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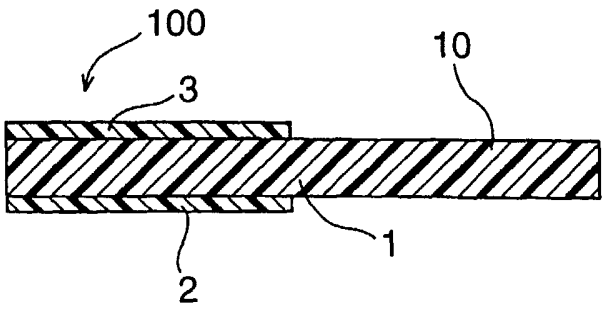

(57) Abstract: An optical filter includes a film layer which comprises an optical film and has a surface to be observed by an observer and a back surface opposite to said surface, and a repeelable adhesive layer which is fixedly provided on said back surface of the film layer and can be repeelably adhered to an adherent surface, said optical filter being fixed to said adherent surface through said repeelable adhesive layer, in which said optical filter further comprises a flexible tab which is fixedly provided on said film layer.

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OPTICAL FILTER

Field of the Invention

The present invention relates to an optical filter comprising a film layer having an optical film such as a louver film, an antireflection film, etc., and an adhesive layer which repeelably adheres the film layer to an adherent surface, and also a tab which facilitates the repeeling work. The optical filter of the present invention is preferably produced by bonding a double-coated adhesive tape (or a double-coated tape) with a tab, which comprises a flexible substrate with a tab and a repeelable adhesive layer.

The optical filter of the present invention is repeelably adhered to an adherent surface, which may be the screen of a display such as a liquid crystal display. For example, when the film layer is a film having a louver layer, the optical filter functions as a privacy filter, which can prevent a person other than a user or an operator from peeping at the screen from the side direction.

Background of the Invention

In general, a liquid crystal display (which may be named a liquid crystal display device) comprises a liquid crystal display panel (screen) (hereinafter occasionally referred to as "liquid crystal panel") and a light source, that is, a backlight which illuminates the liquid crystal panel from its back surface (a surface opposite to the displaying surface).

The liquid crystal panel comprises a pair of first and second polarizing plates and a liquid crystal layer interposed between them. The polarizing plates are placed so that the

polarization axis of the first polarizing plate (the first polarization axis) and that of the second polarizing plate (the second polarization axis) form a certain angle, for example, they are orthogonalized. An example of the backlight is an edge-light type backlight which comprises a light-guide plate and a light source which supplies light in the light-guide plate from the edge face of the plate. Also, a beneath type back light, in which a light source is placed just beneath the back surface of the liquid crystal panel, is used.

When the liquid crystal display is used, usually an optical filter having various optical films is provided on the display screen. The optical film has optical functions or protection effects to protect the screen from dirt or damage. Examples of the optical film include an anti-reflection film (an optical film having an antireflection layer), a louver film (an optical film having a louver layer), etc.

For example, in the case of illumination with the backlight, the light beam which has transmitted through the liquid crystal panel, exits in directions (side directions) remote from the front direction of the display surface. Thus, the liquid crystal display can be seen not only by a user or an operator positioned in the front direction but also by a person standing at a site in the side direction apart from the front direction. Therefore, it is difficult to guard the privacy of the user. Furthermore, when the liquid crystal display is an automobile-loaded equipment such as a car navigation system, etc., the reflection of the panel on a windshield may interfere with the eyeshot of a driver.

In such a case, to guard the privacy and to prevent the reflection on the windshield, a film having a plurality of minute louvers (or louver-form elements) inside, that is, a louver film, is installed in the optical filter which is attached to the display screen so that

the unnecessary propagation of the transmitted light beam from the liquid crystal panel in the side directions. The louver film achieves such an effect that the louvers built in the film control the propagation directions of the light beams which are transmitted through the louver film in a specific exiting angle range. Thus, the unnecessary exiting of the light beams which have transmitted through the liquid crystal panel in the side directions can be effectively prevented. Such a louver film is also named a light control film.

The structures, production and applications of the louver films are disclosed in some prior publications.

For example, US RE27,617 discloses a method for producing a louver film by skiving a billet consisting of alternating plastic layers having a relatively low optical density (transparent) and a relatively high optical density (colored). When the billet is skived, the colored layers provide louver-form elements which collimate the light beam, and these elements can extend in the direction perpendicular to the surface of the louver film according to the specification of the above patent.

JP-A-8-224811 discloses the formation of a pressure-sensitive adhesive layer on at least one of the main surfaces (surface and back surface) of a louver film and the covering of the adhesive surface of the adhesive layer with a transparent protection plastic film to prevent the damage of the louver film in use. The transparent plastic film may optionally have a release layer. The release layer is removed to allow the adhesive layer to expose and the louver film is adhered to a suitable adherent (a panel, etc.) to obtain a finished product.

The pressure-sensitive adhesive layer used in the above patent comprises a pressure-sensitive adhesive containing a self-adherent polymer. The self-adherent polymer is tacky at a room temperature (about 25°C). The self-adherent polymer may be obtained by polymerizing a monomer composition which becomes an adhesive and preferably transparent state after polymerization. The specific example of the self-adherent polymer disclosed in JP-A-8-224811 is a crosslinked self-adherent polymer which is obtained by polymerizing, with UV light, a monomer composition containing 90 parts (parts by weight) of isooctyl acrylate, 10 parts of acrylic acid, 0.2 part of a photopolymerization initiator and 0.1 part of an optically active crosslinking agent.

One example of the commercially available louver film is "LIGHT CONTROL FILM" of 3M.

Although not a louver film, it is known to repeelably adhere and fix a film layer having a transparent protective layer to a display screen.

For example, JP-A-2000-56694 discloses a screen-protection film comprising a laminate of a transparent film layer having a light transmittance of at least 80 % and a rubber layer laminated on one surface of the film layer, characterized in that the light transmittance of the laminate is at least 80 %. The rubber layer is formed of one rubber selected from the group consisting of silicone rubber, fluororubber, acrylic rubber, ethylene-propylene rubber and acrylonitrile-butadiene rubber, or a mixture of two or more of them. Thus, the protective film can be adhered to the display screen and repeelable. Since the transparent film layer is made of a plastic film such as a polyester film, etc., it

has better transparency than the louver film described above. In addition, the commonly used plastic film has no antireflection function.

As described above, a desirable optical function can be imparted to the screen of the liquid crystal display with adhering and fixing the optical filter to the screen. For example, when the optical filter comprises the louver film, it functions as an optical filter which prevents the unnecessary exit of the light beams in the side directions (i.e. a privacy filter), and thus guards the privacy.

However, there is a tendency to prefer that such an optical film is not permanently fixed to the display screen but it can be removed from the screen at any desirable time and easily refixed to the screen. Therefore, it is preferable to use a repeelable adhesive layer to fix the optical filter to the adherent surface so that the optical filter can be easily fixed to the display screen and it may be detached at any desired time and refixed to the screen with ease. The use of the repeelable adhesive layer achieves good results, but there still remains a problem to be solved. This problem is that it is relatively difficult to detach the optical filter once it is fixed to the display screen.

In the case of a liquid crystal display of a notebook personal computer (PC), a liquid crystal panel is assembled in a monitor cover having a frame so that the periphery of the liquid crystal panel is surrounded with the frame, and the liquid crystal panel is fixed to a specific position of the body of PC. With the display having the frame, a step is formed between the display screen and the frame, and the screen is set in the sunken part surrounded with the inner periphery of the frame, so that the screen can be observed by the observer. In general, the thickness of the optical filter is the same as or smaller than the

height of the step, while the optical filter is usually fixed so that it covers the entire screen in the sunken part inside the frame. In such a case, only a very narrow gap is formed between the inner periphery of the frame and the optical filter. Therefore, when the user tries to detach the optical filter, a nail or a prong of a tool is inserted between the inner periphery of the frame and the optical filter, and then a peeling force, which is larger than the peel strength of the repeelable adhesive layer, is applied to remove the optical filter.

However, the optical filter can only be partly removed in the initial step of the removal of the optical filter with inserting the nail or the prong of the tool between the inner periphery of the frame and the optical filter. That is, usually the whole back surface of the optical filter is adhered to the display screen, and almost all the filter is adhered to the screen when the filter is only partly removed. Therefore, it is necessary to further apply a large peeling force to detach the optical filter. However, it may be difficult to apply such a large peeling force in a state where the nail or the prong of the tool is inserted between the inner periphery of the frame and the optical filter having the conventional shape, and the detachment of the optical filter may become difficult.

When there is no step of the frame, the peeling force can be easily applied to the optical filter, since the nail and the like can be inserted between the optical filter and the display screen from the outer periphery of the optical filter the whole back surface of which is adhered to the screen. However, in the case of the optical filter having the louver film, since the flexibility of the whole optical filter is relatively low, it is difficult to increase the peeling angle when the optical filter having a general shape is detached, and the force necessary to peel the filter tends to increase.

Summary of the Invention

To solve the above problems, the present invention provides an optical filter comprising (a) a film layer which comprises an optical film and has a surface to be observed by an observer and a back surface opposite to said surface, and (b) a repeelable adhesive layer which is fixedly provided on said back surface of the film layer and can be repeelably adhered to an adherent surface, said optical filter being fixed to said adherent surface through said repeelable adhesive layer, wherein said optical filter further comprises a flexible tab which is fixedly provided on said film layer.

Brief Description of the Drawings

Fig. 1 shows the method for producing the optical filter of the present invention and the steps for fixing the optical filter to a display.

Fig. 2 is a partial cross sectional view of a display to which the optical filter of the present invention fixed.

Fig. 3 is a cross sectional view of one embodiment of the double-coated tape with the tab according to the present invention.

Fig. 4 is a cross sectional view of another embodiment of the double-coated tape with the tab according to the present invention.

Fig. 5 is a cross sectional view of a further embodiment of the double-coated tape with the tab according to the present invention.

Fig. 6 is a plane view of a display screen to which the optical filter according to one embodiment of the present invention is fixed.

Fig. 7 is a plane view of the substrate with the tab of the optical filter according to the present invention.

Fig. 8 is a plane view of a display to which the optical filter according to another embodiment of the present invention is fixed.

Fig. 9 is a plane view of a display to which the optical filter according to a further embodiment of the present invention is fixed.

Fig. 10 shows one example of the method for producing the double-coated tape with the tab according to the present invention.

Fig. 11 is a plane view of one preferable example of the double-coated tape with the tab according to the present invention.

Detailed Description

The optical filter of the present invention is characterized in that it comprises (1) a film layer comprising an optical filter, (2) a repeelable adhesive layer which is fixedly provided on the back surface of the film layer and allows the film layer to be repeelably adhered to the adherent surface (e.g. a display screen), and (3) a flexible tab which is fixedly provided on said film layer.

The repeelable adhesive layer facilitates the fixing of the optical filter to the adherent surface and also the detaching of the optical filter at any desirable occasion. Since the tab is flexible, it is easily flexed so that the tab and the adherent surface forms an angle at which the peeling force can be readily applied. Accordingly, the optical filter can be detached from the adherent surface with ease by removing the optical filter with

pinching the tab with fingers, even when a relatively small gap is formed between the inner periphery of the frame and the outer periphery of the optical filter. Furthermore, the optical filter comprising a less flexible optical film such as a louver film can be readily detached. That is, since the optical filter can be peeled from the adherent surface in the direction leaving from the adherent surface with pinching the tab, the peeling force can be effectively applied to the optical filter to remove the optical filter from the adherent surface.

The repeelable adhesive layer may have repeeling properties such that the optical filter can be peeled without damaging the adherent surface. The adhesive layer with such repeeling properties may be formed from a composition containing a crosslinked self-adherent polymer or a rubber polymer.

The repeelable adhesive layer has a peel strength of 0.1 to 4.5 N/25 mm against the surface of a polyethylene terephthalate (PET) film, when the peel strength is measured at a peeling rate of 90 inch (about 229 cm)/min. at a peeling angle of 90 degrees.

The tab may be bonded integrally with the film layer, or with a substrate which is fixedly provided on the film layer (a substrate with a tab). When the substrate with the tab is used, it is bonded to the film layer so that it is not delaminated from the film layer in the peeling step. From such a viewpoint, the substrate with the tab is preferably provided between the film layer and the repeelable adhesive layer. To prevent the peeling between the film layer and the substrate, the substrate and the film layer are bonded preferably with the bonding adhesive layer having a larger peel strength than that of the repeelable adhesive layer.

Optical filter

The preferred embodiments of the optical filter according to the present invention will be explained by making reference to Figs. 1, 2 and 3.

The optical filter (6) shown in the figures comprises the film layer (60) having the surface (601), which is observed by an observer, and the back surface (602) opposing to the surface (601), and a repeelable adhesive layer (not shown in Figs. 1 and 2), which is fixedly provided on the back surface (602) and repeelably adhered to the adherent surface.

In the embodiment shown in the figures, the substrate (1) with the tab and the repeelable adhesive layer (2) are assembled in the optical filter (6) with bonding the double-coated tape (100) with the tab, which is shown in Fig. 3, to the film layer (60). The optical filter (6) is fixed to the surface (the display screen (70)) of the display panel (79) of the display (7) through the repeelable adhesive layer (2) of the double-sided tape (100) with the tab.

The display (7) of Fig. 1 has the frame (71) surrounding the display screen (70). Examples of the display having such a structure include a monitor of a notebook PC, a portable terminal such as PDA, etc. In the case of such a display, the film layer (60) comprises the optical film such as the antireflection film, the louver film, etc. The details of the film layer and the optical film will be explained below.

As shown in Fig. 1, the double-coated tapes (100) with the tab, that is, the substrates (1) with the tab, are partly provided on the back surface of the film layer near the periphery thereof. The tab (10) (or the tab portion of the substrate (1)) extends outwardly from the outer periphery of the film layer (60). That is, when the optical filter

is fixed to the adherent surface, the tab (10) extends outwardly from the covered region of the adherent surface (the display screen (70)), which is covered with the film layer (60) (see Fig. 2). Accordingly, the optical filter (60) can be peeled from the adherent surface with pinching the tab and pulling it up, the peeling force is effectively applied to the optical filter, and the optical filter can be detached from the adherent surface together with the substrate (1) with the tab adhered to the optical filter.

Furthermore, since the repeelable adhesive layer is partly provided on the back surface of the film layer near the outer periphery thereof, the optical filter can be detached with a smaller peeling force than the film layer the whole back surface of which is adhered to the adherent surface. The details of the double-coated tape with the tab will be explained below.

The substrate (1) with the tab is usually made of a transparent material. The transparency of the substrate is at least 80 %, preferably at least 85 %, particularly preferably at least 90 %, in terms of a light transmittance.

Herein, the "light transmittance" means a total light transmittance, which is measured with a spectrophotometer or a color meter having a spectrometric function using light having a wavelength of 550 nm.

The substrate is usually formed of a polymer sheet, since it should be flexible. As the polymers of the polymer sheets, polyesters (e.g. PET, polyethylene naphthalate (PEN), etc.), acrylic polymers, vinyl chloride polymers, polyurethane, and the like may be used.

Usually, the bonding adhesive layer and the repeelable adhesive sheet are both made of a transparent adhesive. Thus, the screen can be clearly seen if the film layer (60)

and the substrate (1) with the tab cover the display screen with overlapping as shown in Fig. 2.

A part of the tab which does not overlap with the film layer (60) may not be transparent, and may be made opaque with coloring. When the tab is colored, it is preferably colored with a color which has the same color tone or texture as that of the component (e.g. the frame, etc.) provided around the display screen. Thereby, the tab is made less conspicuous, and the appearance of the surrounding of the display screen are not deteriorated when the optical filter is fixed to the screen.

As shown in the figures, the substrate (1) with the tab is bonded to the film layer (60) through the bonding adhesive layer (3) so that the tab is not detached from the film layer (60) during the peeling work. In general, the bonding adhesive layer has a larger peel strength than that of the repeelable adhesive layer to effectively prevent the peeling of the bonding adhesive layer from the substrate (1) of the film layer. The repeelable adhesive layer (2) is provided so that it is opposed to the bonding adhesive layer (3) with interposing the substrate (1) between them. Thus, in the embodiment of the figures, the substrate (1) with the tab is provided between the film layer and the repeelable adhesive layer. The substrate with the tab may be provided at any place of the film layer insofar as it is not detached from the film layer during the peeling work. For example, the substrate with the tab may be fixed to the surface of the film layer. In this case, the repeelable adhesive layer and the substrate with the tab are assembled in the optical filter as the discrete members.

When the substrates (1) with the tab are partly provided on the back surface (602) of the film layer near the outer periphery thereof as shown in the figures, the repeelable adhesive layers are partly provided on the back surface (602) of the film layer near the outer periphery thereof. In such a case, the optical filter is adhered partially to the display screen, and the gap (G) is formed between the optical filter (6) and the display screen (70). The fixing of the optical filter with such partial adhesion particularly facilitates the detaching of the optical filter. In the example of the figures, four substrates (1) with the tab are fixed to the respective corners of the film layer (60) having the rectangular surface and back surface, and the film layer (that is, the optical filter) is fixed partly to the display screen (70) at the four corners.

The repeelable adhesive layer may be provided on the whole back surface of the film layer insofar as the optical filter can be easily detached. In this case, the number of the tabs may be less than or more than four. From the viewpoint of the easy detachment of the optical filter, the number of the tabs should be at least two so that a peeling operator (i.e. a user) can detach the optical filter with both hands.

For example, as shown in Fig. 6, the optical filter (6) having two tabs (10a, 10b) is fixed to the screen inside of the frame (71) of the display (7). The optical filter (6) shown in Fig. 6 may be formed by bonding the film layer (60) to the surface (11) of the substrate (1) with the tabs (shown in Fig. 7) except the parts corresponding to the tabs (10a, 10b) using the bonding adhesive layer (not shown).

The substrate with the tabs shown may be made by cutting a polymer film in the shape (having two tabs protruding from the periphery) shown in the figure, or by

supplying a polymer film having the same size as the film layer and bonding two pieces of a polymer film, which form the tabs, to the polymer film.

In the optical filter of the present invention, the size and shape of the tab are preferably selected so that the optical filter can be easily peeled and the tab is not broken during the peeling work.

For example, the thickness of the tab is usually from 50 to 300 μm. The length of the tab in the extending direction (the length of the tab beyond the edge of the film layer) is usually from 3 to 30 mm, preferably from 5 to 20 mm. The length of the tab across the extending direction may be the same as or less than the peripheral edge of the film layer to which the tab is bonded, and is usually at least 3 mm, preferably at least 5 mm, particularly preferably at least 10 mm.

The shape of the tab may be arbitrarily selected, as shown in the figures. Preferably, it can be a geometric shape such as a triangle, a rectangle, a circle, a fan, an ellipsoid, an ellipsoidal fan, etc., a shape imitating a good (a flower shape, a star, a handprint, a footprint, etc.), since the optical filter will have a well-designed appearance attractive to the observer. The number of the tabs is 4 or less since the appearance of the surrounding of the display screen is not deteriorated, when the optical filter is fixed to the screen.

In the liquid crystal display (7) shown in Figs. 1, 2 and 6, the display screen (70) is surrounded with the frame (71). Thus, a step is formed between the outer periphery of the display screen and the frame, and the screen (70), which can be seen by the observer, is provided in a sunk area surrounded with the inner periphery (710) of the frame. As shown

in the figures, the thickness of the whole optical filter (6) (the thickness including the double-coated tape with the tab) is less than the height of the step. The optical filter (6) is fixed so that it covers substantially the whole area of the screen (70), and the tab (10) extends outwardly beyond the edge of the film layer (60) through the gap formed between the inner periphery (710) of the frame and the optical filter (60) with the tip end of the tab (10) reaching the frame (see Fig. 2). Accordingly, when the optical filter is detached, it is not necessary to insert the nail or the prong of the tool between the inner periphery of the frame and the optical filter, since the optical filter can be easily detached by lifting up the tab with the fingers and applying the peeling force to the tab with pinching the tab.

In the case of the display (7) shown in the figures, the frame (71) has the inclined plane (712) which connects the inner periphery (710) and the upper face (711). The tab (10) passes through the gap between the inner periphery (710) and the optical filter (6) and is substantially in contact with the inclined plane (712) of the frame, but is not in contact with the upper face (711). The tab (10) is provided at a certain height from the upper face (711) and floats over the frame. When the thickness of the tab is relatively large or the stiffness of the tab is relatively high, the gap between the surface of the frame and the tab tends to increase. When this gap is too large, the appearance of the peripheral area of the display screen may deteriorate. Thus, this gas is made as small as possible.

When the above gap between the surface of the frame and the tab floating thereover is made small, some improved structures described below may be employed.

For example, the tab is folded so that the shape of the tab closely follows the surface contour of the frame.

A repeelable adhesive layer may be provided also on the back surface of the tab (10), and the tab (10) is repeelably adhered to the upper face (711) of the frame.

Alternatively, an adhesive strip comprising a single-coated repeelable adhesive tape is used and the tab (10) is repeelably adhered to the frame.

Furthermore, as shown in Fig. 8, the tabs (10a, 10b) are positioned over the screen (70) surrounded with the frame (71), so that the floating height of the tab can be made as small as possible. In the example of Fig. 8, the two corners of the film layer (60) are cut away in a triangle form having a specific area, and the substrate with the tabs is provided on the back surface of the film layer so that the tabs (10a, 10b) extend from the outer periphery of the film layer (60). In this case, the length of the extended part of each tab is made as short as possible so that the tab is in touch with the inclined plane (712) of the frame but does not extend over the upper face (711)

The optical filter of the present invention may be effectively used with a display having no step of a frame. For example, Fig. 9 shows an embodiment in which the optical filter (6) is fixed to the display (7) having no step of the frame around the display screen. Examples of the display having such a structure include a display of a portable phone, a flat face liquid crystal monitor (the display screen and the frame surface being on the same plane), etc.

The optical filter (6) of Fig. 9 comprises the film layer (60) having the same form and size as those of the display screen to be observed, and two tabs (10a, 10b) extending from the outer periphery of the film layer. The tabs (10a, 10b) are provided continuously along the two opposing sides of the film layer (60), respectively. That is, the shape of the

whole optical filter (6) is a rectangle. With such shape, the appearance of the display screen having the optical filter adhered is not deteriorated, and the design of the display screen can be improved. For example, the film layer (60) may be produced by cutting an optical film such as an antireflection film, a louver film, etc. so that it has the specific shape and size of the screen.

As shown in Fig. 9, the tabs may be colored with a desirable color, or provided with visual information such as designs, symbols, characters, etc. Such visual information includes trade names or trademarks of displays, names or initials of users, any catchwords having no relationship with the displays, or any other messages.

The optical filter (6) shown in the figure may be formed by supplying a flexible substrate having a bonding part with the same shape and size as those of the film layer (60) and tab parts connected with the bonding part, and adhering the film layer (6) only to the bonding part. Alternatively, a double-coated adhesive tape having two tabs (10a, 10b) may be used.

Double-coated tape with tab

The double-coated tape with the tab is assembled in the optical filter in use as described above, and is suitable for constructing the optical filter of the present invention. As shown in Fig. 3 which is referred to in the above explanation, the double-coated tape with the tab comprises the substrate (1) with the flexible tab, the bonding adhesive layer (3) which is adhered to the surface of the substrate (1) and allows the substrate to be adhered to the back surface of the film layer, and the repeelable adhesive layer (2) which is adhered to the back surface of the substrate (1) and fixes the substrate (1) and the film

layer adhered to the substrate (1) to the adhesion surface. As described above (see Figs. 1 and 2), the double-coated tape (100) with the tab has the tab (10) which extends outwardly from the outer periphery of the film layer, when the tape is adhered to the film layer. As shown in Fig. 3, the tab (10) is the part of the adhesive tape, which is adhered to neither the film layer nor the display screen. That is, the bonding adhesive layer (3) and the repeelable adhesive layer (2) are fixedly provided only on the part of the surface and the back surface of the substrate (1), respectively, with the two adhesive layers being opposed each other through the substrate (1). Usually, the adhesion surface of the bonding adhesive layer (3) and that of the repeelable adhesive layer are substantially the same.

The double-coated tape with the tab may have the structure as shown in Fig. 4. In the embodiment of this figure, the bonding adhesive layer (3) is adhered to only the part of the surface of the substrate (1), that is, the part which is adhered to the film layer, while no bonding adhesive layer (3) is provided on the tab (10). The repeelable adhesive layer (2) is provided on substantially the whole back surface of the substrate (1), and the part of the repeelable adhesive layer (2), which is provided on part corresponding to the tab (10), is covered with the covering film (4). In this embodiment, the surface region of the tab (10) having no adhesive layer is non-adhesive, while the back surface region of the tab (10) having the peeable adhesive layer is adhesive as such. The provision of the covering film (4) makes the back surface of the tab (1) non-adhesive.

Preferably, the covering film (4) is made of a material and has a thickness, which do not deteriorate the flexibility of the tab as a whole. For example, the covering film (4) is formed of a polymer film having no adhesion properties at room temperature (about

25°C), a paper sheet, a metal foil, etc. Examples of the polymer of the polymer film include polyester, acrylic polymers, polyvinylidene fluoride, polyurethane, epoxy resins, polyvinyl chloride, etc.

The thickness of the covering film (4) is usually from 1 to 200 μm, preferably from 2 to 100 μm although it depends on the thickness of the substrate.

The covering film (4) may be used without or with being peeled off from the repeelable adhesive layer, when the double-coated tape with the tab is used. For example, when the optical filter is fixed to the display, the tab (10) may be repeelably adhered to the surface of the part (e.g. the frame, etc.) surrounding the display screen through the repeelable adhesive layer (2). When the double-coated tape with the tab is used without peeling the covering film (4) off, the surface of the covering film (4), which will be adhered to the repeelable adhesive layer (2), is preferably subjected to an adhesion-enhancing treatment such as corona treatment, primer treatment, etc.

As described above, the tab (10) may be colored. In this case, the covering film (4) may be formed of a colored film in the embodiment of Fig. 4. Preferably, the color and appearance of the surface side of the colored film, which is seen trough the substrate (1) and the repeelable adhesive layer (2), are the same as those of the part surrounding the display screen. The color and appearance of the back surface side of the colored film are preferably different from those of the surface side. Thus, it is easy to identify the side having the repeelable adhesive layer and the side having the bonding adhesive layer from the color and/or the appearance, when the double-coated tape with the tab is adhered to the film layer.

The double-coated tape with the tab may have the structure as shown in Fig. 5. In the embodiment of this figure, the repeelable adhesive layer (2) is provided on substantially the whole back surface of the substrate (1), while the bonding adhesive layer (3) is provided on substantially the whole surface of the substrate (1). The adhesive surface of the bonding adhesive layer (3) corresponding to the tab (10) is covered with the covering film (4), while the adhesion surface of the remaining part of the bonding adhesive layer (3) forms the bonding part (30). The covering film (4) may be the same as that shown in Fig. 4, and is made of a material and has a thickness, which do not deteriorate the flexibility of the tab as a whole. As described in the above, the covering film (4) preferably comprises the colored film from the viewpoint of the easiness of the adhesion work.

In the embodiment shown in Fig. 5, the tab can be repeelably adhered to the surface of the part surrounding the display screen through the repeelable adhesive layer (2), when the optical filter is fixed to the display.

Furthermore, the second covering film is provided on the part of the repeelable adhesive layer (2) corresponding to the tab, so that the surface and back surface of the tab (10) are both non-tacky.

The double-coated tape with the tab may be produced with the application of the production method of conventional double-coated adhesive tapes. For example, the double-coated tape (100) with the tab shown in Fig. 5 may be produced as follows:

First, the raw tape (109) shown in Fig. 10 is supplied. That is, the first adhesive layer, which serves as the bonding adhesive layer, is fixedly provided on the surface of a

transparent raw substrate (not shown), and the second adhesive layer, which serves as the repeelable adhesive layer, is fixedly provided on the back surface of the raw substrate to form the precursor of the raw tape (109), and then, the raw covering film (49) is provided on the surface of the first adhesive layer to obtain the raw tape (109). In the embodiment shown in the figure, the remaining adhesive surface of the first adhesive layer, which is not covered with the covering film (49) is covered with the first raw liner (59). Preferably, the adhesive surface of the second adhesive layer on the back surface of the substrate is covered with the second raw liner.

The double-coated tape (100) with the tab can be prepared by cutting the raw tape (109) obtained in the above in the desired shape and size. The position, size and shape to be cut are selected so that the cut part includes the part covered with the raw covering film (49) and the part covered with the first raw liner (59). In the embodiment shown in the figure, the raw tape (109) is cut along the cut line (8), that is, in the direction perpendicular to the lengthwise direction of the raw tape (109) to obtain the double-coated tape (100) with the tab.

After the preparation of the double-coated tape (100) shown in Fig. 10, the tab part is trimmed to obtain the double-coated tape (100) with the tab having the desired shape as shown in Fig. 11.

Besides the semicircular shape of Fig. 11, the shape of the tab may be the geometric shape or the shape imitating a good, as described above.

The adhesive layer (the bonding adhesive layer or the repeelable adhesive layer) may be formed of a coated film of a coating composition containing an adhesive

component. Such a coated film may be formed by applying the composition directly on the substrate, or by transferring the coated film, which has been formed on a process substrate, to the substrate. A masking tape may be used when the coating composition is applied directly on the substrate and the adhesive layer is partly formed on one or both of the surfaces of the substrate as shown in Figs. 3 and 4, A masking tape may be used. That is, the masking tape is adhered to the part of the substrate and then the coated film is formed. Thereafter, the masking tape is removed to form the part having no adhesive layer.

At least a part of the substrate, which is laminated with the film layer, is transparent. The transparency of the film is usually at least 80 %, preferably at least 85 %, particularly preferably at least 90 %, in terms of a light transmittance. The substrate is usually formed of a polymer sheet. Examples of the polymer include polyesters (e.g. PET, PEN, etc.), acrylic polymers, vinyl chloride polymers, polyurethane, etc.

The size and shape of the substrate are preferably selected so that the peeling work is easy and the tape is not broken in the peeling work. For example, the thickness of the substrate is usually from 20 to 300 μm, preferably from 30 to 200 μm. When any other layer such as the covering layer is fixed to the surface and/or the back surface of the tab, the thickness of the tab as a whole is usually from 50 to 300 μm. The length of the tab in the extending direction is usually from 5 to 30 mm, preferably from 10 to 20 mm. The width of the tab (in the direction perpendicular to the extending direction) may be the same as or less than the side of the film layer to which the double-coated tape with the tab

is bonded, and is usually at least 5 mm, preferably at least 10 mm. The shape of the tab is preferably the geometric shape or the shape imitating a good, as described above.

Bonding adhesive layer

The bonding adhesive layer preferably has as much high transparency as possible. The light transmittance is at least 80 %, preferably at least 85 %, particularly preferably at least 90 %.

The bonding adhesive layer may be formed of a conventional adhesive such as a pressure-sensitive adhesive, a heat-sensitive adhesive, a curable adhesive, etc. In general, the adhesive comprises a self-adherent polymer, which is preferably crosslinked. The self-adherent polymer means a polymer which exhibits tackiness at room temperature (about 25°C).

The self-adherent polymer of the bonding adhesive layer may be, for example, an acrylic polymer, a nitrile-butadiene copolymer (e.g. NBR, etc.), a styrene-butadiene copolymer (e.g. SBR, etc.), an amorphous polyurethane, a silicone polymer, etc. The self-adherent polymer may comprises one or more of these polymers.

The self-adherent polymer may be prepared by polymerizing a monomer mixture containing a specific starting monomer or monomer(s). The polymerization method may be a conventional one such as solution polymerization, bulk polymerization, emulsion polymerization, etc.

The thickness of the bonding adhesive layer is usually from 5 to 50 μm.

The difference (F-R) of the peel strength (F) of the bonding adhesive layer and the peel strength (R) of the repeelable adhesive layer is preferably at least 3 N/25 mm, more

preferably at least 5 N/25 mm, when the both peel strengths are measured against a PET surface at a peeling rate of 90 inch/min. at a peeling angle of 90 degrees. When the difference of the peel strengths (F-R) is too small, the substrate may be peeled from the film layer, when the optical film is repeatedly detached and attached.

The peel strength (F) of the bonding adhesive layer is not limited but is usually from 4 to 50 N/25 mm. The thickness of the bonding adhesive layer is usually from 10 to 200 μm, preferably from 20 to 100 μm.

Repeelable adhesive layer

The repeelable adhesive layer has an adhesion force (peel strength) in the specific range so that the optical filter can be removed without damaging the adherent surface. Preferably, the repeelable adhesive layer has a peel strength of 0.1 to 4.5 N/25 mm, when the peel strength is measured against a PET surface at a peeling rate of 90 inch/min. at a peeling angle of 90 degrees, as described above. When the peel strength against PET is too small, the optical filter may be detached from the adherent surface while in use. When the peel strength against PET is large, the detaching of the optical filter is easy even when it has an optical film with relatively low flexibility such as the louver film. Accordingly, from the above viewpoint, the peel strength against PET of the adhesive layer is preferably from 0.5 to 4.0 N/25 mm, particularly preferably from 1 to 3.6 N/25 mm.

The repeelable adhesive layer preferably contains a self-adherent polymer and a repeelability-imparting component. Thus, the peel strength of the repeelable adhesive layer is easily controlled in the above-described range.

For example, a crosslinking agent is preferably used as a repeelability-imparting component in a relatively large amount to crosslink the self-adherent polymer so that the cohesive force of the repeelable adhesive layer is increased. In addition, a crystalline polymer is preferably used as a repeelability-imparting component to decrease the tack of the adhesive surface of the repeelable adhesive layer or to impart the thermal repeeling properties to the repeelable adhesive layer. The kind and amount of the repeelability-imparting component are suitable selected so that the desired effects are attained and the transparency of the repeelable adhesive layer is not deteriorated.

In the present invention, the self-adherent polymer used in the repeelable adhesive layer is also a polymer which is tacky at room temperature (about 25°C). Examples of the self-adherent polymer are acrylic polymers, nitrile-butadiene copolymers (e.g. NBR, etc.), styrene-butadiene copolymers (e.g. SBR, etc.), amorphous polyurethane, silicone polymers, etc. These polymers may be used independently or as a mixture of two or more.

The self-adherent polymer may be obtained by polymerizing a monomer mixture comprising the specific starting monomer(s). In general, the polymerization method is solution polymerization, bulk polymerization, emulsion polymerization, etc.

When the self-adherent polymer is crosslinked, it is easy to control the peel strength of the repeelable adhesive layer in the desired range. In such a case, a crosslinking agent is generally used.

As the crosslinking agent, a polyfunctional isocyanate compound, an epoxy resin, a bisamide crosslinking agent, etc. may be used. These compounds react with the carboxyl group of the self-adherent polymer or the crosslinkable functional group which is

optionally contained such as a hydroxyl group to crosslink the self-adherent polymer so that the repeeling properties are improved.

When the repeeling properties are imparted to the repeelable adhesive layer using the crosslinking agent but no other repeeling property-imparting component (e.g. a crystalline polymer, etc.), the content of the crosslinking agent is preferably from 1 to 5 wt. parts, more preferably from 1.5 to 4 wt. parts, based on 100 wt. parts of the self-adherent polymer.

The repeelable adhesive layer may contain a rubbery polymer. The rubbery polymer may be at least one polymer selected from the group consisting of silicone rubber, fluororubber, acrylic rubber, ethylene-propylene rubber and acrylonitrile rubber. Also the elastomeric polymer is preferably crosslinked. Thereby, the peel strength can be adjusted in the above-described range.

Preferably, the elastic modulus of the rubbery polymer is selected so that the peel strength is in the above-described range. For example, the elastic modulus G (storage modulus) is usually from 20 to 300 kPa, preferably from 30 to 200 kPa, more preferably from 50 to 100 kPa, when it is measured by a dynamic viscoelasticity measuring method at 25°C and a frequency of 1 rad/sec. in the shear mode. When the modulus G is too small, the repeeling property may deteriorate. When the modulus G is too large, the adhesion of the optical filter to the adherent surface may deteriorate.

Preferably, the repeelable adhesive layer also has as high transparency as possible. The light transmittance is usually at least 80 %, preferably at least 85 %, particularly

preferably at least 90 %. The thickness of the repeelable adhesive layer is usually from 10 to 200 μm, preferably from 20 to 100 μm.

Film layer

The film layer included in the optical filter according to the present invention comprises the optical film. The optical film is a film which can impart any optical function to the adherent surface. The "optical function" herein used means a function to control at least one property selected from the group consisting of a light transmittance, light reflectance, a refractive index and light-transmitting direction.

For example, the optical film may be a louver film consisting of or comprising a louver layer. The louver layer is a film having minute louvers (or louver-form elements) inside the film, which can control the light-transmitting direction. The louver layer comprises light-transmitting parts and minute louver elements which shield light.

Preferably, the light-transmitting part has a larger width than the width of the louver element (a size of the louver element in the direction in parallel with the surface of the louver layer and perpendicular to the lengthwise direction of the louver element), so that the light transmittance of the optical filter as a whole does not decrease. The width of the light-transmitting part is preferably from 50 to 500 μm, more preferably from 70 to 200 μm.

Preferably the width of the louver element is smaller than that of the light-transmitting part, so that the light transmittance of the optical filter as a whole does not decrease. The width of the louver element is from 1 to 100 μm, preferably from 10 to 50 μm. The angle of the louver element is usually from 40 to 90 degrees. The angle of the

louver element means an angle between the surface of the louver layer and the plane of the louver element. When the louver element lies at right angles with the surface of the louver layer, the angle of the louver element is 90 degrees.

The thickness of the louver layer can be suitably determined according to the application of the optical filter. As the thickness of the louver layer decreases, the effect to control the propagation direction of light tends to decrease. When the thickness of the louver layer is large, it is difficult to decrease the total thickness of the optical filter. Accordingly, the thickness of the louver element is preferably from 10 to 1,000 μm, more preferably from 40 to 500 μm.

The light-transmitting parts of the louver layer are preferably made of a polymer having a high transparency. As such a polymer, a thermoplastic resin, a thermosetting resin, a resin curable with an actinic ray such as UV ray, etc. can be used. Examples of such resins include cellulose resins such as cellulose acetate butyrate, triacetylcellulose, etc.; polyolefin resins such as polyethylene, polypropylene, etc.; polyester resins such as polyethylene terephthalate, etc.; polystyrene; polyurethane; polyvinyl chloride; acrylic resins; polycarbonate resins; and the like.

The louver elements may be formed from a light-shielding material which can absorb or reflect light. Examples of such a material include (1) dark pigments or dark dyes such as black or gray pigments or dyes, (2) metal such as aluminum, silver, etc., (3) dark metal oxides, and (4) the above-described polymers containing the dark pigments or dyes.

The louver layer may be produced by the following method, which is disclosed, for example, in the patent specification cited in the background section above.

First, a layer containing the light-shielding material is fixed to one main surface of the polymer film used as the light-transmitting part to form the louver-form element, that is, a laminate film consisting of the polymer film and the light-shielding material layer. A plurality of such laminate films are prepared and laminated to form a precursor louver film in which the polymer film and the light-shielding material layers are alternately arranged and fixed each other. Such a precursor louver film is skived at a desired thickness along the direction (lamination direction) perpendicular to the main surface (laminated plane) of the precursor film to obtain the louver layer.

As the louver film having the louver layer, a commercially available louver film may also be used. A commercially available louver layer for a louver film may be used as the louver layer used as a component member of the optical filter according to the present invention. One specific example of the commercially available louver film is "LIGHT CONTROL FILM" of 3M.

Besides the louver film, the optical film may be an antireflection film, a Fresnel lens film, an electromagnetic shielding film, etc.

The film layer may have two or more optical films, or a light transmitting film other than the optical film.

The thickness of the film layer as a whole is usually from 20 to 1,000 μm.

Examples

Example 1

In this Example, an optical filter was produced using an optical film and a double-coated tape with a tab having the cross section of Fig. 4 and the semicircular tab shown in Fig. 11, in combination. Two tabs were used, which had the same size and shape.

The louver film had a thickness of about 260 μm and a view angle of 90 degrees (a louver film "OAG 90" manufactured by 3M). In this louver film, the width of the light-transmitting part was 100 μm and the width of the louver-form element was 10 μm.

The optical film used had the rectangular surface and back surface, and its plane size was 245 mm x 185 mm.

The double-coated tape with the tab was produced as follows:

As a transparent substrate, a PET film having a length of about 2 cm (a size in the extending direction of the tab), a width of about 1.5 cm and a thickness of 100 μm was used. The substrate had a light transmittance of 90 %.

On the surface of the substrate, the first adhesive film in a rectangular form of 1 cm x 1.5 cm was adhered as a bonding adhesive layer. The first adhesive film was adhered to the substrate with the side of the tab having the length of 1.5 cm mating with one edge of the substrate in the lengthwise direction. Thus, the tab part, on which no bonding adhesive layer was provided, was formed between the other edge of the substrate and the central part of the substrate in the lengthwise direction. The first adhesive film was made of a transparent adhesive tape (#9483 manufactured by 3M). This adhesive tape had a light transmittance of 93 %. The adhesion surface of the first adhesive film, which was not in contact with the substrate, was protected with a liner.

On the back surface of the substrate, the second adhesive film in a rectangular form of 2 cm x 1.5 cm was adhered as a repeelable adhesive layer. The second adhesive film was made of a transparent adhesive tape (manufactured by PANAC). It had a light transmittance of 93 %. The adhesion surface of the second adhesive film, which was not in contact with the substrate, was protected with a liner.

Finally, the liner on the repeelable adhesive layer (the second adhesive film) was kiss-cut, and the liner was peeled off to expose only the adhesive surface corresponding to the tab on which the bonding adhesive layer was not provide, and a covering film was adhered to the adhesive surface exposed to finish the double-coated tape with the tab. Here, the covering film was an opaque film, which consisted of a PET film having a white coating on one surface and a black coating on the other surface, and had a thickness of about 50 μm as a whole. The covering film was adhered to the repeelable adhesive layer with the white surface facing the repeelable layer.

The peel strength of the two adhesive films against PET was measured. Each adhesive film was adhered to a PET film (thickness: 100 μm; BUM-100 manufactured by UNITIKA) to obtain a sample, and then the sample was subjected to the peel strength test under the specific conditions. The measurement was carried out with a peel strength meter (I-Mass Tester, MODEL SP-102C manufactured by Imass, Inc. (USA)) at a peeling angle of 90 degrees and a peeling rate of 90 inch/min. (about 229 cm/min.).

The test specimen used in the measurement of the peel strength was produced as follows.

The adhesive film was cut to a size of 15 cm x 25 cm to obtain a sample. This sample was press adhered to a PET film, which had been rinsed with isopropanol, with a roller specified in JIS Z 0237 (having a weight of 2 kg) at 20°C and 65%RH, and kept standing for 3 hours under the same conditions. Then, the peel strength was measured under the conditions described above.

The peel strength against PET of the first adhesive film was 20 N/25 mm, while that of the second adhesive film was 2 N/25 mm.

The optical filter of this Example was fixed to the liquid crystal display screen of a note notebook PC through the repeelable adhesive layer of the double-coated tape with the tab, as shown in Fig. 2. Thus, the display having the optical filter of the present invention was assembled.

In the case of the display with the filter assembled in this Example, the double-coated tapes with the tab were adhered to the two corners of the optical filter through the bonding adhesive tapes, so that each double-coated tape was provided at the respective upper corner of the display screen. That is, the optical filter had the same structure as one shown in Fig. 1 except that the two double-coated tapes on the lower side of the display screen were omitted.

Using the display with the filter produced, a practical test was carried out.

The optical filter was easily fixed to the display screen, and achieved the good effect to prevent peeping at the screen from the side direction. That is, when the screen was observed from the direction remote from the front direction (at an angle of about 45 degrees), the image displayed on the screen could not be read.

The fixed optical filter could be easily detached and reattached. In the case of the optical filter of this Example, two tabs passed through the gap formed between the inner periphery of the frame and the optical filter and over the inclined face of the frame, and the tip ends of the tabs reached the upper surface of the frame as shown in Fig. 2. The tabs were in contact with the inclined face, but not with the upper face of the frame. That is, the tabs floated over the surface of the frame. Accordingly, when the optical filter was detached from the screen, the tabs could be easily pinched with fingers, and the optical filter could be easily detached with applying a force to lift up the tabs pinched.

What is Claimed:

1. An optical filter comprising (a) a film layer which comprises an optical film and has a surface to be observed by an observer and a back surface opposite to said surface, and (b) a repeelable adhesive layer which is fixedly provided on said back surface of the film layer and can be repeelably adhered to an adherent surface, said optical filter being fixed to said adherent surface through said repeelable adhesive layer, characterized in that said optical filter further comprises a flexible tab which is fixedly provided on said film layer.

2. The optical filter according to claim 1, wherein said tab extends outwardly from the outer periphery of said film layer.

3. The optical filter according to claim 1, wherein said tab extends outwardly from a region of said adherent surface covered with said film layer, when said optical filer is fixed to said adherent surface.

4. The optical filter according to claim 1, which further comprises a substrate with a tab which is integrally bonded thereto, said substrate being fixedly provided on said film layer.

5. The optical filter according to claim 4, wherein said substrate with a tab is provided between said film layer and said repeelable adhesive layer.

6. The optical filter according to claim 1, wherein said repeelable adhesive layer is partly provided on an area of the back surface of said film layer near the outer periphery thereof.

7. A double-coated adhesive tape with a tab comprising (i) a substrate with a flexible tab, (ii) an adhesive layer for bonding, which is adhered to the surface of said substrate and with which said substrate is bonded to the back surface of a film layer which comprises an optical film, and (iii) a repeelable adhesive layer which is adhered to the back surface of said substrate and can be repeelably adhered to an adherent surface to fix said substrate and said film layer to said adherent surface, wherein said tab extends outwardly from the outer periphery of said film layer, when said substrate is adhered to said film layer.

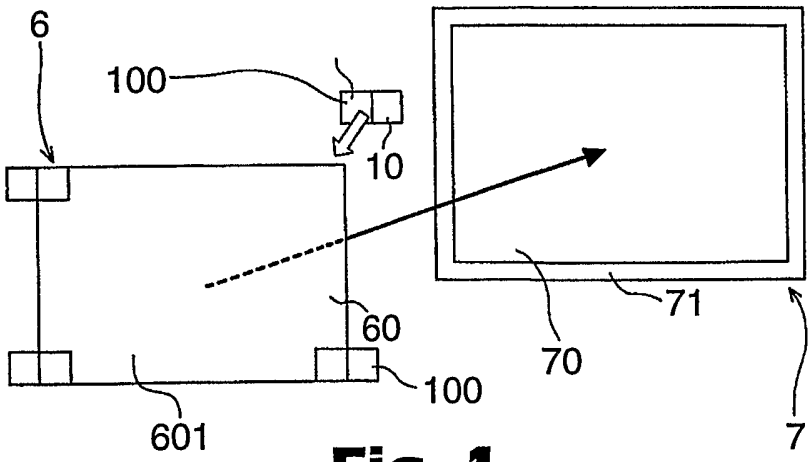

Fig. 1

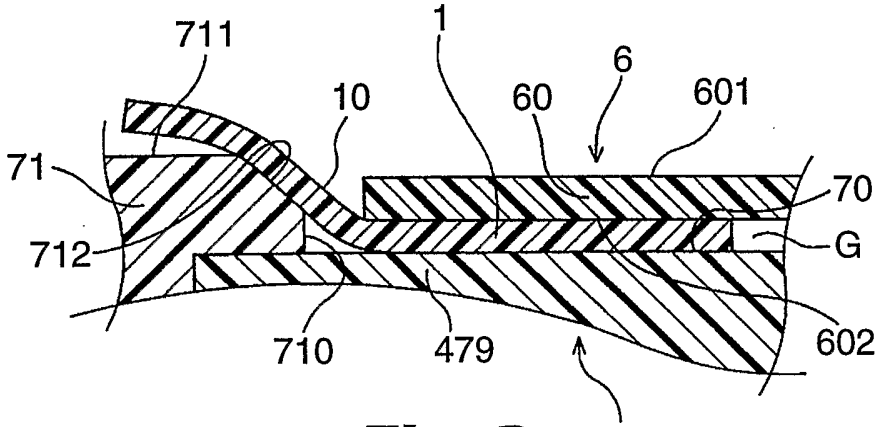

Fig. 2

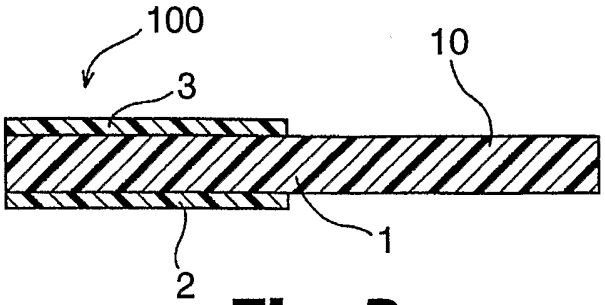

Fig. 3

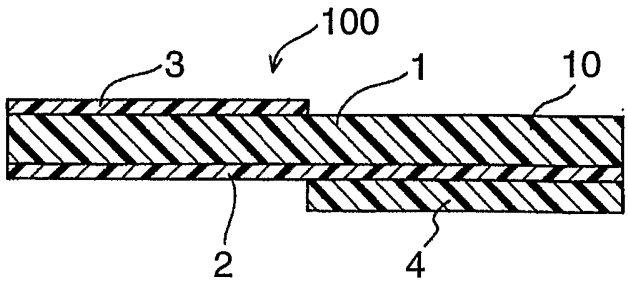

Fig. 4

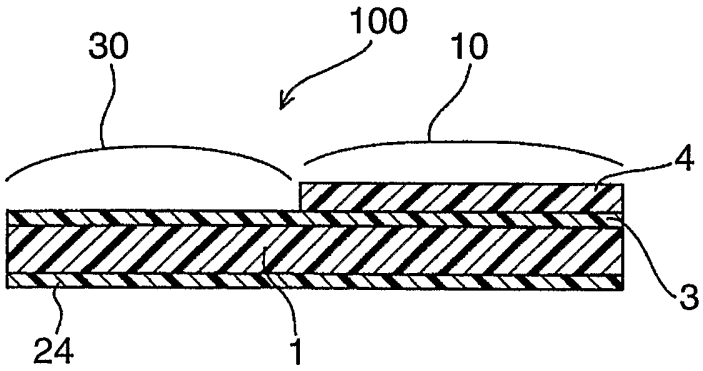

Fig. 5

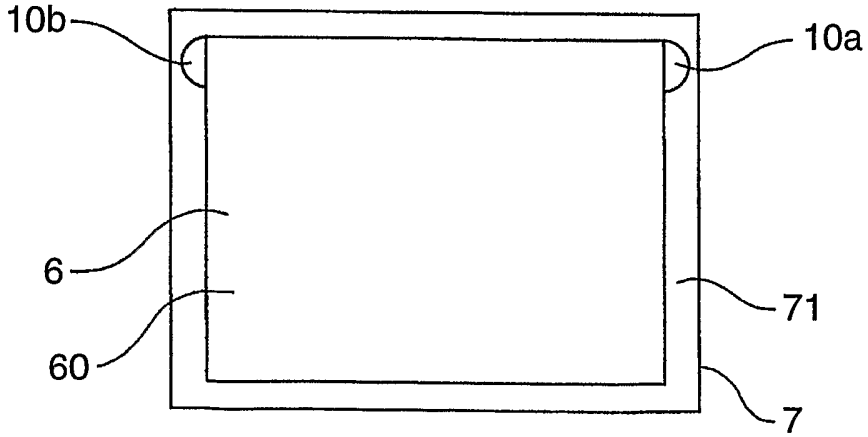

Fig. 6

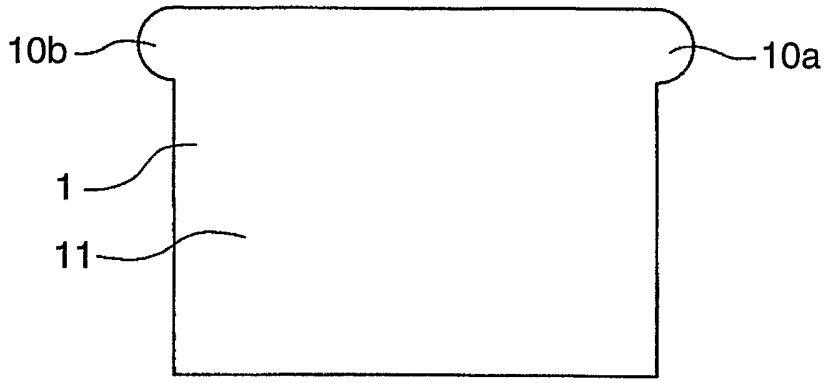

Fig. 7

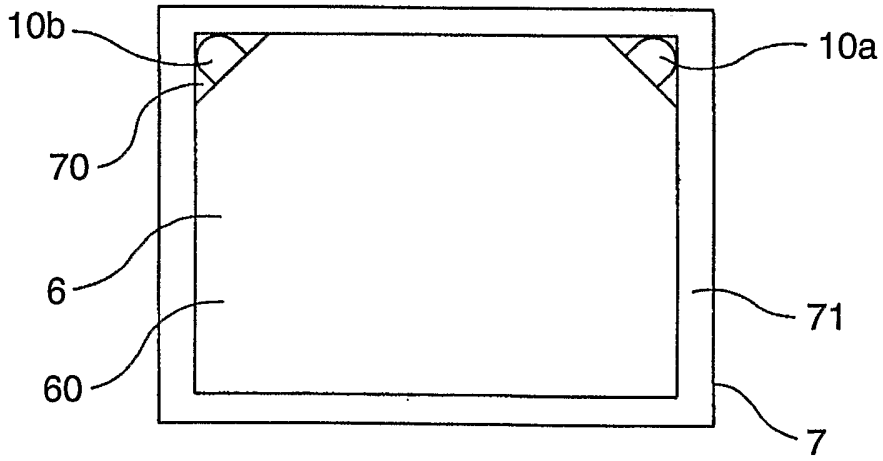

Fig. 8

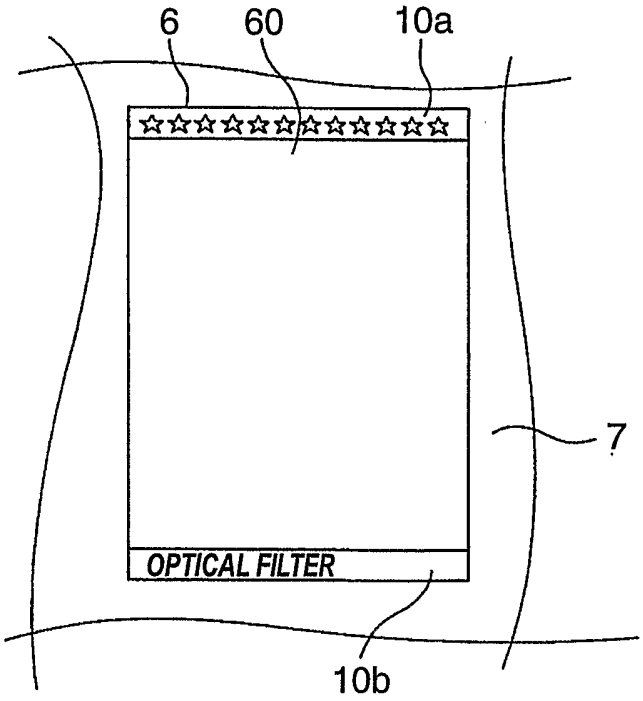

Fig. 9

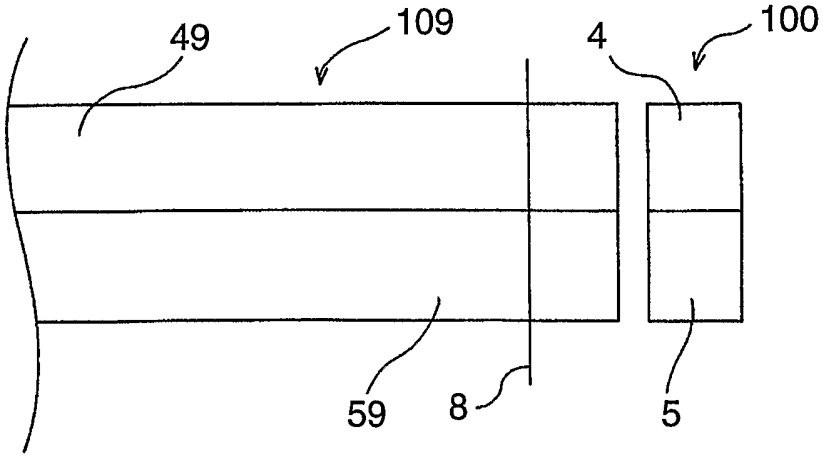

Fig. 10

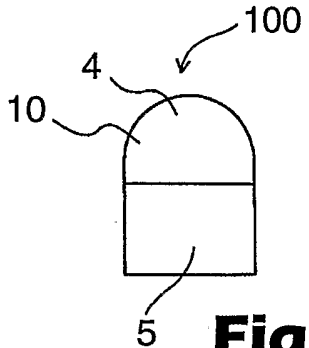

Fig. 11