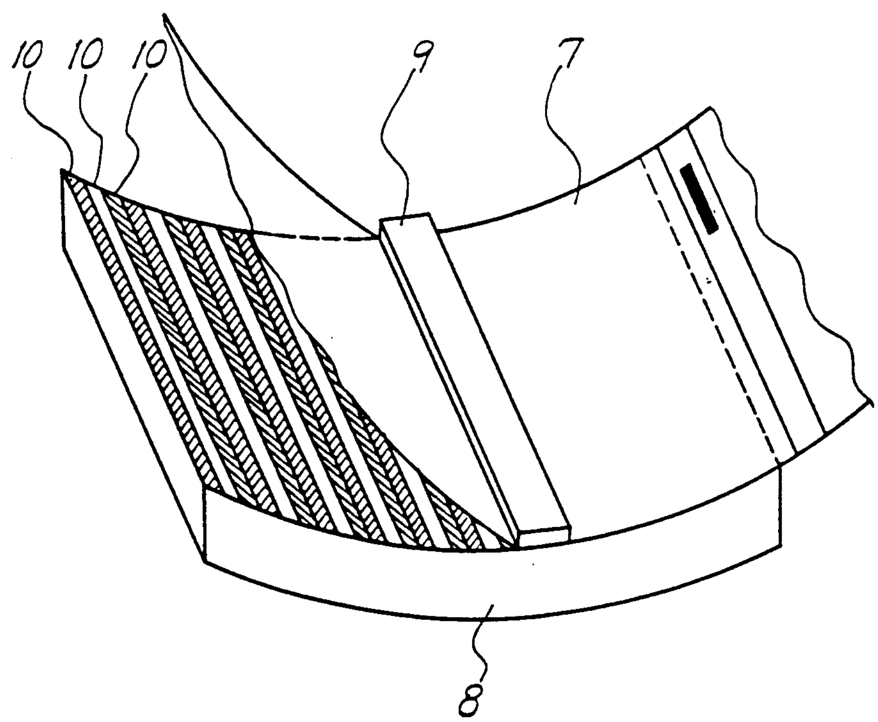


Fig. 7

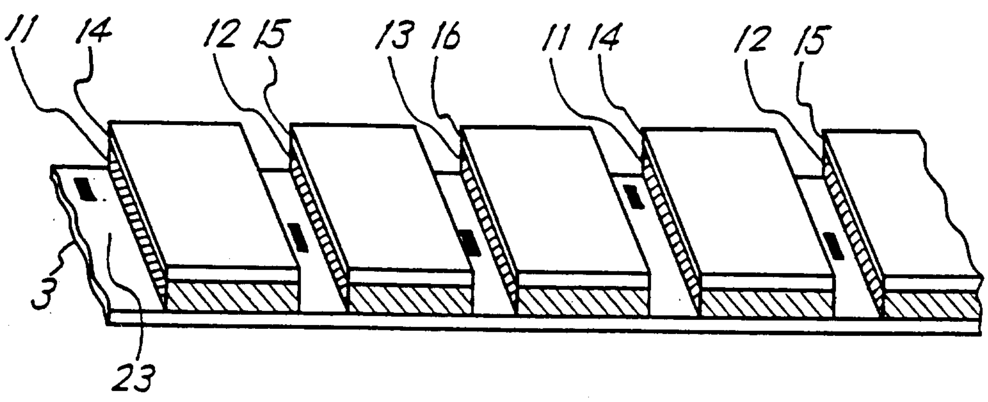


Fig. 8

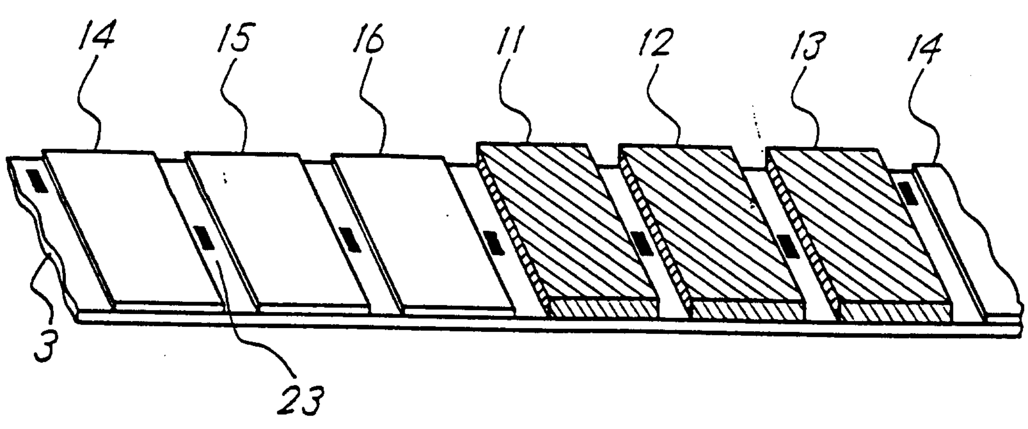


Fig. 9

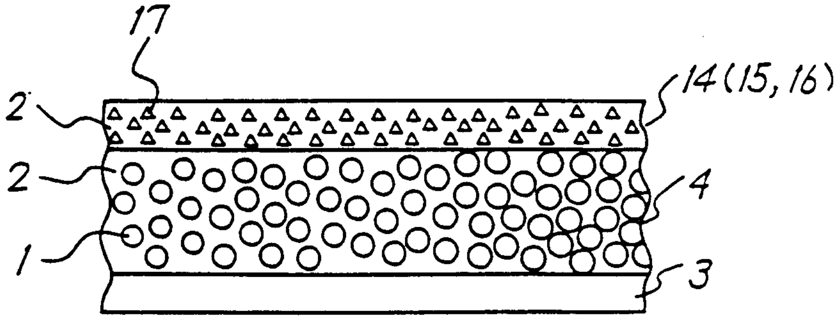


Fig. 10

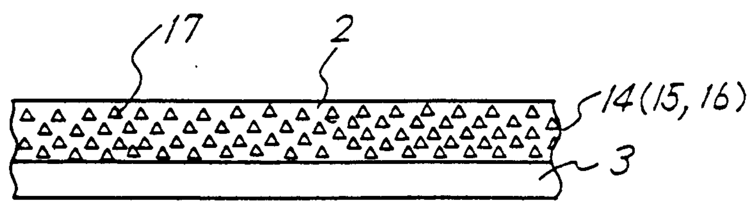


Fig. 11

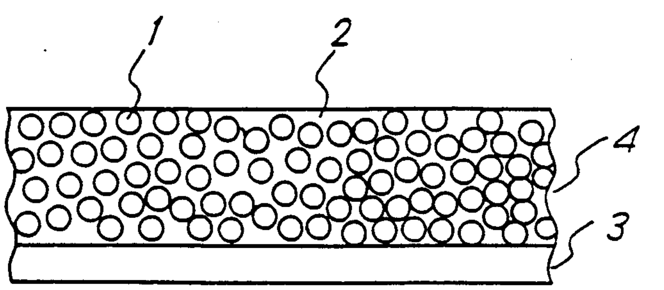


Fig. 12

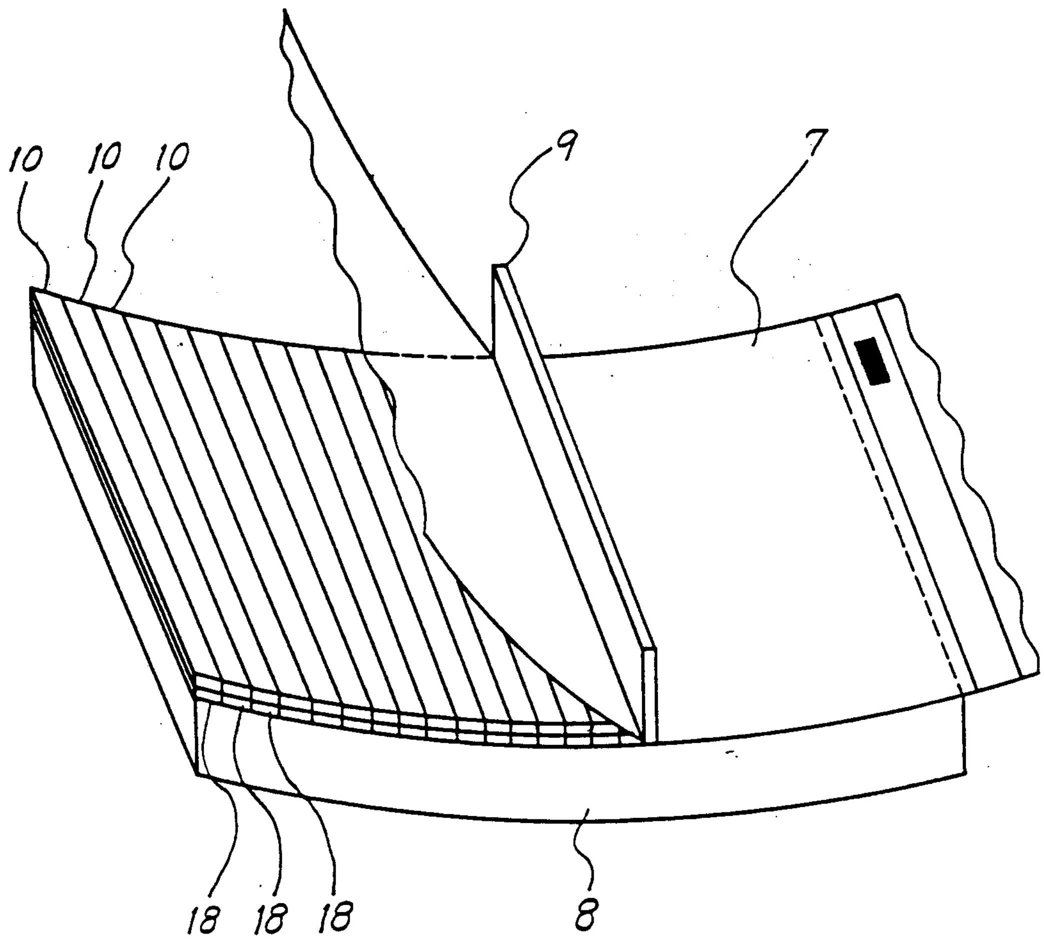


Fig. 13

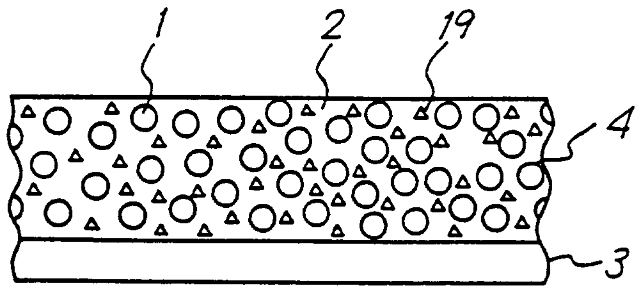


Fig. 14

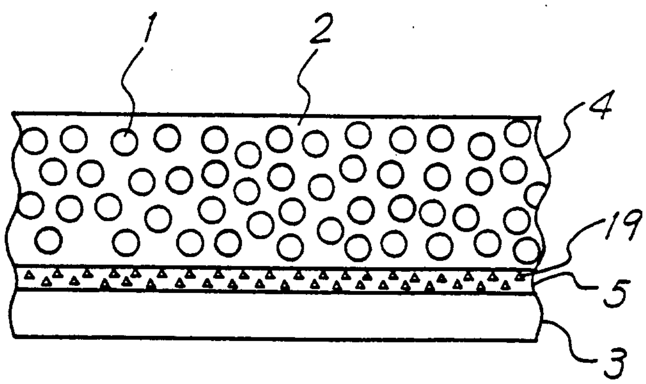


Fig. 15

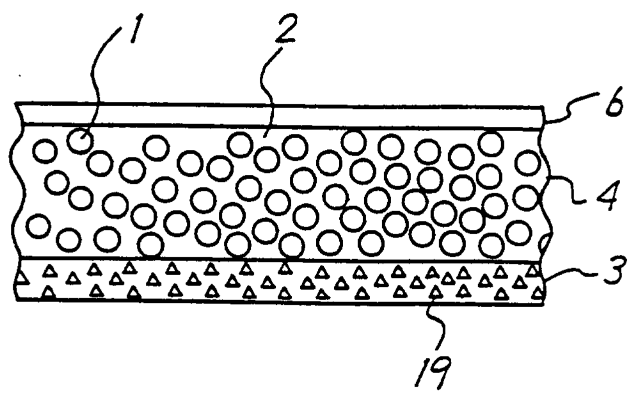
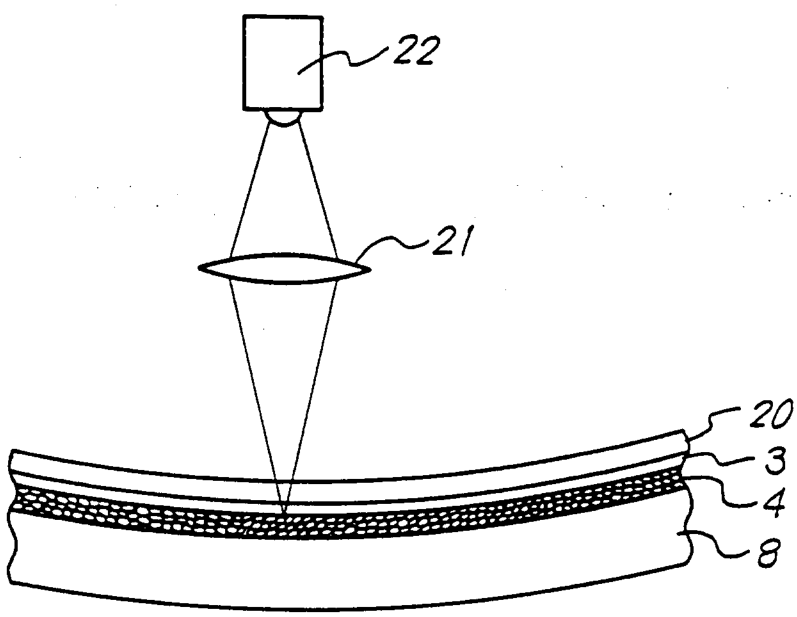


Fig. 16



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP94/00359

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl[5] H01J9/227

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)

Int. Cl[5] H01J9/20-9/236

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1926 - 1994
Kokai Jitsuyo Shinan Koho 1971 - 1994

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y X	JP, A, 2-235692 (Nitto Denko K.K.), September 18, 1990 (18. 09. 90), Lines 4 to 18, left column, page 1, line 9, upper left column to line 3, upper right column, page 2, (Family: none)	1, 6 2, 9, 10
Y A	JP, A, 4-255633 (NEC Kagoshima K.K.), September 10, 1992 (10. 09. 92), Abstract, lines 4 to 12, 18 to 26, right column, page 2, table 1, (Family: none)	1, 6 4, 5
Y	JP, A, 4-319487 (Matsushita Electric Ind. Co., Ltd.), November 10, 1992 (10. 11. 92), Abstract, claim 1, lines 7 to 27, right column, page 2, (Family: none)	7, 13
Y	JP, A, 3-26593 (Eastman Kodak Co.), February 5, 1991 (05. 02. 91), Lines 5 to 17, left column, page 1, lines 1 to 10, upper right column, page 5	7, 8, 13

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
May 13, 1994 (13. 05. 94)	May 31, 1994 (31. 05. 94)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP94/00359

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	& US, A, 4942141 (17. 07. 90) & EP, A1, 403930 (27. 12. 90)	
P	JP, A, 5-234508 (Sony Corp.), September 10, 1993 (10. 09. 93), Claims 1 and 2, lines 3 to 32, right column, page 3, (Family: none)	1