

Description

The present invention relates to the automatic lamination of circuit boards or other substrates with a dry film of photopolymer resist material, and more particularly, to a tacking and laminating method and apparatus that enables an increased speed of lamination with greater reliability of film adherence to the substrates.

Dry films of curable photopolymer resist material have been developed for use in the manufacture of printed circuit boards. Such boards have particular use in the electronics industry. A particularly advantageous form of such film that is available commercially is disclosed in U. S. Patent No. 3,887,450, entitled "PHOTOPOLYMERIZABLE COMPOSITIONS CONTAINING POLYMERIC BINDING AGENTS." U. S. Patent No. 3,887,450 was granted to Michael N. Gilano et al. and is assigned to the assignee of the present invention. As manufactured, the dry film photopolymer is characterized in being easily contaminated. It is also tacky and limp. Although tacky, the film is "peelable." This makes it possible to use polyethylene cover film for protection and for facilitating handling. The composite is packaged in reels. Typically, such dry films of photopolymer have thicknesses of 25.4, 38.1, 50.8 and 76.2 μm (1.0, 1.5, 2.0, and 3.0 mils), and have widths in the range of 15.2 cm (6 inches) to 76 cm (30 inches).

Machines, termed laminators, are known in the prior art for applying dry films of curable photopolymer to the surfaces of each of a plurality of printed circuit boards in succession. In one form thereof, such laminators utilize a so-called two-step laminating process consisting, in a first step, of pressing in the presence of heat, the leading end of a film sheet into pressure sealed contact with the face of the board at a forward portion thereof, a step referred to hereinafter as "tacking;" and in a second step, feeding the board, with the film sheet trailing behind, between heated pressure or lamination roller means for compression bonding of the film sheet onto the face of the board, a step referred to hereinafter as "laminating."

Thus, as disclosed in U. S. Patents 3,658,629 to L. P. Cramer et al., 4,025,380 to E. T. Bernardo, 4,650,536 to A. B. Ceraso and 4,659,419 to E. Miyake, each of a plurality of blank boards is transferred, in turn, to a film web tacking station of the laminator where the leading end of a continuous length of film web is tacked to a forward end portion of the board. The board is then transferred to and moved through a laminating station, with the film web being pulled along, where lamination rolls cause the film web to become bonded to the board. During the laminating operation, the film web is cut to form a film portion of predetermined length that matches the length of the board.

Such film sheet portions may simultaneously be applied to the opposite sides of the board with each film portion being of the same, larger or smaller size than that of the board being laminated. As disclosed in the aforementioned U. S. Patent 4,650,536 to A. B. Ceraso, applying a smaller film sheet portion which fits within the

perimeter of the board advantageously leaves free the edges thereof in which centering holes may be disposed for use in subsequent printed circuit board processing operations.

It is further known in the prior art, as disclosed in the aforementioned U. S. Patent 4,659,419 to E. Miyake, to effect the cutting operation of the film web without interrupting the laminating operation. As there disclosed, the film web cutting system consists of a circular rotating cutting blade which is moved across the width of the film web while at the same time being moved toward the laminating station in the same direction and at the same speed as the film web is being moved thereto.

The prior art laminators are characterized in that the portion of the film web at the leading end thereof that is tacked to the board has a length of a few millimeters only. Moreover, the location where the end of the film web is tacked to the board is spaced a distance of several centimeters from where the laminating action begins. Upon completion of the tacking operation, the board is pushed forward under a lamination roll in the laminating station. This action subjects the film web to a pulling force which places the film web under tension. Such tension on the film web creates a problem, giving rise to a critical situation, as there is a tendency for the film web to be pulled away from and off the board from the region where it had been tacked, laminating action not yet having begun, as illustrated herein in Fig. 1 of the drawings.

A critical situation develops also, when a single side only of a board is being laminated. In this case, the pulling force and resulting tension on the film web tends to cause the board to bend. This problem is most pronounced with thin boards, as illustrated herein in Fig. 2 of the drawings.

The tendency for such critical situations to develop with the prior art laminators requires that the tacking be effected under high pressure and temperature for a sufficient time to effect a tight bond and also places a restriction on the magnitude of the force that may be applied to the film web while the board is being advanced toward the laminating station, and hence, on the speed at which the board may be so advanced. These factors detract seriously from the efficiency of lamination and are significant in determining the number of boards that may be satisfactorily laminated in any given period.

Another factor that is a determinant of the efficiency of lamination is the film web cutting time, that is, the elapsed time required for the rotary cutting blade to be moved across the width of the film web to effect the film sheet portion cutting action. With the rotary blade cutting system of the prior art, the elapsed time required for cutting the film web is sufficiently long, being of the order of several seconds, that it also is a significant factor in determining laminating efficiency, not only in respect of reducing the number of boards that may be laminated in a given period but also in respect of restricting the shortest length of board that may be laminated in the machine to a size larger than desired.

Thus, there exists a need and a demand for improvement in the method of and apparatus employed for tacking, laminating, and film cutting to the end of achieving greater efficiency and reliability of lamination. The present invention was devised to fill the technological gap that has existed in the art in these respects.

EP-A-0 225 927 and 0 278 517, upon which the preambles of claims 1 and 11 are based, disclose apparatus for laminating a film of material to a board, comprising a lamination roll, supporting members arranged to support said lamination roll for rotation about a first axis, a tacking bar and means for moving the tacking bar and the laminating roll successively into and out of a predetermined position in a fixed plane to tack and laminate the film to the board.

According to one aspect of the invention, there is provided apparatus of the aforementioned type, wherein the supporting members have peripheral substantially circular surfaces positioned about a second axis, said first and second axes being positioned in spaced and substantially parallel relation with one another and with said plane with the first axis closer to the plane than the second axis, in that the tacking bar is supported by flanges for rotation about said second axis, said flanges being positioned for rotation about said peripheral surfaces and in that means are provided for moving said flanges and said support members together towards and away from said predetermined position, in concert with rotation of the tacking bar about said second axis.

According to a further aspect of the invention there is provided a process for laminating a film of material to a board having a face, a forward end and a rearward end, comprising the sequential steps of:

- a) gripping the board and advancing it in a predetermined plane to position a face portion of a forward end thereof in cooperative relation with a tacking surface and a laminating surface which are movable alternately towards and away from said face portion;
- b) supplying a length of said film with a leading end thereof adjacent said tacking surface;
- c) initiating movement of said tacking surface in a path substantially perpendicular to said predetermined plane to press the leading end of the film into pressure contact with the forward face portion of the board to tack the leading end of the film thereto;
- d) while maintaining the board immobile, initiating movement of said tacking surface to separate it from the forward face portion of the board and initiating movement of the laminating surface into pressure contact with substantially the same forward face position of the board to which the leading end of the film has been tacked; and
- e) advancing the board relative to the laminating surface, with pressure contact maintained therebetween,

to press the film along its length to the face of the board, characterised in that the length of film is supplied along a curved film guiding surface having a centre of curvature that is offset, in a direction away from said plane, with respect to an axis which is movable substantially perpendicularly towards and away from the predetermined plane, and in that in step (d) the tacking surface is rotated eccentrically about said axis to a waiting position, at the same time as movement of the laminating surface into pressure contact with the board is initiated.

In one embodiment of the invention, two said films are laminated simultaneously onto respective first and second opposite faces of the board. In step (a) a first face portion of the forward end of the board on one side thereof is positioned in cooperative relation with a first said tacking surface a first said laminating surface and a second face portion of said forward end on the opposite side thereof is positioned in cooperative relation with a second said tacking surface and a second said laminating surface. In step (b) a first said film is supplied along said film guiding surface for lamination to said first face portion and a second said film is supplied along a second said movable curved film guiding surface whose centre of curvature is offset, in a direction away from said plane, with respect to an axis which is movable substantially perpendicularly towards and away from said predetermined plane. In step (c) said tacking surfaces are moved towards one another in directions substantially perpendicular to said plane to tack respective leading ends of said films to said first and second face portions. In step (d) said tacking surfaces are separated from the respective forward face portions of the board and rotated in opposite directions about the respective movable axes to respective waiting positions and at the same time the first and second laminating surfaces are moved from opposite sides of the board into pressure contact with respective tacked forward face portions of the board, and in step (e) the board passes between said laminating surfaces with pressure contact to press said films simultaneously along their length to opposite faces of the board.

Steps (a) to (e) can be repeated to laminate a film or films of material to one or both sides of each of a succession of said boards.

The process and apparatus of the invention enable, compared to the laminators of the prior art, not only a reduction in time required for the tacking operation but also a reduction in the temperature and pressure required for the tacking operation. The elapsed time required for cutting a film web portion from a continuous length of film web to form a film sheet can be minimized without interrupting the laminating operation.

In the interval between the tacking operation and the beginning of the laminating operation, the film web is not subjected to a pulling force, as in the laminators of the prior art, which pulling force tends to pull the film web off the board from where it has been tacked. As a consequence, in accordance with the present invention, the

tacking operation no longer is a critical undertaking and can be performed successfully at low temperature and pressure and in a minimum of time.

Pulling force on the film web, as the board is moved into the laminating mode, is not a factor, as in the prior art, in determining the number of boards that may be laminated in a given period. Additionally, single side lamination of boards is possible without any involvement of the bending problem with thin boards that has been encountered in the prior art.

The system provided for cutting the film web is preferably of the shears type. The elapsed time required for cutting across the entire width of the film with this cutting system is extremely short, being about 0.3 seconds. This is shorter by about a factor of 10 than the elapsed time required by the prior art rotary blade cutters.

The cutting unit in accordance with a preferred embodiment of the invention is located eccentrically with respect to the lamination rolls, making it possible for the minimum board length to be very short, specifically 170 mm. (6.7 inches) in one embodiment of the invention. The cutting structure is simple and very efficient. The cutting blade is required to travel a distance of only a few millimeters.

Thus, the present invention enables the achievement of a highly efficient lamination operation, as tacking and cutting are in no way critical.

While the present invention is described in connection with the application of dry films of photopolymer resist material for use in the manufacture of printed circuit boards, it will be understood that the films for application to boards or other substrates may be masking or other films or sheets and that the boards or substrates to which the film sheet is applied may comprise copper laminated glass epoxy board, paper board, plastic board, etc., in accordance with the application requirements. The thickness of the boards or substrates may be in the range from 0.1 to 4.0 mm (0.004 to 0.15 inches).

For a better understanding of the invention, its operating advantages, and specific objects attained by its use, a detailed description of preferred embodiments follows with reference being made to the accompanying figures of drawing which form part of the specification, in which like parts are designated by the same reference numbers, and of which:

Fig. 1 is a schematic illustration typifying the tacking and laminating method of the prior art;

Fig. 2 is a schematic illustration showing the bending of boards, particularly of thin boards that is encountered in single side lamination of boards employing the prior art tacking and laminating method illustrated in Fig. 1;

Fig. 3 is a side view of a laminator constructed in accordance with a preferred embodiment of the invention;

Fig. 4 is a schematic illustration of an automatic centering device employed in the laminator of Fig. 3 for centering incoming boards entering the laminator to be laminated;

Fig. 5 is a fragmented perspective view illustrating an incoming board as being front centered by a barrier positioned adjacent a lower input roll;

Fig. 6 is an end view illustrating the front centered board of Fig. 5 as being gripped by an upper input roll;

Fig. 7 is an end view illustrating the lower roll as rotating and advancing the front centered board of Fig. 5 to a tacking and laminating station;

Fig. 8 is a view on a scale larger than that shown in Fig. 3 of upper and lower eccentric tacking devices and lamination rolls, with the tacking devices in tacking position and the lower tacking device and lamination roll partially broken away;

Fig. 9 illustrates the positioning of a board to be laminated with the upper eccentric tacking device and lamination roll stationary, the tacking device being in the right position to effect the tacking, the lower eccentric tacking device and lamination roll not being shown;

Fig. 10 illustrates the approach of the upper tacking device to the board;

Fig. 11 illustrates the setting of the upper tacking device apart from the board after the leading end of a film of photopolymer resist material has been tacked to the board;

Fig. 12 illustrates the rotation of the upper tacking device and the closing of the upper lamination roll on the board at the same line position or region at which the tacking had been effected;

Fig. 13 illustrates the lamination by the upper lamination roll of the film of photopolymer resist material to the board;

Fig. 14 is a view illustrating the transverse cutting of the film by the upper eccentric tacking/cutting device;

Fig. 15 is a fragmented perspective view illustrating the rest condition and coupling of the film transverse cutting system;

Fig. 16 is a top view showing the relationship of the movable and fixed or counter film cutting blades in the rest condition;

Fig. 17 is a top view showing the relationship of the movable and counter blades in the coupled condition;

Fig. 18 is a fragmented perspective view illustrating the film cutting system at the start of cutting after coupling;

Fig. 19 is a top view showing the relationship of the cutting blades at the start of cutting;

Fig. 20 is a top view showing the relationship of the cutting blades at the completion of the cutting;

Fig. 21 is a fragmented perspective view showing the release of the movable blade from the fixed blade;

Fig. 22 is a fragmented perspective view showing the return to the rest position of the moving unit of the cutting system;

Fig. 23 is a fragmental perspective view of the film cutting;

Fig. 24 illustrates the return of the upper tacking device and laminating roll to the correct position just in time to effect the tacking of the next board, following in sequence to be laminated;

Fig. 25 is a section taken along the lines 25-25 of Fig. 3 modified, however, for clarity of illustration, to show each of the laminating rolls in laminating position and with the upper and lower eccentric tacking devices rotated to extreme upper and lower positions, respectively;

Fig. 26 is a schematic perspective view of mechanism provided in the laminator for opening and closing the laminating rolls;

Fig. 27 is a schematic perspective view of mechanism provided for effecting rotation of the vacuum sectors and of the laminating rolls;

Fig. 28 is a schematic perspective view of the air intake for the vacuum sectors;

Fig. 29 is a schematic fragmented perspective view of the air intake from the rotating vacuum sectors;

Fig. 30 is a schematic fragmented perspective view of a drive mechanism transmitting clockwise and counterclockwise motion to the laminating rolls;

Fig. 31 is a schematic fragmented perspective view of mechanism for effecting control of the film feed rolls;

Fig. 32 is an end view of a support member provided for the left end of the upper laminating roll and for the right end of the lower laminating roll, as seen in Fig. 25;

Fig. 33 is a view taken along the lines 33-33 of Fig. 32;

Fig. 34 is an end view of a support member provided for the right end of the upper laminating roll and for the left end of the lower laminating roll, as seen in Fig. 25;

Fig. 35 is a view taken along the lines 35-35 of Fig. 34;

Fig. 36 is a front view of a flange that is provided for supporting each of the ends of the upper and lower tacking bars, as seen in Fig. 25;

Fig. 37 is a view taken along the lines 37-37 of Fig. 36;

Fig. 38 is a front view of a bearing retaining flange for the upper and lower left side bearings of the tacking and laminating assembled structure, as shown in Fig. 25;

Fig. 39 is a view taken along the lines 39-39 of Fig. 38;

Fig. 40 is a front view of a flange for the upper right side bearings of the tacking and laminating assembled structure, as shown in Fig. 25;

Fig. 41 is a view taken along the lines 41-41 of Fig. 40;

Fig. 42 is a front view of a flange for the lower right side bearing of the tacking and laminating structure, as shown in Fig. 25;

Fig. 43 is a view taken along the lines 43-43 of Fig. 42;

Figs. 44 and 45 are plan and end views, respectively, of an eccentric pivot employed for the ball bearings in Fig. 25;

Figs. 46 and 47 are plan and end views, respectively, of the film guiding structure;

Fig. 48 is a plan view of an angularly adjustable shoulder that is provided at each end of each of the tacking/cutting devices and lamination rolls for the support thereof;

Fig. 49 is a view taken along the lines 49-49 of Fig. 48;

Fig. 50 is a view illustrating the support of the tacking/cutting and lamination roll structures by the angularly adjustable shoulders and the actuation of the latter to effect movements of the tacking/cutting devices and the laminating rolls toward and away from a board to be laminated;

Fig. 51 illustrates electromagnetic coupling devices for controlling the selective actuation of the tacking/cutting devices and of the laminating rolls;

Fig. 52 is a perspective view of a contacting type temperature detector that is employed for measuring the surface temperature of each of the laminating rolls;

Fig. 53 is a cross sectional view taken along the lines 53-53 of Fig. 52;

Fig. 54 is a view in side elevation showing the temperature detector in rolling contact with a lamination roll; and

Fig. 55 is a perspective view illustrating a cabinet in which the main body of the laminator is housed and a mobile cabinet housing electronic controls for the laminator.

Fig. 1 schematically illustrates a laminator 10 according to the prior art. As shown, the laminator 10 comprises input rolls 12, a reel 14 of film 16, a tacking bar 18 and lamination rolls 20. The input rolls 12 push or advance a board 22 to be laminated along a track (not shown) to bring the forward end 24 thereof into a position where it is in cooperative relation with the leading end 26 of the film 16 and the tacking bar 18. The board is stopped at that position following which the tacking bar 18 is moved down to exert force upon and thereby to tack the leading end 26 of the film 16 to the forward end 24 of the board 22. After the tacking operation, the board 22 is pushed forward by the input rolls 12 under the lamination rolls 20. The lamination rolls 20 are spaced a distance, typically several centimeters, forward of the tacking bar 18 in the path of movement of the board 22. This gives rise to a critical situation as the film 16, which is tacked to the board for only a few millimeters along the length thereof, is subjected to a pulling force. It may happen, and there is a natural disposition toward such happening, that the leading end 26 of the film 16 will be pulled from the board 22 as indicated at 28. This necessitates the use of heat and pressure for a sufficient time to ensure a good bond during the tacking operation, and movement forward of the board 22 at a rate sufficiently slow to preclude pulling the end of film 16 off the board 22, thus reducing the laminating efficiency, and resulting in a corresponding reduction in the number of boards 22 that may be laminated with a sheet of film 16 in a given period of time.

Fig. 2 schematically illustrates the bending of boards, particularly of thin boards, that is encountered with the arrangement of the tacking bar 18 and lamination rolls 20 of the prior art laminators. As shown in Fig. 2, the pulling force on the film 16, as the board 22 to be laminated is pushed forward, causes the forward or leading end of the board to be bent upward in single side lamination. The board 22 bends since the film 16 has been tacked on one side only, there being no counter-vailing force on the other side. Single side lamination, particularly of inner layers on thin boards, thus, is critical and reduces laminating efficiency.

Referring to Fig. 3, the laminator 30 of the present invention comprises upper and lower suitably heated lamination rolls 32 and 34 that are paired, respectively, with upper and lower tacking/cutting devices 36 and 35 in a tacking and laminating station 39. Devices 36 and 38 revolve eccentrically with respect to the lamination roll 32 or 34 that is associated therewith. During the various steps in the lamination process, the pair of lamination rolls and tacking/cutting devices 32, 36 and 34, 38 are simultaneously pushed from opposite directions, that is, from upper and lower positions, as seen in Fig. 3, against opposing sides of a board 40 to be laminated, and moved apart from it.

The laminator 30, as shown in Fig. 3, comprises, in addition, a main body 42, an input conveyor means 44, and an output conveyor means 46 for the boards 40 to be laminated. To provide for the lamination of a film sheet simultaneously on both sides of the board 40, the laminator main body 42 is arranged symmetrically with respect to the pair of lamination rolls and tacking/cutting devices 32, 36 and 34, 38 and the planes containing the input conveyor means 44 and the output conveyor means 46.

Each incoming board 40 is detected and centered by an automatic centering device 48 which is illustrated in Fig. 4, although not shown in Fig. 3. Detailed descriptions of the automatic centering device 48 and the manner of the operation thereof are provided hereinafter.

Associated with the automatic centering device 48 is a front centering and front edge adjustment device 50 which is illustrated in Fig. 5. Device 50 includes a barrier 54 that is positioned in cooperative relation with a lower input roll 52 and an upper input roll 56. As advanced into the laminator 30 by the input conveyor means 44, each incoming board 40 normally rests on the lower input roll 52 with the front edge 41 thereof moved into abutting relation with the barrier 54. Such movement causes the front edge 41 of the board 40 to be angularly shifted to squarely face the tacking and laminating station 39 if not already in such a position. Upon lowering thereof into contact with the board 40, as shown in Fig. 6, the upper input roll 56 grips the board 40. The lower roll 52 rotates and advances the board 40 into the laminating station 39.

As shown in Fig. 5, the lower input roll 52 is actuated by a rack 52a that is fixed to the shaft of an air cylinder 52b. The rack 52a is positioned in cooperative relation

with a pinion 52c that is fixedly attached to the shaft 52d of the lower input roll 54.

The travel of the cylinder, and consequently, the number of revolutions of the lower input roll 52 and the distance advanced by the board 40 are determined by a positive stop on the cylinder 52b. The travel of the shaft of the cylinder 52b depends upon the position of the positive stop.

The positive stop (or register) is moved by a d.c. micromotor (not shown) which may be similar to the motor used for the automatic centering device 48 described hereinafter. The d.c. micromotor is controlled directly by a Programmable Logic Control (PLC) in accordance with an edge value preset by the operator.

The front barrier 54 which stops the board 40 with the forward edge 41 squarely facing the laminating station 39, that is, in parallel relation with respect to the tacking bars of the tacking and cutting devices 36 and 38, is actuated by an independent air cylinder 56a and a lever 56b. Specifically, one end of lever 56b is connected to the end of the shaft of the cylinder 56a and the other end thereof is fixedly attached to the lower end of the barrier 54 which, as best seen in Figs. 6 and 7, is L-shaped.

When the laminator 30 is in operation, the output conveyor means 46 travels at the peripheral speed of the lamination rolls 32 and 34. The speed of the input conveyor means 44 is not related to the speed of the laminating rolls 32 and 34. Actually, the input conveyor means 44 stops after the board 40 has been centered and brought forward against the barrier 54.

The laminator 30 includes plate-like support frames at the opposite sides thereof, of which one only, that bearing reference numeral 58, is shown in Fig. 3. Rotatably mounted between the support frames are two film supply rolls or reels 60 and 62 of dry film photoresist material, two film feed rolls 64 and 66, two take-up rolls 68 and 70, two guide rolls 72 and 74, two stripping rolls 76 and 78, and two tension rolls 50 and 82.

Each reel 60 and 62 carries a respectively associated continuous film web 84 and 86 wound around the circumference thereof. The film webs 84 and 86 are each laminated with a respectively associated protective material 88 and 90, which protective material may be polyethylene. Each of the protective materials 88 and 90 is stripped from the associated film web 84 and 86 by the respectively associated stripping roll 76 or 78 and is wound up on the respectively associated take-up roll 68 or 70.

Associated with each of the stripping rolls 76 and 78 is a respectively associated cutting blade 92 and 94 for effecting longitudinal cutting of the dry film webs 84 and 86. Means not shown in Fig. 3 may be provided for effecting lateral adjustment of the cutting blades 92 and 94 with respect to the film webs 84 and 86 for accommodating the lamination of boards 40 of different widths.

Positioned between the support frames 58 are the lamination rolls 32 and 34 and the respectively associated eccentric tacking/cutting devices 36 and 38. The film webs 84 and 86 are drawn in sliding relationship over

a respectively associated fixed curved film guiding surface 96 and 98, which guiding surfaces are associated with the tacking/cutting devices 36 and 38.

As best seen in Fig. 8, the tacking/cutting device 36 and the associated lamination roll 32 is positioned above a plane 100 in which boards 40 to be laminated are placed while the tacking/cutting device 38 and lamination roll 34 are positioned below the plane 100.

In Figs. 3 and 8, the paths through which the tacking/cutting devices 36 and 38 move as they are rotated about the respectively associated lamination rolls 32 and 34 are indicated by the reference numerals 101 and 103.

In a first step in the operation of the laminator 30, the tacking/cutting devices 36 and 38 converge simultaneously from opposite directions toward a board 40 placed in the plane 100 to press and thereby tack the leading end of a respectively associated film web 84 and 86 against the forward end thereof. In a second step, while the devices 36 and 38 are being separated and with the board 40 being maintained immobile, the lamination rolls 32 and 34 converge simultaneously from opposite directions toward the board 40 to press the tacked leading end of an associated one of the films 84 and 86 against the board at precisely the same position where tacking had been effected. The board 40 is then advanced to effect the lamination of the film webs to the surface thereof by the lamination rolls 32 and 34.

The tacking/cutting devices 36 and 38 include respectively associated suitable heated tacking bars 102 and 104. The tacking bars 102 and 104, as best seen in Fig. 25, are mounted between respectively associated pairs of flanges 150, 162 and 174, 186.

Angularly positioned on a vacuum sector 107 on the opposite sides of the tacking bar 102 are vacuum shoes 106 and 108 which have respectively associated film web contacting surfaces 110 and 112. Similarly angularly positioned on a vacuum sector 115 on the opposite sides of the tacking bar 104 are vacuum shoes 114 and 116 having similar respectively associated film web contacting surfaces. The vacuum shoes 106, 108, 114 and 116 may be connected to a common vacuum source such, for example, as a vacuum pump (not shown) by individually associated branch vacuum lines (not shown). A separate control valve may be provided in each such line.

The tacking bars 102 and 104 are rotatable in opposite directions around the respectively associated lamination roll 32 and 34 during the operation of the laminator 30. Specifically, the tacking bar 102 is rotatable in a counterclockwise direction and the tacking bar 104 in a clockwise direction viewing, as seen in Fig. 8.

Fig. 9 shows a board 40 to be laminated positioned under the tacking/cutting device 36 and associated lamination roll 32. The tacking/cutting device 38 and associated lamination roll 34 are not shown in Fig. 9 in the interest of brevity of illustration inasmuch as the device 38 and lamination roll 34 substantially comprise a mirror image of device 36 and lamination roll 32.

Initially, the two tacking/cutting devices 36 and 38 are stationary and are held apart from each other in the correct position to effect the desired tacking of the respective leading ends of the film webs 84 and 86 to the opposite sides of the board 40 at the forward end thereof. The film web 84, as shown in Fig. 9, is drawn over the fixed curved surface 96 and is held in position by suction force provided by the vacuum shoe 110, with the leading end of the film web 84 being positioned under and adjacent the tacking bar 102.

In effecting the tacking operation, as shown in Fig. 10, the tacking/cutting device 36 is moved toward the board 40 to cause the tacking bar 102 to press the leading end of the film web 84 firmly into contact with the surface of the board 40 adjacent the forward end thereof. The tacking temperature, pressure, and time are all adjustable. When the tacking operation has been completed, the film web 84 is not subjected to any pulling force until after the lamination operation begins. The tacking, therefore, can be effected at low temperature and pressure and in a minimum time. At this point, the vacuum in the vacuum shoes 106 and 114 is released by the activation of two electrovalves.

The tacking of the film web 86 to the opposite side of the board 40 by the tacking/cutting device 38 is effected simultaneously with the tacking of film web 84 to the board 40, and in a similar manner, by causing the tacking bar 104 to press the leading end of the film web 86 against the board 40 adjacent the forward end thereof.

After the tacking operation has been completed, the two eccentric tacking devices 36 and 38 are moved apart, with the film webs 84 and 86 tacked to the board 40, as shown in Fig. 11.

In the continued sequence of operation of the laminator 30, as shown in Fig. 12, with the board 40 being maintained immobile, the tacking device 36 is rotated counterclockwise to a waiting position indicated by reference number 105. The tacking device 38 is rotated clockwise to a similar waiting position.

In rotating from the tacking position to the waiting position 105 shown for the tacking device 36, the contacting surfaces 112 and 110 associated respectively with the vacuum shoes 108 and 106 engage the film web 84 and lift it off the curved film guiding surface 96. The contacting surfaces associated with the vacuum devices 116 and 114 of tacking device 38 similarly engage the film web 86 and lift it off its associated curved film guiding surface 98. At the same time each of the lamination rolls 32 and 34 is moved to close on the board 40 at the same line position or region across the width of the respectively associated film web 84 and 86 where the tacking had been effected. The lamination rolls 32 and 34 press the associated film webs 84 and 86 against the opposite surfaces of the board 40, and advance the board 40 therebetween. With the tension rolls 80 and 82 applying tension to the film webs 84 and 86, respectively, the laminating rolls 32 and 34 start to laminate the film webs 84 and 86 thereto, as illustrated in Fig. 13, at a speed, temperature and pressure that may be preset.

Thus, in the operation of the laminator 30, the contacting surface 102a of the tacking bar 102 and an upper forward portion of the board 40 form a first pair of relatively converging surfaces for tacking the leading end of the film web 84 to the board with the surface of the laminating roll 32 and the upper forward portion of the board 40 forming a second pair of relatively converging surfaces. Similarly, the contacting surface 104a of the tacking bar 104 and a lower forward portion of the board 40 form another pair of relatively converging surfaces, which for convenience, is termed hereinafter a third pair of relatively converging surfaces with a fourth pair of relatively converging surfaces being formed by the laminating roll 34 and the lower forward portion of the board 40.

When the end of the board 40 being laminated is detected, as by means of photocell 118 as illustrated in Fig. 14, the tacking/cutting devices 36 and 38 begin revolving around the respectively associated lamination roll 32 and 34 toward the tacking position at a speed that is the same as that of the associated film webs 84 and 86. At the same time, an individually associated movable cutting blade 120 of the shears type, as shown in Fig. 15, is actuated to sever the continuous length of each of the film webs 84 and 86 to form film sheets of such length as to fit or match the length of the board 40 to which the film sheets are being laminated. In effecting such cutting, the movable cutting blade 120 cooperates with a fixed cutting blade or counterblade 121 that is fixedly positioned adjacent the tacking bar 102. The fixed blade 121 is sometimes referred to hereinafter as the counterblade and the blade 120 as the movable blade. The cutting action, as shown in Fig. 14, starts at the positioned designated "START CUTTING" and ends at the position designated "END CUTTING." The cutting blade 120 is advanced at a speed that is the same as that of the film 84 along a path that is that same as that of the tacking bar 102 and fixed cutting blade 121.

The cutting system includes a mechanism for effecting the coupling of the movable cutting blade and the counterblade for cutting operation for each of the tacking/cutting devices 36 and 38 and for effecting such operation.

The complete cutting unit for the tacking/cutting device 36, indicated by the reference numeral 122 in Fig. 15, rotates around the upper lamination roll 32 during the film cutting operation, and follows the movement of the film 84. While the tacking/cutting device for only the tacking/cutting unit 36 is described herein, it will be understood that the cutting unit for the tacking/cutting device 38 may be substantially identical to the cutting unit 122.

The fixed blade 121 is mounted on the rotatable vacuum sector 107, in close contact with the tacking bar 102, and is rotatable with the vacuum shoe 106 through a complete revolution, that is, through 360°, as indicated by the arrow 109 in Fig. 15.

The movable blade 120 is straight and is provided with a 5 mm. cog 120a at a first end. Blade 120 is kept in the rest position shown in Figs. 15 and 16 by a contrast cylinder 120b which supports the blade moving mecha-

nism to which it is connected. When the rotating sector 107 has completed the tacking operation and has been moved to a rest position, the movable blade 120 is moved angularly into a diagonal position by cylinder 120c so that the cog 120a protrudes. This diagonal position is indicated by the dotted lines in Figs. 15 and 16.

When the rotating sector 107 receives a command from the PLC to rotate, to follow the film 84 and to effect the transverse cutting thereof, the counterblade 121 is moved against the cog 120a with the result that the two blades 120 and 121 are moved along together.

The contrast cylinder 120b does not have enough force to preclude the movement of the rotating sector 107, but it keeps the movable blade 120 and the counterblade 121 closely coupled to each other.

As soon as the movable blade 120 and the counterblade 121 are coupled, a cylinder 120d having a double stem actuates levers 120e and 120f. The levers 120e and 120f, by means of cams 120g and 120h, push the movable blade 120 at both ends thereof with the result that the film 84 is cut, the film 84 being positioned between the movable blade 120 and the counterblade 121.

In order to ensure that the movable blade 120 is always in close contact with the counterblade 121, a spring 120i has been provided.

After the cutting of the film has been completed, the rotating sector 107 and the coupled movable blade 120 and counterblade 121 stop. The contrast cylinder 120b is actuated in the same direction as the previous rotation so that the coupling cog 120a of the movable blade 120 is released from the counterblade 121, as shown in Fig. 21. The two cylinders 120c and 120d are then reset and the movable blade 120 is returned to the rest position thereof together with the attached coupling cog 120a. At this time, the contrast cylinder 120b is reset and the movable mechanism 122 together with the movable blade 120 is returned to the rest position, as shown in Fig. 22.

The severing of the film webs 84 and 86 is made in 0.3 of a second. The cutting operation is completed when the tacking/cutting devices 36 and 38 have been revolved approximately half the distance between the waiting position 105 and the tacking position. After being severed, the trailing end of each film sheet is held away from the board 40 being laminated by the associated vacuum shoe 108 and 116, thereby avoiding any tendency for the film sheet to wrinkle while the lamination thereof continues.

As soon as the lamination is completed, as shown in Fig. 24, the lamination rolls 32 and 34 are set apart with the two eccentric tacking/cutting devices 36 and 38 being simultaneously revolved to the tacking positions thereof just in time to be in the correct positions to tack the then leading end of the associated film web 84 or 86 to the opposite sides of the new board 40 that has arrived on the scene to be laminated.

In order to assist in the unwinding of the film webs 84 and 86 from the reels 60 and 62 and to keep the correct film tension during the tacking and laminating oper-

ations, the film feed rolls 64 and 66 and the tension rolls 80 and 82, shown in Fig. 3, are provided.

A detailed view of the assembly of the mechanism for supporting the lamination rolls 32 and 34 and the tacking/cutting devices 36 and 38 is shown in Fig. 25. As there shown, a shaft 124 extending from the left end of the upper lamination roll 32 is supported for rotation in a supporting member 126. A shaft 128 that extends from the right end of lamination roll 32 is supported for rotation in a supporting member 130. Similarly, a shaft 132 extending from the left end of lower lamination roll 34 is supported for rotation in a supporting member 134, and a shaft 136 extending from the right end of lamination roll 34 is supported for rotation in a supporting member 138.

Supporting members 126 and 138 may be identical in structure. Detail views thereof are shown in Figs. 32 and 33. Similarly, supporting members 130 and 134 may be identical in structure with detail views thereof being shown in Figs. 34 and 35.

Fixedly attached to and supported by the supporting members 126 and 130 and extending therebetween is a film guiding sector 140 on which the curved surface 96 previously mentioned is formed. The axis or center or curvature of sector 140 is located at 142, which as seen in Figs. 3, 8-13 and 24, is offset from the center of rotation 143 of the lamination roll 32. A similar film guiding sector 144 is fixedly attached to and extends between the supporting members 132 and 138, the axis or center of curvature of sector 144 being located at 146, as seen in Fig. 3. The previously mentioned curved surface 98 is formed on sector 144.

The structures of the film guiding sectors 140 and 144 may be identical, such structure being illustrated in Figs. 46 and 47.

Tacking bars 102 and 104 are supported for rotation in respective paths 101 and 103 that are in eccentric relation with respect to the individually associated lamination rolls 32 and 34. Specifically, as shown in Fig. 25, the left end of the upper tacking bar 102 is fixedly attached by a tab 148 to a flange 150, the tab 148 being integral with the flange 150 as seen in Figs. 36 and 37. Flange 150 is arranged for rotation around a peripheral surface 152 of supporting member 126. Supporting flange 150 for such rotation is a roller bearing 156 that is positioned between the inner surface 158 thereof and the surface 152 and held in that position by a bearing retaining flange 154. Figs. 38 and 39 illustrate the flange 154 in detail.

Similarly, the right end of tacking bar 102 is fixedly attached by a tab 160 to a flange 162, the tab 160 being integral with the flange 162. Supporting flange 162 for rotation about a peripheral surface 164 of supporting member 130 is a roller bearing 166. Roller bearing 166 is positioned between the surface 164 and the inner surface 168 of flange 162 and is held therebetween by bearing retaining flange 170. Detail views of the bearing retaining flange 170 are shown in Figs. 40 and 41.

The left end of the lower tacking bar 104 is fixedly attached by a tab 172 to a flange 174. Tab 172 is integral

with the flange 174, as shown in Figs. 36 and 37. Flange 174 is supported for rotation about the peripheral surface 176 of supporting member 134, a roller bearing 178 being positioned between the surface 176 and an inner surface 180 of flange 174 and held therein by a bearing retaining flange 182. A detail of flange 182 is shown in Figs. 38 and 39.

The right end of the tacking bar 104 is fixedly attached by a tab 184 to a flange 186, the tab 184 being integral with the flange 186. Flange 186 is supported for rotation about the peripheral surface 188 of supporting member 138. A roller bearing 190 is positioned between the surface 188 of member 138 and in inner surface 192 of flange 186 and is held therein by a bearing retaining flange 194. Detailed views of flange 194 are shown in Figs. 42 and 43.

Two cylinders 191 and 193 (one at the left and one at the right of the machine, as schematically illustrated in Fig. 26) are provided for moving parallel lever systems 195 and 197. The lever systems 195 and 197 are mechanically coupled by means of a shaft 199 so that operation of the cylinders 191 and 193 effect the same movement on the left and right sides of the laminating machine.

The lever systems 195 and 197 rock, that is, drive into and out of the plane of the paper, as seen in Fig. 26, the respective pairs of shoulders 196, 198 and 212, 214. The pairs of shoulders 196, 198 and 212, 214 are pivoted for such rotation on centers of rotation indicated at 196a and 212a, respectively, with the shoulders 196, 198 being arranged to support the upper lamination roll 32 and the shoulders 212 and 214 arranged to support the lower lamination roll 34, as shown in Fig. 27. One central bearing 201 and three peripheric bearings 203, 205 and 207 are provided for the eccentric rotation of the vacuum sector 107, the peripheric bearing 207 being provided with an eccentric adjustment. The vacuum rotating sector 107 carries the tacking bar 102 and counterblade 121.

The two upper shoulders 196 and 198 are laterally separated with respect to the lower shoulders 212 and 214, as shown in Figs. 25, 26 and 27, so that the lamination rolls 32 and 34 can be pressed one against the other.

In the operation of the laminator 30, upon initial movement of the tacking/cutting devices 36 and 38 toward the plane 100 the respectively associated tacking bar 102 and 104 is positioned to tack the leading end of an associated film web 84 and 86 against the opposite sides of a board 40. Upon movement of the tacking/cutting devices 36 and 38 away from the plane 100, the tacking/cutting devices 36 and 38 are rotated counterclockwise and clockwise, respectively, to waiting positions as illustrated at 105 in Figs. 12, 13, and 14. Subsequent movements of the tacking/cutting devices 36 and 38 toward the plane 100 thus allow the respectively associated laminating roll 32 and 34 to make contact with the film web on the precise line at which it had been tacked to a board 40, following which contact lam-

ination of the respective film web 84 and 86 to the board 40 is enabled.

Electromagnetic coupling devices 248 and 250, as shown in Figs. 50 and 51, are provided for controlling the selective actuation of the tacking/cutting devices 36 and 38 for rotation. Two coupling devices (not shown) are provided to stop the laminating rolls 32 and 34 when they are closed and the eccentric sectors are rotating to the rest position. Coupling devices 252 and 254 are provided to start and stop the film feed rolls 64 and 66.

Electromagnetic coupling devices 219 and 221, as shown in Fig. 31, are provided for controlling the film feed rolls 64 and 66. Also provided are notched wheels 234 and 236 which rotate with the film feed rolls 64 and 66, respectively. Proximity switches 238 and 240 individually associated, respectively, with the notched wheels 223 and 225 are provided for sounding an alarm system (not shown) to signal the end of the film and any missed cut.

Heating of the lamination rolls is effected, in accordance with the invention, by infra red lamps that are externally positioned with respect to the laminating rolls 32 and 34. Thus, as shown in Figs. 8-13, an infra red lamp 256, that is suitably supported by brackets 258 and 260 attached to the inner wall of the film guiding sector 140 is provided for heating the lamination roll 32. A similarly positioned and mounted infra red lamp is provided for heating the lamination roll 34. Preferably, the infra red lamps employed are of the so-called short wave type. In one embodiment of the invention the infra red lamps each have an output of 4200 watts.

For controlling the temperature of each of the laminating rolls 32 and 34, there is provided a separate suitably mounted temperature detector for each said roll, which detector is characterized by the capacity thereof to measure the temperature at the peripheral surface of a laminating roll without the introduction of friction and consequent damage thereto and independently of the heat color of the roll surface. Specifically, a temperature detector 262 provided in association with lamination roll 32 comprises a contacting, or more specifically, a rolling type iron-constantan thermocouple 273. Thermocouple 273 is disposed with the hot junction 264 thereof in a hollow sleeve 266 at a position that is coincident with the axis of rotation thereof.

More specifically, the temperature detector 262 comprises an elongated bifurcated support 268 of thermoplastic polyester, reinforced with glass fiber which carries a tubular steel pin 270 between the branches thereof with the iron-constantan thermocouple 273 positioned in the pin 270. One end of steel pin 270 is wrapped around the side of the support 268, as shown, being lodged and retained in a groove 271. The thermocouple 273 extends into the interior of the steel pin 270 through the other end thereof. The roller bearing 266, which preferably is made of a material having high thermal conductivity such as copper, with a thin lining or bushing 272 made of thermoplastic polyester reinforced with glass fiber, rotates on the steel pin 270.

The copper bearing 266 is positioned in rolling contact with the peripheral surface of the laminating roll 32. As a result, the bearing 266 assumes the peripheral speed and temperature of the lamination roll 32.

With this arrangement, the hot junction of the thermocouple 273 assumes substantially the same temperature as that of the lamination roll 32. The difference in temperature, if any, is negligible due to the high thermal conductivity of the copper in the bearing 266 and the thinness of both the bushing 272 and the wall of the tubular pin 270.

As a result, the temperature detector 262 detects the contact temperature of the surface of the rotating lamination roll 32 in a substantially friction free manner independently of the heat color of the surface.

Wearing of the temperature detector 262 is very low, being of the order of 0.03 millimeters per 1000 hours at 3 mts./min. due to the high lubricating properties of the thermoplastic polyester reinforced with glass fiber. It is noted that this material is available commercially from "Schuely" (Nederlan) under the trademark "ARNITE."

In accordance with the invention, a microprocessor is provided in cooperation with the temperature detector 262 for effecting automatic adjustment in the heating level of the infrared lamps and thereby of the temperature of the lamination rolls 32 and 34 depending upon the lamination speed, the thickness of the boards or panels to be laminated, and the pressure of the lamination rolls in order to maintain constant the exit temperature of the laminated boards or panels.

The automatic centering device 48 to which reference has been made hereinbefore and which is shown in Fig. 4 is driven by a direct current low inertia reversible motor 274 and is controlled by a servocontrol 276 which, in turn, is controlled by a Programmable Logic Controller (PLC) 280 that is housed in a mobile electronic control cabinet 282, as shown in Fig. 55. The motor 274 drives a screw 284 for adjusting the lateral positions of spaced parallel edges 286 and 288 between which each panel 40 is advanced by the input conveyor means 44 of the laminator 30.

A panel 40, advanced by the input conveyor 44, intercepts the light beam of a mirror photocell. This photocell further includes one infrared beam emitter 294, one receiver 296 and vertically spaced parallel elongate mirrors 290, 292. A modulated infrared beam emitted by 294 reaches the receiver 296 by a series of reflections on the mirrors, thus forming a net of beam segments. When the panel 40 intercepts one of these beam segments, the receiver 296 signals to the servocontrol 276 that a panel is under the mirrors. The motor 274 is energized and rotates in the direction that closes the parallel edges to center the panel.

When the two parallel edges 286 and 288 close toward the center, the photocells 298 and 300, one of which is located 1 cm. over the edge 286 and the other 1 cm. over the edge 288 and both of which are connected to the servocontrol 276, detect the panel. Sensing of the panel 40 by both photocells 298 and 300 results in a

decrease in the energization of the motor 274 for rotation and consequent slowing down thereof.

With continued advance of the two parallel edges at low speed, panel 40 moves into the sensing path of "stop photocells" 302 and 304, which are carried 1 mm. over the edge of 286 and 288 and also are connected to the servocontrol 276. When the panel 40 is sensed by both the photocells 302 and 304, the energization of the motor 274 is discontinued and the motor 274 stops immediately with the panel 40 properly centered. After a delay of a few seconds, the motor 274 is energized for rotation in the opposite direction and opens the parallel edges 286 and 288.

It is noted that the centering device 48 is characterized by a precision of operation that enables boards or panels having a thickness as small as 0.002 inches (0.05 mm.) to be centered without causing any damage thereto.

In accordance with the invention the main body 42 of the laminator 30 may be completely enclosed in a cabinet 306, as illustrated in Fig. 55, and include in association therewith the aforementioned mobile cabinet 282 in which electronic controls for the laminator 30 may be housed. The mobile cabinet 282 includes the PLC unit 280 previously mentioned, which unit may comprise a LANDIS and GYR with serial line RS232. The mobile cabinet 282 may also contain a microprocessor with intelligent peripherals such as the previously mentioned temperature controller, motor controls, etc., and further includes a video display unit to interface the operator for diagnostic purposes and control of process parameters.

The electronic controls provided in the mobile cabinet 282 enable a high degree of flexibility in operation. Thus, the system is adaptable to automatic, manual, and single stroke operation. An alarm system signals any missed cut, the end of film, missed lamination, and/or output conveyor busy. Additionally, an alarm is given and diagnostic analysis provided for any fault in operation.

Input and output roller tables for conveying the boards to be laminated are provided with adjustable height, independent motor and synchronized speed. The input table is fitted with a centering device and gripping system, as described, for feeding the boards to the lamination rolls. The output table carries temperature sensors to measure the temperature of the boards and photocells to detect jamming of the boards.

The invention enables the achievement of a highly efficient lamination operation, with tacking and cutting being in no way critical.

Claims

1. A process for laminating a film of material (84) to a board (40) having a face, a forward end (41) and a rearward end, comprising the sequential steps of:

- a) gripping the board and advancing it in a predetermined plane (100) to position a face portion of a forward end thereof in cooperative

The copper bearing 266 is positioned in rolling contact with the peripheral surface of the laminating roll 32. As a result, the bearing 266 assumes the peripheral speed and temperature of the lamination roll 32.

With this arrangement, the hot junction of the thermocouple 273 assumes substantially the same temperature as that of the lamination roll 32. The difference in temperature, if any, is negligible due to the high thermal conductivity of the copper in the bearing 266 and the thinness of both the bushing 272 and the wall of the tubular pin 270.

As a result, the temperature detector 262 detects the contact temperature of the surface of the rotating lamination roll 32 in a substantially friction free manner independently of the heat color of the surface.

Wearing of the temperature detector 262 is very low, being of the order of 0.03 millimeters per 1000 hours at 3 mts./min. due to the high lubricating properties of the thermoplastic polyester reinforced with glass fiber. It is noted that this material is available commercially from "Schuely" (Nederlan) under the trademark "ARNITE."

In accordance with the invention, a microprocessor is provided in cooperation with the temperature detector 262 for effecting automatic adjustment in the heating level of the infrared lamps and thereby of the temperature of the lamination rolls 32 and 34 depending upon the lamination speed, the thickness of the boards or panels to be laminated, and the pressure of the lamination rolls in order to maintain constant the exit temperature of the laminated boards or panels.

The automatic centering device 48 to which reference has been made hereinbefore and which is shown in Fig. 4 is driven by a direct current low inertia reversible motor 274 and is controlled by a servocontrol 276 which, in turn, is controlled by a Programmable Logic Controller (PLC) 280 that is housed in a mobile electronic control cabinet 282, as shown in Fig. 55. The motor 274 drives a screw 284 for adjusting the lateral positions of spaced parallel edges 286 and 288 between which each panel 40 is advanced by the input conveyor means 44 of the laminator 30.

A panel 40, advanced by the input conveyor 44, intercepts the light beam of a mirror photocell. This photocell further includes one infrared beam emitter 294, one receiver 296 and vertically spaced parallel elongate mirrors 290, 292. A modulated infrared beam emitted by 294 reaches the receiver 296 by a series of reflections on the mirrors, thus forming a net of beam segments. When the panel 40 intercepts one of these beam segments, the receiver 296 signals to the servocontrol 276 that a panel is under the mirrors. The motor 274 is energized and rotates in the direction that closes the parallel edges to center the panel.

When the two parallel edges 286 and 288 close toward the center, the photocells 298 and 300, one of which is located 1 cm. over the edge 286 and the other 1 cm. over the edge 288 and both of which are connected to the servocontrol 276, detect the panel. Sensing of the panel 40 by both photocells 298 and 300 results in a

decrease in the energization of the motor 274 for rotation and consequent slowing down thereof.

With continued advance of the two parallel edges at low speed, panel 40 moves into the sensing path of "stop photocells" 302 and 304, which are carried 1 mm. over the edge of 286 and 288 and also are connected to the servocontrol 276. When the panel 40 is sensed by both the photocells 302 and 304, the energization of the motor 274 is discontinued and the motor 274 stops immediately with the panel 40 properly centered. After a delay of a few seconds, the motor 274 is energized for rotation in the opposite direction and opens the parallel edges 286 and 288.

It is noted that the centering device 48 is characterized by a precision of operation that enables boards or panels having a thickness as small as 0.002 inches (0.05 mm.) to be centered without causing any damage thereto.

In accordance with the invention the main body 42 of the laminator 30 may be completely enclosed in a cabinet 306, as illustrated in Fig. 55, and include in association therewith the aforementioned mobile cabinet 282 in which electronic controls for the laminator 30 may be housed. The mobile cabinet 282 includes the PLC unit 280 previously mentioned, which unit may comprise a LANDIS and GYR with serial line RS232. The mobile cabinet 282 may also contain a microprocessor with intelligent peripherals such as the previously mentioned temperature controller, motor controls, etc., and further includes a video display unit to interface the operator for diagnostic purposes and control of process parameters.

The electronic controls provided in the mobile cabinet 282 enable a high degree of flexibility in operation. Thus, the system is adaptable to automatic, manual, and single stroke operation. An alarm system signals any missed cut, the end of film, missed lamination, and/or output conveyor busy. Additionally, an alarm is given and diagnostic analysis provided for any fault in operation.

Input and output roller tables for conveying the boards to be laminated are provided with adjustable height, independent motor and synchronized speed. The input table is fitted with a centering device and gripping system, as described, for feeding the boards to the lamination rolls. The output table carries temperature sensors to measure the temperature of the boards and photocells to detect jamming of the boards.

The invention enables the achievement of a highly efficient lamination operation, with tacking and cutting being in no way critical.

Claims

1. A process for laminating a film of material (84) to a board (40) having a face, a forward end (41) and a rearward end, comprising the sequential steps of:

a) gripping the board and advancing it in a pre-determined plane (100) to position a face portion of a forward end thereof in cooperative



- relation with a tacking surface (102a) and a laminating surface (32) which are movable alternately towards and away from said face portion;
- b) supplying a length of said film (84) with a leading end thereof adjacent said tacking surface (102a);
- c) initiating movement of said tacking surface in a path substantially perpendicular to said predetermined plane to press the leading end of the film into pressure contact with the forward face portion of the board to tack the leading end of the film thereto;
- d) while maintaining the board immobile, initiating movement of said tacking surface (102a) to separate it from the forward face portion of the board and initiating movement of the laminating surface (32) into pressure contact with substantially the same forward face position of the board to which the leading end of the film has been tacked; and
- e) advancing the board relative to the laminating surface, with pressure contact maintained therebetween, to press the film along its length to the face of the board, characterised in that the length of film (84) is supplied along a curved film guiding surface (96) having a centre of curvature (142) that is offset, in a direction away from said plane, with respect to an axis (143) which is movable substantially perpendicularly towards and away from the predetermined plane, and in that in step (d) the tacking surface (102a) is rotated eccentrically about said axis (143) to a waiting position, at the same time as movement of the laminating surface (32) into pressure contact with the board is initiated.
2. A process according to claim 1 in which the board (40) is aligned with the forward end (41) adjusted to face squarely with respect to said tacking and laminating surfaces (102a, 32) prior to step (a), the alignment and adjustment being retained by the gripping of a support member (52, 56) in step (a).
 3. A process according to claim 2 in which the board has side edges and the alignment thereof is effected by conveying the board along a path, sensing by noncontacting means (290, 292, 294, 296) the side edges of the boards, and laterally shifting the boards as required to bring them into alignment.
 4. A process according to claim 2 or claim 3 in which the adjustment of the board causing the forward end (41) thereof to face squarely with respect to said tacking and laminating surfaces (102a, 32) is effected by conveying the board along a path into contact with a barrier (54) that is disposed in parallel relation to said tacking and laminating surfaces.
 5. A process according to any preceding claim including the further steps of:
 - (f) supplying a continuous length of curable dry film (84) of polymeric material to the upstream side of said tacking and laminating surfaces (102a, 32) without contact with the face of the board (41);
 - (g) advancing the film with respect to said laminating surface (32) in response to the movement of the board; and
 - (h) cutting the film to proper length fitted to the face of the board without interrupting the action of pressing the film to the face of the board.
 6. A process according to claim 5 wherein the curable dry film (84) of polymeric material is photosensitive.
 7. A process according to claim 5 or claim 6 wherein the cutting of the film is effected by a cutter (120, 121) of the shears type.
 8. A process according to any preceding claim wherein said laminating surface is the surface of a laminating roll having said axis (143) as its axis of rotation.
 9. A process according to any preceding claim wherein two said films (84, 86) are laminated simultaneously onto respective first and second opposite faces of the board (40);

wherein in step (a) a first face portion of the forward end (41) of the board on one side thereof is positioned in cooperative relation with a first said tacking surface (102a) and a first said laminating surface (32) and a second face portion of said forward end on the opposite side thereof is positioned in cooperative relation with a second said tacking surface (104a) and a second said laminating surface (34);

wherein in step (b) a first said film (84) is supplied along said film guiding surface (140) for lamination to said first face portion and a second said film (86) is supplied along a second said movable curved film guiding surface (98) whose centre of curvature (146) is offset, in a direction away from said plane, with respect to an axis which is movable substantially perpendicularly towards and away from said predetermined plane;

wherein in step (c) said tacking surfaces (102a, 104a) are moved towards one another in directions substantially perpendicular to said plane to tack respective leading ends of said films (84, 86) to said first and second face portions;

wherein in step (d) said tacking surfaces (102a, 104a) are separated from the respective forward face portions of the board and rotated in opposite directions about the respective movable axes to respective waiting positions and at the same time the first and second laminating surfaces (32, 34) are moved from opposite sides of the board into pres-



sure contact with respective tacked forward face portions of the board;
and wherein in step (e) the board passes between said laminating surfaces (32, 34) with pressure contact to press said films (84, 86) simultaneously along their length to opposite faces of the board.

10. A process according to any preceding claim wherein steps (a) to (e) are repeated to laminate a film or films of material (84, 86) onto one or both sides of each of a succession of said boards.
11. Apparatus for laminating a film of material (84) to a board (40), comprising a lamination roll (32), supporting members (126, 130) arranged to support said lamination roll for rotation about a first axis (143), a tacking bar (102) and means for moving the tacking bar and the laminating roll successively into and out of a predetermined position in a fixed plane (100) to tack and laminate the film to the board, characterised in that the supporting members (126, 130) have peripheral substantially circular surfaces (152, 164) positioned about a second axis (142), said first and second axes being positioned in spaced and substantially parallel relation with one another and with said plane (100) with the first axis (143) closer to the plane than the second axis (142), in that the tacking bar (102) is supported by flanges (150, 162) for rotation about said second axis, said flanges being positioned for rotation about said peripheral surfaces (152, 164) and in that means are provided for moving said flanges and said support members together towards and away from said predetermined position, in concert with rotation of the tacking bar about said second axis.
12. Laminating apparatus according to claim 11 wherein said flanges (150, 162) include peripheral surfaces (158, 168) centred substantially around said second axis, and wherein means for moving the flanges and support members comprises shoulders (196, 198) in which said peripheral surfaces of said flanges are supported for rotation, said shoulders being pivoted for rotation on a third axis (196a) that is positioned on the same side of said plane (100) as said first and second axes (143, 142) and is parallel to said first and second axes.
13. Lamination apparatus according to claim 12 further including cylinder means (191, 193) attached to and operative to rock said shoulders (196, 198) about said third axis (196a) thereby to move said flanges towards and away from said plane (100).
14. Laminating apparatus according to any one of claims 11 to 13 further including:
a conveyor for advancing a board (40) coincident with said plane (100) to a position wherein a

forward end surface thereof is substantially coincident with said predetermined position, and

means for positioning a leading end of said film of material (84) in cooperative relation with said tacking bar (102),

whereby upon movement of said tacking bar toward said predetermined position in said plane the leading end of said film sheet is pressed and thereby tacked to said forward surface portion of said board, and

whereby upon subsequent movement of said lamination roll (32) toward said predetermined position and upon subsequent further advancement by said conveyor of said board coincident with said plane said film material is pressed to the said surface of said board from the forward to the rearward end thereof.

15. Laminating apparatus according to claim 14, further including:

means operative, upon movement of said tacking bar (102) from said predetermined position on said plane (100), to rotate said tacking bar through a path to a waiting position, the initial direction of such rotation being forward of the forward end (41) of said board and the extent of rotation to the waiting position being substantially less than a complete revolution;

means for supplying a continuous web of said film material (84) along a predetermined path that is in intersecting relation with the path through which said tacking bar is rotated to said waiting position;

a counterblade (121) positioned contiguously to said tacking bar and movable therewith;

a movable cutting blade (120) of the shears type;

means for moving said movable cutting blade into operative relation with said counterblade and with said film web while said tacking bar is in said waiting position, and

means (122) for actuating said movable cutting blade across said film web while said film web is being supplied through said predetermined path for pressing on the surface of said board by said lamination roll for cutting the film sheet into a length such that the trailing end of the film sheet matches a predetermined position at a rearward end portion of said board,

whereby said film sheet is pressed by said lamination roll on the surface of the board without interruption in such pressing operation due to cutting of such film sheet length from said film web.

16. Laminating apparatus according to claim 15, further including:

vacuum means (106, 107, 108) for guiding the trailing end of the cut film sheet to prevent wrinkling thereof as it is being pressed on the surface of said board (40) by said lamination roll (32).



17. Laminating apparatus according to claim 16, wherein said means (122) for moving the cutting blade (120) into operative relation with said counter-blade (121) includes double acting piston cylinder (120b). 5
18. Laminating apparatus according to any one of claims 11 to 17 further including:
 an elongated sector (140) carried by said shoulders, said sector having an inner wall with a centre of curvature that is coincident with said second axis (142), and 10
 an infrared lamp (256) mounted on said inner wall of the sector (140) for heating said lamination roll (32). 15
19. Laminating apparatus according to claim 18, further including:
 a temperature detector (262) for measuring the temperature of said lamination roll, said temperature detector including a hollow sleeve roller bearing (266) disposed in rolling contact with the surface of said lamination roll (32) and a thermocouple (273) having the hot junction (264) thereof positioned approximately coincidental with the centre of rotation of said hollow sleeve roller bearing, and 20
 means controlled by said temperature detector for controlling the intensity of energization of said infrared lamp. 25
20. Laminating apparatus according to claim 19, wherein said thermocouple (273) is of the iron-constantan type. 30
21. Laminating apparatus according to claim 19 or claim 20 wherein the temperature detector (262) comprises:
 an elongated bifurcated support member (268) having first and second sides with the branches thereof having forward edge portions; 35
 a hollow pin (270) extending between and supported by the said forward edge portions of said branches of said support member, said hollow pin having a first end wrapped around said first side of said support member and retained in a groove (271) therein and having a second end terminating at said second side of said support member, the hollow sleeve bearing (266) being positioned for rotation on said hollow pin between the branches of said support member, and 40
 a bushing (272) for said hollow sleeve bearing comprising a thin layer of thermoplastic polyester reinforced with glass fiber, the thermocouple (273) extending onto said second end of said hollow pin with the hot junction (264) thereof substantially coincidental with the centre of rotation of said hollow sleeve bearing. 45 50 55
22. Laminating apparatus according to claim 21, wherein said support member (268) is made of thermoplastic polyester reinforced with glass fiber and said hollow pin (270) is made of steel.
23. Laminating apparatus according to any one of claims 18 to 22, wherein said hollow sleeve bearing (266) is made of a material having high thermal conductivity.
24. Laminating apparatus according to any one of claims 11 to 22 further including an automatic centring device (48) for centring a board (40) with parallel side edges being conveyed into the apparatus, said centring device comprising:
 means providing adjustable spaced parallel edges (286, 288) between which said board is conveyed with the side edges thereof substantially parallel to said adjustable spaced parallel edges,
 a reversible motor (274) and a screw (284) connected between said adjustable spaced parallel edges for effecting lateral displacement thereof,
 a pair of vertically spaced elongated parallel mirrors (290, 292) between which said board is moved as said board is conveyed into the machine, said mirrors having adjacent first ends and adjacent second ends and being positioned substantially perpendicularly with respect to said adjustable spaced parallel edges,
 modulated infrared beam emitting means (294) positioned adjacent said first ends of said mirrors,
 infrared beam receiving means (296) positioned adjacent said second ends of said mirrors and operative to respond to infrared reflections therebetween thereby to provide a signal to said reversible motor (274) that said board is between said mirrors for effecting energization thereof in the direction to close said parallel edges to centre said board,
 a slowing down photocell (298, 300) positioned above each of said adjustable spaced parallel edges, each of said slowing down photocells being arranged to respond to the presence of said board to provide a signal for effecting a decrease in the energization of said reversible motor,
 a stop photocell (302, 304) positioned above each of said adjustable spaced parallel edges and arranged to respond to the presence of said board to provide a signal for effecting a discontinuance of the energization of said reversible motor, and
 a servocontrol (276) to which said signals from said infrared beam receiving means, slowing down photocells, and stop photocells are applied for controlling the operation of said reversible motor to close said adjustable spaced parallel edges to centre said board, the signals from said slowing down photocells being operative to effect a slowing down action on said reversible motor, and the signals from said stop photocells being operative to effect stop-



ping of said reversible motor,

whereby precise centring of said board is effected with the side edges thereof parallel to said adjustable spaced parallel edges.

25. Laminating apparatus according to any one of claims 11 to 24, including a main body (42) with a pair of support frames (58) between which are located a tacking and laminating station (39), an input conveyor (44) for conveying a board (40) in said plane (100) to said predetermined position, an output conveyor (46) to convey the laminated board away from said predetermined position and means (50) for holding the board immobile from completion of the tacking operation until the beginning of the pressure rolling operation, to ensure that the pressure rolling operation begins at substantially the same position at the forward end (41) of the board at which the end of the film has been tacked thereto.
26. Laminating apparatus according to claim 25 comprising two similar tacking and laminating devices, positioned respectively above and below said plane in a mirror image formation, to laminate two said films of material (84, 86) simultaneously onto opposite sides of the board (40).

Patentansprüche

1. Verfahren zum Laminieren eines Materialfilms (84) auf eine Platte (40), die eine Fläche, ein vorderes Ende (41) und ein rückwärtiges Ende hat, mit den aufeinanderfolgenden Schritten des:
- a) Greifens der Platte und ihres Vorbewegens in eine vorbestimmte Ebene (100), um einen Flächenteil eines ihres Vorderendes in einer zusammenwirkenden Beziehung mit einer Anheftoberfläche (102a) und einer Laminieroberfläche (32) zu positionieren, die abwechselnd zu diesem Flächenteil hin und von ihm weg bewegbar sind;
- b) Zuführens einer Länge des Filmes (84), wobei eines seiner Vorderenden an die Anheftoberfläche (102a) angrenzt;
- c) Einlebens der Bewegung der Anheftoberfläche in einem Weg, der im wesentlichen senkrecht zu der vorbestimmten Ebene ist, um das Vorderende des Filmes in Preßkontakt mit dem vorderen Flächenteil der Platte zu pressen, um das Vorderende des Filmes daran anzuheften;
- d) Einlebens, während die Platte immobil gehalten wird, der Bewegung der Anheftoberfläche (102a), um sie von dem vorderen Flächenteil der Platte zu trennen, und Einlebens der Bewegung der Laminieroberfläche (32) in Druckkontakt mit im wesentlichen demselben vorderen Flächenteil der Platte, an welche das Vorderende des Filmes angeheftet wurde; und

e) Vorbewegens der Platte bezüglich der Laminieroberfläche, wobei Druckkontakt dazwischen aufrechterhalten wird, um den Film entlang seiner Länge an die Fläche der Platte zu pressen, dadurch gekennzeichnet, daß die Länge des Filmes (84) entlang einer gekrümmten FilmführungsOberfläche (96) zugeführt wird, die ein Krümmungszentrum (142) hat, das in einer Richtung von der Ebene weg, bezüglich einer Achse (143) versetzt ist, die im wesentlichen senkrecht gegen eine vorbestimmte Ebene und von dieser wegbewegbar ist, und daß bei Schritt (d) die Anheftoberfläche (102a) exzentrisch um die Achse (143) in eine Warteposition zur selben Zeit gedreht wird, wenn die Bewegung der Laminieroberfläche (32) in Druckkontakt mit der Platte eingeleitet wird.

2. Verfahren nach Anspruch 1, wobei die Platte (40) mit dem vorderen Ende (41) ausgerichtet wird, die ausgerichtet ist, direkt in Bezug auf die Anheft- und Laminieroberflächen (102a, 32) vor dem Schritt (a) gegenüber zu liegen, wobei die Ausrichtung und Einstellung durch das Greifen eines Stützteils (52, 56) in Schritt (a) zurückgehalten werden.
3. Verfahren nach Anspruch 2, wobei die Platte Seitenkanten hat und ihre Ausrichtung durch Fördern der Platte entlang eines Weges, Abtasten der Seitenkanten der Platten durch nicht berührende Mittel (290, 292, 294, 296) und seitliches Verschieben der Platten durchgeführt wird, wie es erforderlich ist, um sie in Ausrichtung zu bringen.
4. Verfahren nach Anspruch 2 oder Anspruch 3, wobei die Einstellung der Platte, welche ihr Vorderende (41) veranlaßt, direkt bezüglich der Anheft- und Laminieroberflächen (102a, 32) gegenüber zu liegen, durch Fördern der Platte entlang eines Weges in Kontakt mit einer Sperre (54) durchgeführt wird, die in paralleler Beziehung zu den Anheft- und Laminieroberflächen angeordnet ist.
5. Verfahren nach einem vorhergehenden Anspruch mit den weiteren Schritten:
- (f) Zuführen einer fortlaufenden Länge eines aushärtbaren, trockenen Filmes (84) aus polymerem Material zu der abstromigen Seite der Anheft- und Laminieroberflächen (102a, 32) ohne Kontakt mit der Fläche der Platte (41);
- (g) Vorbewegen des Filmes bezüglich der Laminieroberfläche (32) in Abhängigkeit von der Bewegung der Platte; und
- (h) Schneiden des Filmes in geeignete Länge, die zu der Fläche der Platte paßt, ohne die Preßfähigkeit des Filmes an die Fläche der Platte zu unterbrechen.



6. Verfahren nach Anspruch 5, wobei der aushärtbare, trockene Film (84) aus polymärem Material fotosensitiv ist.
7. Verfahren nach Anspruch 5 oder Anspruch 6, wobei das Schneiden des Filmes durch eine Schneideinrichtung (120, 121) vom Scherentyp durchgeführt wird.
8. Verfahren nach einem vorhergehenden Anspruch, wobei die Laminieroberfläche die Oberfläche einer Laminierrolle ist, welche die Achse (143) als ihre Drehachse hat.
9. Verfahren nach einem vorhergehenden Anspruch, wobei die zwei Filme (84, 86) gleichzeitig auf die ersten bzw. zweiten gegenüberliegenden Seiten der Platte 40 laminiert werden;
wobei in Schritt (a) ein erster Flächenteil des vorderen Endes (41) der Platte auf einer ihrer einen Seite in zusammenwirkender Beziehung mit einer ersten Anheftoberfläche (102a) und einer ersten Laminieroberfläche (32) positioniert wird und ein zweiter Flächenteil des vorderen Endes auf ihrer entgegengesetzten Seite in zusammenwirkender Beziehung mit einer zweiten Anheftoberfläche (104a) und einer zweiten Laminieroberfläche (34) positioniert wird;
wobei in Schritt (b) ein erster Film (84) entlang der Filmführungsfläche (140) zum Laminieren auf das erste Flächenteil zugeführt wird und ein zweiter Film (86) entlang einer zweiten beweglichen, gekrümmten Filmführungsfläche (98) zugeführt wird, deren Krümmungszentrum (146) in einer Richtung von der Ebene weg, bezüglich einer Achse versetzt ist, die im wesentlichen senkrecht zu der vorbestimmten Ebene und von dieser wegbeweglich ist;
wobei in Schritt (c) die Anheftoberflächen (102a, 104a) gegeneinander in Richtungen bewegt werden, die im wesentlichen senkrecht zu der Ebene sind, um die jeweiligen vorderen Enden der Filme (84, 86) an die ersten und zweiten Flächenteile anzuheften;
wobei in Schritt (d) die Anheftoberflächen (102a, 104a) von den jeweiligen vorderen Flächenteilen der Platte getrennt und in entgegengesetzten Richtungen um die jeweiligen beweglichen Achsen zu entsprechenden Wartepositionen gedreht werden, und zur selben Zeit die ersten und zweiten Laminieroberflächen (32, 34) von den entgegengesetzten Seiten der Platte in Druckkontakt mit den entsprechenden, angehefteten vorderen Flächenteilen der Platte bewegt werden;
und wobei in Schritt (e) die Platte zwischen den Laminieroberflächen (32, 34) mit Druckkontakt hindurchgehen, um die Filme (84, 86) gleichzeitig entlang ihrer Länge an die entgegengesetzten Flächen der Platte zu pressen.
10. Verfahren nach einem vorhergehenden Anspruch, wobei Schritte (a) bis (e) wiederholt werden, um einen Film oder Materialfilme (84, 86) auf eine oder beide Seiten jeder Platte einer Folge von Platten zu laminieren.
11. Vorrichtung zum Laminieren eines Materialfilmes (84) an eine Platte (40), mit einer Laminierrolle (32), Stützteilen (126, 130), die angeordnet sind, die Laminierrolle für die Drehung um eine erste Achse (143) zu stützen, einem Anheftstab (102) und Mitteln, um den Anheftstab und die Laminierrolle nacheinander in eine vorbestimmte Position in einer festen Ebene (100) und aus dieser hinaus zu bewegen, um den Film an der Platte anzuheften und zu laminieren, dadurch gekennzeichnet, daß die Stützteile (126, 130) am Umfang im wesentlichen kreisrunde Oberflächen (152, 164) haben, die um eine zweite Achse (142) positioniert sind, wobei die ersten und zweiten Achsen in im Abstand gehaltener und im wesentlichen paralleler Lage zueinander und zu der Ebene (100) positioniert sind, wobei die erste Achse (143) näher an der Ebene ist, als die zweite Achse (142), daß der Anheftstab (102) durch Flansche (150, 162) für die Drehung um die zweite Achse gehalten wird, wobei die Flansche für Drehung um die Umfangsoberflächen (152, 164) positioniert werden, und das Mittel für die Bewegung der Flansche und der Stützteile miteinander zu der vorbestimmten Position hin und von dieser weg gemeinsam mit Drehung des Anheftstabes um die zweite Achse vorgesehen sind.
12. Laminiervorrichtung nach Anspruch 11, wobei die Flansche (150, 162) Umfangsoberflächen (158, 168) aufweisen, die im wesentlichen um die zweite Achse zentriert sind, und wobei Mittel zum Bewegen der Flansche und Stützteile Schultern (196, 198) aufweisen, in welchen die Umfangsoberflächen der Flansche für Rotation gehalten sind, wobei die Schultern für Rotation auf einer dritten Achse (196a) drehbar sind, die auf derselben Seite der Ebene (100) wie die ersten und zweiten Achsen (143, 142) positioniert ist und sich parallel zu den ersten und zweiten Achsen befindet.
13. Laminiervorrichtung nach Anspruch 12, die ferner Zylindermittel (191, 193) aufweist, welche an den Schultern (196, 198) angebracht sind und diese betrieblich um die dritte Achse (196a) schwenken, wodurch die Flansche zur Ebene (100) hin und von dieser wegbewegt werden.
14. Laminiervorrichtung nach einem der Ansprüche 11 bis 13, die ferner aufweist:
eine Fördereinrichtung zum Vorbewegen einer Platte (40), die mit der Ebene (100) in einer Position zusammenfällt, wobei ihre eine vorwärts gerichtete Endoberfläche im wesentlichen mit der vorbestimm-



mten Position übereinstimmt, und Mittel zum Positionieren eines Vorderendes des Materialfilmes (84) in zusammenwirkender Beziehung mit dem Anheftestab (102), wodurch auf Bewegung des Anheftestabes zu der vorbestimmten Position in der Ebene hin das Vorderende des Filmblattes gepreßt wird und dadurch an den vorwärts gerichteten Oberflächenteil der Platte angeheftet wird, und wodurch auf anschließende Bewegung der Laminierrolle (32) zu der vorbestimmten Position hin und auf anschließendes weiteres Vorbewegen durch die Fördereinrichtung der Platte, die mit der Ebene zusammenfällt, der Materialfilm an die Oberfläche der Platte von seinem vorwärts gerichteten zum rückwärts gerichteten Ende gepreßt wird.

15. Laminiervorrichtung nach Anspruch 14, die ferner aufweist:

Mittel, die betriebsbereit sind, auf Bewegung des Anheftestabes (102) von der vorbestimmten Position auf der Ebene (100) den Anheftestab über einen Weg zu einer Warteposition zu drehen, wobei die Anfangsrichtung einer solchen Drehung nach vorwärts von dem nach vorwärts gerichteten Ende (41) der Platte gerichtet ist und die Drehgröße zu der Warteposition im wesentlichen geringer ist als eine vollständige Umdrehung;

Mittel zum Zuführen einer fortlaufenden Bahn des Materialfilmes (84) entlang eines vorbestimmten Weges, der sich in kreuzender Beziehung zu dem Weg befindet, über welchen der Anheftestab zu der Warteposition gedreht wird;

ein Gegenmesser (121), das an den Anheftestab angrenzend und mit diesem beweglich positioniert ist;

ein bewegliches Abschneidemesser (120) vom Scherentyp;

Mittel zum Bewegen des beweglichen Abschneidmessers in Betriebsbeziehung mit dem Gegenmesser und mit der Filmbahn, während der Anheftestab sich in Warteposition befindet, und

Mittel (122) zum Betätigen des beweglichen Abschneidmessers über die Filmbahn, während die Filmbahn durch den vorbestimmten Weg zum Pressen auf der Oberfläche der Platte durch die Laminierrolle zugeführt wird, um das Filmblatt in eine solche Länge zu schneiden, daß das hintere Ende des Filmblattes zu einer vorbestimmten Position an einem rückwärtigen Endteil der Platte paßt,

wodurch das Filmblatt durch die Laminierrolle auf die Oberfläche der Platte gepreßt wird, ohne Unterbrechung in einer solchen Preßstätigkeit aufgrund des Schneidens einer solchen Filmblattlänge von der Filmbahn.

16. Laminiervorrichtung nach Anspruch 15, die ferner aufweist:

Vakuummittel (106, 107, 108) zum Führen des

hinteren Endes des geschnittenen Filmblattes, um sein Zerknittern zu vermeiden, wenn es auf die Oberfläche der Platte (40) durch die Laminierrolle (32) gepreßt wird.

17. Laminiervorrichtung nach Anspruch 16, wobei das Mittel (122), welches das Abschneidemesser (120) in zusammenwirkende Beziehung mit dem Gegenmesser (121) bringt, einen doppelt wirkenden Kolbenzylinder (120b) aufweist.

18. Laminiervorrichtung nach einem der Ansprüche 11 bis 17, die ferner aufweist:
einen durch die Schultern getragenen verlängerten Sektor 140, der eine Innenwand mit einem Krümmungszentrum hat, das mit der zweiten Achse (142) zusammenfällt, und eine auf der Innenwand des Sektors (140) befestigte Infrarotlampe (256) zum Erhitzen der Laminierrolle (32).

19. Laminiervorrichtung nach Anspruch 18, die ferner aufweist:

einen Temperaturgeber (262) zum Messen der Temperatur der Laminierrolle, wobei der Temperaturgeber ein Hohlhülsenrollager (266) aufweist, das in Rollkontakt mit der Oberfläche der Laminierrolle (32) angeordnet ist und ein Thermoelement (273), dessen Meßstelle (264) ungefähr mit dem Krümmungszentrum des Hohlhülsenrollagers zusammenfallend angeordnet ist, und durch den Temperaturgeber gesteuerte Mittel, um die Erregungsintensität der Infrarotlampe zu steuern.

20. Laminiervorrichtung nach Anspruch 19, wobei das Thermoelement (273) vom Eisen-Konstanten-Typ ist.

21. Laminiervorrichtung nach Anspruch 19 oder Anspruch 20, wobei der Temperaturgeber (262) aufweist:

ein verlängertes, gegabeltes Stützteil (268), das erste und zweite Seiten hat, deren Schenkel nach vorwärts gerichtete Kantenteile haben;
einen Hohlstift (270), der sich zwischen den nach vorn gerichteten Kantenteilen der Schenkel des Stütztes erstreckt und von diesen gehalten wird, wobei der Hohlstift ein erstes Ende hat, das um die erste Seite des Stütztes gewickelt und in einer darin vorhandenen Nut (271) gehalten wird und ein zweites Ende hat, das an der zweiten Seite des Stütztes endet, wobei das Hohlhülsenlager (266) für die Drehung auf dem Hohlstift zwischen den Schenkel des Stütztes angebracht ist, und eine Büchse 272 für das Hohlhülsenlager mit einer dünnen Schicht von glasfaserverstärktem, thermoplastischem Polyester, wobei sich das Thermoelement (273) auf dem zweiten Ende des Hohlstiftes erstreckt, wobei seine Meßstelle (264) im wesentli-



chen mit dem Rotationszentrum des Hohlhülsenlagers zusammenfällt.

22. Laminiervorrichtung nach Anspruch 21, wobei das Stützteil (268) aus glasfaserverstärktem, thermoplastischem Polyester hergestellt ist und der Hohlstift (270) aus Stahl hergestellt ist. 5
23. Laminiervorrichtung nach einem der Ansprüche 18 bis 22, wobei das Hohlhülsenlager (266) aus einem Material hergestellt ist, das hohe Wärmeleitfähigkeit hat. 10
24. Laminiervorrichtung nach einem der Ansprüche 11 bis 22, die ferner eine automatische Zentrierung (48) aufweist, um eine Platte (40) zu zentrieren, wobei die parallelen Seitenkanten in die Vorrichtung befördert werden und die Zentrierung aufweist: Mittel, die feineinstellbare, in Abstand gehaltene, parallele Kanten (286, 288) schafft, zwischen denen die Platte befördert wird, wobei ihre Seitenkanten im wesentlichen parallel zu den feineingestellten, in Abstand gehaltenen, parallelen Kanten ist, 20
- einen Umkehrmotor (274) und eine Schraube (284), die zwischen den feineingestellten, in Abstand gehaltenen, parallelen Kanten verbunden sind, um ihr seitliches Verschieben zu bewirken, 25
- ein Paar von vertikal in Abstand angeordneten, länglichen, parallelen Spiegeln (290, 292), zwischen denen die Platte bewegt wird, wenn die Platte in die Maschine befördert wird, wobei die Spiegel angrenzende erste Enden und angrenzende zweite Enden haben und im wesentlichen senkrecht bezüglich den feineingestellten, in Abstand gehaltenen, parallelen Kanten angeordnet sind, 30
- modulierte Infrarotstrahlen emittierende Mittel (294), die angrenzend an die ersten Enden der Spiegel angeordnet sind, 35
- Infrarotstrahlen aufnehmende Mittel (296), die angrenzend an die zweiten Enden der Spiegel angeordnet und betriebsfähig sind, auf Infrarotreflexion dazwischen anzusprechen, wodurch dem Umkehrmotor (274) ein Signal geliefert wird, daß sich die Platte zwischen den Spiegeln befindet, um ihre Erregung in die Richtung zu bewirken, daß die parallelen Kanten für die Zentrierung der Platte geschlossen werden, 45
- eine langsam werdende Fotozelle (298, 300), die oberhalb jeder der feineingestellten, in Abstand gehaltenen parallelen Kanten angeordnet ist, wobei jede langsam werdende Fotozelle angeordnet ist, um auf die Anwesenheit der Platte für die Schaffung eines Signales anzusprechen, um ein Abnehmen der Erregung des Umkehrmotors zu bewirken, eine Stoppfotozelle (302, 304), die oberhalb jeder der feineingestellten, in Abstand gehaltenen, parallelen Kanten angeordnet und eingerichtet ist, um auf die Anwesenheit der Platte für die Schaffung eines Sig-

nales anzusprechen, um die Unterbrechung der Erregung des Umkehrmotors zu bewirken, und eine Servosteuerung (276), auf welche die Signale von den Infrarotstrahlen aufnehmenden Mitteln, langsam werdenden Fotozellen und Stoppfotozellen aufgebracht werden, um den Betrieb des Umkehrmotors für die Schließung der feineingestellten, in Abstand gehaltenen, parallelen Kanten zu steuern, um die Platte zu zentrieren, wobei die Signale von den langsam werdenden Fotozellen betriebsfähig sind, auf den Umkehrmotor eine langsam werdende Tätigkeit auszuüben, und wobei die Signale von den Stoppfotozellen betriebsfähig sind, das Anhalten des Umkehrmotors zu bewirken, wodurch genaues Zentrieren der Platte bewirkt wird, wobei seine Seitenkanten sich parallel zu den feineingestellten, in Abstand gehaltenen, parallelen Kanten befinden.

25. Laminiervorrichtung nach einem der Ansprüche 11 bis 24, die einen Hauptkörper (42) mit einem Paar von Stützrahmen (58) aufweist, zwischen denen eine Anhefte- und Laminierstation (39) angeordnet sind, eine Eingabefördereinrichtung (44), um eine Platte (40) in der Ebene (100) zu der vorbestimmten Stellung zu befördern, eine Ausgabefördereinrichtung (46), um die laminierte Platte von der vorbestimmten Position wegzubefördern, und Mittel (50), um die Platte von der Beendigung der Anheftetätigkeit bis zum Beginn der Druckrolltätigkeit fest zu halten und sicherzustellen, daß die Druckrolltätigkeit an im wesentlichen derselben Position an dem vorderen Ende (41) der Platte beginnt, an welcher das Filmende angeheftet wurde.
26. Laminiervorrichtung nach Anspruch 25 mit zwei ähnlichen Anhefte- und Laminiervorrichtungen, die oberhalb bzw. unterhalb der Ebene in einer Spiegelbildform angeordnet sind, um zwei Materialfilme (84, 86) gleichzeitig auf entgegengesetzte Seiten der Platte (40) zu laminieren.

Revendications

1. Procédé de stratification d'un film d'une matière (84) sur une carte (40) ayant une face, une extrémité avant (41) et une extrémité arrière, comprenant les étapes successives suivantes :
- a) le serrage de la carte et son avance dans un plan prédéterminé (100) afin qu'une partie de face de l'extrémité avant de la carte soit positionnée en coopération avec une surface d'adhésivité (102a) et une surface de stratification (32) qui sont mobiles en alternance afin qu'elles se rapprochent et s'écartent de ladite partie de face,



- b) la transmission d'un tronçon de film (84) de manière qu'une extrémité avant de celui-ci soit adjacente à la surface d'adhésivité (102a),
- c) le déclenchement d'un déplacement de la surface d'adhésivité sur un trajet qui est sensiblement perpendiculaire au plan prédéterminé afin que l'extrémité avant du film soit repoussée en contact sous pression avec la partie de surface avant de la carte afin que l'extrémité avant du film soit collée à celle-ci,
- d) alors que la carte est maintenue immobile, le déclenchement du déplacement de la surface d'adhésivité (102a) afin qu'elle se sépare de la partie de face avant de la carte et le déclenchement du déplacement de la surface de stratification (32) en contact sous pression pratiquement avec la même position de la face avant de la carte sur laquelle l'extrémité avant du film a été collée, et
- e) l'avance de la carte par rapport à la surface de stratification, avec maintien entre elles d'un contact sous pression, afin que le film soit repoussé sur sa longueur vers la face de la carte,
- caractérisé en ce que le tronçon de film (84) est transmis le long d'une surface courbe (96) de guidage de film ayant un centre de courbure (142) qui est décalé, du côté qui l'écarte du plan, par rapport à un axe (143) qui est mobile en direction pratiquement perpendiculaire au plan prédéterminé, et en ce que, dans l'étape (d), la surface d'adhésivité (102a) est tournée excentriquement autour dudit axe (143) vers une position d'attente, en même temps que commence un déplacement de la surface de stratification (32) en contact sous pression avec la carte.
2. Procédé selon la revendication 1, caractérisé en ce que la carte (40) est alignée sur l'extrémité avant (41) ajustée afin qu'elle soit bien orientée en face des surfaces d'adhésivité et de stratification (102a, 32) avant l'étape (a), l'alignement et l'ajustement étant conservés grâce au serrage d'un organe de support (52, 56) dans l'étape (a).
 3. Procédé selon la revendication 2, dans lequel la carte a des bords latéraux et son alignement est réalisé par transport de la carte le long d'un trajet, par détection des bords latéraux des cartes par un dispositif sans contact (290, 292, 294, 296), et le décalage latéral des cartes de la quantité nécessaire pour qu'elles soient alignées.
 4. Procédé selon la revendication 2 ou 3, dans lequel l'ajustement de la carte provoquant la mise de son extrémité avant (41) de façon orientée en face des surfaces d'adhésivité et de stratification (102a, 32) est réalisé par transport de la carte le long d'un trajet au contact d'une barrière (54) placée parallèlement aux surfaces d'adhésivité et de stratification.
 5. Procédé selon l'une quelconque des revendications précédentes, comprenant les étapes supplémentaires suivantes :
 - (f) la transmission d'un tronçon continu d'un film sec durcissable (84) de matière polymère vers la face amont des surfaces d'adhésivité et de stratification (102a, 32) en contact avec la face de la carte (41),
 - (g) l'avance du film par rapport à la surface de stratification (32) lors du déplacement de la carte, et
 - (h) la découpe du film à la longueur convenable, lorsqu'il est placé sur la carte, sans interruption de l'action de pression du film vers la face de la carte.
 6. Procédé selon la revendication 5, dans lequel le film sec durcissable (84) de matière polymère est photosensible.
 7. Procédé selon la revendication 5 ou 6, dans lequel la découpe du film est réalisée par un organe de coupe (120, 121) du type à cisaille.
 8. Procédé selon l'une quelconque des revendications précédentes, dans lequel la surface de stratification constitue la surface d'un rouleau de stratification dont ledit axe (143) constitue l'axe de rotation.
 9. Procédé selon l'une quelconque des revendications précédentes, dans lequel deux films (84, 86) sont stratifiés simultanément sur la première et la seconde face opposée respective de la carte (40), dans lequel, dans l'étape (a), une première partie de surface de l'extrémité avant (41) de la carte, d'un premier côté, est positionnée en coopération avec une première surface d'adhésivité (102a) et une première surface de stratification (32), et une seconde partie de surface de l'extrémité avant, du côté opposé, est positionnée en coopération avec une seconde surface d'adhésivité (104a), et la seconde surface de stratification (34), dans lequel, dans l'étape (b), un premier film (84) est transmis le long de la surface (140) de guidage de film pour la stratification sur la première partie de surface et un second film (86) est transmis le long d'une seconde surface courbe et mobile de guidage de film (98) dont le centre de courbure (146) est décalé, du côté opposé au plan, par rapport à un axe immobile en direction pratiquement perpendiculaire audit plan prédéterminé, dans lequel, dans l'étape (c), les surfaces d'adhésivité (102a, 104a) sont déplacées l'une vers l'autre en directions pratiquement perpendiculaires audit plan afin que les extrémités respectives avant



des films (84, 86) soient collées aux première et seconde parties de surface,

dans lequel, dans l'étape (d), les surfaces d'adhésivité (102a, 104) sont séparées des parties respectives de surface avant de la carte et entraînés en rotation en sens opposés autour des axes respectifs mobiles vers des positions respectives d'attente et, en même temps, les première et seconde surfaces de stratification (32, 34) sont déplacées depuis les côtés opposés de la carte en contact sous pression avec les parties respectives de surface avant collées de la carte, et

dans l'étape (e), la carte passe entre les surfaces de stratification (32, 34) en contact sous pression afin que les films (84, 86) soient repoussés simultanément sur leur longueur vers les faces opposées de la carte.

10. Procédé selon l'une quelconque des revendications précédentes, dans lequel les étapes (a) à (e) sont répétées pour la stratification d'un ou plusieurs films de matière (84, 86) sur un côté ou les deux de chaque carte d'une série de cartes.

11. Appareil de stratification d'un film d'une matière (84) sur une carte (40), comprenant un rouleau de stratification (32), des organes de support (126, 130) disposés afin qu'ils supportent le rouleau de stratification de manière qu'il tourne autour d'un premier axe (143), une barre d'adhésivité (102), et un dispositif destiné à déplacer la barre d'adhésivité et le rouleau de stratification successivement vers une position prédéterminée dans un plan fixe (100) et à partir de cette position afin que le film soit collé et stratifié sur la carte,

caractérisé en ce que les organes de support (126, 130) ont des surfaces périphériques sensiblement circulaires (152, 164) placées autour d'un second axe (142), le premier et le second axe étant placés à distance et étant pratiquement parallèles l'un à l'autre et audit plan (100), le premier axe (143) étant plus près de ce plan que le second axe (142), en ce que la barre d'adhésivité (102) est supportée par des flasques (150, 162) afin qu'elle puisse tourner autour du second axe, les flasques étant disposés afin qu'ils tournent autour des surfaces périphériques (152, 164), et en ce qu'un dispositif est destiné à déplacer les flasques et les organes de support afin qu'ils se rapprochent et s'écartent de la position prédéterminée, en coopération avec la rotation de la barre d'adhésivité autour du second axe.

12. Appareil de stratification selon la revendication 11, dans lequel les flasques (150, 162) ont des surfaces périphériques (158, 168) centrées pratiquement autour du second axe, et

dans lequel le dispositif de déplacement des flasques et des organes de support comporte des

épaulements (196, 198) dans lesquels sont supportées les surfaces périphériques des flasques afin qu'ils puissent tourner, les épaulements étant montés de manière pivotante afin qu'ils puissent tourner sur un troisième axe (196a) qui est placé du même côté dudit plan (100) que le premier et le second axe (143, 142) et qui est parallèle aux premier et second axes.

13. Appareil de stratification selon la revendication 12, comprenant en outre un dispositif à vérin (191, 193) fixé aux épaulements et destiné à faire basculer ces épaulements (196, 198) autour du troisième axe (196a) en déplaçant ainsi les flasques de manière qu'ils se rapprochent et s'écartent dudit plan (100).

14. Appareil de stratification selon l'une quelconque des revendications 11 à 13, comprenant en outre :

un transporteur destiné à faire avancer une carte (40) afin qu'elle coïncide avec ledit plan (100) vers une position dans laquelle une surface d'extrémité avant de la carte coïncide pratiquement avec la position prédéterminée, et

un dispositif de positionnement d'une extrémité avant du film de matière (84) en coopération avec la barre d'adhésivité (102),

si bien que, lors du déplacement de la barre d'adhésivité vers la position prédéterminée dans ledit plan, l'extrémité avant de la feuille du film est repoussée par pression et ainsi collée à la partie de surface avant de la carte, et que,

lors d'un déplacement ultérieur du rouleau de stratification (32) vers la position prédéterminée et lors d'une avance supplémentaire ultérieure de la carte par le transporteur en coïncidence avec ce plan, le film de matière est repoussé vers ladite surface de la carte de l'extrémité avant vers l'extrémité arrière de celle-ci.

15. Appareil de stratification selon la revendication 14, comprenant en outre :

un dispositif qui, lors du déplacement de la barre d'adhésivité (102) depuis la position prédéterminée sur ledit plan (100), est destiné à faire tourner la barre d'adhésivité suivant un trajet vers une position d'attente, le sens initial de rotation étant tourné en avant de l'extrémité avant (41) de la carte et l'amplitude de la rotation vers la position d'attente étant nettement inférieure à un tour complet,

un dispositif destiné à transmettre une bande continue du film de matière (84) le long d'un trajet prédéterminé qui recoupe le trajet suivant lequel la barre d'adhésivité tourne vers la position d'attente, une lame auxiliaire (121) placée afin qu'elle soit contiguë à la barre d'adhésivité et mobile avec celle-ci,

une lame mobile (120) de coupe du type à cisaille,

un dispositif de déplacement de la lame



mobile de coupe en position de coopération avec la lame auxiliaire et avec la bande de film lorsque la barre d'adhésivité est dans la position d'attente, et un dispositif (122) de commande de la lame mobile de coupe sur la bande de film lorsque la bande de film est transmise suivant le trajet prédéterminé pour qu'elle subisse une pression à la surface de la carte sous l'action du rouleau de stratification et que la feuille du film soit découpée à une longueur telle que l'extrémité arrière de la feuille de film corresponde à la position prédéterminée à la partie d'extrémité arrière de la carte,

si bien que la feuille de film est repoussée par pression par le rouleau de stratification à la surface de la carte sans interruption de l'opération de pression due à la découpe du tronçon de feuille de film de la bande de film.

16. Appareil de stratification selon la revendication 15, comprenant en outre :

un dispositif sous vide (106, 107, 108) destiné à guider l'extrémité arrière de la feuille de film coupée pour empêcher son plissement lorsqu'elle est pressée contre la surface de la carte (40) par le rouleau de stratification (32).

17. Appareil de stratification selon la revendication 16, dans lequel le dispositif (122) de déplacement de la lame de coupe (120) en position de coopération avec la lame auxiliaire (121) comprend un vérin à double effet (120b).

18. Appareil de stratification selon l'une quelconque des revendications 11 à 17, comprenant en outre :

un secteur allongé (140) porté par les épaulements, le secteur ayant une paroi interne dont le centre de courbure coïncide avec le second axe (142), et

une lampe infrarouge (256) montée sur la paroi interne du secteur (140) et destinée à chauffer le rouleau de stratification (32).

19. Appareil de stratification selon la revendication 18, comprenant en outre :

un détecteur (262) de température destiné à mesurer la température du rouleau de stratification, le détecteur de température comprenant un support (266) de rouleau formé d'un manchon creux placé en contact roulant avec la surface du rouleau de stratification (32) et un thermocouple (273) dont la jonction chaude (264) est placée approximativement au centre de rotation du support à rouleau sous forme d'un manchon creux, et

un dispositif commandé par le détecteur de température et destiné à régler l'intensité d'excitation de la lampe infrarouge.

20. Appareil de stratification selon la revendication 19, dans lequel le thermocouple (273) est du type fer-constantan.

21. Appareil de stratification selon la revendication 19 ou 20, dans lequel le détecteur de température (262) comprend :

un organe fourchu et allongé de support (268) ayant un premier et un second côté dont les branches ont des parties de bord avant,

une broche creuse (270) placée entre les parties de bord avant des branches de l'organe de support et supportée par ces parties, la broche creuse ayant une première extrémité qui s'enroule autour du premier côté de l'organe de support et qui est retenue dans une gorge (271) de celui-ci et ayant une seconde extrémité aboutissant d'un second côté de l'organe de support, le support (266) en forme de manchon creux étant disposé afin qu'il tourne sur la broche creuse entre les branches de l'organe de support, et

un coussinet (272) destiné au support en forme de manchon creux et comprenant une mince couche d'un polyester thermoplastique renforcé de fibres de verre, le thermocouple (273) étant placé sur la seconde extrémité de la broche creuse, sa jonction chaude (264) coïncidant pratiquement avec le centre de rotation du support creux en forme de manchon.

22. Appareil de stratification selon la revendication 21, dans lequel l'organe de support (268) est formé d'un polyester thermoplastique armé de fibres de verre et la broche creuse (270) est formée d'acier.

23. Appareil de stratification selon l'une quelconque des revendications 18 à 22, dans lequel le support creux (266) en forme de manchon est formé d'un matériau ayant une conductibilité thermique élevée.

24. Appareil de stratification selon l'une quelconque des revendications 11 à 22, comprenant en outre un dispositif automatique (48) de centrage d'une carte (40) avec des bords latéraux parallèles transportés dans l'appareil, le dispositif de centrage comprenant :

un dispositif formant des bords parallèles distants et réglables (286, 288) entre lesquels la carte est transportée avec ses bords latéraux pratiquement parallèles aux bords parallèles distants et réglables,

un moteur réversible (274) et une vis (284) connectée entre les bords parallèles distants réglables et destinée à réaliser leur déplacement latéral, deux miroirs parallèles allongés (290, 292), distants verticalement et entre lesquels la carte se déplace lorsqu'elle est transportée dans la machine, les miroirs ayant des premières extrémités et des secondes extrémités adjacentes et étant placés en directions pratiquement perpendiculaires aux bords



parallèles réglables distants,

un dispositif (294) d'émission d'un faisceau infrarouge modulé, placé près des premières extrémités des miroirs,

un dispositif (296) de réception du faisceau infra-rouge, placé près des secondes extrémités des miroirs et destiné à répondre aux réflexions infrarouges entre eux en donnant un signal destiné au moteur réversible (274) et indiquant que la carte est placée entre les miroirs afin que ceux-ci puissent être commandés dans le sens qui rapproche les bords parallèles du centre de la carte,

une cellule photoélectrique de ralentissement (298, 300) placée au-dessus de chacun des bords parallèles distants réglables, chaque cellule photoélectrique de ralentissement étant destinée à être commandée par la présence de la carte afin qu'elle donne un signal provoquant une réduction de l'excitation du moteur réversible,

une cellule photoélectrique d'arrêt (302, 304) placée au-dessus de chacun des bords parallèles réglables distants et destinée à être commandée par la présence de la carte en donnant un signal destiné à provoquer l'interruption de l'alimentation du moteur réversible, et

une servocommande (276) à laquelle sont transmis les signaux du dispositif récepteur de faisceau infrarouge, des cellules photoélectriques de ralentissement et des cellules photoélectriques d'arrêt afin qu'elles commandent le fonctionnement du moteur réversible d'une manière telle que les bords parallèles réglables distants sont rapprochés du centre de la carte, les signaux des cellules photoélectriques de ralentissement étant utilisés pour assurer une action de ralentissement du moteur réversible, et les signaux des cellules photoélectriques d'arrêt étant utilisés pour assurer l'arrêt du moteur réversible,

si bien que le centrage précis de la carte est réalisé, ses bords latéraux étant parallèles aux bords parallèles réglables distants.

25. Appareil de stratification selon l'une quelconque des revendications 11 à 24, comprenant un corps principal (42) ayant deux cadres de support (58) entre lesquels sont placés un poste d'adhésivité et de stratification (39), un transporteur d'entrée (44) destiné à transporter une carte (40) dans ledit plan (100) vers la position prédéterminée, un transporteur de sortie (46) destiné à transporter la carte stratifiée afin qu'elle s'écarte de la position prédéterminée, et un dispositif (50) de maintien de la carte mobile depuis la fin de l'opération d'adhésivité jusqu'au début de l'opération d'application du rouleau sous pression afin que l'opération d'application du rouleau sous pression commence pratiquement à la position de l'extrémité avant (41) de la carte à laquelle a été collée l'extrémité du film.

26. Appareil de stratification selon la revendication 25, comprenant deux dispositifs analogues d'adhésivité et de stratification, placés respectivement au-dessus et au-dessous du plan avec une disposition d'image spéculaire pour la stratification de deux films de matière (84, 86) simultanément sur les côtés opposés de la carte (40).

