Title: METHOD AND APPARATUS FOR ATTACHMENT OF BACKLIGHT FILMS TO LCD MODULES

Abstract: A method and apparatus for attachment of backlight films to an LCD module in a laminated state is disclosed. In the method, a backlight film is separated and extracted from protective films by a film feeding unit (100), and is picked up by vacuum using a vacuum pad (710) of a film attachment unit (700), and is aligned in a designated position. A mold frame (1) of the LCD module is fed to a film attachment position using a module feeding unit (500). The backlight film is, thereafter, placed and attached to the mold frame while the vacuum pad is moved in vertical and horizontal directions. The present invention improves work efficiency and reduces time consumption while producing LCD modules, thus resulting in an increase in productivity. Furthermore, the backlight films are damaged less often to reduce the production costs and allow for estimation of productivity of LCD modules.
METHOD AND APPARATUS FOR ATTACHMENT OF BACKLIGHT FILMS TO LCD MODULES

Technical Field

The present invention relates, in general, to systems for attachment of backlight films to LCD modules in which LCD panels are backlit to clearly display images produced thereon and, more particularly, to a method and apparatus for attachment of a plurality of backlight films to an LCD module for mobile phones, in which the plurality of backlight films capable of evenly transmitting the light from a light source to the entire display surface of an LCD panel is automatically and sequentially attached to the LCD module at the underside of the LCD panel.

Background Art

Generally, liquid crystal display (LCD) modules have been preferably used as display devices in mobile phones. Furthermore, to allow users of the mobile phones to clearly view images produced on the LCD modules, a light source is provided to backlight the LCD panels. In the LCD modules, to evenly transmit the light from a light source to the entire display surface of an LCD panel, a plurality of backlight films individually having a light-diffusing, light-scattering or light-shading function is provided in a laminated state in the LCD module at the underside of the LCD panel.

In a detailed description, prior to installing an LCD panel on a mold frame to produce an LCD module, a plurality of backlight films which are light-diffusing films, light-scattering films and a light-shading film capable of evenly
transmitting the light from a light source to the entire display surface of the LCD panel is sequentially attached to the mold frame.

In the related art, the above-mentioned backlight films for the LCD modules are distributed to workers with first and second protective films that cover and support upper and lower surfaces of the backlight films. In a conventional method of attachment of the backlight films to a mold frame to provide an LCD module, the first protective film is removed from the upper surface of the backlight films. Thereafter, a worker manually separates the backlight films from the second protective film, which covers and supports the lower surfaces of the backlight films, with his/her fingers one by one, and attaches the separated backlight films to the mold frame to provide a laminated structure of the backlight films on the mold frame.

However, the above-mentioned conventional film attachment method is problematic in that, due to the manual process of film separation and film attachment, work efficiency is reduced and time consumption is increased, resulting in a substantial reduction in productivity.

Furthermore, because the backlight films are highly sensitive articles, the backlight films may be seriously damaged during the manual process of film separation and film attachment, thus reducing the production yield and increasing the production costs of the LCD modules.

Description of Drawings

FIGS. 1a and 1b are a side view and a front view of an apparatus for attachment of backlight films to an LCD module according to an embodiment of the present invention,
respectively;

FIG. 2 is a block diagram of a control circuit of the film attachment apparatus according to the embodiment of the present invention;

FIG. 3 is a sectional view of a mold frame of the LCD module, with the backlight films sequentially attached to the mold frame in a laminated state;

FIG. 4 is a flowchart of a method of attachment of backlight films to an LCD module using the apparatus of FIG. 2;

FIGS. 5a to 5c are views showing the step of feeding and extracting light-diffusing films in the film attachment method of the present invention;

FIGS. 6a to 6c are views showing the step of feeding and extracting light-scattering films in the film attachment method of the present invention;

FIG. 7 is a flowchart of the process of picking up by vacuum and attaching a backlight film in the film attachment method of the present invention;

FIGS. 8a to 8c are views showing the step of feeding and picking up by vacuum a light-shading film in the film attachment method of the present invention; and

FIG. 9 is a view showing the construction of a film feeding unit constituting the film attachment apparatus according to the embodiment of the present invention.

Disclosure of Invention

Accordingly, the present invention has been made keeping in mind the above problems occurring in the prior art, and an object of the present invention is to provide a method and apparatus for attachment of backlight films to an LCD module,
in which the backlight films capable of evenly transmitting the light from a light source to the entire display surface of an LCD panel are attached to a mold frame of the LCD module through an automatic process, in place of the conventional manual process, thus improving work efficiency and reducing time consumption, thereby increasing productivity while producing LCD modules.

Another object of the present invention is to provide a method and apparatus for attachment of backlight films to an LCD module, in which, because the backlight films are attached to the mold frame of the LCD module through the automatic process, the backlight films are damaged less often to reduce the production costs and allow for estimation of productivity of LCD modules, resulting in an improvement in business efficiency.

In order to accomplish the above object(s), the present invention provides a method of attachment of a plurality of backlight films, individually having a function of diffusing, scattering or shading light, to a liquid crystal display (LCD) module in a laminated state, comprising: a first step of initializing a module feeding unit, a film feeding unit and a vacuum pad of a film attachment unit; a second step of separating and extracting a backlight film from protective films, which cover upper and lower surfaces of the backlight film, using the film feeding unit; a third step of picking up by vacuum the backlight film using the vacuum pad of the film attachment unit; a fourth step of aligning the backlight film picked up by the vacuum pad in a designated position to precisely attach the backlight film to a mold frame of the LCD module; a fifth step of feeding the mold frame to a
predetermined film attachment position using the module feeding unit; a sixth step of placing and attaching the backlight film to the mold frame while moving the vacuum pad in vertical and horizontal directions; and a seventh step of moving the mold frame with the backlight film attached thereon to a next designated stage, and repeating the process to attach another backlight film to another mold frame newly fed to the predetermined film attachment position.

The present invention further provides an apparatus for attachment of a plurality of backlight films, individually having a function of diffusing, scattering or shading light, to a liquid crystal display (LCD) module in a laminated state, comprising: a film feeding unit to rotate a film roll having a rolled base film thereon at a predetermined rotating angle, thus unwinding a predetermined length of the base film from the film roll and extracting a backlight film from the unwound base film; a module feeding unit to horizontally move a module jig with a mold frame of the LCD module seated thereon along a guide rail by predetermined distances; a film attachment unit to horizontally and vertically move a vacuum pad, which picks up by vacuum the extracted backlight film, in X-, Y-, and Z-axial directions, thus attaching the backlight film to the mold frame that has been fed to a designated film attachment position by the module feeding unit; and a controller to synchronously control the operations of the film feeding unit, the module feeding unit and the film attachment unit, and control the operation of the film attachment apparatus in response to input signals indicative of a variety of detected information.

The film attachment apparatus may further comprise a film
staying unit independently installed at a side of the film feeding unit, so that the backlight film extracted from the film feeding unit is seated on the film staying unit and waits for the vacuum pad of the film attachment unit.

5 Best Mode for Carrying Out the Invention

Reference should now be made to the drawings, in which the same reference numerals are used throughout the different drawings to designate the same or similar components.

FIGS. 1a and 1b are a side view and a front view of an apparatus for attachment of backlight films to an LCD module according to an embodiment of the present invention, respectively. FIG. 2 is a block diagram of a control circuit of the film attachment apparatus according to the embodiment of the present invention. As shown in the drawings, the film attachment apparatus of the present invention comprises a film feeding unit 100, a film staying unit 300, a module feeding unit 500, a film attachment unit 700, and a controller 900.

The film feeding unit 100 is constructed to unwind a base film 10 of a desired length from a film roll 110, on which the base film 10 is wound to form a rolled state, by rotating the film roll 110. The film feeding unit 100 also separates and extracts a plurality of backlight films, which are light-diffusing films, light-scattering films and light-shading films, from the unwound base film 10. The film staying unit 300, which is placed at a position adjacent to the film feeding unit 100, is a waiting stage on which the backlight films extracted from the base film 10 by the film feeding unit 100 wait to be picked up by the film attachment unit 700. The module feeding unit 500 comprises a module jig 520 which
supports a mold frame 1 of an LCD module thereon and intermittently moves along a guide rail 501 by predetermined distances. The film attachment unit 700 comprises a vacuum pad 710 which picks up by vacuum the backlight films from the film staying unit 300 and horizontally and vertically moves in X-, Y-, and Z-axial directions, thus sequentially attaching the backlight films to the mold frame 1 that has been fed to a designated film attachment position by the module feeding unit 500. The controller 900 comprises a control unit 910 that synchronously controls the operations of the film feeding unit 100, the module feeding unit 500 and the film attachment unit 700 according to a control program preset in memory 920 and in response to the user’s input. Furthermore, the control unit 910 controls the operation of the film attachment apparatus in response to input signals transmitted from a variety of sensors. The controller 900 further comprises an input panel 930, an alarm unit 940, and a monitor 950.

In LCD modules used as display devices in mobile phones, a plurality of backlight films that individually have a light-diffusing, light-scattering or light-shading function capable of evenly transmitting the light from a light source to the entire display surface of an LCD panel are sequentially attached to a mold frame, prior to installing the LCD panel on an upper end of the mold frame to produce an LCD module. For example, as shown in FIG. 3, a first backlight film that is a first light-diffusing film 11, a second backlight film that is a first light-scattering film 13, a third backlight film that is a second light-scattering film 15, and a fourth backlight film that is a second light-diffusing film 17 are sequentially attached to the mold frame 1. Thereafter, a fifth backlight
film 19 that is a light-shading film with an adhesive applied along the margin thereof is attached to the mold frame 1, thus fixing the plurality of backlight films to the mold frame 1.

During the process of sequentially attaching the plurality of backlight films 11, 13, 15, 17 and 19 to the mold frame 1 of the LCD module, the backlight films are fed and extracted in different manners according to the kind of backlight film.

The film feeding unit 100 and the film attachment unit 700 are provided as a set of units as shown in FIG. 1a. In a detailed description, the same number of film feeding units 100 and the same number of film attachment units 700 as the number of the backlight films to be attached to the mold frame 1 of the LCD module are installed on a working table of the film attachment apparatus.

The detailed construction of the above-mentioned film feeding unit 100, the film staying unit 300, the module feeding unit 500 and the film attachment unit 700 will be described herein below with reference to FIGS. 1a through 2.

First, the film feeding unit 100 comprises the film roll 110 on which the base film 10 is wound to form a rolled state, a first take-up roll 121 to wind the first protective film 10-1 which covers the upper surfaces of the protective films 11, 13, 15, 17 or 19, thus collecting the first protective film 10-1, and a second take-up roll 125 to wind the second protective film 10-2 which covers the lower surfaces of the protective films 11, 13, 15, 17 or 19, thus collecting the second protective film 10-2. The film feeding unit 100 further comprises a film extracting unit 130 which separates and extracts a backlight film 11, 13, 15, 17 or 19 from the first
and second protective films 10-1 and 10-2 of the base film 10 unwound from the film roll 110. The film feeding unit 100 further includes a pitch sensor 140 and a roll driving motor 120. The pitch sensor 140 is installed on an upper end of the film extracting unit 130 to detect distances that the backlight films have moved. The roll driving motor 120 controllably rotates the first and second take-up rolls 121 and 125 to unwind the base film 10 from the film roll by predetermined distances.

Furthermore, the pitch sensor 140, which is installed on the upper end of the film extracting unit 130, detects a moving pitch of the base film 10, and outputs a signal indicative of the detected moving pitch of the base film 10 to the control unit 910. Thus, the control unit 910 controls the roll driving motor 120 to cause the base film 10 to move by one pitch.

The film staying unit 300 is independently installed in front of the film extracting unit 130 of the film feeding unit 100, so that the backlight film extracted from the film feeding unit 100 is seated on the film staying unit 300 and waits for the vacuum pad 710 of the film attachment unit 700. As shown in FIG. 9, a film staying jig 310 is provided on an upper end of the film staying unit 300 to seat thereon a backlight film extracted from the film feeding unit 100. In the present invention, only the light-diffusing films and the light-scattering films are seated on the film staying unit 300 to wait for the vacuum pad 710 of the film attachment unit 700, but the light-shading film is directly picked up by the vacuum pad 710 without being seated on the film staying unit 300 to wait for the vacuum pad 710.

Particularly to extract the light-scattering films 13
and 15, the film staying jig 310 of the film staying unit 300 must be moved forwards and backwards by a forward/backward moving motor 330 to be spaced apart from the film feeding unit 100 at a predetermined interval, and must be rotated by a rotating motor 340 at a predetermined rotating angle. The above-mentioned movement and rotation of the film staying jig 310 is required for the following reasons. Because the light-scattering films 13 and 15 are positioned in the base film 10 while being tilted to one side relative to both edges of the base film 10 due to the intrinsic light-scattering angles of the films 13 and 15 as shown in FIG. 6b, the light-scattering films 13 and 15 are not placed in a straight state, but placed in a tilted state when the films 13 and 15 are extracted from the base film 10 unwound from the film roll 110. Thus, the film staying jig 310 of the film staying unit 300 is rotated to correct the tilted state of the light-scattering films 13 and 15.

Furthermore, an L-shaped aligning jig 380 is placed above the film staying unit 300 to align a backlight film, which is picked up by the vacuum pad 710 of the film attachment unit 700, in a designated position. Thus, after the vacuum pad 710 picks up by vacuum a backlight film 11, 13, 15, 17 or 19 from the film staying jig 310, the vacuum pad 710 brings a side of the backlight film into contact with the aligning jig 380 to mechanically correct the position of the backlight film.

The film attachment unit 700 comprises the vacuum pad 710 that has an air passage therein and a vacuum pickup jig 720 that is provided on a lower surface of the vacuum pad 710 to direct the air passage of the vacuum pad 710 and pick up by vacuum a backlight film. The film attachment unit 700 further
includes a horizontal actuating motor 730, a vertical actuating unit 740, and a speed control unit 750. The horizontal actuating motor 730 moves the vacuum pad 710 in horizontal directions along x- and y-axial guide frames, while the vertical actuating unit 740 moves the vacuum pad 710 in a vertical direction by a z-axial cylinder actuator. The speed control unit 750 controls a vertical moving speed of the z-axial cylinder actuator. The film attachment unit 700 further includes a vacuum unit 770 and an air supply unit 790. The vacuum unit 770 creates a vacuum state in the air passage of the vacuum pad 710, thus allowing the vacuum pad 710 to pick up by vacuum a backlight film and attach the backlight film to a mold frame 1. The air supply unit 790 supplies air to the air passage of the vacuum pad 710 to detach the backlight film from the vacuum pickup jig 720.

The vacuum unit 770 is provided in an air passage thereof with a vacuum sensor 780 to detect a pressure variation in the air passage while the vacuum pad 710 picks up by vacuum a backlight film, and output a pressure signal indicative of the detected pressure variation to the control unit 910. In response to the pressure signal output from the vacuum sensor 780, the control unit 910 determines whether or not the vacuum pad 710 has picked up by vacuum a backlight film.

The module feeding unit 500 comprises the guide rail 501, a plurality of carriages 510, the module jig 520, and a carriage actuating unit 550. The guide rail 501 is installed to correspond to the vacuum pad 710 of the film attachment unit 700, while the plurality of carriages 510 is installed along the guide rail 501 at regular intervals to intermittently move by predetermined distances in response to drive control
signals. The module jig 520 having a shape similar to the shape of a mold frame of an LCD module is installed on an upper end of each of the carriages 510 to seat the mold frame thereon, while the carriage actuating unit 550 intermittently moves the plurality of carriages 510 along the guide rail 501.

The module jig 520 and the vacuum pickup jig 720 of the film attachment unit 700 are provided as a set of jigs in which the module jig 520 and the pickup jig 720 have a positioning hole and a positioning pin, respectively. Therefore, the positioning pin of the pickup jig 720 engages with the positioning hole of the module jig 520 during a step of attaching a backlight film to a mold frame 1. Furthermore, to cause the module jig 520 to be precisely aligned with the pickup jig 720 regardless of a positional difference between them, the module jig 520 is installed on the carriage 510 so that the positioning pin may slightly move in the positioning hole of the pickup jig 720 with a predetermined gap when the positioning pin engages with the positioning hole.

The module feeding unit 500 further comprises a module sensor 530 and a proximity sensor (not shown). The module sensor 530 comprises, for example, both a light emitting diode and a light receiving transistor to sense a presence of a mold frame 1 on the module jig 520 of the carriage 510 using light beams. The proximity sensor senses a variable position of the carriage 510. Thus, when no mold frame 1 is loaded on the module jig 520, the control unit 910 stops the film attachment apparatus. Furthermore, when the carriage 510 is not placed in a designated position, the proximity sensor outputs a positional error signal to the control unit 910. In response to the positional error signal, the control unit 910
temporarily stops the operation of the film attachment apparatus and generates an alarm signal through the alarm unit 940.

FIG. 4 is a flowchart of the method of attachment of the backlight films to a mold frame of an LCD module using the apparatus of FIG. 2. The method of attachment of the plurality of backlight films to the mold frame 1 in a laminated state is executed as follows. First, all the elements of the film feeding unit 100, the module feeding unit 500, the film attachment unit 700 and the film staying unit 300 are initialized at step S10, and thereafter, the control unit 910 synchronously controls the operation of the film feeding unit 100, the module feeding unit 500 and the film attachment unit 700. In the film attachment method, the film feeding unit 100, the module feeding unit 500 and the film attachment unit 700 which have been initialized are simultaneously operated under the synchronous control of the control unit 910. However, for ease of description, the operation process of the above-mentioned units will be described as a sequential process. Furthermore, it should be understood that the sequence of the operation of the units may be changed as designed.

After initializing all the units, the control unit 910 drives the roll driving motor 120 of the film feeding unit 100 to rotate the first and second take-up rolls 121 and 125, thus mechanically separating and extracting a backlight film from the unwound base film 10 by the film extracting unit 130. In a detailed description, at step 20, the first and second take-up rolls 121 and 125 wind and collect the first and second protective films 10-1 and 10-2 respectively which cover the upper and lower surfaces of the backlight film 11, 13, 15, 17
or 19 in the base film 10, and at the same time, the film extracting unit 130 extracts the backlight film, which has a light-diffusing, light-scattering or light-shading function, from the base film 10.

Thereafter, the control unit 910 moves the vacuum pad 710 of the film attachment unit 700 in an x-, y- or z-axial direction to place the vacuum pad 710 at a position where the extracted backlight film has been placed. At this position, the vacuum pad 710 picks up by vacuum the backlight film at step S30.

To cause the backlight film to be precisely seated on the mold frame 1, the vacuum pad 710 brings a side of the backlight film into contact with the aligning jig 380, thus mechanically correcting a tilted position of the backlight film.

Thereafter, the vacuum pad 710 of the film attachment unit 700 is moved in the x-, y- or z-axial direction to be placed at the film attachment position at step S40.

In the meantime, the carriage 510 of the module feeding unit 500 with a mold frame 1 seated thereon is moved to a designated position by an operation of the carriage actuating unit 550 controlled by the control unit 910 at step S50. In the above state, when the mold frame 1 has arrived at the designated position, the control unit 910 stops the operation of the carriage actuating unit 550, thus stopping the movement of the carriage 510.

When the mold frame 1 loaded on the carriage 510 has arrived at the designated position, the film attachment unit 700 moves the backlight film from the vacuum pad 710, thus seating and attaching the backlight film to the mold frame 1 at step S60.
After the step S60 of attaching the backlight film to the mold frame 1, it is determined at step S70 whether or not the desired number of backlight films has been attached to the mold frame 1. When it is determined at step S70 that the desired number of backlight films has not been attached to the mold frame 1, the control unit 910 controls the carriage actuating unit 550 to move the mold frame 1 to a next designated stage. At the same time, the vacuum pad 710 of the film attachment unit 700 is moved to the film feeding unit 100, so that the above-mentioned steps (S20 to S60) are repeated to attach another backlight film to another mold frame 1.

When the desired number of backlight films including light-diffusing, light-scattering and light-shading films 11, 13, 15, 17 and 19 has been completely attached to the mold frame 1, an upper end of the mold frame 1 is pressed at step S80, thus fixing the backlight films to the mold frame 1. Thereafter, the mold frame 1 is unloaded from the film attachment apparatus at step S90.

The detailed processes of the film feeding and extracting step and the film picking-up and attaching step vary according to the kind of backlight film to be attached to a mold frame 1. In the case of feeding and extracting a light-diffusing film 11 or 17, the step S20 of FIG. 4 is executed through the process of FIG. 5a. As shown in FIG. 5a, after installing a roll of base film 10 on the film roll 110, the ends of the first and second protective films 10-1 and 10-2 that respectively cover the upper and lower surfaces of the light-diffusing film 11 or 17 are wound around the first and second take-up rolls 121 and 125.

Thereafter, the control unit 910 of the controller 900
operates the roll driving motor 120 of the first and second
take-up rolls 121 and 125, thus rotating the first and second
take-up rolls 121 and 125 at predetermined rotating angles at
step S20-1. Due to the rotation of the first and second take-
up rolls 121 and 125, the first and second protective films 10-
1 and 10-2 are respectively wound around the first and second
take-up rolls 121 and 125, so that the light-diffusing film 11
or 17 which was between the two protective films 10-1 and 10-2
is automatically separated from the protective films 10-1 and
10-2 at step S20-2. In the above state, the pitch sensor 140
senses a distance that the light-diffusing film 11 or 17 has
moved. When the light-diffusing film 11 or 17 has moved by one
pitch, the control unit 910 stops the operation of the roll
driving motor 120.

Because the light-diffusing film 11 or 17 is
automatically separated from the protective films 10-1 and 10-
2, the light-diffusing film 11 or 17 is automatically extracted
to the film staying unit 300 placed around the film feeding
unit 100. Thus, the extracted film 11 or 17 is seated on the
film staying jig 310 that is provided on the upper end of the
film staying unit 300, at step S20-3.

In the embodiment, a plurality of light-diffusing films
11-1 and 11-2 is arranged in the base film 10 in two lines as
shown in FIG. 5b and 5c, so that two films 11-1 and 11-2 are
extracted at the same time during the film extracting step. Of
course, the film staying jig 310 comprises a plurality of film
staying jigs to seat the extracted films thereon respectively,
so that the vacuum pad 710 of the film attachment unit 700
picks up by vacuum the films 11-1 and 11-2 one by one to attach
the films 11-1 and 11-2 to different mold frames 1.
In other words, after the films 11-1 and 11-2 are extracted at the same time, the vacuum pad 710 selects and picks up by vacuum one of the two extracted films 11-1 and 11-2 to attach the selected film to a mold frame 1 and, thereafter, executes the above-mentioned process once more to attach the remaining film to another mold frame 1. Thus, the vacuum pad 710 attaches the two extracted films 11-1 and 11-2 to two mold frames 1.

Thereafter, an extracted film sensor 320 detects at step 20-4 whether the film staying unit 300 is loaded with the light-diffusing film 11 or 17 or emptied and outputs a signal to the control unit 910. When the film 11 or 17 is loaded on the film staying unit 300, the film 11 or 17 on the film staying unit 300 waits for the vacuum pad 710 at step S20-5. However, when the film staying unit 300 is emptied, the control unit 910 operates the roll driving motor 120 to rotate the first and second take-up rolls 121 and 125 at predetermined rotating angles, thus extracting another light-diffusing film 11 or 17 to the film staying jig 310 through the above-mentioned process.

In the meantime, when a light-scattering film 13 or 15 must be fed and extracted, the step S20 of FIG. 4 is executed through the process of FIG. 6a. As shown in FIG. 6a, after installing a roll of base film 10 on the film roll 110, the ends of the first and second protective films 10-1 and 10-2 that respectively cover the upper and lower surfaces of the light-scattering film 13 or 15 are wound around the first and second take-up rolls 121 and 125.

Thereafter, the control unit 910 of the controller 900 operates the roll driving motor 120 of the first and second
take-up rolls 121 and 125, thus rotating the first and second take-up rolls 121 and 125 at predetermined rotating angles at step S20-11. Due to the rotation of the first and second take-up rolls 121 and 125, the first and second protective films 10-1 and 10-2 are respectively wound around the first and second take-up rolls 121 and 125 to be collected. Thus, the light-scattering film is automatically separated from the protective films 10-1 and 10-2 by the film extracting unit 130 at step S20-12. Because the light-scattering film is automatically separated from the protective films 10-1 and 10-2, the light-scattering film is extracted to the film staying unit 300, placed around the film feeding unit 100, and seated on the film staying jig 310 at step S20-13.

In the embodiment, a plurality of light-scattering films 13-1 and 13-2 is arranged in the base film 10 in two lines as shown in FIG. 6b and 6c, so that two films 13-1 and 13-2 are extracted at the same time during the film extracting step. Of course, the film staying jig 310 comprises a plurality of film staying jigs to seat the extracted films thereon respectively in the same manner as described above. Thus, the vacuum pad 710 of the film attachment unit 700 picks up by vacuum the films 13-1 and 13-2 one by one to attach the films 13-1 and 13-2 to different mold frames 1.

In other words, after the films 13-1 and 13-2 are extracted at the same time, the vacuum pad 710 selects and picks up by vacuum one of the two extracted films 13-1 and 13-2 to attach the selected film to a mold frame 1 and, thereafter, executes the above-mentioned process once more to attach the remaining film to another mold frame 1. Thus, the vacuum pad 710 attaches the two extracted films 13-1 and 13-2 to two mold
frames 1.

Thereafter, the control unit 910 operates the forward/backward moving motor 330 of the film staying unit 300 to move the film staying jig 310 forwards and backwards and space the jig 310 apart from the film feeding unit 100 at a predetermined interval at step S20-14. The control unit 910 also operates the rotating motor 340 to rotate the jig 310 at a predetermined rotating angle, thus aligning the light-scattering film 13 or 15 in a designated position at step S20-15. In other words, the extracted film 13 or 15 in a tilted position that is a V-shaped position is aligned in a straight position that is a 9-shaped position by rotating the film staying jig 310. Of course, the rotating angle of the film staying jig 310 may be changed according to the tilt angle of the film 13 or 15.

After the extracted light-scattering film 13 or 15 is completely aligned in the designated position as described above, the film 13 or 15 on the film staying jig 310 waits for the vacuum pad 710 of the film attachment unit 700. Thereafter, the extracted film sensor 320 detects at step 20-16 whether the film staying unit 300 is loaded with the light-scattering film 13 or 15 or emptied and outputs a signal to the control unit 910. When the film 13 or 15 is loaded on the film staying unit 300, the film 13 or 15 on the film staying unit 300 waits for the vacuum pad 710 at step S20-17. However, when the film staying unit 300 is emptied, the control unit 910 operates the roll driving motor 120 to rotate the first and second take-up rolls 121 and 125 at predetermined rotating angles, thus extracting another light-scattering film 13 or 15 to the film staying jig 310 through the above-
mentioned process.

After the light-diffusing film or the light-scattering film is extracted from the film feeding unit as described above, the steps S30, S40, S50 and S60 of picking up by vacuum and attaching the film to the mold frame are executed as follows. First, as shown in FIG. 7, the vacuum pad 710 of the film attachment unit 700 is moved from the initial position to the film staying unit 300. That is, the vacuum pad 710 is moved horizontally in the x- and y-axial directions to be placed at a position above the upper end of the film staying unit 300 at step S30-1. Thereafter, the vacuum pad 710 is moved vertically downwards in the z-axial direction to be placed on the upper end of the film staying unit 300 at step S30-2. The control unit 910 operates the vacuum unit 770 to create a vacuum in the air passage of the vacuum pad 710, thus picking up by vacuum the backlight film using the vacuum pad 710 at step S30-3.

After picking up by vacuum the backlight film using the vacuum pad 710, the vacuum sensor 780 detects whether or not the vacuum pad 710 has picked up by vacuum the backlight film. When the vacuum pad 710 has picked up by vacuum the backlight film, the control unit 910 moves the vacuum pad 910 horizontally and vertically to the module feeding unit 500. In the above state, the backlight film picked up by the vacuum pad 710 is aligned in a designated position by bringing a side of the backlight film into contact with the L-shaped aligning jig 380 placed in a predetermined position around the film staying unit 300 at step S30-4. Thus, the position of the backlight film is corrected.

Thereafter, the vacuum pad 710 of the film attachment
unit 700 is moved horizontally in the x- and y-axial directions to place the backlight film at a position above the upper end of a carriage 510 at step S40-1. When a mold frame 1 is loaded on the carriage 510, the vacuum pad 71 is moved downwards onto the upper end of the mold frame 1 to allow the vacuum pad 710 to approach the upper end of the mold frame 1 at step S40-2 until the positioning pin of the pickup jig 720 of the vacuum pad 710 engages with the positioning hole of the module jig 520 of the carriage 510. Thereafter, the control unit 910 turns the vacuum unit 770 off, and operates the air supply unit 790 to supply air to the air passage of the vacuum pad 710, thus forcibly separating the backlight film from the vacuum pad 710 and attaching the backlight film to the mold frame 1 at step S60.

In the present invention, the plurality of carriages 510 is installed along the guide rail 501 at regular intervals which are equal to the intervals of the film attachment units 700. Thus, the carriages 510 intermittently move by the same distance at the same time while passing around the front ends of the film attachment units 700. In the above state, the moving distances of the carriages 510 are precisely controlled by the carriage actuating unit 550 which is fabricated with, for example, rack and pinion. Furthermore, the proximity sensor senses the variable positions of the carriages 510. Thus, when a carriage 510 is not placed in a designated position, the proximity sensor outputs a signal so that the control unit 910 generates an alarm signal through the alarm unit 940.

When the backlight film to be fed and attached to the mold frame 1 is the light-shading film 19, the step S20 of
feeding and extracting the light-shading film 19 is executed as follows. Because the light-shading film 19 has an adhesive applied along its margin, the process of feeding and extracting the light-shading film 19 is different from the process for the light-diffusing film or the light-scattering film, as represented in FIG. 8a.

First, the control unit 910 of the controller 900 operates the roll driving motor 120 of the first and second take-up rolls 121 and 125, thus rotating the first and second take-up rolls 121 and 125 at predetermined rotating angles at step S20-21. Due to the rotation of the first and second take-up rolls 121 and 125, the first and second protective films 10-1 and 10-2 are respectively wound around the first and second take-up rolls 121 and 125. Thus, the light-shading film 19 is automatically separated from the protective films 10-1 and 10-2 by the film extracting unit 130 at step S20-22.

When the light-shading film 19 is separated from the protective films 10-1 and 10-2 as described above, the vacuum pad 710 is moved to a position above the light-shading film 19, thus picking up by vacuum the light-shading film at step S20-23. In the above state, only the central portion of the light-shading film 19, and not the margin, is picked up by the vacuum pad 710 because the margin of the light-shading film 19 has adhesive tape attached thereto.

Thereafter, the light-shading film 19 picked up by the vacuum pad 710 is aligned in a designated position at step S20-24 using the aligning jig. After the light-shading film 19 is completely aligned in the designated position, the vacuum pad 710 is moved in the manner as that described for the light-diffusing film or the light-scattering film. However, it
should be understood that a plurality of light-shading films 19 is arranged in the base film 10 in one line as shown in FIGS. 8b and 8c unlike the arrangement of the light-diffusing film or the light-scattering film.

The operation of the film attachment apparatus according to the present invention will be described in detail herein below.

In the film attachment apparatus, the guide rail 501 is arranged on the working table, with twelve carriages 510 each having a module jig 520 installed along the guide rail 501 at regular intervals.

During operation of the apparatus, in response to a signal output from the module sensor 530 which indicates that the mold frame 1 has been loaded on the module jig 520, the control unit 910 of the controller 900 may operate a stepping motor that is the carriage actuating unit 550 to actuate the carriages 510, thus moving the carriages 510 by a predetermined distance. Alternatively, the control unit 910 may operate the stepping motor until the proximity sensor (not shown) detects the next module jig 520. When the proximity sensor detects the next module jig 520, the control unit 910 stops the stepping motor. In a brief description, the control unit 910 operates the carriages 510 to move the module jigs 520 by one pitch.

Furthermore, the backlight film is fed and extracted using the film feeding unit 100 of FIG. 9. To feed and extract the backlight film, the control unit 910 outputs a film extracting signal to the roll driving motor 120 of the first and second take-up rolls 121 and 125, thus rotating the first and second take-up rolls 121 and 125. When the pitch sensor 140 detects the backlight film after the backlight film has been
moved by one pitch, the control unit 910 stops the roll driving motor 120. In the above state, the first and second protective films 10-1 and 10-2 are wound around the first and second take-up rolls 121 and 125 respectively, while the backlight film is automatically separated from the protective films 10-1 and 10-2 to be extracted to the film staying unit 300.

Thereafter, when a signal that indicates that the backlight film has been extracted to the film staying unit 300 is transmitted from the extracted film sensor 320 to the control unit 910, the control unit 910 operates the horizontal actuating motor 730 at a high speed to move the vacuum pad 710 horizontally in the x- and y-axial directions, thus moving the vacuum pad to a designated position.

When the vacuum pad 710 has reached the designated position during the horizontal movement thereof, the control unit 910 stops the horizontal actuating motor 730, but operates the vertical actuating unit 740 that is the z-axial cylinder actuator. Thus, the vacuum pad 710 is moved downwards onto the film staying unit 300. Furthermore, the vacuum unit 770 is operated to create a vacuum in the air passage of the vacuum pad 710, thus picking up by vacuum the backlight film extracted to the film staying unit 300.

In the above state, the vacuum sensor 780 detects a pressure variation higher than a predetermined reference value in the air passage of the vacuum pad 710, and outputs a pressure signal indicative of the detected pressure variation to the control unit 910. In response to the pressure signal from the vacuum sensor 780, the control unit 910 determines that the vacuum pad 710 has picked up by vacuum the backlight film. Thus, the control unit 910 moves the vacuum pad 710 to
the film attachment position. However, when such a pressure signal indicative of the pressure variation higher than the predetermined reference value is not output from the vacuum sensor 780, the control unit 910 moves the cylinder actuator upwards to execute the process of picking up by vacuum the backlight film. Of course, the number of processes to be repeated in the above state may be changed according to the control program preset in the memory 920.

When such a pressure signal indicative of the pressure variation higher than the predetermined reference value is not received from the vacuum sensor 780 after repeated attempts, the control unit 910 temporarily stops the operation of the film attachment apparatus while generating an alarm signal through the alarm unit 940 or outputting an error message through the monitor 950.

When the vacuum pad 710 has picked up by vacuum the backlight film, the control unit 710 moves the cylinder actuator upwards and moves the vacuum pad 710 to an offset position around the aligning jig 380 to align the film in a designated position. In the above state, the moving speed of the cylinder actuator is reduced, while the vacuum pad 710 brings a side of the backlight film into contact with the aligning jig 380 placed above the film staying unit 300, thus mechanically correcting the position of the backlight film.

In the above state, the control unit 910 checks the vacuum sensor 780 once more to determine whether or not the backlight film has remained on the vacuum pickup jig 720 of the vacuum pad 710 during the aligning process.

Thereafter, the control unit 910 moves the vacuum pad 710 horizontally in the x- and y-axial directions, thus moving
the vacuum pad 710 to the film attachment position.

In the present invention, the film pickup position, the film alignment position and the film attachment position are determined according to repeated experiments, and stored as data in the memory. However, the positional data may be changed according to the kind of backlight film.

After the vacuum pad 710 has been moved horizontally, the cylinder actuator is moved downwards by the vertical actuating unit 740, so that the positioning pin of the pickup jig 720 of the vacuum pad 710 precisely engages with the positioning hole of the module jig 520 of the carriage 510. In the above state, because the module jig 520 is installed on the carriage 510 so that the positioning pin may slightly move in the positioning hole of the pickup jig 720 with a predetermined gap, the module jig 520 is precisely aligned with the pickup jig 720.

After the backlight film picked up by vacuum approaches the mold frame 1, the control unit 910 turns the vacuum unit 770 off and operates the air supply unit 790 to supply air to the air passage of the vacuum pad 710. Thus, the backlight film is reliably detached from the vacuum pickup jig 720 for attachment to the mold frame 1 without remaining on the vacuum pickup jig 720 due to static electricity even after the vacuum unit 770 is turned off.

Thereafter, the control unit 910 moves the cylinder actuator of the film attachment unit 700 upwards, thus moving the vacuum pad 710 upwards to its original position. Furthermore, the module feeding unit 500 moves the carriages 510 loaded with the mold frames 1 by one pitch. For example, the mold frame 1 to which a first backlight film 11 has been completely attached is moved to a position at which a second
backlight film 13 is attached to the mold frame 1, while a new mold frame 1 is moved to the position at which another first backlight film 11 is attached to the new mold frame 1.

In the embodiment, the first and fourth backlight films 11 and 17 are light-diffusing films, the second and third backlight films 13 and 15 are light-scattering films and the fifth backlight film 19 is light-shading film. Thus, the processes of attachment of the first and fourth films 11 and 17 are the same, while the processes of attachment of the second and third films 13 and 15 are the same. However, the process of feeding and extracting the first and fourth films 11 and 17 is different from the process of feeding and extracting the second and third films 13 and 15 or the fifth film 19. The vacuum pad 710 of the film attachment unit 700 during the above-mentioned processes is operated in a similar manner.

Because the second and third backlight films 13 and 15 are the light-scattering films, the films 13 and 15 are arranged in the base film 10 in a tilted position that is a V-shaped position due to the intrinsic light-scattering angles of the films 13 and 15. Thus, the films 13 and 15 must be aligned in a straight position that is a 9-shaped position as follows before the films 13 and 15 are attached on the mold frames 1.

First, the film staying unit 300 is moved to a position close to the film feeding unit 100 so that a light-scattering film is extracted from the film feeding unit 100 onto the film staying jig 310. Thereafter, the film staying unit 300 is moved forwards and backwards by the forward/backward moving motor 330 to be spaced apart from the film feeding unit 100. Furthermore, the film staying unit 300 is rotated by the rotating motor 340 at a predetermined rotating angle, thus
aligning the light-scattering film in the designated position that is the 9-shaped position. In the present invention, the film staying unit 300 must be rotated at an angle of 360°. To allow the rotation of the film staying unit 300 at an angle of 360° while avoiding any interference between the film feeding unit 100 and the film staying unit 300, the film staying unit 300 must be spaced apart from the film feeding unit 100 by a distance longer than the radius of motion of the film staying unit 300.

In a detailed description, when the extracted film sensor 320 outputs a signal to the control unit 910, indicative of the light-scattering film having been extracted to the film staying unit 300, the film staying unit 300 is moved forwards and backwards by the forward/backward moving motor 330, thus being spaced apart from the film feeding unit 100 by a predetermined distance. Furthermore, the film staying unit 300 is rotated by the rotating motor 340 at a predetermined rotating angle, thus aligning the light-scattering film in the designated position. Thereafter, the light-scattering film on the film staying unit 300 waits for the film attachment unit 700. The process of picking up by vacuum and attaching the light-scattering film is executed in the same manner as that of the light-diffusing film.

The fifth backlight film 19 that is the light-shading film has an adhesive applied along its margin unlike the light-diffusing film or the light-scattering film. Thus, the fifth backlight film 19 cannot be extracted in the same manner as the light-diffusing film or the light-scattering film, so that the fifth backlight film 19 must be picked up by vacuum synchronously with the separation of the fifth backlight film.
19 from the protective films.

That is, the motion and speed of the film feeding unit 100 to separate and extract the light-shading film must be synchronized with the motion and speed of the vacuum pad 710 of the film attachment unit 700 to pick up by vacuum the light-shading film as follows.

First, the vacuum pad 710 is moved in the x- and y-axial directions by the horizontal actuating motor 730 to reach a position above a film pickup position.

Thereafter, the control unit 910 moves the cylinder actuator of the vacuum pad 710 downwards, thus moving the vacuum pad 710 to the film pickup position. At the same time, the vacuum unit 770 is operated to create a vacuum in the air passage of the vacuum pad 710.

The control unit 910 rotates the roll driving motor 120 of the first and second take-up rolls 121 and 125 of the film feeding unit 100, thus moving the base film 10 by one pitch and separating the light-shading film from the base film 10. At the same time, the vacuum pad 710 is moved in the same direction at the same speed as those of the base film 10, thus picking up by vacuum the separated light-shading film.

Thereafter, in response to a signal output from the vacuum sensor 780, the control unit 910 determines whether the vacuum pad 710 has picked up the light-shading film. When the vacuum pad 710 has picked up no light-shading film, the above-mentioned process is repeated to separate and pick up the light-shading film. However, when the vacuum pad 710 has picked up the light-shading film, the film is attached to the mold frame 1 by actuating the vacuum pad 710 in the same manner as that described for the light-diffusing or light-scattering
film.

When the first to fifth backlight films 11, 13, 15, 17 and 19 are completely attached to the mold frame 1, the mold frame 1 is moved by one pitch. Thereafter, the control unit 910 operates a pressing unit 800 to press the upper end of the mold frame 1, thus fixing the backlight films to the mold frame 1 so that the light-shading film is not separated from the mold frame 1. The process of attaching the backlight films to the mold frame 1 is terminated by the pressing step. The pressing unit 800 comprises an up/down cylinder press that is designed to allow a user to check the up/down motion of the pressing unit 800. The pressing unit 800 presses the light-shading film for about 1000ms. Of course, the pressing time is not limited, but may be changed as desired.

Although the preferred embodiment of the present invention has been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

**Industrial Applicability**

As described above, the present invention provides a method and apparatus for attachment of backlight films to an LCD module. In the present invention, the backlight films capable of evenly transmitting the light from a light source to the entire display surface of an LCD panel are attached to a mold frame of the LCD module through an automatic process, in place of the conventional manual process. Thus, work efficiency is improved and time consumption is reduced,
resulting in an increase in productivity while producing LCD modules.

Furthermore, because the backlight films are attached to the mold frame of the LCD module through the automatic process, the backlight films are damaged less often to reduce the production costs and allow for estimation of productivity of LCD modules, resulting in an improvement in business efficiency.
CLAIMS

1. A method of attachment of a plurality of backlight films, individually having a function of diffusing, scattering or shading light, to a liquid crystal display (LCD) module in a laminated state, comprising:
   a first step of initializing a module feeding unit, a film feeding unit and a vacuum pad of a film attachment unit;
   a second step of separating and extracting a backlight film from protective films, which cover upper and lower surfaces of the backlight film, using the film feeding unit;
   a third step of picking up by vacuum the backlight film using the vacuum pad of the film attachment unit;
   a fourth step of aligning the backlight film picked up by the vacuum pad in a designated position to precisely attach the backlight film to a mold frame of the LCD module;
   a fifth step of feeding the mold frame to a predetermined film attachment position using the module feeding unit;
   a sixth step of placing and attaching the backlight film to the mold frame while moving the vacuum pad in vertical and horizontal directions; and
   a seventh step of moving the mold frame with the backlight film attached thereon to a next designated stage, and repeating the process to attach another backlight film to another mold frame newly fed to the predetermined film attachment position.

2. The method according to claim 1, wherein the second step comprises:
rotating first and second take-up rolls at predetermined rotating angles to respectively wind the protective films that cover the upper and lower surfaces of the backlight film;

automatically separating the backlight film from the protective films according to the rotation of the first and second take-up rolls, and extracting the backlight film to a film staying unit;

detecting whether the film staying unit is loaded with the backlight film or emptied; and

extracting the other backlight film to the film staying unit by rotating the first and second take-up rolls at the predetermined rotating angles when the film staying unit is emptied.

3. The method according to claim 1, wherein the third step comprises:

horizontally moving the vacuum pad of the film attachment unit in x- and y-axial directions to place the vacuum pad at a position above an upper end of a film staying unit;

vertically moving the vacuum pad of the film attachment unit downwards in a z-axial direction to place the vacuum pad on the upper end of the film staying unit; and

creating a vacuum in the vacuum pad to pick up by vacuum the backlight film, and moving the vacuum pad with the backlight film upwards in the z-axial direction.

4. The method according to claim 1, wherein, when the backlight film picked up by the vacuum pad is aligned in the designated position during the fourth step, the backlight film
comes into contact with an aligning jig placed in a predetermined position, so that the position of the backlight film is corrected.

5. The method according to claim 1, wherein the fifth step comprises:

   horizontally moving the vacuum pad of the film attachment unit in x- and y-axial directions to place the backlight film picked up by the vacuum pad at a position above an upper end of the mold frame on the module feeding unit; and

   vertically moving the vacuum pad downwards onto the upper end of the mold frame when the mold frame is seated on an upper end of the module feeding unit.

6. The method according to claim 1, wherein the sixth step comprises:

   moving the vacuum pad of the film attachment unit to allow the vacuum pad to approach an upper end of the mold frame;

   removing the vacuum state from the vacuum pad; and

   supplying air to the vacuum pad released from the vacuum, thus separating the backlight film from the vacuum pad and seating the backlight film on the mold frame.

7. The method according to claim 1, wherein, when the extracted backlight film during the second step is a light-scattering film, the second step comprises:

   horizontally moving a film staying unit forwards and backwards;

   horizontally rotating the film staying unit at a
predetermined rotating angle to adjust an angular position of the light-scattering film to a designated position; and
waiting for the vacuum pad of the film attachment unit after the angular position of the light-scattering unit is adjusted.

8. The method according to claim 1, wherein, when the extracted backlight film during the second step is a light-shading film, the second step comprises:
simultaneously picking up by vacuum the backlight film using the vacuum pad of the film attachment unit and extracting the backlight film.

9. The method according to claim 1, wherein, when the backlight film picked up by the vacuum pad of the film attachment unit during the third step is a light-shading film, only a central portion of the light-shading film, and not a margin, is picked up by the vacuum pad because the margin of the light-shading film has double-sided adhesive tape attached thereto.

10. The method according to claim 1, wherein, when the backlight film placed and attached to the mold frame during the sixth step is a light-shading film, the method further comprises:
moving the mold frame to a next designated stage;
pressing an upper end of the mold frame using a pressing machine, thus fixing light-diffusing films, light-scattering films and the light-shading film to the mold frame; and
unloading the mold frame after the fixing of the
backlight films to the mold frame, thus ending the process of attaching the backlight films to the mold frame of the LCD module.

11. An apparatus for attachment of a plurality of backlight films, individually having a function of diffusing, scattering or shading light, to a liquid crystal display (LCD) module in a laminated state, comprising:

a film feeding unit to rotate a film roll having a rolled base film thereon at a predetermined rotating angle, thus unwinding a predetermined length of the base film from the film roll and extracting a backlight film from the unwound base film;

a module feeding unit to horizontally move a module jig with a mold frame of the LCD module seated thereon along a guide rail by predetermined distances;

a film attachment unit to horizontally and vertically move a vacuum pad, which picks up by vacuum the extracted backlight film, in X-, Y-, and Z-axial directions, thus attaching the backlight film to the mold frame that has been fed to a designated film attachment position by the module feeding unit; and

a controller to synchronously control the operations of the film feeding unit, the module feeding unit and the film attachment unit, and control the operation of the film attachment apparatus in response to input signals indicative of a variety of detected information.

12. The apparatus according to claim 11, wherein the film feeding unit and the film attachment unit are provided as a set
of units, and a plurality of sets of film feeding units and film attachment units is provided for feeding and attaching the plurality of backlight films which individually have the function of diffusing, scattering or shading light.

13. The apparatus according to claim 11, wherein the film feeding unit comprises:

   the film roll on which the base film is wound to form a rolled state;

   a first take-up roll to wind a first protective film which covers an upper surface of the protective film, thus collecting the first protective film;

   a second take-up roll to wind a second protective film which covers a lower surface of the protective film, thus collecting the second protective film;

   a film extracting unit to separate and extract the backlight film from the first and second protective films of the base film unwound from the film roll; and

   a roll driving motor to controllably rotate the first and second take-up rolls to unwind the base film from the film roll by predetermined distances.

14. The apparatus according to claim 13, further comprising:

   a pitch sensor installed on an upper end of the film extracting unit to detect moving distances that the backlight films, thus causing the backlight films to move by one pitch.

15. The apparatus according to claim 11, further comprising:
a film staying unit independently installed at a side of
the film feeding unit, so that the backlight film extracted
from the film feeding unit is seated on the film staying unit
and waits for the vacuum pad of the film attachment unit.

16. The apparatus according to claim 15, further
comprising:

a film staying jig provided on an upper end of the film
staying unit to seat thereon the backlight film extracted from
the film feeding unit.

17. The apparatus according to claim 15, wherein the film
staying unit comprises:

a forward/backward moving motor to move the film staying
unit forwards and backwards; and

a rotating motor to rotate the film staying unit at a
predetermined rotating angle.

18. The apparatus according to claim 15, further
comprising:

an aligning jig placed above the film staying unit to
align the backlight film, which is picked up by the vacuum pad
of the film attachment unit, in a designated position.

19. The apparatus according to claim 11, wherein the film
attachment unit comprises:

the vacuum pad having an air passage therein;

a vacuum pickup jig provided on a lower surface of the
vacuum pad to communicate with the air passage of the vacuum
pad and thereby pick up by vacuum the backlight film;
a horizontal actuating motor to move the vacuum pad in horizontal directions along x- and y-axial guide frames;

a vertical actuating unit to move the vacuum pad in a vertical direction by a z-axial cylinder actuator;

a speed control unit to control a vertical moving speed of the z-axial cylinder actuator;

a vacuum unit to create a vacuum state in the air passage of the vacuum pad, thus allowing the vacuum pad to pick up by vacuum the backlight film;

an air supply unit to supply air to the air passage of the vacuum pad to detach the backlight film from the vacuum pad.

20. The apparatus according to claim 11, wherein the module feeding unit comprises:

the guide rail installed to correspond to the vacuum pad of the film attachment unit;

a plurality of carriages installed along the guide rail at regular intervals to move by predetermined distances in response to drive control signals;

a carriage actuating unit to move the plurality of carriages along the guide rail by the predetermined distances; and

the module jig having a shape similar to a shape of the mold frame and installed on an upper end of each of the carriages to seat the mold frame thereon.

21. The apparatus according to claim 20, wherein the module jig and a vacuum pickup jig of the film attachment unit are provided as a set of jigs in which the module jig and the
vacuum pickup jig have a positioning hole and a positioning pin, respectively, so that the positioning pin engages with the positioning hole when the backlight film is attached to the mold frame.

22. The apparatus according to claim 21, wherein the module jig is installed to move relative to the vacuum pickup jig within a predetermined tolerance, so that the module jig is precisely aligned with the vacuum pickup jig.

23. The apparatus according to claim 11, wherein the module feeding unit further comprises a module sensor to detect whether or not the mold frame has been loaded on the module jig.
FIG. 3
FIG. 4

1. Start

S10: Initialize system

2. Extract backlight film from base film supplied from film roll

S20

3. Pick up by vacuum extracted backlight film using film attachment unit

S30

4. Feed backlight film to designated position

S40

5. Feed module to designated position

S50

6. Attach backlight film to module

S60

7. Check if backlight films completely attached?

S70

8. Yes: Press module

S80

9. No: Go back to step 2

S70

10. Unload module

S90

End
FIG. 5a

1. Film feeding process (light-diffusing film)

2. Rotate 1st and 2nd take-up rolls at predetermined rotating angels

3. Separate backlight film from base film according to rotation of the take-up rolls

4. Extract separated film to film staying unit

5. Backlight film present on film staying unit?
   - No
   - Yes
     - Waiting for vacuum pad
FIG. 6a

film feeding process
(light-scattering film)

rotate 1st and 2nd take-up rolls at predetermined rotating angels

separate backlight film from base film according to rotation of the take-up rolls

extract separated film to film staying unit

space film staying unit from film feeding unit by moving film staying unit forwards and backwards

align backlight film in precise position by rotating film staying unit

no

backlight film present on film staying unit?

yes

waiting vacuum pad

S20-11

S20-12

S20-13

S20-14

S20-15

S20-16

S20-17
FIG. 6b

FIG. 6c
FIG. 7

- **S50** feed module
- **S30-1** move vacuum pad horizontally to a position above film staying unit
- **S30-2** move vacuum pad vertically to an upper surface of backlight film
- **S30-3** pick up by vacuum backlight film
- **S30-4** align backlight film in precise position
- **S40-1** move vacuum pad horizontally and vertically to module feeding unit
- **S40-2** closely move vacuum pad to upper end of module
- **S60** attach backlight film to module
- **S31**
FIG. 8a

film feeding and picking up process (light-shading film)

rotate 1st and 2nd take-up rolls at predetermined rotating angels

S20-21

separate backlight film from base film according to rotation of the take-rolls

S20-22

pick up by vacuum separated backlight film using vacuum pad

S20-23

align backlight film in precise position

S20-24

S40
FIG. 9
INTERNATIONAL SEARCH REPORT

INTERNATIONAL APPLICATION NO.
PCT/KR2004/003453

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 G02F 1/13

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7 G02F

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

Korean Patents and applications for inventions since 1975

Korean Utility models and applications for Utility models since 1975

Japanese Utility models and applications for Utility models since 1975

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

NPS: "liquid crystal", "attach*", laminat*, stick*, bond"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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* Special categories of cited documents:
  *A* document defining the general state of the art which is not considered to be of particular relevance
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search

Date of mailing of the international search report
27 APRIL 2005 (27.04.2005)

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Facsimile No. 82-42-472-7140

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KIM Jung Hun
Telephone No. 82-42-481-5767

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