Title: APPARATUS FOR AND METHOD OF MANUFACTURING PHOTOSENSITIVE LAMINATED BODY

Abstract: A manufacturing apparatus (20) has first and second reel-out mechanisms (32a, 32b), first and second processing mechanisms (36a, 36b), first and second label bonding mechanisms (40a, 40b), first and second reservoir mechanisms (42a, 42b), first and second peeling mechanisms (44a, 44b), a substrate feed mechanism (45), an attachment mechanism (46), and a base peeling mechanism (186). A cooling mechanism (122) is disposed between the attachment mechanism (46) and the base peeling mechanism (186), for cooling an attached substrate (24a), the attached substrate (24a) being made up of a glass substrate (24) and a photosensitive web (22) attached thereto, from which a protective film (30) has been peeled off, together with a heating mechanism (182) for heating a resin layer, for example a cushion layer (27), inside the cooled attached substrate (24a) to within a predetermined temperature range, which is at or below the glass transition temperature.
European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG). For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Published:
— without international search report and to be republished upon receipt of that report
DESCRIPTION

APPARATUS FOR AND METHOD OF MANUFACTURING
PHOTOSENSITIVE LAMINATED BODY

5

Technical Field

The present invention relates to an apparatus for and a method of manufacturing a photosensitive laminated body by delivering two or more elongate photosensitive webs each comprising a photosensitive material layer and a protective film that are successively deposited on a support, peeling off the protective films to expose the photosensitive material layers, and attaching the exposed photosensitive material layers parallel to each other to substrates.

10

Background Art

Substrates for liquid crystal panels, substrates for printed wiring boards, and substrates for PDP panels, for example, have a photosensitive sheet (photosensitive web) having a photosensitive material (photosensitive resin) layer and applied to a substrate surface. The photosensitive sheet comprises a photosensitive material layer and a protective film that are successively deposited on a flexible plastic support.

15

An applying apparatus for applying such a photosensitive sheet usually operates to feed substrates such as glass substrates, resin substrates, or the like at
predetermined intervals, and peel off the protective film from the photosensitive sheet for a length corresponding to the range of the photosensitive material layer that is to be applied to each of the substrates.

According to a method of and an apparatus for applying a film as disclosed in Japanese Laid-Open Patent Publication No. 11-34280, for example, as shown in FIG. 50 of the accompanying drawings, a laminated film 1a unreeled from a film roll 1 is trained around guide rolls 2a, 2b and extends along a horizontal film feed plane. The guide roll 2b is combined with a rotary encoder 3 for outputting as many pulses as depending on the length by which the laminated film 1a is fed.

The laminated film 1a that extends along the horizontal film feed plane from the guide rolls 2a, 2b is trained around a suction roll 4. A partial cutter 5 and a cover film peeler 6 are disposed along the horizontal film feed plane between the guide roll 2b and the suction roll 4.

The partial cutter 5 has a pair of disk cutters 5a, 5b. The disk cutters 5a, 5b are movable transversely across the laminated film 1a to cut off a cover film (not shown) of the laminated film 1a together with a photosensitive resin layer (not shown) on the reverse side of the cover film.

The cover film peeler 6 presses a sticky tape 7a unreeled from a sticky tape roll 7 strongly against the cover film between presser rollers 8a, 8b, and then winds up the sticky tape 7a around a takeup roll 9. The cover film
is peeled off from the photosensitive resin layer by the sticky tape 7a, and wound together with the sticky tape 7a around the takeup roll 9.

The suction roll 4 is followed downstream by a pair of lamination rolls 12a, 12b for superposing and pressing the laminated film 1a against upper surfaces of a plurality of substrates 11 which are successively intermittently fed by a substrate feeder 10. A support film takeup roll 13 is disposed downstream of the lamination rolls 12a, 12b.

Light-transmissive support films (not shown) applied to the respective substrates 11 are peeled off and wound up by the support film takeup roll 13.

As liquid crystal panels, plasma display panels, and other panels are becoming larger in size, the sizes of substrates for use in those panels are also becoming larger in size. Larger-size substrates have transversely larger, i.e., wider, areas to which a photosensitive resin layer is to be transferred, and hence a photosensitive sheet for use therewith needs to have a larger transverse dimension, i.e., a larger width.

However, a wider photosensitive sheet in the form of a roll cannot be handled efficiently with ease, and a reel-out mechanism for unreeling the photosensitive sheet from the roll is also larger in size. The wider photosensitive sheet is heavier, is more liable to develop wrinkles therein, and is more difficult to handle.
Disclosure of Invention

A principal object of the present invention is to provide an apparatus for and a method of manufacturing a photosensitive laminated body, which is easy to handle, by reliably attaching two or more elongate photosensitive webs parallel to each other to substrates through a simple process and arrangement.

According to the present invention, there is provided an apparatus for manufacturing a photosensitive laminated body, comprising at least two web reel-out mechanisms for synchronously reeling out elongate photosensitive webs each comprising a support, a photosensitive material layer disposed on the support, and a protective film disposed on the photosensitive material layer, the protective film having a peel-off section and a residual section, at least two processing mechanisms for forming processed regions which are transversely severable in the protective films of the elongate photosensitive webs which have been reeled out by the web reel-out mechanisms, at respective boundary positions between the peel-off section and the residual section, at least two peeling mechanisms for peeling the peel-off section off from each of the elongate photosensitive webs, leaving the residual section, a substrate feed mechanism for feeding a substrate which has been heated to a predetermined temperature to an attachment position, an attachment mechanism for positioning the residual section between substrates and integrally attaching
in parallel at least two exposed areas of the photosensitive material layers from which the peel-off section has been peeled off to the substrate in the attachment position, thereby producing an attached substrate, at least two support peeling mechanisms positioned downstream from the attachment mechanism for peeling off the support from each attached substrate, a cooling mechanism positioned between the attachment mechanism and the support peeling mechanisms, for cooling the attached substrate, and a heating mechanism for heating a resin layer, which is laminated on the support, within a predetermined temperature range which is at or below the glass transition temperature.

Further, the support peeling mechanism may preferably include a tension applying structure for applying tension to the support along the attachment direction with the substrate when peeling off the support.

Furthermore, the support peeling mechanism may also preferably comprise a peeling roller for peeling the support from the substrate following an outer circumferential portion thereof, and a peeling guide member for guiding the support along an outer circumference of the peeling roller while moving between substrates.

Still further, the attachment mechanism may preferably comprise a pair of rubber rollers, which can be heated to a predetermined temperature, and a pair of backup rollers in sliding contact with the pair of rubber rollers, wherein outer circumferential surfaces of at least one of the rubber
rollers and/or at least one of the backup rollers is set with a crown shape.

Further, according to the present invention, there is provided an apparatus for manufacturing a photosensitive laminated body, comprising at least two web reel-out mechanisms for synchronously reeling out elongate photosensitive webs each comprising a support, a photosensitive material layer disposed on the support, and a protective film disposed on the photosensitive material layer, the protective film having a peel-off section and a residual section, at least two processing mechanisms for forming processed regions which are transversely severable in the protective films of the elongate photosensitive webs which have been reeled out by the web reel-out mechanisms, at respective boundary positions between the peel-off section and the residual section, at least two peeling mechanisms for peeling the peel-off section off from each of the elongate photosensitive webs, leaving the residual section, a substrate feed mechanism for feeding a substrate which has been heated to a predetermined temperature to an attachment position, an attachment mechanism for positioning the residual section between substrates and integrally attaching in parallel at least two exposed areas of the photosensitive material layers from which the peel-off section has been peeled off to the substrate while in the attachment position, thereby producing an attached substrate, and at least two support peeling mechanisms
positioned downstream from the attachment mechanism for peeling off the support from each attached substrate, wherein the processing mechanisms comprise a cutter for forming partially cut regions, which constitute the processed regions, in the elongate photosensitive webs, and a heater for heating the partially cut regions at the time of making the partial cuts to a predetermined temperature corresponding to the cutter.

According to the present invention, there is also provided a method of manufacturing a photosensitive laminated body, comprising the steps of synchronously reeling out at least two elongate photosensitive webs each comprising a support, a photosensitive material layer disposed on the support, and a protective film disposed on the photosensitive material layer, the protective film having a peel-off section and a residual section, forming processed regions which are transversely severable in the protective films of the elongate photosensitive webs which have been reeled out, at respective boundary positions between the peel-off section and the residual section, peeling the peel-off section off from each of the elongate photosensitive webs, leaving the residual section, feeding a substrate which has been heated to a predetermined temperature to an attachment position, positioning the residual section between substrates and integrally attaching in parallel at least two exposed areas of the photosensitive material layers from which the peel-off section has been
peeled off to the substrate in the attachment position, thereby producing an attached substrate, cooling the attached substrate at a position downstream from the attachment position, and heating a resin layer, which is laminated on the support, within a predetermined temperature range which is at or below the glass transition temperature.

Furthermore, the method may preferably comprise a step of peeling each support from the attached substrate for obtaining a photosensitive laminated body, after severing each elongate photosensitive web between attached substrates downstream from the attachment position, and applying tension to the support along the attachment direction thereof with the substrate when the support is peeled.

Further, the method may preferably comprise the steps of peeling the support from the substrate following an outer circumferential portion of a peeling roller, and guiding the support along an outer circumference of the peeling roller while a peeling guide member moves between substrates.

In addition, according to the present invention, there is also provided a method of manufacturing a photosensitive laminated body, comprising the steps of synchronously reeling out at least two elongate photosensitive webs each comprising a support, a photosensitive material layer disposed on the support, and a protective film disposed on the photosensitive material layer, the protective film having a peel-off section and a residual section, making partial cuts in the elongate photosensitive web while
heating partially cut regions to a predetermined temperature corresponding to a cutter, which are transversely severable in the protective films of the elongate photosensitive webs which have been reeled out, at respective boundary positions between the peel-off section and the residual section, peeling the peel-off section off from each of the elongate photosensitive webs, leaving the residual section, feeding a substrate which has been heated to a predetermined temperature to an attachment position, positioning the residual section between substrates and integrally attaching in parallel at least two exposed areas of the photosensitive material layers from which the peel-off section has been peeled off to the substrate in the attachment position, thereby producing an attached substrate, and preheating the elongate photosensitive web to a predetermined temperature at a vicinity upstream of the attachment position.

As a result of the above features, at least two photosensitive material layers that are transversely spaced from each other can be transferred effectively onto a wide substrate, and a high-quality photosensitive laminated body can efficiently be produced. Further, in the elongate photosensitive webs, residual stresses within the resin layer are reliably mitigated, and the support can be easily and favorably peeled off from the resin layer.

The above and other objects, features, and advantages of the present invention will become more apparent from the following description when taken in conjunction with the
accompanying drawings in which preferred embodiments of the present invention are shown by way of illustrative example.

Brief Description of Drawings

FIG. 1 is a schematic side elevational view of a manufacturing apparatus according to a first embodiment of the present invention;

FIG. 2 is an enlarged fragmentary cross-sectional view of an elongate photosensitive web used in the manufacturing apparatus;

FIG. 3 is a fragmentary plan view of the elongate photosensitive web with adhesive labels applied thereto;

FIG. 4 is a front elevational view of an attachment mechanism of the manufacturing apparatus;

FIG. 5 is a perspective view of a film feed roller and a nip roller group;

FIG. 6 is a fragmentary cross-sectional view of a through region of the manufacturing apparatus;

FIG. 7 is a schematic view of a portion of the manufacturing apparatus, showing an initial state thereof;

FIG. 8 is a fragmentary side elevational view showing the manner in which a protective film is peeled off from the elongate photosensitive web;

FIG. 9 is a schematic view of a portion of the manufacturing apparatus, showing the manner in which a glass substrate enters between rubber rollers;

FIG. 10 is a schematic view of a portion of the
manufacturing apparatus, showing the manner in which the rubber rollers start to rotate;

FIG. 11 is a schematic view of a portion of the manufacturing apparatus, showing its operation upon completion of a lamination process on a first glass substrate;

FIG. 12 is a schematic view of a portion of the manufacturing apparatus, showing the manner in which the rubber rollers and substrate feed rollers rotate;

FIG. 13 is a fragmentary cross-sectional view of glass substrates to which a photosensitive resin layer is transferred;

FIG. 14 is a schematic view of a portion of the manufacturing apparatus, showing the manner in which the substrate feed rollers are spaced from an end of an attached substrate;

FIG. 15 is a schematic view of a portion of the manufacturing apparatus, showing the manner in which elongate photosensitive webs are severed between attached substrates;

FIG. 16 is a schematic view of a portion of the manufacturing apparatus, showing a stopped state thereof;

FIG. 17 is a schematic view of a portion of the manufacturing apparatus, showing a finished state thereof;

FIG. 18 is a schematic view of a portion of the manufacturing apparatus, showing the manner in which the elongate photosensitive webs have their leading ends set in
position;

FIG. 19 is a plan view showing the manner in which photosensitive resin layers are advanced with respect to a glass substrate;

FIG. 20 is a plan view showing the manner in which photosensitive resin layers are stretched with respect to a glass substrate;

FIG. 21 is a plan view showing the manner in which photosensitive resin layers have their leading ends in different positions with respect to a glass substrate;

FIG. 22 is a plan view showing the manner in which photosensitive resin layers have different lengths with respect to a glass substrate;

FIG. 23 is a plan view showing the manner in which photosensitive resin layers have different lengths and have their leading ends in different positions with respect to a glass substrate;

FIG. 24 is a schematic side elevational view of a manufacturing apparatus according to a second embodiment of the present invention;

FIG. 25 is a plan view showing the manner in which photosensitive resin layers having a prescribed length are applied to a glass substrate;

FIG. 26 is a plan view showing the manner in which photosensitive resin layers longer than a prescribed length are applied to a glass substrate;

FIG. 27 is a plan view showing the manner in which
photosensitive resin layers shorter than a prescribed length are applied to a glass substrate;

FIG. 28 is a schematic side elevational view of a manufacturing apparatus according to a third embodiment of the present invention;

FIG. 29 is an enlarged cross-sectional view of a pre-peeler of the manufacturing apparatus according to the third embodiment;

FIG. 30 is an enlarged cross-sectional view showing the manner in which the pre-peeler operates;

FIG. 31 is a view illustrative of the manner in which the position of a photosensitive resin layer applied to a glass substrate is detected;

FIG. 32 is a schematic side elevational view of a manufacturing apparatus according to a fourth embodiment of the present invention;

FIG. 33 is a cross sectional view of an elongate photosensitive web used in the manufacturing apparatus;

FIG. 34 is a view showing characteristics between temperature and a tan δ;

FIG. 35 is a schematic perspective view illustrating a peeling mechanism forming a portion of the manufacturing apparatus;

FIG. 36 is a perspective view of an essential part of the peeling mechanism;

FIG. 37 is a view illustrating operation of the peeling mechanism;
FIG. 38 is a view indicating a relationship between a base film surface temperature and defects in film peeling;

FIG. 39 is a schematic perspective view of a base peeling mechanism, making up the manufacturing apparatus in accordance with a fifth embodiment of the present invention;

FIG. 40 is a schematic perspective view of a base peeling mechanism, making up the manufacturing apparatus in accordance with a sixth embodiment of the present invention;

FIG. 41 is a schematic perspective view of an automatic base peeling mechanism, making up the manufacturing apparatus in accordance with a seventh embodiment of the present invention;

FIG. 42 is a view illustrating operation of the automatic base peeling mechanism;

FIG. 43 is a view illustrating operation of the automatic base peeling mechanism;

FIG. 44 is a view illustrating operation of the automatic base peeling mechanism;

FIG. 45 is a view showing a peeling bar including a tapered portion;

FIG. 46 is a frontal view showing an attachment mechanism making up the manufacturing apparatus in accordance with an eighth embodiment of the present invention;

FIG. 47 is a view showing a crown roller, which forms a portion of the attachment mechanism;

FIG. 48 is a schematic perspective view of first and
second processing mechanisms making up the manufacturing apparatus in accordance with a ninth embodiment of the present invention;

FIG. 49 is a schematic side elevational view of the first and second processing mechanisms; and

FIG. 50 is a schematic side elevational view of a conventional film applying apparatus.

Best Mode for Carrying Out the Invention

FIG. 1 shows in schematic side elevation an apparatus 20 for manufacturing a photosensitive laminated body according to a first embodiment of the present invention. The manufacturing apparatus 20 operates to thermally transfer respective photosensitive resin layers 28 (described later) of elongate photosensitive webs 22a, 22b parallel to each other to glass substrates 24 in a process of manufacturing liquid crystal or organic EL color filters. The photosensitive webs 22a, 22b have such respective widths that the elongate photosensitive web 22a is wider than the photosensitive web 22b, for example.

FIG. 2 shows in cross section each of the photosensitive webs 22a, 22b that are employed in the manufacturing apparatus 20. Each of the photosensitive webs 22a, 22b comprises a laminated assembly of a flexible base film (support) 26, a photosensitive resin layer (photosensitive material layer) 28 disposed on the flexible base film 26, and a protective film 30 disposed on the
photosensitive resin layer 28.

As shown in FIG. 1, the manufacturing apparatus 20 has first and second reel-out mechanisms 32a, 32b for accommodating two (or more) photosensitive web rolls 23a, 23b in the form of rolled photosensitive webs 22a, 22b and synchronously reeling out the photosensitive webs 22a, 22b from the photosensitive web rolls 23a, 23b, first and second processing mechanisms 36a, 36b for forming partially cut regions (processed regions) 34 which are located at transversely severable boundary positions in protective films 30 of the photosensitive webs 22a, 22b reeled out from the photosensitive web rolls 23a, 23b, and first and second label bonding mechanisms 40a, 40b for bonding adhesive labels 38 (see FIG. 3) each having a non-adhesion area 38a to the protective films 30.

The manufacturing apparatus 20 also has, positioned downstream of the first and second label bonding mechanisms 40a, 40b, first and second reservoir mechanisms 42a, 42b for changing the feed mode of the photosensitive webs 22a, 22b from an intermittent feed mode to a continuous feed mode, first and second peeling mechanisms 44a, 44b for peeling predetermined lengths of the protective films 30 from the photosensitive webs 22a, 22b, a substrate feed mechanism 45 for feeding a glass substrate 24 which is heated to a predetermined temperature to an attachment position, and an attachment mechanism 46 for attaching the photosensitive resin layers 28 which have been exposed by peeling off the
protective films 30, integrally and parallel to each other, to the glass substrate 24.

First and second detecting mechanisms 47a, 47b for directly detecting the partially cut regions 34 at the boundary positions of the photosensitive webs 22a, 22b are disposed upstream of and closely to the attachment position in the attachment mechanism 46. An inter-substrate web cutting mechanism 48 for cutting the photosensitive webs 22a, 22b altogether between adjacent glass substrates 24 is disposed downstream of the attachment mechanism 46. A web cutting mechanism 48a that is used when the manufacturing apparatus 20 starts and finishes operating is disposed upstream of the inter-substrate web cutting mechanism 48.

Attachment bases 49 for attaching the trailing ends of photosensitive webs 22a, 22b that have essentially been used up and the leading ends of photosensitive webs 22a, 22b that are to be newly used are disposed downstream or and closely to the first and second reel-out mechanisms 32a, 32b, respectively. The attachment bases 49 are followed downstream by respective film end position detectors 51 for controlling transverse shifts of the photosensitive webs 22a, 22b due to winding irregularities of the photosensitive web rolls 23a, 23b. The film ends of the photosensitive webs 22a, 22b are positionally adjusted by transversely moving the first and second reel-out mechanisms 32a, 32b. However, the film ends of the photosensitive webs 22a, 22b may be adjusted by position adjusting mechanisms combined
with rollers. Each of the first and second reel-out mechanisms 32a, 32b may comprise a multi-shaft mechanism including two or three unreeling shafts for supporting one of the photosensitive web rolls 23a, 23b and feeding out one of the photosensitive webs 22a, 22b.

The first and second processing mechanisms 36a, 36b are disposed downstream of respective roller pairs 50 for calculating the diameters of the photosensitive web rolls 23a, 23b accommodated in the respective first and second reel-out mechanisms 32a, 32b. The first and second processing mechanisms 36a, 36b have respective single circular blades 52 which travel transversely across the photosensitive webs 22a, 22b to form partially cut regions 34 in the photosensitive webs 22a, 22b at a given position thereon.

As shown in FIG. 2, partially cut regions 34 need to be formed in and across at least the protective films 30. Actually, the circular blades 52 are set to a cutting depth large enough to cut into the photosensitive resin layer 28 or the base film 26 in order to reliably cut off the protective films 30. The circular blades 52 may be fixed against rotation and moved transversely across the photosensitive webs 22a, 22b to form partially cut regions 34, or may be rotated without slippage on the photosensitive webs 22a, 22b and moved transversely across the photosensitive webs 22a, 22b to form partially cut regions 34. The circular blades 52 may be replaced with a laser
beam or ultrasonic cutter, a knife blade, or a pushing blade (Thomson blade), for example.

Each of the first and second processing mechanisms 36a, 36b may comprise two processing mechanisms disposed at a predetermined interval in the direction indicated by the arrow A in which the photosensitive webs 22a, 22b are fed, for simultaneously forming two partially cut regions 34 with a residual section 30b interposed therebetween.

Two closely spaced partially cut regions 34 formed in the protective film 30 serve to set a spaced interval between two adjacent glass substrates 24. For example, these partially cut regions 34 are formed in the protective film 30 at positions that are 10 mm spaced inwardly from respective edges of the glass substrates 24. The section of the protective film 30 which is interposed between the partially cut regions 34 and exposed between the glass substrates 24 functions as a mask when the photosensitive resin layer 28 is applied as a frame to the glass substrate 24 in the attachment mechanism 46 to be described later.

The first and second label bonding mechanisms 40a, 40b supply adhesive labels 38 for interconnecting a front peel-off section 30aa and a rear peel-off section 30ab in order to leave a residual section 30b of the protective film 30 between glass substrates 24. As shown in FIG. 2, the front peel-off section 30aa which is to be peeled off initially and the rear peel-off section 30ab which is to be peeled off subsequently are positioned on respective both sides of the
residual section 30b.

As shown in FIG. 3, each of the adhesive labels 38 is of a rectangular strip shape and is made of the same material as the protective film 30. Each of the adhesive labels 38 has a non-adhesion (or slightly adhesive) area 38a positioned centrally which is free of an adhesive, and a first adhesion area 38b and a second adhesion area 38c which are disposed respectively on the longitudinally opposite ends of the reverse side (adhesion side) of the non-adhesion area 38a, i.e., on the longitudinally opposite end portions of the adhesive label 38, the first adhesion area 38b and the second adhesion area 38c being bonded respectively to the front peel-off section 30aa and the rear peel-off section 30ab.

As shown in FIG. 1, each of the first and second label bonding mechanisms 40a, 40b has suction pads 54a through 54e for applying a maximum of five adhesive labels 38 at predetermined intervals. Support bases 56 that are vertically movable for holding the photosensitive webs 22a, 22b, respectively, from below are disposed in respective positions where adhesive labels 38 are applied to the photosensitive webs 22a, 22b by the suction pads 54a through 54e.

The first and second reservoir mechanisms 42a, 42b have respective dancer rollers 60 which are rotatable and swingable for absorbing a speed difference between the intermittent feed mode in which the photosensitive webs 22a,
22b are fed upstream of the first and second reservoir mechanisms 42a, 42b and the continuous feed mode in which the photosensitive webs 22a, 22b are fed downstream of the first and second reservoir mechanisms 42a, 42b. The second reservoir mechanism 42b also has a dancer roller 61 for equalizing feed path lengths for the photosensitive webs 22a, 22b to travel from the first and second reel-out mechanisms 32a, 32b to the attachment mechanism 46.

The first and second peeling mechanisms 44a, 44b, which are disposed downstream of the respective first and second reservoir mechanisms 42a, 42b, have respective suction drums 62 for blocking variations of the tension to which the supplied photosensitive webs 22a, 22b are subjected for thereby stabilizing the tension of the photosensitive webs 22a, 22b when they are subsequently laminated. The first and second peeling mechanisms 44a, 44b also have respective peeling rollers 63 disposed closely to the suction drums 62. The protective films 30 that are peeled off from the photosensitive webs 22a, 22b at a sharp peel-off angle are wound, except residual sections 30b, by respective protective film takeup units 64.

First and second tension control mechanisms 66a, 66b for imparting tension to the photosensitive webs 22a, 22b are disposed downstream of the first and second peeling mechanisms 44a, 44b, respectively. The first and second tension control mechanisms 66a, 66b have respective cylinders 68 that are actuatable to angularly displace
respective tension dancers 70 to adjust the tension of the photosensitive webs 22a, 22b with which the tension dancers 70 are held in rolling contact. The first and second tension control mechanisms 66a, 66b may be employed only when necessary, and may be dispensed with.

The first and second detecting mechanisms 47a, 47b have respective photoelectric sensors 72a, 72b such as laser sensors, photosensors, or the like for directly detecting changes in the photosensitive webs 22a, 22b due to wedge-shaped grooves in the partially cut regions 34, steps produced by different thicknesses of the protective films 30, or a combination thereof. Detected signals from the photoelectric sensors 72a, 72b are used as boundary position signals representative of the boundary positions in the protective films 30. The photoelectric sensors 72a, 72b are disposed in confronting relation to respective backup rollers 73a, 73b. Alternatively, non-contact displacement gauges or image inspecting means such as CCD cameras or the like may be employed instead of the photoelectric sensors 72a, 72b.

The positional data of the partially cut regions 34 which are detected by the first and second detecting mechanisms 47a, 47b can be statistically processed and converted into graphic data in real time. When the positional data detected by the first and second detecting mechanisms 47a, 47b show an undue variation or bias, the manufacturing apparatus 20 may generate a warning.
The manufacturing apparatus 20 may employ a different system for generating boundary position signals. According to such a different system, the partially cut regions 34 are not directly detected, but marks are applied to the photosensitive webs 22a, 22b. For example, holes or recesses may be formed in the photosensitive webs 22a, 22b near the partially cut regions 34 in the vicinity of the first and second processing mechanisms 36a, 36b, or the photosensitive webs 22a, 22b may be slit by a laser beam or an aqua jet or may be marked by an ink jet or a printer. The marks on the photosensitive webs 22a, 22b are detected, and detected signals are used as boundary position signals.

The substrate feed mechanism 45 has a plurality of substrate heating units (e.g., heaters) 74 disposed for sandwiching and heating glass substrates 24, and a feeder 76 for feeding glass substrates 24 in the direction indicated by the arrow C. The temperatures of the glass substrates 24 in the substrate heating units 74 are monitored at all times. When the monitored temperature of a glass substrate 24 becomes abnormal, the feeder 76 is inactivated and a warning is issued, and abnormality information is sent to reject and discharge the abnormal glass substrate 24 in a subsequent process, and is also used for quality control and production management. The feeder 76 has an air-floated plate (not shown) for floating and feeding glass substrates 24 in the direction indicated by the arrow C. Instead, the feeder 76 may comprise a roller conveyor for feeding glass
substrates 24.

The temperatures of the glass substrates 24 should preferably be measured in the substrate heating units 74 or immediately prior to the attachment position according to a contact process (using a thermocouple, for example) or a non-contact process.

A substrate storage frame 71 for storing a plurality of glass substrates 24 is disposed upstream of the substrate heating unit 74. The glass substrates 24 stored in the substrate storage frame 71 are attracted one by one by a suction pad 79 on a hand 75a of a robot 75, taken out from the substrate storage frame 71, and inserted into the substrate heating units 74.

Downstream of the substrate heating units 74, there are disposed a stopper 77 for abutting against the leading end of a glass substrate 24 and holding the glass substrate 24, and a position sensor 78 for detecting the position of the leading end of the glass substrate 24. The position sensor 78 detects the position of the leading end of the glass substrate 24 on its way toward the attachment position. After the position sensor 78 has detected the position of the leading end of the glass substrate 24, the glass substrate 24 is fed a predetermined distance and is positioned between rubber rollers 80a, 80b of the attachment mechanism 46. Preferably, a plurality of position sensors 78 are disposed at predetermined intervals along the feed path for monitoring the times at which a glass substrate 24
reaches the respective positions of the position sensors 78, thereby to check a delay due to a slippage or the like of the glass substrate 24 when the glass substrate 24 starts to be fed. In FIG. 1, glass substrates 24 are heated by the substrate heating units while the glass substrates 24 are being fed. However, glass substrates 24 may be heated in a batch-heating oven and fed by a robot.

The attachment mechanism 46 has a pair of vertically spaced laminating rubber rollers 80a, 80b that can be heated to a predetermined temperature. The attachment mechanism 46 also has a pair of backup rollers 82a, 82b held in rolling contact with the rubber rollers 80a, 80b, respectively. The backup roller 82b is pressed against the rubber roller 80b by pressing cylinders 84a, 84b of a roller clamp unit 83.

As shown in FIG. 4, the roller clamp unit 83 has a drive motor 93 having a drive shaft coupled to a speed reducer 93a which has a drive shaft 93b coaxially connected to a ball screw 94. A nut 95 is threaded over the ball screw 94 and fixed to a slide base 96. Tapered cams 97a, 97b are fixedly mounted on respective opposite ends of the slide base 96 in the transverse direction of the photosensitive webs 22a, 22b, which is indicated by the arrow B. The tapered cams 97a, 97b are progressively higher in the direction indicated by the arrow B1. Rollers 98a, 98b are placed on the respective tapered cams 97a, 97b and held on the respective lower ends of pressing cylinders 84a, 84b.
As shown in FIG. 1, a contact prevention roller 86 is movably disposed near the rubber roller 80a for preventing the photosensitive webs 22a, 22b from contacting the rubber roller 80a. A preheating unit 87 for preheating the photosensitive webs 22a, 22b to a predetermined temperature is disposed upstream of and closely to the attachment mechanism 46. The preheating unit 87 comprises an infrared bar heater or a heat applying means.

Glass substrates 24 are fed from the attachment mechanism 46 through the inter-substrate web cutting mechanism 48 along a feed path 88 which extends in the direction indicated by the arrow C. The feed path 88 comprises an array of rollers including film feed rollers 90a, 90b and substrate feed rollers 92 with the web cutting mechanism 48a interposed therebetween. The distance between the rubber rollers 80a, 80b and the substrate feed rollers 92 is equal to or less than the length of one glass substrate 24.

As shown in FIG. 5, the film feed rollers 90a, 90b are elongate transversely across the photosensitive webs 22a, 22b which are fed parallel to each other from the attachment mechanism 46. The film feed rollers 90a, 90b are driven to rotate independently of each other. The film feed rollers 90a, 90b are associated with respective nip roller groups 89a, 89b.

The nip roller group 89a comprises a plurality of, e.g., five, nip rollers 91a that are disposed at
predetermined intervals along the film feed roller 90a, i.e., in the direction indicated by the arrow D. The nip rollers 91a are individually movable toward and away from the film feed roller 90a by respective cylinders 99a.

Similarly, the nip roller group 89b comprises a plurality of, e.g., five, nip rollers 91b that are disposed at predetermined intervals along the film feed roller 90b, i.e., in the direction indicated by the arrow D. The nip rollers 91b are individually movable toward and away from the film feed roller 90b by respective cylinders 99b.

In the manufacturing apparatus 20, the first and second reel-out mechanisms 32a, 32b, the first and second processing mechanisms 36a, 36b, the first and second label bonding mechanisms 40a, 40b, the first and second reservoir mechanisms 42a, 42b, the first and second peeling mechanisms 44a, 44b, the first and second tension control mechanisms 66a, 66b, and the first and second detecting mechanisms 47a, 47b are disposed above the attachment mechanism 46. Conversely, the first and second reel-out mechanisms 32a, 32b, the first and second processing mechanisms 36a, 36b, the first and second label bonding mechanisms 40a, 40b, the first and second reservoir mechanisms 42a, 42b, the first and second peeling mechanisms 44a, 44b, the first and second tension control mechanisms 66a, 66b, and the first and second detecting mechanisms 47a, 47b may be disposed below the attachment mechanism 46, so that the photosensitive webs 22a, 22b may be rendered upside down such that the
photosensitive resin layer 28 is attached to the lower surfaces of glass substrates 24. Alternatively, all the mechanisms of the manufacturing apparatus 20 may be linearly arrayed.

As shown in FIG. 1, the manufacturing apparatus 20 is controlled in its entirety by a lamination process controller 100. The manufacturing apparatus 20 also has a lamination controller 102, a substrate heating controller 104, etc. for controlling the different functional components of the manufacturing apparatus 20. These controllers are interconnected by an in-process network. The lamination process controller 100 is connected to the network of a factory which incorporates the manufacturing apparatus 20, and performs information processing for production, e.g., production management and mechanism operation management, based on instruction information (condition settings and production information) from a factory CPU (not shown).

The substrate heating controller 104 controls the substrate heating units 74 to receive glass substrates 24 from an upstream process and heat the received glass substrates 24 to a desired temperature, controls the feeder 76 to feed the heated glass substrates 24 to the attachment mechanism 46, and also controls the handling of information about the glass substrates 24.

The lamination controller 102 serves as process master for controlling the functional components of the
manufacturing apparatus 20. The lamination controller 102 operates as a control mechanism for controlling relative positions of the boundary positions and the glass substrate 24 and relative positions of the boundary positions themselves in the attachment position based on the positional information, detected by the first and second detecting mechanisms 47a, 47b, of the partially cut regions 34 of the photosensitive webs 22a, 22b.

The installation space of the manufacturing apparatus 20 is divided into a first clean room 112a and a second clean room 112b by a partition wall 110. The first clean room 112a houses therein the first and second reel-out mechanisms 32a, 32b, the first and second processing mechanisms 36a, 36b, the first and second label bonding mechanisms 40a, 40b, the first and second reservoir mechanisms 42a, 42b, the first and second peeling mechanisms 44a, 44b, and the first and second tension control mechanisms 66a, 66b. The second clean room 112b houses therein the first and second detecting mechanisms 47a, 47b and the other components following the first and second detecting mechanisms 47a, 47b. The first clean room 112a and the second clean room 112b are connected to each other by a through region 114.

As shown in FIG. 6, the through region 114 has a deduster 115 disposed in the first clean room 112a and an air sealer 116 disposed in the second clean room 112b.

The deduster 115 has a pair of suction nozzles 117a
disposed in confronting relation to respective opposite surfaces of the photosensitive webs 22a, 22b, and a pair of ejection nozzles 118 disposed respectively in the suction nozzles 117a. The ejection nozzles 118 eject air to the photosensitive webs 22a, 22b to remove dust particles from the photosensitive webs 22a, 22b, and the suction nozzles 117a draw the ejected air and the removed dust particles. Preferably, the air from the ejection nozzles 118 may be electric neutralizing (or antistatic) air.

The air sealer 116 has a pair of suction nozzles 117b disposed in confronting relation to respective opposite surfaces of the photosensitive webs 22a, 22b. The suction nozzles 117b draw air to seal the through region 114. The deduster 115 and the air sealer 116 may be switched around in position, or a plurality of dedusters 115 and a plurality of air sealers 116 may be combined with each other. Only the suction nozzle 117a, but not the ejection nozzle 118, may be disposed in confronting relation to the side of the photosensitive webs 22a, 22b where the photosensitive resin layers 28 are exposed.

In the manufacturing apparatus 20, the partition wall 110 prevents heated air from the attachment mechanism 46 from thermally affecting the photosensitive webs 22a, 22b, i.e., from wrinkling, deforming, thermally shrinking, or stretching the photosensitive webs 22a, 22b. The partition wall 110 separates an upper area of the manufacturing apparatus 20, i.e., the first clean room 112a, where dust
particles are liable to occur and fall, from a lower area of the manufacturing apparatus 20, i.e., the second clean room 112b, thereby keeping the attachment mechanism 46 in particular clean. It is desirable to keep the pressure in the second clean room 112b higher than the pressure in the first clean room 112a, thereby preventing dust particles from flowing from the first clean room 112a into the second clean room 112b.

An air supply (not shown) for supplying a downward flow of clean air is disposed in an upper portion of the second clean room 112b.

Operation of the manufacturing apparatus 20 for carrying out a manufacturing method according to the present invention will be described below.

Initially for positioning the leading ends of the photosensitive webs 22a, 22b in place, the photosensitive webs 22a, 22b are unreeled from the respective photosensitive web rolls 23a, 23b accommodated in the first and second reel-out mechanisms 32a, 32b. The photosensitive webs 22a, 22b are delivered through the first and second processing mechanisms 36a, 36b, the first and second label bonding mechanisms 40a, 40b, the first and second reservoir mechanisms 42a, 42b, the first and second peeling mechanisms 44a, 44b, and the attachment mechanism 46 to the film feed rollers 90a, 90b.

As shown in FIG. 5, of the nip roller group 89a, three nip rollers 91a which are positioned over the wider
photosensitive web 22a (closer to the viewer) are displaced toward the film feed roller 90a by the respective cylinders 99a until the wider photosensitive web 22a is sandwiched between the three nip rollers 91a and the film feed roller 90a.

Of the nip roller group 89b, two nip rollers 91b which are positioned over the narrower photosensitive web 22b (remoter from the viewer) are displaced toward the film feed roller 90b by the respective cylinders 99b until the narrower photosensitive web 22b is sandwiched between the two nip rollers 91b and the film feed roller 90b.

The remaining two nip rollers 91a (remoter from the viewer) of the nip roller group 89a are spaced away from the film feed roller 90a, and the remaining three nip rollers 91b (closer to the viewer) of the nip roller group 89b are spaced away from the film feed roller 90b.

When a partially cut region 34 of the photosensitive web 22a is detected by the photoelectric sensor 72a of the first detecting mechanism 47a, the film feed roller 90a is rotated based on a detected signal from the photoelectric sensor 72a. The photosensitive web 22a is now fed a predetermined distance to the attachment position by the film feed roller 90a and the three nip rollers 91a which sandwich the photosensitive web 22a therebetween.

When a partially cut region 34 of the photosensitive web 22b is detected by the photoelectric sensor 72b of the second detecting mechanism 47b, the film feed roller 90b is
rotated based on a detected signal from the photoelectric sensor 72b. The photosensitive web 22b is now fed a predetermined distance to the attachment position by the film feed roller 90b and the two nip rollers 91b which sandwich the photosensitive web 22b therebetween. The partially cut regions 34 of the photosensitive webs 22a, 22b are now positioned in the attachment position. The partially cut regions 34 of the photosensitive webs 22a, 22b may be detected downstream of the attachment position, and the photosensitive webs 22a, 22b may be stopped at a given position.

After the photosensitive webs 22a, 22b have been fed the predetermined distance, as shown in FIG. 7, the contact prevention roller 86 is lowered to prevent the photosensitive webs 22a, 22b from contacting the rubber roller 80a. A glass substrate 24 is waiting immediately prior to the attachment position. The photosensitive webs 22a, 22b are now in an initial state of the manufacturing apparatus 20.

Operation of the functional components of the manufacturing apparatus 20 in a lamination mode will be described below.

As shown in FIG. 1, in the first and second processing mechanisms 36a, 36b, the circular blades 52 move transversely across the photosensitive webs 22a, 22b to cut into the protective films 30, the photosensitive resin layers 28, and the base films 26, thereby forming partially
cut regions 34 (see FIG. 2). Then, the photosensitive webs 22a, 22b are fed again a distance corresponding to the dimension of the residual sections 30b of the protective films 30 in the direction indicated by the arrow A (see FIG. 1), and then stopped, whereupon other partially cut regions 34 are formed therein by the circular blades 52. As shown in FIG. 2, a front peel-off section 30aa and a rear peel-off section 30ab are now provided in each of the photosensitive webs 22a, 22b, with the residual section 30b interposed therebetween.

Then, the photosensitive webs 22a, 22b are fed to the first and second label bonding mechanisms 40a, 40b to place respective predetermined bonding areas of the protective films 30 on the support bases 56. In the first and second label bonding mechanisms 40a, 40b, a predetermined number of adhesive labels 38 are attracted under suction and held by the suction pads 54b through 54e and are securely bonded to the front peel-off section 30aa and the rear peel-off section 30ab of the protective film 30 across the residual section 30b thereof (see FIG. 3).

The photosensitive webs 22a, 22b with the five adhesive labels 38 bonded thereto, for example, are isolated by the first and second reservoir mechanisms 42a, 42b from variations of the tension to which the supplied photosensitive webs 22a, 22b are subjected, and then continuously fed to the first and second peeling mechanisms 44a, 44b. In the first and second peeling mechanisms 44a,
44b, as shown in FIG. 8, the base films 26 of the photosensitive webs 22a, 22b are attracted to the suction drum 62, and the protective films 30 are peeled off from the photosensitive webs 22a, 22b, leaving the residual sections 30b. The protective films 30 are peeled off at a sharp peel-off angle and wound by the protective film takeup units 64 (see FIG. 1). Preferably, electric neutralizing air may be blown on the peeled portions.

At this time, inasmuch as the photosensitive webs 22a, 22b are firmly held by the suction drum 62, shocks produced when the protective films 30 are peeled off from the photosensitive webs 22a, 22b are not transferred to the photosensitive webs 22a, 22b downstream of the suction drum 62. Consequently, such shocks are not transferred to the attachment mechanism 46, and hence laminated sections of glass substrates 24 are effectively prevented from developing a striped defective region.

After the protective films 30 have been peeled off from the base films 26, leaving the residual sections 30b, by the first and second peeling mechanisms 44a, 44b, the photosensitive webs 22a, 22b are adjusted in tension by the first and second tension control mechanisms 66a, 66b, and then partially cut regions 34 of the photosensitive webs 22a, 22b are detected by the photoelectric sensors 72a, 72b of the first and second detecting mechanisms 47a, 47b.

Based on detected information of the partially cut regions 34, the film feed rollers 90a, 90b are rotated to
feed the photosensitive webs 22a, 22b a predetermined length to the attachment mechanism 46. At this time, the contact prevention roller 86 is waiting above the photosensitive webs 22a, 22b and the rubber roller 80b is disposed below the photosensitive webs 22a, 22b.

As shown in FIG. 9, the first glass substrate 24 which is preheated is fed to the attachment position by the substrate feed mechanism 45. The glass substrate 24 is tentatively positioned between the rubber rollers 80a, 80b in alignment with the attached photosensitive resin layers 28 of the photosensitive webs 22a, 22b which lie parallel to each other.

Then, as shown in FIG. 4, the ball screw 94 is rotated in a certain direction by the speed reducer 93a coupled to the drive motor 93, moving the slide base 96 in the direction indicated by the arrow B2 in unison with the nut 95 threaded over the ball screw 94. Therefore, the tapered cams 97a, 97b have their cam surfaces in contact with the rollers 98a, 98b raised, displacing the rollers 98a, 98b upwardly. The pressing cylinders 84a, 84b are elevated, lifting the backup roller 82b and the rubber roller 80b to sandwich the glass substrate 24 under a predetermined pressing pressure between the rubber rollers 80a, 80b. At this time, the pressing pressure is adjusted by the pressure of air supplied to the pressing cylinders 84a, 84b. The rubber roller 80a is rotated to transfer, i.e., laminate, the parallel photosensitive resin layers 28, which are
melted with heat, to the glass substrate 24.

The photosensitive resin layers 28 are laminated onto the glass substrate 24 under such conditions that the photosensitive resin layers 28 are fed at a speed in the range from 1.0 m/min. to 10 m/min., the rubber rollers 80a, 80b have a temperature ranging from 100°C to 150°C, and a hardness ranging from 40 to 90, and apply a pressure (linear pressure) ranging from 50 N/cm to 400 N/cm.

As shown in FIG. 10, when the leading end of the glass substrate 24 reaches a position near the film feed rollers 90a, 90b, the nip rollers 91a, 91b are moved away from the film feed rollers 90a, 90b. When the leading ends of the photosensitive webs 22a, 22b which project forwardly of the glass substrate 24 in the direction indicated by the arrow C reach a predetermined position with respect to the web cutting mechanism 48a, the web cutting mechanism 48a is actuated to cut off the leading ends of the photosensitive webs 22a, 22b, as indicated by the broken lines in FIG. 10. The web cutting mechanism 48a returns to its standby position except for the time of cutting off the leading ends of the photosensitive webs 22a, 22b, the time of operation termination, and the time of cutting off the photosensitive webs 22a, 22b in case of trouble. The web cutting mechanism 48a will not be used while the manufacturing apparatus 20 is in normal operation.

As shown in FIG. 11, when the photosensitive webs 22a, 22b have been laminated onto the glass substrate 24 up to
its trailing end by the rubber rollers 80a, 80b, the rubber roller 80a is stopped against rotation, and the glass substrate 24 with the laminated photosensitive webs 22a, 22b (also referred to as "attached substrate 24a") is clamped by the substrate feed rollers 92.

The rubber roller 80b is retracted away from the rubber roller 80a, unclamping the attached substrate 24a. Specifically, as shown in FIG. 4, the speed reducer 93a coupled to the drive motor 93 is reversed, causing the ball screw 94 and the nut 95 to move the slide base 96 in the direction indicated by the arrow B1. Therefore, the tapered cams 97a, 97b have their cam surfaces in contact with the rollers 98a, 98b lowered, displacing the pressing cylinders 84a, 84b downwardly. The backup roller 82b and the rubber roller 80b are lowered, unclamping the attached substrate 24a.

The substrate feed rollers 92 then start rotating to feed the attached substrate 24a a predetermined distance in the direction indicated by the arrow C. The position of the photosensitive webs 22a, 22b which is to be brought between two adjacent glass substrates 24 is now displaced to a position beneath the rubber roller 80a. A next glass substrate 24 is fed toward the attachment position by the substrate feed mechanism 45. When the leading end of the next glass substrate 24 is positioned between the rubber rollers 80a, 80b, the rubber roller 80b is lifted, clamping the next glass substrate 24 and the photosensitive webs 22a,
22b between the rubber rollers 80a, 80b. The rubber rollers 80a, 80b and the substrate feed roller 92 are rotated to start laminating the photosensitive webs 22a, 22b onto the glass substrate 24 and feed an attached substrate 24a in the direction indicated by the arrow C (see FIG. 12).

At this time, as shown in FIG. 13, the attached substrate 24a has opposite ends covered with respective residual sections 30b. Therefore, when the photosensitive resin layers 28 are transferred to the glass substrate 24, the rubber rollers 80a, 80b are not smeared by the photosensitive resin layers 28.

As shown in FIG. 14, when the trailing end of the first attached substrate 24a reaches the substrate feed rollers 92, the upper one of the substrate feed rollers 92 is lifted to unclamp the first attached substrate 24a, and the lower one of the substrate feed rollers 92 and the other rollers of the feed path 88 are continuously rotated to feed the attached substrate 24a. When the trailing end of the next, i.e., second, attached substrate 24a reaches a position near the rubber rollers 80a, 80b, the rubber rollers 80a, 80b and the substrate feed rollers 92 are stopped against rotation. The upper one of the substrate feed rollers 92 is lowered to clamp the second attached substrate 24a, and the rubber roller 80b is lowered to unclamp the second attached substrate 24a. Then, the substrate feed rollers 92 are rotated to feed the second attached substrate 24a. The position of the photosensitive webs 22a, 22b which is to be
brought between two adjacent glass substrates 24 is now displaced to the position beneath the rubber roller 80a, and the photosensitive webs 22a, 22b are repeatedly laminated onto a third glass substrate 24.

As shown in FIG. 15, when the position between two adjacent attached substrates 24a reaches a position corresponding to the inter-substrate web cutting mechanism 48, the inter-substrate web cutting mechanism 48 severs the two photosensitive webs 22a, 22b together between the attached substrates 24a while moving in the direction indicated by the arrow C at the same speed as the attached substrates 24a. Thereafter, the inter-substrate web cutting mechanism 48 returns to a standby position, and the base films 26 and the residual sections 30b are peeled off from the leading attached substrate 24a, thereby manufacturing a photosensitive laminated body 106 (see FIG. 1).

When the laminating process is temporarily stopped, as shown in FIG. 16, the nip roller groups 89a, 89b and the rubber roller 80b are brought into unclamping positions, and the contact prevention roller 86 is lowered to prevent the two photosensitive webs 22a, 22b from contacting the rubber roller 80a.

When the manufacturing apparatus 20 is to be shut off, the substrate feed rollers 92 are rotated to feed the attached substrate 24a in the direction indicated by the arrow C, and the film feed roller 90 clamps the photosensitive webs 22a, 22b. While the film feed rollers
90a, 90b in rotation are clamping the photosensitive webs 22a, 22b, the web cutting mechanism 48a travels transversely across the photosensitive webs 22a, 22b, cutting off the photosensitive webs 22a, 22b.

Consequently, as shown in FIG. 17, the two photosensitive webs 22a, 22b pass between the rubber rollers 80a, 80b and are sandwiched by the film feed rollers 90a, 90b, and are supported away from the rubber roller 80a by the contact prevention roller 86 which is lowered. The web cutting mechanism 48a has been placed in its standby position.

When the inter-substrate web cutting mechanism 48 and the web cutting mechanism 48a cut off the photosensitive webs 22a, 22b, they move in synchronism with the photosensitive webs 22a, 22b in the direction indicated by the arrow C. However, the inter-substrate web cutting mechanism 48 and the web cutting mechanism 48a may move only transversely across the photosensitive webs 22a, 22b to cut off the photosensitive webs 22a, 22b. The photosensitive webs 22a, 22b may be cut off by a Thomson blade while they are held at rest, or may be cut off by a rotary blade while they are in motion.

When the manufacturing apparatus 20 operates in its initial state, as shown in FIG. 18, the contact prevention roller 86 is disposed in the lower position and the rubber roller 80b is spaced away from the rubber roller 80a. Then, the film feed roller 90a is rotated to discharge the
photosensitive webs 22a, 22b into a web disposal container (not shown). At this time, the photosensitive webs 22a, 22b are severed into a certain length by the web cutting mechanism 48a.

When the first and second detecting mechanisms 47a, 47b detect partially cut regions 34 of the photosensitive webs 22a, 22b, the photosensitive webs 22a, 22b are fed a predetermined length from the detected position. Specifically, when the contact prevention roller 86 is elevated, the photosensitive webs 22a, 22b are fed until the partially cut regions 34 reach a position where the photosensitive webs 22a, 22b are to be laminated by the rubber rollers 80a, 80b. The leading ends of the photosensitive webs 22a, 22b are now positioned in place.

In the first embodiment, the partially cut regions 34 of the photosensitive webs 22a, 22b are directly detected by the respective first and second detecting mechanisms 47a, 47b upwardly of and closely to the attachment mechanism 46. The distance from the first and second detecting mechanisms 47a, 47b to the position where the partially cut regions 34 are stopped by the rubber rollers 80a, 80b needs to be smaller than the shortest length of the photosensitive webs 22a, 22b to be laminated. This is because the information of the detected partially cut regions 34 is used for a next laminating process through feedback.

The first and second detecting mechanisms 47a, 47b perform two measuring processes as described below.
According to the first measuring process, the rubber rollers 80a, 80b clamp the glass substrate 24, and the number of pulses generated by an encoder combined with a drive motor (not shown) for rotating the rubber rollers 80a, 80b, as representing the distance by which the glass substrate 24 is fed from the start of rotation of the rubber rollers 80a, 80b, is compared with the preset numbers of pulses generated when the respective partially cut regions 34 are to be detected by the first and second detecting mechanisms 47a, 47b, thereby measuring displacements of the partially cut regions 34. If the partially cut region 34 of each of the photosensitive webs 22a, 22b is detected before the preset number of pulses is reached, then the partially cut region 34 is judged as being displaced forwardly of a predetermined position on the glass substrate 24 by a distance indicated by the difference between the numbers of pulses. Conversely, if the partially cut region 34 of each of the photosensitive webs 22a, 22b is detected after the preset number of pulses is reached, then the partially cut region 34 is judged as being displaced rearwardly of a predetermined position on the glass substrate 24.

According to the second measuring process, the number of pulses generated by an encoder combined with a drive motor (not shown) for rotating the rubber rollers 80a, 80b is measured from the detection of a partially cut region 34 to the detection of a next partially cut region 34, thereby measuring the laminated length of each of the photosensitive
webs 22a, 22b. The preset number of pulses corresponding to the laminated length under normal conditions of each of the photosensitive webs 22a, 22b is compared with the actually measured number of pulses. If the actually measured number of pulses is greater than the preset number of pulses, then the photosensitive webs 22a, 22b are judged as being stretched due to heat or the like by a distance indicated by the difference between the numbers of pulses. If the actually measured number of pulses is smaller than the preset number of pulses, then the photosensitive webs 22a, 22b are judged as being short.

If the leading ends of the photosensitive resin layers 28 are detected as being displaced (advanced) equal distances or substantially equal distances with respect to an attached range P1 - P2 of the glass substrate 24 according to the first measuring process, as shown in FIG. 19, then the relative positions of the glass substrate 24 and the partially cut regions 34 of the photosensitive webs 22a, 22b are adjusted.

Specifically, if the partially cut regions 34 detected by the photoelectric sensors 72a, 72b are detected as being advanced from a predetermined position, then as shown in FIG. 11, the substrate feed rollers 92 feed unattached portions of the photosensitive webs 22a, 22b after being laminated by a distance represented by the difference between the preset distance and the advanced distance. As a result, the partially cut regions 34 are positionally
adjusted and placed in a predetermined position between the rubber rollers 80a, 80b. Thereafter, the glass substrate 24 is delivered under normal delivery control between the rubber rollers 80a, 80b, and the photosensitive resin layers 28 are attached at a normal position to the glass substrate 24, i.e., in the attached range P1 - P2 of the glass substrate 24.

If the partially cut regions 34 detected by the photoelectric sensors 72a, 72b are detected as being delayed from the attached range P1 - P2 of the glass substrate 24, then the substrate feed rollers 92 feed unattached portions of the photosensitive webs 22a, 22b after being laminated by a distance represented by the sum of the preset distance and the delayed distance. As a result, the partially cut regions 34 are positionally adjusted and placed in a predetermined position between the rubber rollers 80a, 80b. Thereafter, the glass substrate 24 is delivered under normal delivery control between the rubber rollers 80a, 80b, and the photosensitive resin layers 28 are attached at a normal position to the glass substrate 24, i.e., in the attached range P1 - P2 of the glass substrate 24.

Rather than adjusting the distance that the attached substrate 24a is fed by the substrate feed rollers 92, the substrate feed mechanism 45 may be controlled to adjust the position at which the glass substrate 24 is to be stopped, by the advanced or delayed distance.

The distances between the partially cut regions 34
detected by the photoelectric sensors 72a, 72b, i.e., the lengths H of the photosensitive resin layers 28 to be attached to the glass substrate 24, are measured according to the second measuring process. If the lengths H are greater than the attached range P1 - P2 by equal lengths or substantially equal lengths (see FIG. 20), then the positions of the partially cut regions 34 are changed by the first and second processing mechanisms 36a, 36b so that the distances between the partially cut regions 34, i.e., the lengths H, are reduced by the differences. If the lengths H are smaller than the attached range P1 - P2, then the positions of the partially cut regions 34 are changed by the first and second processing mechanisms 36a, 36b so that the distances between the partially cut regions 34, i.e., the lengths H, are increased by the differences. In this manner, the attached lengths of the photosensitive resin layers 28 are adjusted to a predetermined length.

It is also possible to change the amount of stretch of the photosensitive webs 22a, 22b by adjusting the tension of the photosensitive webs 22a, 22b with the tension dancers 70 of the first and second tension control mechanisms 66a, 66b.

If the leading ends of the photosensitive resin layers 28 of the photosensitive webs 22a, 22b are judged as being displaced from the attached range P1 - P2 of the glass substrate 24 according to the first measuring process, as shown in FIG. 21, then the glass substrate 24 is unclamped from the rubber rollers 80a, 80b immediately after the
photosensitive webs 22a, 22b have been laminated onto the
glass substrate 24, and then the substrate feed rollers 92
feed the attached substrate 24a to feed the photosensitive
webs 22a, 22b to a position where the photosensitive webs
22a, 22b can be cut off. After the photosensitive webs 22a,
22b are cut off, the photosensitive webs 22a, 22b are
positioned using the respective film feed rollers 90a, 90b.

The photosensitive resin layers 28 to be attached to
the glass substrate 24 may be adjusted in position by
positionally adjusting one or both of the partially cut
regions 34 of the photosensitive webs 22a, 22b. At this
time, the relative positions of the glass substrate 24 and
the photosensitive resin layers 28 may be set to position
the attached range P1 - P2 in alignment with the
intermediate position of the displacement of the
photosensitive resin layers 28 in the direction indicated by
the arrow C until the displacement is corrected. The
relative positions may be set by adjusting the feed by the
substrate feed rollers 92 of the unattached portion of the
photosensitive web 22a or 22b after being laminated or by
adjusting the stopped position of the glass substrate 24
under the control of the substrate feed mechanism 45.

If the length of the photosensitive resin layer 28 of
the photosensitive web 22a and the length of the
photosensitive resin layer 28 of the photosensitive web 22b
are judged as being different from each other according to
the second measuring process, as shown in FIG. 22, then the
position of one or both of the partially cut regions 34 of the photosensitive webs 22a, 22b may be adjusted. Alternatively, rather than adjusting the position of one or both of the partially cut regions 34, the tension of the photosensitive webs 22a, 22b may be adjusted by the first and second tension control mechanisms 66a, 66b.

If the lengths and positions of the leading ends of the photosensitive resin layers 28 are judged as being different from each other according to the first and second measuring processes, as shown in FIG. 23, then the attached substrate 24a is unclamped from the rubber rollers 80a, 80b immediately after the photosensitive webs 22a, 22b have been laminated, and thereafter fed to a position where the photosensitive webs 22a, 22b can be cut off. After the photosensitive webs 22a, 22b have been cut off, the photosensitive webs 22a, 22b are positionally aligned by the film feed rollers 90a, 90b. The lengths of the photosensitive resin layers 28 may also be equalized by adjusting the position of one or both of the partially cut regions 34 of the photosensitive webs 22a, 22b or by adjusting the tension of the photosensitive webs 22a, 22b with the first and second tension control mechanisms 66a, 66b.

The transverse positions of the photosensitive webs 22a, 22b can be controlled by the film end position detectors 51 and film end position adjusting mechanisms (not shown). The transverse position of the glass substrate 24
can be corrected by a transverse position adjusting mechanism (not shown) which is disposed immediately before the attachment position.

Consequently, the partially cut regions 34 of the photosensitive webs 22a, 22b can be positioned highly accurately with respect to the attachment position, allowing the photosensitive resin layers 28 of the photosensitive webs 22a, 22b to be attached parallel to each other accurately in a desired area of the glass substrate 24. It is thus possible to efficiently manufacture a high-quality photosensitive laminated body 106 through a simple process and arrangement.

According to the first embodiment, since two photosensitive resin layers 28 that are transversely spaced from each other can well be transferred onto the wide glass substrate 24, the photosensitive webs 22a, 22b do not need to be wide per se. Therefore, the photosensitive webs 22a, 22b can be handled with increased ease, so that the overall manufacturing process can be performed efficiently and the expenses of the manufacturing facility can be reduced easily.

The first embodiment of FIG. 1 is constructed such that respective resin layers 28 of two photosensitive webs 22a, 22b are integrally attached to the glass substrate 24, however, the invention is not necessarily limited to this structure. For example, respective resin layers from three or four different photosensitive webs may be integrally
attached to the glass substrate.

FIG. 24 schematically shows in side elevation a manufacturing apparatus 120 according to a second embodiment of the present invention. Those parts of the manufacturing apparatus 120 according to the second embodiment which are identical to those of the manufacturing apparatus 20 according to the first embodiment are denoted by identical reference characters, and will not be described in detail below.

As shown in FIG. 24, the manufacturing apparatus 120 has first and second detecting mechanisms 121a, 121b, a cooling mechanism 122 disposed downstream of the inter-substrate web cutting mechanism 48, and a base peeling mechanism 124 disposed downstream of the cooling mechanism 122. The first and second detecting mechanisms 121a, 121b have photoelectric sensors 123a, 123b and photoelectric sensors 123c, 123d, respectively, which are spaced from each other by a predetermined distance L and disposed in confronting relation to backup rollers 73a, 73c and backup rollers 73b, 73d, respectively.

The cooling mechanism 122 supplies cold air to an attached substrate 24a to cool the attached substrate 24a after the photosensitive webs 22a, 22b are cut off between the attached substrate 24a and a following attached substrate 24a by the inter-substrate web cutting mechanism 48. Specifically, the cooling mechanism 122 supplies cold air having a temperature of 10°C at a rate ranging from 1.0
to 2.0 m/min.

The base peeling mechanism 124 disposed downstream of the cooling mechanism 122 has a plurality of suction pads 126 for attracting the lower surface of an attached substrate 24a. While the attached substrate 24a is being attracted under suction by the suction pads 126, the base films 26 and the residual sections 30b are peeled off from the attached substrate 24a by a robot hand 128. Electric neutralizing blowers (not shown) for ejecting ion air to four sides of the laminated area of the attached substrate 24a are disposed upstream, downstream, and laterally of the suction pads 126. The base films 26 and the residual sections 30b may be peeled off from the attached substrate 24a while a table for supporting the attached substrate 24a thereon is being oriented vertically, obliquely, or turned upside down for dust removal.

The base peeling mechanism 124 is followed downstream by a photosensitive laminated body storage frame 132 for storing a plurality of photosensitive laminated bodies 106. A photosensitive laminated body 106 that is produced when the base films 26 and the residual sections 30b are peeled off from the attached substrate 24a by the base peeling mechanism 124 is attracted by suction pads 136 on a hand 134a of a robot 134, taken out from the base peeling mechanism 124, and placed into the photosensitive laminated body storage frame 132.

To the lamination process controller 100, there are
connected the lamination controller 102, the substrate heating controller 104, and also a base peeling controller 138. The base peeling controller 138 controls the base peeling mechanism 124 to peel off the base film 26 from the attached substrate 24a that is supplied from the attachment mechanism 46, and also to discharge the photosensitive laminated body 106 to a downstream process. The base peeling controller 138 also handles information about the attached substrate 24a and the photosensitive laminated body 106.

In the first and second detecting mechanisms 121a, 121b according to the second embodiment, the photoelectric sensors 123a, 123c which are positioned upstream of the photoelectric sensors 123b, 123d first detect the partially cut regions 34 of the photosensitive webs 22a, 22b. Thereafter, the downstream photoelectric sensors 123b, 123d detect the partially cut regions 34 of the photosensitive webs 22a, 22b. The distance L between the backup rollers 73a, 73c and the backup rollers 73b, 73d corresponds to the length of each of the photosensitive resin layers 28 applied to the glass substrate 24.

The actual applied lengths of the photosensitive resin layers 28 can accurately be calculated from the difference between the time when the upstream photoelectric sensors 123a, 123c detect the partially cut regions 34 of the photosensitive webs 22a, 22b and the time when the downstream photoelectric sensors 123b, 123d detect the same
partially cut regions 34 of the photosensitive webs 22a, 22b. Based on the calculated actual applied lengths of the photosensitive resin layers 28, the speeds at which the photosensitive webs 22a, 22b are fed are adjusted to apply the photosensitive resin layers 28 centrally to the glass substrate 24.

According to the second embodiment, therefore, the distance between the partially cut regions 34 of the photosensitive webs 22a, 22b, i.e., the length \( H \) of each of the photosensitive resin layers 28 applied to the glass substrate 24, is accurately detected to apply the photosensitive resin layers 28 centrally to the glass substrate 24 (see FIG. 25).

If the length \( H_1 \) of each of the photosensitive resin layers 28 which is detected by the first and second detecting mechanisms 121a, 121b is larger than the normal length \( H \), as shown in FIG. 26, then the photosensitive resin layers 28 are applied centrally to the glass substrate 24 such that the opposite ends of the photosensitive resin layers 28 are spaced equal distances outwardly from the ends of the applied length \( L \).

If the length \( H_2 \) of each of the photosensitive resin layers 28 which is detected by the first and second detecting mechanisms 121a, 121b is smaller than the normal length \( H \), as shown in FIG. 27, then the photosensitive resin layers 28 are applied centrally to the glass substrate 24 such that the opposite ends of the photosensitive resin
layers 28 are spaced equal distances inwardly from the ends of the applied length L. In this case, a target displacement of the applied position of the photosensitive resin layers 28 is about one-half the displacement that occurs if the opposite ends of the photosensitive resin layers 28 are not spaced equal distances inwardly from the ends of the applied length L.

According to the second embodiment, furthermore, the partially cut regions 34 are formed in the photosensitive webs 22a, 22b unreeled from the first and second reel-out mechanisms 32a, 32b, and then the protective films 30 are peeled off, leaving the residual sections 30b, after which the photosensitive webs 22a, 22b are laminated onto the glass substrate 24 to transfer the photosensitive resin layers 28, and then the base films 26 and the residual sections 30b are peeled off by the base peeling mechanism 124, thereby manufacturing the photosensitive laminated body 106. The photosensitive laminated body 106 can be manufactured easily automatically.

FIG. 28 schematically shows in side elevation a manufacturing apparatus 140 according to a third embodiment of the present invention. Those parts of the manufacturing apparatus 140 according to the third embodiment which are identical to those of the manufacturing apparatus 20 according to the first embodiment are denoted by identical reference characters, and will not be described in detail below.
The manufacturing apparatus 140 includes the inter-substrate web cutting mechanism 48 which is usually not used except for cutting off the photosensitive webs 22a, 22b in case of trouble and separating the photosensitive webs 22a, 22b to discharge defective sections. The manufacturing apparatus 140 has a cooling mechanism 122 and an automatic base peeling mechanism 142 which are disposed downstream of the web cutting mechanism 48a. The automatic base peeling mechanism 142 serves to continuously peel off elongate base films 26 by which glass substrates 24 spaced at given intervals are attached together. The automatic base peeling mechanism 142 has a pre-peeler 144, a peeling roller 146 having a relatively small diameter, a takeup roll 148, and an automatic attaching unit 150. The takeup roll 148 performs torque control during operation thereof, for applying tension to the base film 26. For example, it is preferable that a tension feedback control be performed in accordance with a tension detecting device (not illustrated) which is disposed in the peeling roller 146.

As shown in FIGS. 29 and 30, the pre-peeler 144 has a pair of nip roller assemblies 152, 154 and a peeling bar 156. The nip roller assemblies 152, 154 are movable toward and away from each other in the direction in which glass substrates 24 are fed. The nip roller assemblies 152, 154 have vertically movable upper rollers 152a, 154a and lower rollers 152b, 154b. When the upper rollers 152a, 154a are lowered, the upper rollers 152a, 154a and the lower rollers
152b, 154b grip glass substrates 24 therebetween. The peeling bar 156 is vertically movable between adjacent glass substrates 24. The upper rollers 152a, 154a may be replaced with presser bars or presser pins.

The photosensitive webs 22a, 22b are reheated to a temperature in the range from 30°C to 120°C by the peeling roller 146 or at a position immediately before the peeling roller 146. When the photosensitive webs 22a, 22b are thus reheated, color material layers are prevented from being peeled off therefrom when the base films 26 are peeled off, so that a high-quality laminated surface can be produced on the glass substrates 24.

The automatic base peeling mechanism 142 is followed downstream by a measuring unit 158 for measuring the area of a photosensitive resin layer 28 that is actually attached to a glass substrate 24. The measuring unit 158 has a plurality of spaced cameras 160 each comprising a CCD or the like. As shown in FIG. 31, the measuring unit 158 has four cameras 160, for example, for capturing the images of four corners K1 through K4 of a glass substrate 24 to which a photosensitive resin layer 28 is attached. Alternatively, the measuring unit 158 may have at least two cameras for capturing the images of each of longitudinal and transverse sides of a glass substrate 24, rather than the four corners K1 through K4 thereof.

The measuring unit 158 may comprise color sensors or laser sensors for detecting end faces of a glass substrate
24 or may comprise a combination of LED sensors, photodiode sensors, or line sensors for detecting end faces of a glass substrate 24. At least two of these sensors should desirably be employed to capture the image of each of the end faces for detecting the linearity of each of the end faces.

Surface inspection units (not shown) may be employed to detect surface defects of photosensitive laminated bodies 106, such as surface irregularities caused by the photosensitive webs 22a, 22b themselves, laminated film density irregularities caused by the manufacturing facility, wrinkles, striped patterns, dust particles, and other foreign matter. When such a surface defect is detected, the manufacturing apparatus 140 issues an alarm, ejects defective products, and manages subsequent processes based on the detected surface defect.

According to the third embodiment, the attached substrate 24a to which the photosensitive webs 22a, 22b are laminated is cooled by the cooling mechanism 122 and then delivered to the pre-peeler 144. In the pre-peeler 144, the nip roller assemblies 152, 154 grip the trailing and leading ends of two adjacent glass substrates 24, and the nip roller assembly 152 moves in the direction indicated by the arrow C at the same speed as the glass substrates 24, with the nip roller assembly 154 being decelerated in its travel in the direction indicated by the arrow C.

Consequently, as shown in FIG. 30, the photosensitive
webs 22a, 22b between the glass substrates 24 are flexed between the nip roller assemblies 152, 154. Then, the peeling bar 156 is lifted to push the photosensitive webs 22a, 22b upwardly, peeling the projecting films 30 off from the trailing and leading ends of the two adjacent glass substrates 24.

In the automatic base peeling mechanism 142, the takeup roll 148 is rotated to continuously wind the base films 26 from the attached substrate 24a. After the photosensitive webs 22a, 22b are cut off in case of trouble and separated to discharge defective sections, leading ends of the base films 26 on an attached substrate 24a to which the photosensitive webs 22a, 22b start being laminated and the trailing ends of the base films 26 wound on the takeup roll 148 are automatically attached to each other by the automatic attaching unit 150.

The glass substrate 24 from which the base films 26 are peeled off is placed in an inspecting station combined with the measuring unit 158. In the inspecting station, the glass substrate 24 is fixed in place, and the four cameras 160 capture the images of the glass substrate 24 and the photosensitive resin layer 28. The captured images are processed to determine applied positions a through d.

In the inspecting station, the glass substrate 24 may be fed along without being stopped, and transverse ends of the glass substrate 24 may be detected by cameras or image scanning, and longitudinal ends thereof may be detected by
timing sensors. Then, the glass substrate 24 may be measured based on the detected data produced by the cameras or image scanning and the sensors.

According to the third embodiment, after the photosensitive webs 22a, 22b have been laminated onto glass substrates 24, the photosensitive webs 22a, 22b between two adjacent attached substrates 24a are not cut off. Rather, while the attached substrates 24a are being pressed by the peeling roller 146, the base films 26 are continuously peeled off from the attached substrates 24a and wound around the takeup roll 148 which is in rotation.

According to the third embodiment, the same advantages as those of the second embodiment are achieved, e.g., the photosensitive laminated body 106 can be manufactured automatically and efficiently. Furthermore, the manufacturing apparatus 140 is simple in structure. In the second and third embodiments, the two photosensitive web rolls 23a, 23b are employed. However, the manufacturing apparatus according to the second and third embodiments may employ three or more photosensitive web rolls.

FIG. 32 is a schematic side elevational view of a manufacturing apparatus 180 according to a fourth embodiment of the present invention.

As shown in FIG. 33, the photosensitive web 22 that is used in the manufacturing apparatus is a laminate made up from a base film 26, a cushion layer (thermoplastic resin layer) 27, an intermediate layer (oxygen barrier film) 29, a
photosensitive resin layer 28, and a protective film 30.

The base film 26 is formed from polyethylene-telephthalate (PET), the cushion layer 27 is formed from an ethylene and oxidized-vinyl copolymer, the intermediate layer 29 is formed from polyvinyl alcohol, the photosensitive resin layer 28 is formed from a color photosensitive resin composition containing an alkaline soluble binder, a monomer, a photo-polymerizing initiator, and a coloring agent, and the protective film 30 is formed from polypropylene.

The manufacturing apparatus 180 comprises, at a position downstream from the inter-substrate web cutting mechanism 48, a cooling mechanism 122 for cooling an attached substrate 24a, i.e., a glass substrate 24 and the photosensitive web 22 attached thereto, from which the protective film 30 has been peeled off, a heating mechanism 182 for heating the resin layers, e.g., the cushion layer 27, inside of the aforementioned cooled attached substrate 24a, to within a predetermined temperature range (stated below), which is at or below the glass transition temperature (Tg), and a base peeling mechanism 186 for peeling the base film 26 away from the aforementioned attached substrate 24a, which is supported under suction by a plurality of suction pads 184, thereby producing the photosensitive laminated body 106.

The cooling mechanism 122 performs a cooling process by supplying a chilled air stream toward the attached substrate
24a. More specifically, such cooling is performed by setting a cooling temperature of 10°C and a wind or air stream speed of 0.5 to 2.0 m/min. The heating mechanism 182 is equipped with a heating roller 188 arranged on the base film 26 side of the attached substrate 24a, and a receiving roller 190 arranged on the glass substrate 24 side opposite from the heating roller 188.

The heating roller 188 conducts internal and external heating in accordance with an electromagnetic induction heating method, and through direct contact with the base film 26 heats the cushion layer 27 from the base film 26 side. Instead of electromagnetic induction heating, a heating method using a sheathed heater, or a heated water (liquid) heating method may also be employed. Further, the heating roller 188 may be constructed from a rubber roller, a metal roller, a fabric wound roller, or a resin roller, or the like, while in addition, multiple rollers may be disposed along the direction of the arrow C.

It is unnecessary for the receiving roller 190 to be heated, and if deemed necessary, the receiving roller 190 may be constructed as a cooling roller having a cooling liquid circulated therein.

The heating roller 188 heats the cushion layer 27 to within a preset temperature range, which is at or below the glass transition temperature. In this case, for the glass transition temperature of the cushion layer 27, e.g., tan δ (loss coefficient) is detected by measuring viscoelasticity,
and the glass transition temperature is obtained from the value at which tan δ becomes maximum.

A viscoelasticity measurement device manufactured by Toyo Baldwin Co., Ltd. was used on the laminated body film for detecting the characteristics of temperature versus tan δ, whereby the results shown in FIG. 34 were obtained. From such results, the glass transition temperature of the cushion layer 27 was determined to be 37.8°C.

As shown in FIG. 35, the base peeling mechanism 186 is equipped with a frame member 192. In the frame member 192, upper guide rails 194a, 194b, which extend in the direction of the arrow D perpendicular to the feed direction (direction of arrow C) of the attached substrate 24a, extend mutually in parallel at a given fixed distance from each other. Beneath the upper guide rails 194a, 194b, shorter lower guide rails 195a, 195b extend similarly mutually in parallel in the direction of the arrow D. Mobile members 198a, 198b capable of reciprocating movement along the direction of the arrow D by means of motors 196a, 196b are supported on the upper guide rails 194a, 194b.

As shown in FIGS. 35 and 36, the mobile members 198a, 198b extend vertically (in the direction of arrow E), wherein vertically extending guide rails 200a, 200b are disposed along the mutually opposing faces thereof. Elevating platforms 202a, 202b are supported on the guide rails 200a, 200b, wherein the platforms 202a, 202b are elevated and lowered by means of motors 204a, 204b.
Rotating drive sources 206a, 206b are installed horizontally on the elevating platforms 202a, 202b. Chucks 208a, 208b are fixed to the rotation axes (not illustrated) of the rotating drive sources 206a, 206b. The chucks 208a, 208b are formed to be freely rotatable, and further, at a base film peeling position of the attached substrate 24a, are positionally adjustable so as to acquire positions for grasping both side portions of the base film 26, which project outward from both ends in the feed direction of the glass substrate 24 from which the aforementioned attached substrate 24a is constructed.

As shown in FIG. 35, slide bases 210a, 210b are supported on the lower guide rails 195a, 195b, and both ends of a profiling roller 212 are ascendably and descendably supported on the slide bases 210a, 210b. The slide bases 210a, 210b can be moved reciprocally within a fixed position interval integrally with the mobile members 198a, 198b in the direction of arrow D.

As shown in FIG. 32, according to the fourth embodiment, each of the attached substrates 24a which are separated by the inter-substrate web cutting mechanism 48 is fed to the cooling mechanism 122, and after being forcibly cooled, for example to room temperature (about 20°C) under action of the supplied cooling air, is subsequently fed to the heating mechanism 182. In the heating mechanism 182, the attached substrate 24a is gripped between the heating roller 188 and the receiving roller 190, and direct heat
transfer is conducted from the heating roller 188 to the base film 26 of the attached substrate 24a.

As a result, after the cushion layer 27 is heated to a predetermined temperature by the base film 26, the attached substrate 24a is delivered to the base peeling mechanism 186. In the base peeling mechanism 186, while the glass substrate 24 side of the attached substrate 24a is supported under a suction action of the suction pads 184, the chucks 208a, 208b are each arranged in the direction of arrow D toward one end side of the base film 26, which projects inwardly from both ends of the glass substrate 24 in the feed direction. (Refer to FIG. 37.)

Then, the mobile members 198a, 198b are moved toward the attached substrate 24a under action of the motors 196a, 196b and each of the chucks 208a, 208b is closed for gripping both end portions of the base film 26 in the feed direction. Further, the chucks 208a, 208b are rotated under action of the rotating drive sources 206a, 206b, while the elevating platforms 202a, 202b and mobile members 198a, 198b are controllably driven in a given direction.

As a result, as shown in FIGS. 36 and 37, the chucks 208a, 208b are moved along a fixed peeling trajectory, and the base film 26 which is gripped by the chucks 208a, 208b is separated from the cushion layer 27 and is peeled away from the attached substrate 24a. At this time, the profiling roller 212 is moved integrally with the mobile members 198a, 198b in the direction of arrow D until
reaching a fixed position, whereby the base film 26 is smoothly and favorably peeled off. The photosensitive laminated body 106 is obtained as a result of peeling the base film 26 away from the attached substrate 24a.

In this case, according to the fourth embodiment, after the cushion layer 27 of the attached substrate 24a, which has been forcibly cooled through the cooling mechanism 122, is then heated to a temperature in the vicinity of the glass transition temperature from the side of the base film 26 under action of the heating mechanism 182, peeling of the base film 26 is performed through means of the base peeling mechanism 186.

More specifically, in the attachment mechanism 46, the photosensitive web 22 is attached by thermocompression to the glass substrate 24 under application of a fixed tension, wherein residual stresses are easily generated within the cushion layer 27. Furthermore, residual stresses are also generated in the cushion layer 27 because the attached substrate 24a is subjected to forcible cooling by the cooling mechanism 122. Accordingly, in this condition, when the base film 26 is peeled away from the attached substrate 24a, it is easy for the cushion layer 27 to become torn or otherwise damaged as a result of the residual stresses in the cushion layer 27. Therefore, defective regions such as dimples or cavities may be formed in the cushion layer 27, causing a lowering of product quality.

According to the fourth embodiment, before peeling of
the base film 26, heating is performed from the side of the base film 26 up to a temperature in the vicinity of the glass transition temperature of the cushion layer 27, and as a result, residual stresses in the cushion layer 27 are mitigated.

The surface temperature of the base film 26 was variously modified, and a test was performed in order to detect the presence of tearing defects during peeling of the base film 26. The results of this test are shown in FIG. 38. According to this test, favorable peeling processes were accomplished and high quality photosensitive laminated bodies 106 were obtained by setting the surface temperature of the base film 26 to within a temperature range of 32°C to 38°C, corresponding to a fixed temperature range that is at or below the glass transition temperature (37.8°C) of the cushion layer 27.

Furthermore, the heating mechanism 182 heats the attached substrate 24a from the base film 26 side thereof. Accordingly, in comparison to the case of heating from the glass substrate 24 side, since the peeling region between the base film 26 and the cushion layer 27 can be swiftly and reliably heated to the desired temperature, highly accurate peeling processing at the peeling region can be achieved.

In addition, the base peeling mechanism 186 is separated from the heating mechanism 182 by a fixed interval. Therefore, the attached substrate 24a, which has been once heated and within which residual stresses have
been alleviated, is cooled while being transported to the base peeling mechanism 186.

Incidentally, the profiling roller 212, which makes up part of the base peeling mechanism 186, may also be heated through an unillustrated heating mechanism and brought into contact with the base film 26. As a result, the base film 26 may be peeled away from the cushion layer 27 while applying heat thereto. Further, the profiling roller 212 may also be arranged as a plurality of rollers.

In the fourth embodiment, the base peeling mechanism 186 is constructed so as to peel the base film 26 in the direction of arrow D, which intersects the feed direction (direction of arrow C) of the attached substrate 24a. However, the peeling direction of the base film 26 may also be set in the direction of arrow C, which is parallel to the feed direction of the attached substrate 24a.

Further, a pre-heating mechanism (not shown) may be installed at an upstream side of the heating mechanism 182 for performing supplemental heating of the attached substrate 24a. For example, an infrared power heater comprising a coil, carbon or halogen source, or a ceramic IR heater, or other of various contact type heating rollers, may be employed as the pre-heating mechanism.

In addition, in the fourth embodiment, the manufacturing apparatus 20 basically in accordance with the first embodiment is employed. However, the invention is not limited in this manner, and the features of this embodiment
may also be applied to the manufacturing apparatuses 120, 140 according to the second and third embodiments.

FIG. 39 is a schematic perspective view of a base peeling mechanism 220, making up the manufacturing apparatus in accordance with a fifth embodiment of the present invention. Structural elements thereof, which are the same as those of the base peeling mechanism 186 making up the manufacturing apparatus 180 according to the fourth embodiment are designated by like reference numerals and detailed explanations thereof shall be omitted.

The base peeling mechanism 220 comprises a tension applying structure 222, for applying tension to the base film 26 in the attachment direction thereof (direction of arrow C) with the glass substrate 24, when the base film 26 is peeled from the attached substrate 24a.

The tension applying structure 222 comprises movable chuck members 224a, 226a, 228a, 230a, capable of gripping an end portion 26a of the base film 26 that projects outwardly from a transport direction front end side of the attached substrate 24a, and movable chuck members 224b, 226b, 228b, 230b, capable of gripping a trailing end portion 26b of the base film 26 that projects toward a transport direction rear end side of the attached substrate 24a.

The chuck members 224a, 224b mutually face one another in the direction of arrow C, and the other chuck members 226a, 226b, 228a, 228b and 230a, 230b are arranged respectively mutually facing each other in the direction of
the arrow C. The chuck members 224a to 230a and 224b to 230b are respectively openable and closable, and further, are movable toward and away from the base film 26.

In the fifth embodiment, when the attached substrate 24a is arranged in the base peeling position, the chuck members 224a to 230a which make up the tension applying structure 222 grip the front end portion 26a of the base film 26, and the chuck members 224b to 230b grip the rear end portion 26b of the base film 26. In this condition, a fixed tension is applied to the base film in the direction of arrow C, due to a torque control in a direction for mutually separating the chuck members 224a to 230a and the chuck members 224b to 230b.

Consequently, the chucks 208a, 208b grip the front end portion 26a and the rear end portion 26b of the base film 26, and move in the direction of arrow D1 along a preset peeling trajectory. At this time, a fixed tension is applied to the base film 26 in the direction of arrow C, so that the base film 26 can be smoothly and reliably peeled away from the glass substrate 24.

In addition, as the profiling roller 212 moves in the direction of arrow D1 and approaches the chuck members 224a, 224b, after releasing the gripping actions on the front end portion 26a and the rear end portion 26b of the base film 26, the chuck members 224a, 224b are moved in directions to mutually separate away from each other (i.e., in the directions of the arrows). Therefore, the chuck members
224a, 224b do not interfere with the profiling roller 212. As the profiling roller 212 continues to move in the direction of the arrow D1, the chuck members 226a, 226b separate away from the base film 26, and in succession, the chuck members 228a, 228b, and then the chuck members 230a, 230b separate away from the base film 26, whereupon the pealing operation of the base film 26 is completed.

FIG. 40 is a schematic perspective view of a base peeling mechanism 230, making up the manufacturing apparatus in accordance with a sixth embodiment of the present invention.

The base peeling mechanism 230 is equipped with a tension applying mechanism 232 for applying tension to the base film 26 in an attachment direction thereof with the attached substrate 24a, when the base film 26 is peeled away from the attached substrate 24a.

The tension applying mechanism 232 comprises a front end chuck 234, which is capable of gripping a front end portion 26a of the base film 26 that projects toward a feed direction front end side of the attached substrate 24a, and a rear end chuck 236, which is capable of gripping a rear end portion 26b of the base film 26 that projects rearwardly of the feed direction of the attached substrate 24a. The front end chuck 234 and the rear end chuck 236 are widely formed in the direction of the arrow D, for gripping substantially the entire width dimension of the front end portion 26a and the rear end portion 26b of the base film.
26, respectively.

The front end chuck 234 is installed to the rotating drive sources 206a, 206b, whereas other parts of the structure are formed in the same manner as the base peeling mechanism 186 of the fourth embodiment. In this case, the movement direction of the front end chuck 234 is set in the direction of arrow C, which is perpendicular to the movement direction (direction of arrow D) of the chucks 208a, 208b.

In the sixth embodiment, when the attached substrate 24a is fed to the base peeling position, the front end portion 26a of the base film, which projects toward the front end side of the attached substrate 24a, is gripped by the front end chuck 234. On the other hand, the rear end portion 26b of the base film 26, which projects toward the rear end side of the attached substrate 24a, is gripped by the rear end chuck 236.

Next, the rear end chuck 236, or the rear end chuck 236 and the front end chuck 234, are subjected to torque control, wherein tension is applied to the base film 26 gripped thereby along the direction of arrow C. In this condition, the base film 26 to which a predetermined tension is applied is smoothly and reliably peeled away from the glass substrate 24, by moving the front end chuck 234 along a preset peeling trajectory.

FIG. 41 is a schematic view of an automatic base peeling mechanism 250, making up the manufacturing apparatus in accordance with a seventh embodiment of the present
invention. Structural elements thereof, which are the same as those of the automatic base peeling mechanism 142 making up the manufacturing apparatus 140 according to the third embodiment are designated by like reference numerals, and detailed explanations thereof shall be omitted.

The automatic base peeling mechanism 250 is equipped with a peeling bar (peeling guide member) 252 that guides the base film 26 along an outer circumference of the peeling roller 146 while moving between the attached substrates 24a. The peeling bar 252 is capable of advancing and retracting vertically (in the direction of arrow E) under the action of a cylinder 254. A ball screw 258 connected to a motor 256 is screw-engaged with the cylinder 254, for reciprocal movement in the direction of the arrow C. It is preferable for the peeling roller 146 to be heated by a non-illustrated heat source.

According to the seventh embodiment, as shown in FIG. 42, when the peeling bar 252 is positioned between respective attached substrates 24a, the peeling bar 252 projects upwardly under an action of the cylinder 254, for pressing the base film 26 from a residual section 30b side on the outer circumferential surface of the peeling roller 146. Further, the ball screw 258 is rotated under an action of the motor 256, and the cylinder 254 is moved in the direction of the arrow C, whereby the peeling bar 252 is pressed against the peeling roller 146 through means of the cylinder 254 (see, FIG. 43).
As a result, the peeling bar 252 guides the residual section 30b along the outer circumferential surface of the peeling roller 146. Accordingly, as shown in FIG. 44, due to the peeling bar 252 moving up to a fixed position on the outer circumference of the peeling roller 146, the residual section 30b is reliably peeled away from the rear end portion of the forwardly-advancing attached substrate 24a and is integrally wound up with the base film 26. Therefore, when the base film 26 is peeled away from the attached substrate 24a, the residual section 30b does not remain on the attached substrate 24a, and favorable automated peeling processing can be accomplished.

Furthermore, the peeling bar 252 is formed with a spherically shaped tip; however, the invention is not limited to this structure. For example, as shown in FIG. 45, a peeling bar 260 having a tapered tip portion 260a, with a tapered surface on the peeling roller 146 side thereof, may also be used.

FIG. 46 is a frontal view showing an attachment mechanism 270 making up the manufacturing apparatus in accordance with an eighth embodiment of the present invention.

The attachment mechanism 270 comprises rubber rollers 80a, 80b and backup rollers 272a, 272b, wherein an outer circumference of the backup rollers 272a, 272b are configured to have a crown shape. Further, at least one of the backup rollers 272a, 272b and/or at least one of the
rubber rollers 80a, 80b may be formed as a crown roller.

The crown shape may be a sine curve, a quadratic curve or a quartic curve. For example, as shown in FIG. 47, the roller surface length $L = 1000$ mm to 3000 mm, the roll diameter $\phi = 200$ mm to 300 m, the crown rate $d (= 2d1) = 0.1$ mm to 3.0 mm, and the laminate linear pressure is 100 N/cm to 200 N/cm.

FIG. 48 is a schematic perspective view of first and second processing mechanisms 290a, 290b making up the manufacturing apparatus in accordance with a ninth embodiment of the present invention. FIG. 49 is a schematic side elevational view of the first and second processing mechanisms 290a, 290b.

The first and second processing mechanisms 290a, 290b each comprises a heating mechanism 292 for heating partially cut regions 34 in the photosensitive webs 22a, 22b to a predetermined temperature (discussed later), and a cutting mechanism 294 for making partial cuts along the partially cut regions 34 that have been heated to the predetermined temperature.

The cutting mechanism 294 comprises a linear guide 296 extending in the direction of arrow B perpendicular to the feed direction (direction of arrow A) of the photosensitive web 22, wherein a slide table 298 is supported on the linear guide 296. A motor 300 is installed inside of the slide table 298, and a pinion 302 is axially fitted to the rotational axis 300a of the motor 300. A rack 304, which
engages with the pinion 302, extends in the direction of arrow B along the linear guide 296, wherein the slide table 298 is reciprocally movable in the direction of arrow B under the action of the motor 300.

A rotational axis 306 is disposed in the slide table 298, which projects from an opposite side of the side on which the pinion 302 is disposed. A rotating circular blade (cutter) 308 is integrally installed to the rotational axis 306. At a position opposite to the rotating circular blade 308, a cutting table 310 is disposed, with the photosensitive webs 22a, 22b sandwiched therebetweem.

The cutting table 310 comprises a two-ply metal plate structure, and extends in the direction of the arrow B. A concave groove 312 is formed in the upper surface of the cutting table 310 so as to extend along a movement range of the rotating circular blade 308 in the direction of arrow B, wherein the concave groove 312 accommodates a resin-made receiving portion 314 therein.

The heating mechanism 292 is embedded in the cutting table 310, and more specifically, comprises a sheet type heater 316 sandwiched between the two metal plates. The cutting table 310 serves as a heating member for directly heating a partially cut region 34 of photosensitive webs 22a, 22b that contact the cutting table 310. The sheet type heater 316 may also be arranged between the concave groove 312 and the receiving portion 314.

In place of the rotating circular blade 308, a fixed
circular blade 320, which is fixed to a fixed axis 318 that extends from the slide table 298, may also be used. Such a fixed circular blade 320 may be adjustable at each of respective angular positions forming preset angles with respect to the fixed axis 318.

The partially cut region 34 is provided for cutting (severing) at least the protective film 30, and in actuality, the cutting depth of the rotating circular blade 308 (or the fixed circular blade 320) is set in order to reliably sever the protective film 30. In the partially cut region 34, a cutting method using ultrasonic waves, or any of methods formed by a knife blade, a band-shaped push cutting blade (Thomson Blade), or the like, may be used in place of the rotating circular blade 308 (or the fixed circular blade 320). The push cutting blade may include a slanted push cutting structure, in addition to a vertical push cutting-structure.

In the ninth embodiment, the sheet heater 316 forming the heating mechanism 292 is activated, wherein the cutting table 310 comprising the sheet heater 316 therein is heated to a preset desired temperature. As a result, the photosensitive web 22a, 22b fed in the direction of arrow A contacts the cutting table 310, which moves simultaneously with the photosensitive web 22a, 22b, and is directly heated thereby, and while the partially cut region 34 is heated to a predetermined fixed temperature corresponding to the rotating circular blade 308, a partial cut is made via the
cutting mechanism 294. It is also acceptable for the
partial cut to be made while the photosensitive web 22a, 22b
is in a stationary condition.

Specifically, when the pinion 302 is rotated under a
driving action of the motor 300 disposed in the slide table
298, under an engagement action of the pinion 302 and rack
304, the slide table 298 is supported by the linear guide
296 and moves in the direction of arrow B. Consequently,
the rotating circular blade 308 rotates while moving in the
direction of arrow B, under a state in which the blade cuts
into the partially cut region 34 of the photosensitive web
22a, 22b at a desired depth. As a result, a partially cut
region 34 of a desired cutting depth from the protective
film 30 is formed in the photosensitive web 22a, 22b.

In this case, the partially cut region 34 is partially
cut by the cutting mechanism 294, while the partially cut
region 34 of the photosensitive web 22a, 22b is heated via
the heating mechanism 292. At this time, generation of
cutting debris or interlaminar peeling (delamination) can be
effectively prevented, as a result of setting the heating
temperature of the photosensitive web 22a, 22b for each of
the rotating circular blades 308 or the fixed circular
blades 320.

In the above-described ninth embodiment, a concave
groove 312 is formed in the cutting table 310 and a
receiving portion 314 is accommodated inside the concave
groove 312. However, it is also acceptable to provide a
resin receiving film on an upper surface of the cutting
table without forming any concave groove therein. Further,
in place of a sheet heater 316, it is acceptable to use a
sheathed heater or a tubular type heater. Still further, a
heating box, accommodating the cutting mechanism 294 and the
partially cut region 34 therein may be provided, wherein
heated air is supplied to the interior of the heating box.
Furthermore, it is also acceptable to provide a heating
plate, a bar heater, or a heating box or the like upstream
of the cutting mechanism 294, in order to heat the
photosensitive web 22a, 22b before making the partial cut
therein.

Although certain preferred embodiments of the present
invention have been shown and described in detail, it should
be understood that various changes and modifications may be
made therein without departing from the scope of the
appended claims.
CLAMS

1. An apparatus for manufacturing a photosensitive laminated body, comprising:

   at least two web reel-out mechanisms (32a, 32b) for synchronously reeling out at least two elongate photosensitive webs (22a, 22b) each comprising a support (26), a photosensitive material layer (28) disposed on said support (26), and a protective film (30) disposed on said photosensitive material layer (28), said protective film (30) having a peel-off section (30aa) and a residual section (30b);

   at least two processing mechanisms (36a, 36b) for forming processed regions (34) which are transversely severable in said protective films (30) of said elongate photosensitive webs (22a, 22b) which have been reeled out by said web reel-out mechanisms (32a, 32b), at respective boundary positions between said peel-off section (30aa) and said residual section (30b);

   at least two peeling mechanisms (44a, 44b) for peeling said peel-off section (30aa) off from each of said elongate photosensitive webs (22a, 22b), leaving said residual section (30b);

   a substrate feed mechanism (45) for feeding a substrate (24) which has been heated to a predetermined temperature to an attachment position;

   an attachment mechanism (46) for positioning said
residual section (30b) between said substrates (24) and integrally attaching in parallel at least two exposed areas of said photosensitive material layers (28) from which said peel-off section (30aa) has been peeled off to said substrate (24) in said attachment position, thereby producing an attached substrate (24a);

at least two support peeling mechanisms (186) positioned downstream from said attachment mechanism (46) for peeling off said support (26) from each attached substrate (24a);

a cooling mechanism (122) positioned between said attachment mechanism (46) and said support peeling mechanisms (186), for cooling said attached substrate (24a); and

a heating mechanism (182) for heating a resin layer (27), which is laminated on said support (26), within a predetermined temperature range which is at or below the glass transition temperature.

2. The apparatus according to claim 1, wherein said support peeling mechanism (186) comprises a tension applying structure (222) for applying tension to said support (26) along the attachment direction with said substrate (24) when peeling off said support (26).

3. The apparatus according to claim 1, wherein said support peeling mechanism (250) comprises a peeling roller
(146) for peeling said support (26) from said substrate (24) following an outer circumferential portion thereof, and a peeling guide member (252) for guiding said support (26) along an outer circumference of said peeling roller (146) while moving between said substrates (24).

4. The apparatus according to claim 1, wherein said attachment mechanism (270) comprises:

   a pair of rubber rollers (80a, 80b) which are heated to a predetermined temperature; and

   a pair of backup rollers (272a, 272b) in sliding contact with said pair of rubber rollers (80a, 80b), wherein outer circumferential surfaces of at least one of said rubber rollers (80a) and/or at least one of said backup rollers (272a) is set with a crown shape.

5. An apparatus for manufacturing a photosensitive laminated body, comprising:

   at least two web reel-out mechanisms (32a, 32b) for synchronously reeling out at least two elongate photosensitive webs (22a, 22b) each comprising a support (26), a photosensitive material layer (28) disposed on said support (26), and a protective film (30) disposed on said photosensitive material layer (28), said protective film (30) having a peel-off section (30aa) and a residual section (30b);

   at least two processing mechanisms (290a, 290b) for
forming partially cut regions (34) which are transversely severable in said protective films (30) of said elongate photosensitive webs (22a, 22b) which have been reeled out by said web reel-out mechanisms (32a, 32b), at respective boundary positions between said peel-off section (30aa) and said residual section (30b);

at least two peeling mechanisms (44a, 44b) for peeling said peel-off section (30aa) off from each of said elongate photosensitive webs (22a, 22b), leaving said residual section (30b);

a substrate feed mechanism (45) for feeding a substrate (24) which has been heated to a predetermined temperature to an attachment position;

an attachment mechanism (46) for positioning said residual section (30b) between said substrates (24) and integrally attaching in parallel at least two exposed areas of said photosensitive material layers (28) from which said peel-off section (30aa) has been peeled off to said substrate (24) in said attachment position, thereby producing an attached substrate (24a); and

at least two support peeling mechanisms (186) positioned downstream from the attachment mechanism (46) for peeling off said support (26) from each attached substrate (24a),

wherein said processing mechanisms (290a, 290b) comprise:

determine (294) for forming said partially cut regions
(34) in said elongate photosensitive webs (22a, 22b); and
a heater (292) for heating said partially cut regions
(34) at the time of making the partial cuts to a
predetermined temperature corresponding to said cutter
(294).

6. A method of manufacturing a photosensitive
laminated body, comprising the steps of:
synchronously reeling out at least two elongate
photosensitive webs (22a, 22b) each comprising a support
(26), a photosensitive material layer (28) disposed on said
support (26), and a protective film (30) disposed on said
photosensitive material layer (28), said protective film
(30) having a peel-off section (30aa) and a residual section
(30b);
forming processed regions (34) which are transversely
severable in said protective films (30) of said elongate
photosensitive webs (22a, 22b) which have been reeled out,
at respective boundary positions between said peel-off
section (30aa) and said residual section (30b);
peeling said peel-off section (30aa) off from each of
said elongate photosensitive webs (22a, 22b), leaving said
residual section (30b);
feeding a substrate (24) which has been heated to a
predetermined temperature to an attachment position;
positioning said residual section (30b) between said
substrates (24) and integrally attaching in parallel at
least two exposed areas of said photosensitive material layers (28) from which said peel-off section (30aa) has been peeled off to said substrate (24) in said attachment position, thereby producing an attached substrate (24a); cooling said attached substrate (24a) at a position downstream from said attachment position; and heating a resin layer (27), which is laminated on said support (26), within a predetermined temperature range which is at or below the glass transition temperature.

7. The method according to claim 6, further comprising the steps of:

peeling each support (26) from said attached substrate (24a) and obtaining a photosensitive laminated body (106), after severing each elongate photosensitive web (22a, 22b) between said attached substrates (24a) downstream from said attachment position; and applying tension to said support (26) along the attachment direction with said substrate (24) when said support (26) is peeled.

8. The method according to claim 7, further comprising the steps of:

peeling said support (26) from said substrate (24) following an outer circumferential portion of a peeling roller (146); and guiding said support (26) along an outer circumference
of said peeling roller (146) while a peeling guide member (252) moves between said substrates (24).

9. A method of manufacturing a photosensitive laminated body, comprising the steps of:

synchronously reeling out at least two elongate photosensitive webs (22a, 22b) each comprising a support (26), a photosensitive material layer (28) disposed on said support (26), and a protective film (30) disposed on said photosensitive material layer (28), said protective film (30) having a peel-off section (30aa) and a residual section (30b);

making partial cuts in said elongate photosensitive webs (22a, 22b) while heating partially cut regions (34) to a predetermined temperature corresponding to a cutter (294) which are transversely severable in said protective films (30) of said elongate photosensitive webs (22a, 22b) which have been reeled out, at respective boundary positions between said peel-off section (30aa) and said residual section (30b);

peeling said peel-off section (30aa) off from each of said elongate photosensitive webs (22a, 22b), leaving said residual section (30b);

feeding a substrate (24) which has been heated to a predetermined temperature to an attachment position;

positioning said residual section (30b) between said substrates (24) and integrally attaching in parallel at
least two exposed areas of said photosensitive material layers (28) from which said peel-off section (30aa) has been peeled off to said substrate (24) in the attachment position, thereby producing an attached substrate (24a); and preheating said elongate photosensitive webs (22a, 22b) to a predetermined temperature at a vicinity upstream of said attachment position.
FIG. 38

<table>
<thead>
<tr>
<th>BASE FILM SURFACE TEMPERATURE</th>
<th>TEST SAMPLE EVALUATION RESULT (VISUAL EVALUATION)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=1</td>
</tr>
<tr>
<td>50</td>
<td>×</td>
</tr>
<tr>
<td>45</td>
<td>×</td>
</tr>
<tr>
<td>39</td>
<td>Δ</td>
</tr>
<tr>
<td>38</td>
<td>O</td>
</tr>
<tr>
<td>37</td>
<td>O</td>
</tr>
<tr>
<td>35</td>
<td>O</td>
</tr>
<tr>
<td>32</td>
<td>O</td>
</tr>
<tr>
<td>30</td>
<td>Δ</td>
</tr>
<tr>
<td>25</td>
<td>Δ</td>
</tr>
<tr>
<td>20 (ROOM TEMPERATURE)</td>
<td>×</td>
</tr>
</tbody>
</table>

○: ACCEPTABLE PEELING OF FILM FROM SUBSTRATE (NO RESIDUAL Cu LAYER)
△: SOME DEFECTIVE PEELING OF FILM FROM SUBSTRATE
×: SUBSTANTIAL DEFECTIVE PEELING OF FILM FROM SUBSTRATE