REGISTERED PRINTING AND EMBOSSING OF LAMINATED BOARDS

Filed March 10, 1969 2 Sheets-Sheet 1

Fig. 1.

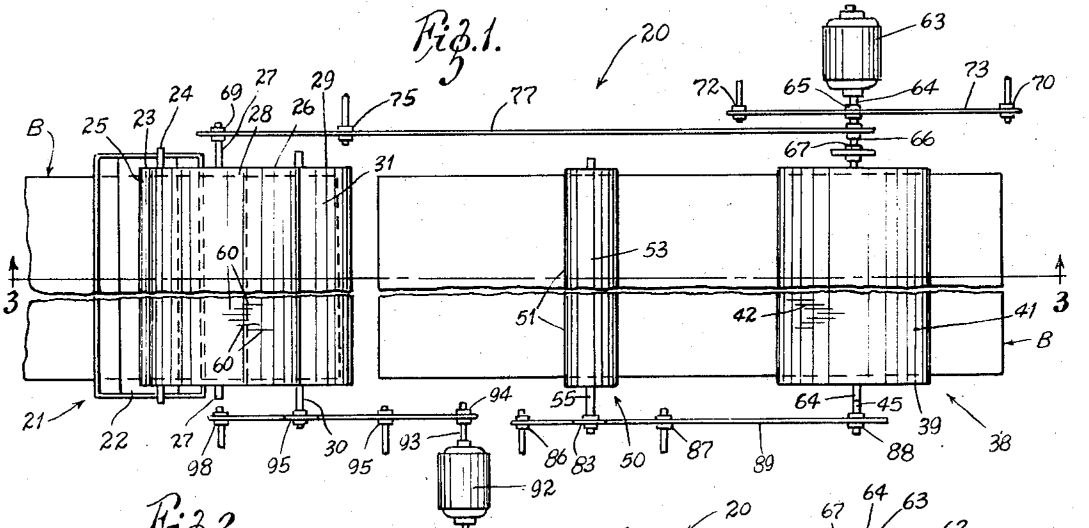


Fig. 2.

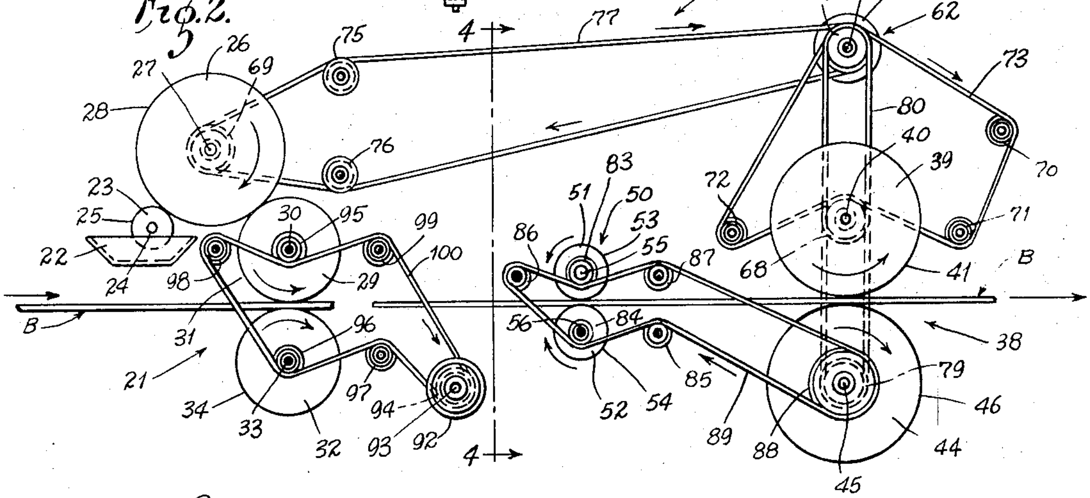
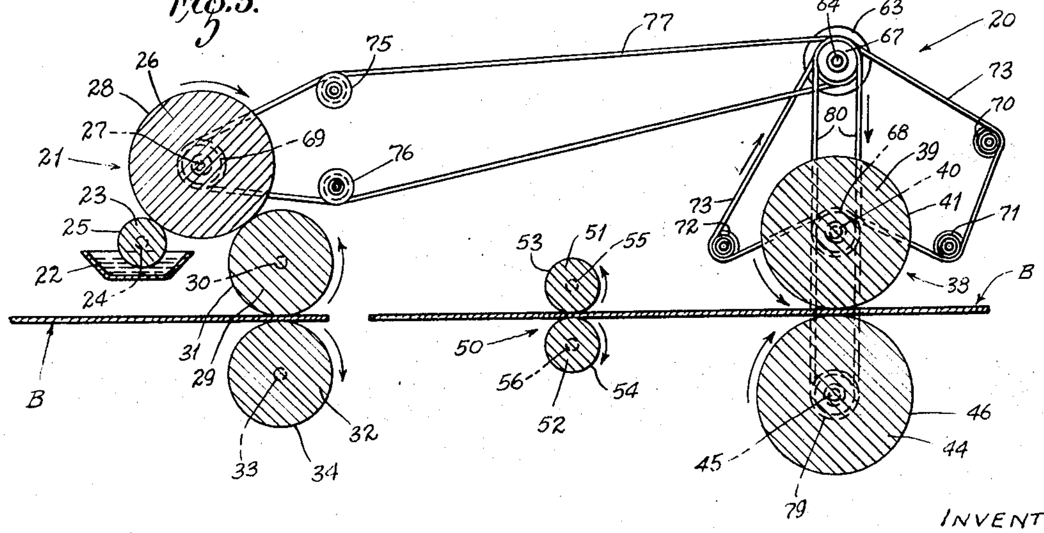


Fig. 3.



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REGISTERED PRINTING AND EMBOSSING OF LAMINATED BOARDS

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Fig.4.

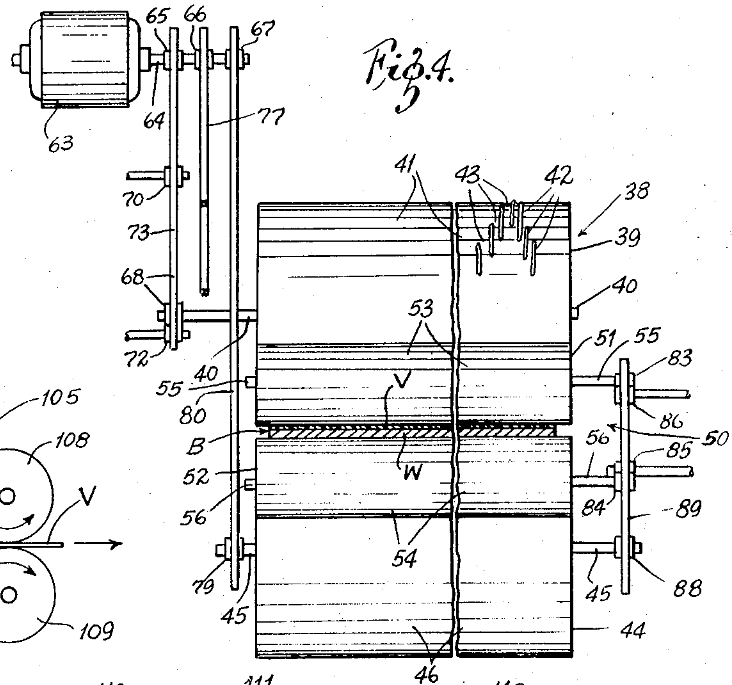


Fig.5.

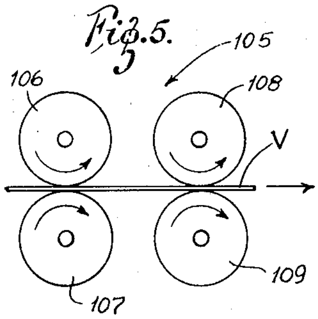


Fig.6.

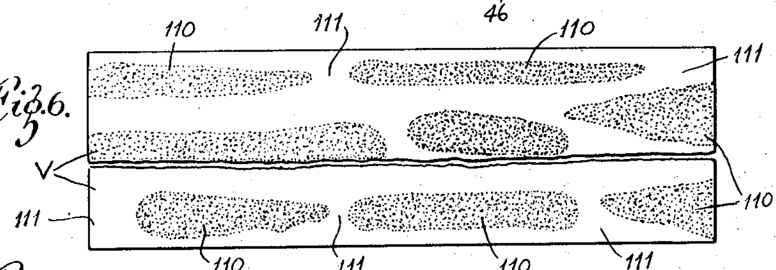


Fig.7.

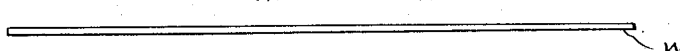


Fig.8.

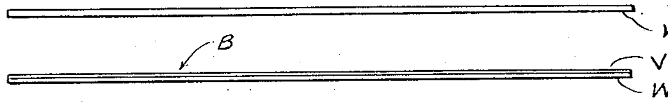


Fig.9.

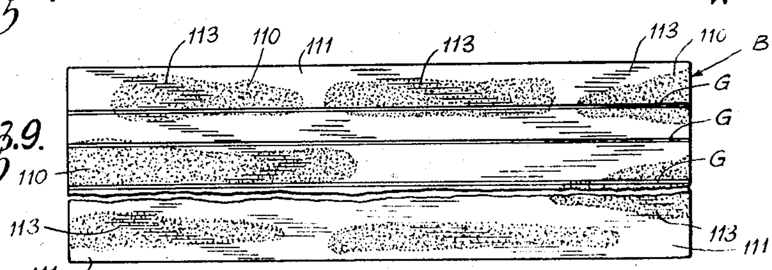


Fig.10.

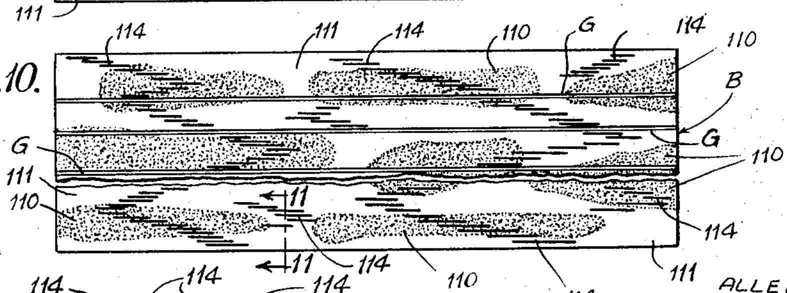
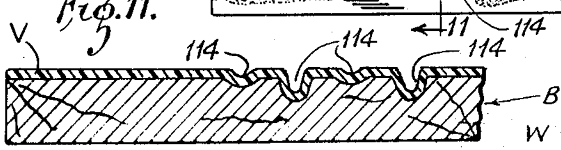


Fig.11.



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REGISTERED PRINTING AND EMBOSSING OF LAMINATED BOARDS

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Int. Cl. B31f *1/20*
U.S. Cl. 156—209 9 Claims

ABSTRACT OF THE DISCLOSURE

A method of and apparatus for producing a textured printed surface on laminated boards by printing and embossing in registration. Registration of the printing and embossing is achieved by providing printing and embossing rolls of identical diameter and driving them at identical rotational speeds, such as from a single power source. Printing and embossing are repeated by continuous rotation of printing and embossing rolls but, since boards are fed to the printing and embossing rolls at random and since the repeat cycles of the rolls do not correspond to the lengths of the boards, the printed and embossed patterns appear to be realistically random on successive boards.

BRIEF DESCRIPTION OF THE INVENTION

The process of this invention involves the printing and embossing of lines simulating actual wood grain on a board of laminated wood substrate and vinyl. Although the process is well suited for wood-vinyl laminated boards, any other materials may be used as desired. Prior to being laminated, the vinyl sheet is subjected to rotogravure printing of a plurality of registered background color tones simulating the color tones appearing in the background of actual wood. The rotogravure printing may comprise as many printing stages as required to produce the number of tonal color variations desired. After the background tones have been printed on the vinyl sheet, the vinyl sheet is laminated to the wood sheet (or board) with the printed surface of the vinyl sheet facing against the wood sheet. Then the laminated board is fed to the printing and embossing apparatus.

The printing and embossing apparatus comprises a printing stage having a printing roll and an embossing stage having an embossing roll with the usual backup rolls and with the usual transfer and inking rolls at the printing stage. Registration of printing with embossing is attained by driving both the printing and embossing rolls at the same speeds. This may be done from separate power sources, but is conveniently done using a single power supply which assures uniform rates of rotational speeds. With the identical speeds of rotation, registration is attained by making the printing and embossing rolls of identical diameters. In addition, an adjustment is provided to adjust the rotational starting point of the printing roll relative to the surface position of the embossing roll to achieve initial registration between the printing roll and the embossing roll. After the registration is initially attained, it is maintained because of the identical speeds of rotation of the printing and embossing rolls and because of their identical diameters.

In the printing and embossing apparatus, the printing roll prints wood grain-simultating lines on the vinyl surface of the laminated board. The embossing roll has a surface etched to varying depths to produce embossing of varying depths on the board. The pattern of the crests on the embossing is identical to the pattern of the printing roll so that, when the embossing roll is registered with the printing roll, the board will be embossed in registry

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with the printed lines imparted to the board by the printing roll. This simulates the natural registration of rough graining with dark and light color variations that occur at the graining of actual wood. On the other hand, although the embossing of wood graining is registered with the printing of wood grain in this printing and embossing apparatus, the printed and embossed wood grains are located in random relative to the background tonal variations that are printed on the vinyl sheet prior to lamination of the vinyl sheet to the wood sheet. Also, the boards are fed through the printing and embossing apparatus at random so that printing and embossing, although repeated, are random for different boards. Thus, since the printing and embossing, although registered, are random for different boards, the random relationship is compounded when the random printing and embossing is applied to the random background-printed boards. The result is the kind of random wood grain and background total effects that simulates actual wood in a process that does involve repeating.

Thus, the primary object of this invention is to treat laminated boards in such a way as to simulate natural wood by producing registration of the grain embossing with the wood embossing, but with such random variations in wood grain and background tones as will simulate natural wood variations. The result is that no two panels are exactly alike. Also, the invention enables repeat operation with random spacing or feeding of the boards in the production line.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic top plan view, with parts broken away, of a printing and embossing apparatus for carrying out the process of this invention.

FIG. 2 is a schematic side elevation view of the printing and embossing apparatus of FIG. 1.

FIG. 3 is a schematic view in section taken along the line 3—3 of FIG. 1.

FIG. 4 is a schematic enlarged elevation view in section taken along the line 4—4 of FIG. 2.

FIG. 5 is a schematic side elevation view of apparatus for printing background tones on a vinyl sheet.

FIG. 6 is a fragmentary plan view of a printed vinyl sheet with the printed side facing up.

FIG. 7 is a fragmentary side elevation view of a board prior to lamination of vinyl to the board.

FIG. 8 is a fragmentary side elevation view of the board of FIG. 7 with the vinyl sheet of FIG. 6 laminated to it, and with the printed side facing down against the board.

FIG. 9 is a fragmentary plan view of the laminated vinyl board of FIG. 8 with the vinyl facing up and with the embossed grooves having been imparted and the simulated grain printing having been applied, but without showing the background tones printed on the vinyl sheet.

FIG. 10 is a fragmentary plan view similar to that of FIG. 9 but subsequent to the embossing step and with the background tones illustrated.

FIG. 11 is a fragmentary enlarged view in section taken along the line 11—11 of FIG. 10.

DETAILED DESCRIPTION OF THE INVENTION

In the printing and embossing system **20**, there is a printing section or stage **21** that may be of conventional form. An ink pan **22** contains a supply of printing ink. An ink roller **23** is rotatable on a shaft **24** and is mounted so that its cylindrical surface **25** rotates in contact with the printing ink within the ink pan **22**. A printing roll **26** is rotatable on a shaft **27**. The printing roll **26** is positioned so that its surface **28** rotates in contact with the ink roll **23**. A transfer roll **29** is rotatably mounted on a shaft **30**. The transfer roll **29** has a cylindrical surface **31**, conventionally of resilient material such as rubber, that rotates in contact with the surface 28 of the printing roll 26. A backup roll 32 is rotatably mounted on a shaft 33. The backup roll 32 has a cylindrical surface 34 positioned adjacent to but spaced from the cylindrical surface 31 of the transfer roll 29. As is conventional, the ink roll 23, the printing roll 26, the transfer roll 29, and the backup roll 32 are mounted on shafts that are adjustable in position so that the rolls can be adjusted to function properly.

The printing and embossing system 20 includes an embossing section or stage 38. The embossing section 38 comprises an embossing roll 39 that is rotatably mounted on a shaft 40. The outer cylindrical surface 41 of the embossing roll 39 is etched to form crests 42 and valleys 43 only a few of which are typically and diagrammatically shown in FIG. 4. These crests and valleys are preferaby of varying depths and are identical to a printing pattern on the printing surface 28 of the roll 26 as will be described more fully hereinafter. A backup roll 44 is rotatably mounted on a shaft 45. The backup roll 44 has an outer cylindrical surface 46 that is positioned in close proximity to the embossing surface 41 of the embossing roll 39.

The printing and embossing apparatus 20 includes a pinch roll section 50 to enable accommodation of boards that are shorter than the span between the printing stage and the embossing stage. The pinch roll section 50 comprises a pair of pinch rolls 51 and 52 having cylindrical surfaces 53 and 54, respectively, positioned in close proximity to one another. The pinch rolls 51 and 52 are rotatably mounted on shafts 55 and 56 respectively. The pinch rolls 51 and 52 are mounted on adjustable bearings (not shown) so that they can be moved apart and rendered inoperative when not needed.

One of the important features of this invention is directed to registration of the matter printed by the printing roll 26 with the matter embossed by the embossing roll 39. For example, the schematic drawing of FIG. 1 illustrates certain print lines 60. These print lines 60, and other print lines on the printing roll 28 which are not shown, are to be transferred to the surface 31 of the transfer roll 29 and from the transfer roll 29 to the surface of the board B as the board B moves between the transfer roll 29 and the backup roll 32. The print lines 60 are to register with the crest lines 42 shown for example on the embossing roll 39 as the etched embossing crest lines 42 contact the board B. Typically, these print lines 60 and embossing crest lines 42 are in a wood grain simulating pattern.

To attain and assure this registration, the circumference of the cylindrical surface 28 of the printing roll 26 is the same as the circumference 41 of the embossing roll 39. Although these circumferences may be varied, they are typically established at five feet. Furthermore, both the printing roll 26 and the embossing roll 39 are rotated at the same speed. These identical rates of rotation are assured by driving both the printing roll 26 and the embossing roll 39 from the same drive source.

The drive mechanism 62 is also shown schematically in the drawings. In the following, sprocket chain drives are described as typical and illustrative drive connections, but it will be understood that other known drive connections may be used in whole or in part in place of the sprocket chains. The drive mechanism includes a motor 63 having an output shaft 64 on which three sprocket wheels 65, 66 and 67 are mounted. The sprocket wheels 65, 66 and 67 are all of the same pitch and with the same number of teeth. A sprocket wheel 68 is mounted on the shaft 40 that rotatably supports the embossing roll 39. Another sprocket wheel 69 is mounted on the shaft 45 that rotatably supports the printing roll 44. The sprocket wheels 68 and 69 are of identical pitch and have the same number of teeth. There are idler sprocket wheels 70, 71 and 72 with a sprocket chain 73 passing over the sprocket wheel 65, extending about the idler sprocket wheels 70 and 71, passing over the sprocket wheel 68, extending about the sprocket wheel 72, and returning to pass over the sprocket wheel 67. The idler sprocket wheels 70, 71 and 72 permit orientation of the sprocket chain 73 so that, as the output shaft 64 from the motor 63 rotates in a clockwise direction, as viewed in FIG. 2, the sprocket chain 73 will drive the embossing roll 39 in a counter clockwise direction.

There are a pair of idler sprocket wheels 75 and 76 that are mounted by means (not shown) that are conventional for permitting vertical adjustment of the positions of the idler sprocket wheels 75 and 76. A sprocket chain 77 extends round the sprocket wheel 66 that is mounted on the motor output shaft 64, passes beneath the idler sprocket wheel 76, around the sprocket wheel 69, and over the sprocket wheel 75 to return to the sprocket wheel 66. The arrangement of the sprocket chain 77 is such that, as the motor output shaft 64 rotates in a clockwise direction as viewed in FIG. 2, the printing roll 26 also rotates in a clockwise direction.

Since it is important that the embossing backup roll 44 rotate at the same surface speed as the embossing roll 39, the backup roll 44 has the same circumference as the embossing roll 39. Likewise, it is driven by the motor 63. For this, a sprocket wheel 79 is attached to the shaft 45 that rotatably supports the backup roll 44. The sprocket wheel 79 is of the same pitch and has the same number of teeth as the sprocket wheels 68 and 69. A sprocket chain 80 extends around the sprocket wheel 67 and the sprocket wheel 79. This arrangement of the sprocket chain 80 causes the backup roll 44 to rotate in a clockwise direction as the motor output shaft 64 rotates in a clockwise direction as viewed in FIG. 2.

The pinch rolls 51 and 52 have sprocket wheels 83 and 84 mounted on their supporting shafts 55 and 56, respectively. There are idler sprocket wheels 85, 86 and 87 adjacent the sprocket wheels 83 and 84. Another sprocket wheel 89 is mounted on the shaft 45 that rotatably supports the backup roll 44. A sprocket chain 89 extends around the sprocket wheel 88, over the idler sprocket wheel 85, under the sprocket wheel 84, around the sprocket wheel 86, unde the sprocket wheel 83, and over the idler sprocket wheel 87, returning to the sprocket wheel 88. The arrangement of the sprocket chain 89 is such that, as the motor output shaft 64 rotates in a clockwise direction to rotate the backup roll 44 in a clockwise direction, the sprocket chain 89 drives the pinch roll 52 in a clockwise direction and the pinch roll 51 in a counter clockwise direction. The sprocket wheels 83, 84, 85, 86, 87 and 88 are chosen so that the surface speeds of the pinch rolls 51 and 52 will be equal to the surface speeds of the embossing and backup rolls 39 and 44.

The transfer roll 29 may be of a different circumference than that of the printing roll 26. Also, since the transfer roll 29 has a rubber surface and, since in typical printing machines the diameter of the transfer roll 29 may vary somewhat with the use of different inks, a separate and variable speed motor 92 is provided for driving the transfer roll 29. The motor 92 has an output shaft 93 on which a sprocket wheel 94 is mounted. Sprocket wheels 95 and 96 are mounted on the shafts 30 and 33, respectively, that support the transfer roll 29 and the backup roll 32. The sprocket wheels 95 and 96 are of the same pitch and have identical numbers of teeth. There are idler sprocket wheels 97, 98 and 99 positioned adjacent the sprocket wheels 95 and 96. A sprocket chain 100 extends around the sprocket wheel 94, thence over the idler sprocket wheel 97, under the sprocket wheel 96, around the idler sprocket wheel 98, under the sprocket wheel 95, and over the idler sprocket wheel 99 to return to the sprocket wheel 94. The arrangement of the sprocket chain 100 is such that, as the sprocket wheel 94 is driven by the motor 92 in a clockwise direction as viewed in FIG. 2, the backup roll 32 is driven in a clockwise direction and the transfer roll 29 is driven in a counter clockwise direction. The speed of the motor 92 is set in conjunction with the sprocket wheels 94, 95, 96, 97, 98 and 99 to cause the speeds of the surfaces 31 and 34 of the transfer roll 29 and the backup roll 32, respectively, to be the same as the speed of rotation of the printing roll 28. If the diameter of the transfer roll 29 varies somewhat with different applied inks, the speed of the variable-speed motor 92 is correspondingly adjusted.

In carrying out the process of this invention, tonal variations are printed on a vinyl sheet V. These tonal variations may be printed on the vinyl sheet V by conventional rotogravure printing such as by a rotogravure printing machine 105 schematically illustrated in FIG. 5. This schematic illustration of a rotogravure printing machine shows two printing stages with the first stage comprising a printing roll 106 and a backup roll 107 and the second stage comprising a printing roll 108 and a backup roll 109. The number of stages of printing may be varied. The purpose of the rotogravure printing is to impart two or more color tonal variations, such as the dark variations 110 and the light variations 111 schematically illustrated on the vinyl sheets shown in FIG. 6.

OPERATION

This invention provides repeat and random printing and embossing of laminated boards in that printed and embossed laminated boards are continuously produced by being fed through the printing and embossing apparatus 20 in random spacing with a resulting realistically random printing and embossing effect simulating actual wood. To begin the process, a plurality of wood sheets (or boards) W are provided, having the desired dimensions, such as four feet by eight feet or four feet by seven feet.

First, the vinyl V is back-printed in the rotogravure printing machine 105 illustrated in FIG. 5. In the printing machine 105, each vinyl sheet V is subjected to a plurality of printing stages comprising the two printing stages illustrated or more than two printing stages. In these printing stages, undertones or background tones of color variations are printed in registry with one another.

Next the vinyl V is laminated to the wood sheets W by conventional laminating procedures. Each vinyl sheet V is laminated to a wood sheet W with the surface bearing the printed tones 110 and 111 facing down or directly against the wood sheet W. The laminated board having the vinyl and wood sheets V and W is illustrated in FIG. 8.

After the vinyl sheets V have been laminated to the wood sheets W, the resulting laminated boards are treated by a conventional printing and embossing machine to produce conventional printed and embossed grooves G simulating the grooves between adjacent wood planks. Then the laminated boards are ready for printing and embossing of wood graining by the printing and embossing apparatus 20. In production, such laminated boards are fed successively through the apparatus 20.

Before the printing and embossing apparatus is operated in line production, it is adjusted for initial registry of the printing and embossing rolls. This is done by feeding scrap material through the apparatus 20 as the motors 63 and 92 are operated to rotate the various rolls. The vertically adjustable idler sprocket wheels 75 and 76, permit adjustment of registry of the printing roll 26 relative to the embossing roll 39. For example, if printing on the sample or scrap material is behind the corresponding embossing, the idler sprocket wheels are moved higher to advance the printing roll 26 independently of the continuous drive of the sprocket chain 77. Conversely, if the printing is behind the embossing, the idler sprocket wheels 75 and 76 are lowered to retard the printing roll 26. (If the printing roll 26 is initially further from registry with the embossing roll 39 than can be corrected by adjusting the idler sprocket wheels 75 and 76; a gross adjustment is accomplished by disengaging the chain 77 from the sprocket wheel 69 so the printing roll 26 can be manually rotated to near registry with the embossing roll 39.) In

this manner, initial registration is achieved and thereafter will be maintained automatically.

Since the various rolls in the printing and embossing apparatus 20 are continuously rotating, as soon as a board B is fed between the transfer roll 29 and the backup roll 32, it is carried on through the machine, the transfer roll 29 and backup roll 32 conveying the board to the right until it enters the space between the pinch rolls 51 and 52 which also deliver the board to the right until the board enters the area between the embossing roll 41 and the backup roll 44. The embossing roll 41 and backup roll 44 continue to deliver the board B to the right until it emerges from the printing and embossing apparatus 20.

The pinch rolls 51 and 52 are preferably mounted for vertical movement so that the roll 51 can be moved upwardly and the roll 52 downwardly when four foot by eight foot boards are being operated upon in the printing and embossing apparatus 20. When four foot by eight foot boards are being used, the span between the printing stage (the transfer roll 29 and its backup roll 32) and the embossing stage (the embossing roll 39 and its backup roll 44) is such that contact is maintained with the board B and the board will be conveyed through the apparatus. When shorter boards, such as four foot by seven foot boards, are being used, the press rolls 51 and 52 are moved vertically closer together so that they will establish contact with the shorter board B, the shorter boards failing to span the distance between the transfer roll 29 and its backup roll 32 and the embossing roll 39 and its backup roll 44.

As the board B passes between the transfer roll 29 and its backup roll 32, wood grain lines, such as the lines 60, impart printed lines 113 to the upper side of the vinyl sheet V that is laminated to the wood sheet W. These printed lines 113 are applied in the usual printing process as ink is applied from the ink pan 22 to the printing roll 26 by the ink roll 23, the image from the printing roll 26 is transferred to the transfer roll 29, and the image is transferred from the transfer roll 29 to the board B as the board B travels between the transfer roll 29 and the backup roll 32.

As the board B is delivered on to pass between the embossing roll 39 and its backup roll 44, the crests and valleys 42 and 43 on the embossing roll 39 produce embossings 114 of various depths as illustrated in FIGS. 10 and 11. Since the embossing roll 39 has the same five foot circumference as the printing roll 26, and since the embossing roll 39 and the printing roll 26 are both driven by the same motor 36 at the same peripheral speed, and since the starting position of the printing roll 26 was adjusted by adjustment of the idler sprocket wheels 75 and 76, the embossing lines 114 are registered with the printing lines 113. Thus, registration is maintained as successive boards are fed through the apparatus 20, with print lines 113 applied first followed by embossing lines 114 substantially directly over the print lines. This order of printing first followed by embossing affords better control over the quality of the final product, since the ordinarily wider embossing lines 114 will mask slight errors in registration with the narrower printed lines 113. This permits some latitude, on the order of 3/32 inch to 1/4 inch in registration error.

The process is a repeat process enabling boards B to be fed in random spacing through the apparatus 20 for assembly production. However, although the circumferences of the embossing and printing rolls are fixed at five feet, their patterns on successive boards B vary because the boards B are fed through the printing and embossing apparatus in random spacing. Furthermore, the printing and embossing lines 113 and 114, which are registered with one another, appear in random relative to the printed background tones 110 and 111 because the printing rolls 106 and 108 in the rotogravure printing machine 105 are four feet rather than five feet in circumference and because the vinyl sheets V are fed in random spacing through the printing machine **105**.

Accordingly, this process produces laminated boards, having vinyl protection, that closely resemble the natural appearance of wood, with natural-appearing graining and with natural variations among panels. The process is repeatable with compounded random variations to eliminate duplication among boards.

Various changes and modifications may be made within this invention as will be readily apparent to those skilled in the art. Such changes and modifications are within the scope and teaching of this invention as defined by the claims appended hereto.

What is claimed is:

1. A method of printing and embossing boards with random and repeat printing and embossing comprising the steps of passing a succession of boards past the rotating printing surface of a printing roll, with the printing surface in printing relation to a side of each board as it passes, passing the boards past the rotating embossing surface of an embossing roll with the embossing surface in embossing relation to the printed side of each board as it passes, operating the printing roll at a printing surface speed identical to the embossing surface speed of the embossing roll, and initially adjusting the starting position of the printing roll relative to the position of the embossing roll so that the printing and embossed patterns on each board are registered, whereby once the boards are passed to the printing roll the process is automatic to continuously produce the printed and embossed boards.

2. The method of claim **1** including the step of providing the printing roll and the embossing roll with identical diameters, and wherein the step of maintaining identical surface speed comprises driving the printing and embossing rolls from a single power supply.

3. The method of claim **1** wherein the boards are laminated vinyl on wood sheets.

4. The method of claim **1** including the step of printing background tonal variations on the board prior to the aforesaid printing and embossing steps.

5. A method of producing printed and embossed laminated sheets with random and repeat printing and embossing comprising the steps of printing background tonal variations on vinyl sheets, laminating the vinyl sheets to wood sheets, passing a succession of the laminated sheets past the rotating printing surface of a printing roll with the printing surface in printing relation to the vinyl surfaces of the laminated sheets as they pass, passing the laminated sheets past the rotating embossing surface of an embossing roll with the embossing surface in embossing relation to the vinyl surfacs of the laminated sheets as they pass, operating the printing roll at a printing surface speed identical to the embossing surface speed of the embossing roll, and initially adjusting the starting position of the printing roll relative to the position of the embossing roll so that the printed and embossed patterns on each laminated sheet are registered, whereby once the laminated sheets are passed to the printing roll the process is automatic to continuously produce the printed and embossed laminated sheets.

6. The method of claim **5** wherein the vinyl sheet is laminated to the wood sheet with the background tone printed side of the vinyl sheet faced against the wood sheet.

7. The method of claim **1** wherein the embossing produced in the embossing step is of different depths.

8. The method of claim **1** including the step of printing and embossing grooves on the boards to simulate grooves between wood planks.

9. The method of claim **1** wherein the boards are fed past the printing roll at random intervals.

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U.S. Cl. X.R.

101—6; 156—220, 277, 306; 264—293