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(71) Applicant: **FAUS GROUP, INC.** [ES/ES]; Avda. Almansa, s/n, E-46700 Ganadía Valencia (ES).

(72) Inventors; and

(75) Inventors/Applicants (*for US only*): **SABATER, Vincente** [ES/ES]; Dr. Waksman, 16, Pta. 2, S-46006 Valencia (ES). **GARCIA, Eugenio, Cruz** [ES/ES]; Avda. de Almansa, s/n, E-46700 Gandia Valencia (ES).

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(54) Title: FLOORING SYSTEM HAVING MULTIPLE ALIGNMENT POINTS

(57) Abstract: Laminated flooring planks include decorative motifs, mechanically embossed-in-registration surface textures, recessed perimeters, and locking mechanisms. By arranging portions of the decorative motifs along edges of a flooring plank, a periodic flooring pattern larger than an individual plank can be formed by placing identical planks adjacent to one another in a horizontal direction and adjacent in a vertical direction.

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## **FLOORING SYSTEM HAVING MULTIPLE ALIGNMENT POINTS**

### **BACKGROUND OF THE INVENTION**

#### **Field of the Invention**

[0001] The present invention relates to building materials, including flooring, paneling and laminated materials. More particularly, the present invention relates to a flooring system of interlocked planks having decorative motifs and surface textures that are mechanically embossed in registration with their decorative motifs.

#### **Discussion of the Related Art**

[0002] Because of their look and feel, traditional building and finishing flooring materials such as fine woods, slate, granite, stones, brick, and concrete are generally preferred by consumers. However, such traditional building and finishing flooring materials tend to be expensive to produce and install. For example, while a solid wood floor has a highly valued luxurious appearance, the materials and labor required to install such floors can be prohibitively expensive.

[0003] Many alternatives to traditional building and finishing flooring materials are available, including laminates such as high-pressure laminates (HPL), direct-pressure laminates (DPL), and continuous-pressure laminates (CPL). However, such alternatives typically do not possess the realistic look and texture of the traditional building and finishing flooring materials. For example, most alternatives having an outer surface with a wood motif look artificial and can readily be identified as something other than authentic wood. Furthermore, while high quality HPL, DPL, or CPL boards may visually look like wood, their textures readily reveal that they are not.

[0004] One problem with most alternatives to traditional building and finishing flooring materials is that their surface textures do not match their decorative motifs. For example, visual depictions of wood knots in alternative flooring materials are not matched with surface textures characteristic of the wood knots. Accordingly, the attractiveness of these alternative materials is significantly reduced.

[0005] One approach used to match the surface texture of alternative flooring materials to their decorative motifs includes a technique known as chemical embossing. In chemical embossing, the surface texture of the alternative material is developed by chemically reacting an ink that forms the decorative motif with an agent added to a sub-surface layer. While somewhat successful, the resulting surface texture tends to lack the textual sharpness and three-dimensional characteristics of traditional materials.

[0006] As an alternative to the traditional building and finishing flooring materials laminated materials may be mechanically embossed to produce a surface texture. See, for example U.S. Patent Application 09/903,807 and U.S. Patent No. 6,401,415, which are hereby incorporated by reference. Such methods produce embossed-in-registration laminated materials having decorative motifs and matching high-quality three-dimensional textures. Embossed-in-registration laminated materials require accurate registration of mechanical embossment and the decorative motif. An advantage of embossed-in-registration laminated materials is that they can realistically reproduce the look and feel of traditional products.

[0007] No matter what type of flooring system is used, the flooring system must be easily moved to a work site while being easy and quick to install. To this end, assembly and locking mechanisms may be incorporated within flooring systems to facilitate on-site installation. One type of assembly and locking mechanism is the tongue and groove system

used for connecting panels. It is understood that such tongue and groove systems are disclosed in Cherry, U.S. Pat. No. 2,057,135, and in Urbain, U.S. Pat. No. 2,046,593. For example, Figure 1 can be interpreted to illustrate a tongue and groove system 11 that uses clips 12 to secure panels together.

[0008] Another type of assembly and locking mechanism is understood to be disclosed in Chevaux, U.S. Pat. No. 3,946,529 where a flooring system 13 appears to be connected using a tongue and groove system arranged underneath the flooring, reference Figure 2.

[0009] Still another assembly and locking mechanism is taught in Kajiwara, U.S. Pat. No. 5,295,341. There, it is understood that laminated boards are provided with a snap-together system such as a groove-tongue joint. As a result the laminated boards can be assembled without glue. Referring to Figure 3, the laminated boards are provided with a locking means in the form of a groove connector 16, and a tongue connector 18. The groove connector 16 has forwardly protruding grooves 20, while the tongue 18 is provided with a pair of forwardly diverging sidewalls 22 and 24 that are separated by an elongated groove 26. The sidewalls include rear locking surfaces 28 and 36. The sidewalls can be compressed together to enable locking.

[0010] Another type of assembly and locking mechanism is the snap-together joint is suggested in Mårtensson, U.S. Pat. No. 6,101,778. As shown in Figure 4, it is understood that laminated boards are provided with a locking means comprised of a groove 6 and a tongue 7 that form a tongue-groove assembly. The groove 6 and tongue 7 may be made of water tight material and snapped together with a portion 9 fitting in a slot 4.

**[0011]** While the aforementioned assembly and locking mechanisms have proven useful, they have not been used with embossed-in-registration laminate systems in which embossed-in-registration decorative motifs or graphics align across joints between the individual embossed-in-registration laminates. This significantly detracts from the visual and textural impression of systems comprised of embossed-in-registration laminate boards. Therefore, a new embossed-in-registration laminate system in which the visual and textural patterns cross joints while retaining the embossed-in-registration aspects would be beneficial. Even more beneficial would be an embossed-in-registration laminate system comprised of interlocking embossed-in-registration laminate boards in which the visual and textural patterns cross joints while retaining embossed-in-registration aspects.

**[0012]** Further, the aforementioned flooring systems have a relatively low ability to resist wear. While not wishing to be bound by any particular theory, it is hypothesized that premature aging (wear) begins at or near the perimeter edges and/or along tongue and groove lines. The aforementioned flooring systems have a substantially even (level) surface texture such that the center and perimeter of each panel contact users (e.g., pedestrians) an equal amount. The perimeter of each panel, however, is substantially weaker than the center of the panel and therefore deteriorates first.

**[0013]** In addition, flooring systems typically do not have decorative motifs or pattern designs that are longer than, or have a period greater than, the length of a plank. For example, in a flooring system designed to reproduce a wood floor having wood strips, the length of the wood strip pattern is typically equal to or shorter than the length of a single plank. This is desirable in related art flooring systems because it does not require the installer to plan more than one plank beyond the plank being installed.

[0014] Accordingly, there is a need for a workable method of fabricating alternative building or finishing materials where the alternatives have the realistic look and feel of traditional products and have an increased capacity to resist premature wear, and in which the minimum number of planks is used maintained while still being able to create design motifs or pattern elements with a length greater than that of a single plank.

### **SUMMARY OF THE INVENTION**

[0015] Accordingly, the present invention is directed to embossed-in-registration flooring system that substantially obviates one or more of the problems due to limitations and disadvantages of the related art.

[0016] An advantage of the present invention provides an embossed-in-registration flooring system including individual adjacent flooring planks having embossed-in-registration decorative motifs where at least one of a surface texture and decorative motif is substantially aligned between adjacent flooring plank.

[0017] Another advantage of the present invention provides an embossed-in-registration flooring system including interlocked flooring planks having embossed-in-registration decorative motifs where at least one of a surface texture and decorative motif is substantially aligned between adjacent flooring planks such that substantially continuous embossed-in-registration patterns are formed across the interlocked flooring planks.

[0018] Another advantage of the present invention provides an embossed-in-registration flooring system may, for example, include flooring planks wherein a surface of a perimeter of each individual flooring plank may be recessed such that an upper surface of the

perimeter of the flooring planks is below a portion of an upper surface of the flooring planks surrounded by the perimeter.

**[0019]** Another advantage of the present invention provides a plank comprising a plurality of sides defining a perimeter; a plurality of edge patterns arranged proximate at least one first portion of the perimeter, wherein at least two of the plurality of edge patterns are substantially identical; and at least one bulk pattern arranged adjacent the plurality of edge patterns and proximate at least one second portion of the perimeter, wherein at least one bulk pattern and an edge pattern adjacent the at least one bulk pattern forms a substantially continuous pattern.

**[0020]** Another advantage of the present invention provides a flooring system, comprising at least two planks adjacent each other along a predetermined direction, wherein each plank comprises: a plurality of sides defining a perimeter; a plurality of edge patterns arranged proximate at least one first portion of the perimeter, wherein at least two of the plurality of edge patterns are substantially identical; and at least one bulk pattern arranged adjacent the plurality of edge patterns and proximate at least one second portion of the perimeter, wherein at least one bulk pattern and an edge pattern adjacent the at least one bulk pattern forms substantially continuous pattern; herein edge patterns of the at least two planks form a substantially continuous pattern.

**[0021]** A further advantage of the present invention provides a floor panel, comprising a plurality of sides defining a perimeter; a surface having thereon a decorative motif, said decorative motif comprising at least two edge patterns adjacent each of the sides of the panel and at least one bulk pattern in the interior of the panel and adjacent the edge pattern on each side, wherein at least one edge pattern along a side is substantially identical to

the edge pattern in a corresponding position along an opposite side; and wherein at least one portion of the decorative motif along a side is substantially different from the corresponding portion of the decorative motif along an opposite side.

**[0022]** Additional features and advantages of the invention will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice of the invention. These and other advantages of the invention will be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

**[0023]** It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

[0024] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention.

[0025] In the drawings:

[0026] Figure 1 illustrates a related art assembly and locking mechanism;

[0027] Figure 2 illustrates another related art assembly and locking mechanism;

[0028] Figure 3 illustrates yet another related art assembly and locking mechanism;

[0029] Figure 4 illustrates still another related art assembly and locking mechanism;

[0030] Figure 5 illustrates a perspective view of components in an embossed-in-registration flooring plank according to the principles of the present invention;

[0031] Figure 6 illustrates a press machine capable of fabricating embossed-in-registration flooring planks in accordance with the principles of the present invention;

[0032] Figure 7 illustrates an embossed-in-registration flooring plank in one aspect of the present invention;

[0033] Figure 8 illustrates a top view of a system of embossed-in-registration flooring planks in another aspect of the present invention;

[0034] Figure 9 illustrates a cross-sectional view along line 9-9 shown in Figure 8;

[0035] Figure 10 illustrates a top view of a system of embossed-in-registration flooring planks in yet another aspect of the present invention;

[0036] Figure 11 illustrates a cross-sectional view along line 11-11 shown in Figure 10;

[0037] Figures 12A and 12B illustrate schematic views including a perimeter surface portion of a flooring plank in accordance with the principles of the present invention;

[0038] Figures 13A and 13B illustrate a flooring system in still another aspect of the present invention;

[0039] Figures 14A-14C illustrate an exemplary plank of a flooring system in still another aspect of the present invention;

[0040] Figures 15A-15E illustrate an exemplary method of forming patterns on a flooring plank in accordance with the principles of the present invention;

[0041] Figure 16 illustrates an exemplary method of forming patterns on a flooring plank in accordance with the principles of the present invention;

[0042] Figure 17 illustrates an exemplary method of forming patterns on a flooring plank in accordance with the principles of the present invention;

[0043] Figure 18 illustrates an exemplary method of forming patterns on a flooring plank in accordance with the principles of the present invention; and

[0044] Figure 19 illustrates an exemplary method of forming patterns on a flooring plank in accordance with the principles of the present invention.

#### **DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS**

[0045] Reference will now be made in detail to embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

[0046] Figure 5 generally illustrates components of a flooring plank according to the principles of the present invention.

[0047] Referring to Figure 5, an embossed-in-registration flooring system may, for example, include at least one flooring plank. In one aspect of the present invention each flooring plank may include a board substrate 40 made out of a substrate material (e.g., a medium or high density fiberboard, chipboard, etc.), at least one base sheet 48 (e.g., a kraft paper sheet) impregnated with predetermined resins and arranged over and/or under the board substrate 40, a decorative paper sheet 44 about 0.15 mm thick and impregnated with a polymerizable resin (e.g., phenols such as melamine) arranged over the board substrate, and at least one protective overlay sheet 46 arranged over the decorative paper sheet 44. In one aspect of the present invention, each protective overlay sheet 46 may be formed from a highly resistant paper impregnated with a melamine solution containing corundum ( $\text{Al}_2\text{O}_3$ ), silica, etc. In another aspect of the present invention, different papers may be arranged between the decorative paper sheet 44 and the board substrate 40.

[0048] In one aspect of the present invention, the at least one protective overlay sheet 46 and the base sheet 48 may be impregnated with a resin. In another aspect of the present invention the resin impregnating the at least one protective overlay sheet 46 and the base sheet 48 may be different from the melamine resin used to impregnate the decorative paper sheet 44.

[0049] In one aspect of the present invention, flooring planks within a flooring system may be fabricated from substantially the same paper, resin, etc. For example, flooring planks within a flooring system may be fabricated using paper made from substantially the same paper fibers (having, for example, substantially the same ash content, color, and orientation)

on the same on the same paper making machine. Further, flooring planks within a flooring system may be fabricated using paper originating from a single, contiguous section on the manufacturing spool. All of the aforementioned paper use restrictions that may be employed in fabricating flooring planks of a flooring system ensure that impregnated papers will always have substantially the same final dimensions after they are pressed and cured. In one aspect of the present invention, the warehousing of paper used to fabricated flooring planks within a flooring system may be controlled such that the time, temperature, and humidity in which the paper is stored is maintained to facilitate consistent flooring plank dimensions.

[0050] In another aspect of the present invention, flooring planks within a flooring system may be fabricated using cellulose paste made from the same manufacturer. In yet another aspect of the present invention, flooring planks within a flooring system may be fabricated using resins made from the same manufacturer. In still another aspect of the present invention, the resins may contain powder originating from substantially the same source, have substantially the same chemical and physical qualities, and be mixed in the same reactor. Further, flooring planks within a flooring system may be fabricated using resins have a substantially constant solids content. All of the aforementioned resin use restrictions that may be employed in fabricating the flooring planks ensure that impregnated papers will always have substantially the same final dimensions after they are pressed and cured. In still another aspect of the present invention, each of the flooring planks within a flooring system may be fabricated using substantially the same impregnation process. For example, when dipping the various sheets of paper into melamine resin, the paper should experience a constant, uniform melamine load. Further, a band tension and oscillation of the impregnation

machine should be precisely controlled as they influence the degree to which the various paper sheets are impregnated with the resin.

[0051] According to the principles of the present invention, the aforementioned sheets and substrates may be fabricated into an embossed-in-registration flooring system including a plurality of interlocking flooring planks. To produce such a flooring system, a press machine, such as a press machine shown in Figure 6, may be used to mechanically emboss each flooring plank in registration with a decorative motif arranged on the decorative paper sheet 44.

[0052] Referring to Figure 6, the press machine may, for example, include a base 42, a top press 54, and an upper press plate 56. In one aspect of the present invention, the upper press plate may include an embossing pattern (e.g., a three-dimensionally textured surface). Accordingly, the embossing pattern may, for example, include elevated ridges, dots, depressions, etc., of any design capable of being aligned with a decorative motif formed on the decorative paper sheet 44.

[0053] According to the principles of the present invention, the impregnated decorative paper sheet 44 arranged on the board substrate 40 must be accurately positioned relative to the embossing pattern of the upper press plate to enable an embossed-in-registration flooring plank. In one aspect of the present invention, alignment between the embossing pattern of the press plate and the decorative motif must be ensured when the press is in a locked position and the board is under pressure. The degree of control required may vary depending on the type of decorative motif used. For example, alignment of a wood grain embossed-in-registration motif across adjacent embossed-in-registration flooring planks

requires a higher degree of alignment than alignment of a wood grain embossed-in-registration motif that is not aligned with adjacent flooring planks.

**[0054]** Alignment between the decorative motif on the decorative paper sheet 44 and the embossing pattern on the upper press plate 56 may be achieved by removing about 2 to 3 millimeters of material around the perimeter of the board substrate 40 in a milling process thereby yielding several reference planes (e.g., board edges) and a board substrate having tightly controlled dimensions. Next, an impregnated decorative paper sheet 44 having exterior dimensions about 8 or 10 mm smaller than the board substrate 40 is arranged on the board substrate 40. In one aspect of the present invention, the impregnated decorative paper sheet 44 may be arranged on the board substrate 40 using the board edges as alignment means. In one aspect of the present invention, alignment marks may be arranged on the board substrate 40 and be alignable with alignment marks provided on the decorative paper sheet 44.

**[0055]** In one aspect of the present invention, the decorative paper sheet 44 may be attached to the board substrate 40 via static electricity. After they are attached, the decorative paper sheet 44 and the board substrate 40 are arranged on a carriage feeding into the press machine. The static electricity may substantially prevent the decorative paper sheet 44 from being accidentally displaced as the board substrate 40 is moved with the carriage. In one aspect of the present invention, the carriage may be stopped just before it enters into the press machine such that the decorative paper sheet 44 may be precisely arranged over the board substrate 40 using, for example, tweezers (not shown). In another aspect of the present invention, the tweezers may be used to precisely arrange the decorative paper sheet 44 over the board substrate 40 arranged on the lower press plate. In one aspect of the present

invention, the decorative paper sheet 44, the at least one protective overlay sheet 46, and the optional base sheet 48 may be arranged over the board substrate 40 prior to being arranged within the press machine. After the decorative paper sheet 44 is arranged over the board substrate 40, the carriage may be moved out of the press machine. Next, an alignment system substantially aligns the decorative paper sheet 44/board substrate 40 system with the embossing pattern in the upper press plate 56. In one aspect of the present invention, the alignment system may use the board edges to substantially align the decorative motif 44 with the embossing pattern on the upper press plate 56. The press machine may be operated after the alignment is complete.

[0056] In one aspect of the present invention, after the components illustrated in Figure 5 are arranged within the press machine and aligned with the embossing pattern, the various sheets and substrate may be pressed and cured for predetermined amount of time until the resins set, yielding an extremely hard and wear resistant flooring plank. For example, after being inserted into the press machine and aligned with the embossing pattern, the board substrate 40, decorative paper sheet 44, protective overlay sheet 46, and optional base sheet 48 may be heated at a temperature of about 160-220 °C and pressed together under a pressure of about 20-40 Kg/cm<sup>2</sup> for about 20 to 60 seconds. Accordingly, the top press 54 presses the embossing pattern of the upper press plate 56 into the decorative paper sheet 44 and board substrate 40 structure. The combination of the applied heat and pressure fuses the decorative paper sheet 44 and the board substrate 40 together. The alignment system ensures that the decorative paper sheet 44 is substantially aligned with the embossing pattern in the upper press plate 56. Accordingly, melamine resin within the various sheets may be cured and an embossed-in-registration plank may be produced.

[0057] In one aspect of the present invention, porosity within the fused piece may be minimized by slowly curing the resins (e.g., the melamine). Accordingly, as the operating temperature is reduced, the time during which the various sheets within the press machine are pressed is increased. In another aspect of the present invention, as the press plate 56 is heated to about 160-220°C the embossing pattern included within the press plate may expand. Accordingly, the embossing pattern on the press plate 56 may be provided so as to compensate for the expansion of the pattern. Therefore, the dimensions of the embossing pattern are provided such that they substantially correspond to the design of the decorative motif when the resins within the components of Figure 5 are cured.

[0058] According to the principles of the present invention, a mechanically embossed surface texture may be imparted to an individual flooring plank having a decorative motif. In one aspect of the present invention, the mechanically embossed surface texture may be provided in registration with the decorative motif. Accordingly, an embossed-in-registration flooring plank may be fabricated. In another aspect of the present invention, a plurality of embossed-in-registration flooring planks may be joined together to form an embossed-in-registration flooring system. In yet another aspect of the present invention, at least a portion of embossed-in-registration patterns of adjacent flooring planks may be substantially aligned with each other to form substantially contiguous embossed-in-registration patterns across adjacent flooring planks within the flooring system.

[0059] While the embossed-in-registration process described above is suitable for embossed surface textures that are less than about 0.2 mm deep, deeper surface textures may be problematic. Embossing patterns capable of imparting deep surface textures, for example, require relatively large press plate protrusions that tend to disturb the pressure homogeneity

applied across the board surface. This pressure disturbance can cause distortions in the final product. In one aspect of the present invention, embossed surface textures may be formed greater than about 0.2 mm deep by hollowing out the board substrate 40 at locations where deep surface textures are desired. In one aspect of the present invention, the hollowing out process may be performed before, during, or after the perimeter of the board substrate 40 is milled as described above. In another aspect of the present invention, the board edges may be used to locate the boundaries of the hollowed out portions of the board substrate 40.

[0060] Referring to Figure 7, an embossed-in-registration flooring plank 60, fabricated according to the process described above may optionally include a protective padding layer 50 on one side. The mechanically embossed surface texture is registered with the decorative motif 68 of the decorative paper sheet 44. By registration, it is meant that the embossed surface texture is substantially aligned with the decorative motif of the decorative paper sheet 44. By providing an embossed-in-registration flooring plank, a realistic representation of a natural material may be provided to individual flooring planks. While the decorative motif illustrated in Figure 7 realistically represents the image and texture of a wood grain, it should be appreciated that other embossed-in-registration designs such as ceramic planks, concrete, marble, etc., may be produced.

[0061] According to the principles of the present invention, each of the individual flooring planks may, for example, include at least one locking mechanism.

[0062] In one aspect of the present invention, locking mechanisms may be incorporated within the board substrate 40 before the embossing pattern is imparted to the surface of the board substrate 40 in registration with the decorative motif. Accordingly, locking mechanisms may be fabricated within individual board substrates 40. Next, the

locking mechanisms may be used to join individual board substrates together to form a plank structure. The plank structure may then be inserted into the press 54. After the embossing pattern is imparted to the plank structure and the fused components are fused together, the plank structure is removed from the press 54. Next, embossed-in-registration flooring planks 60 within the fused plank structure are separated by unlocking the locking mechanisms. In one aspect of the present invention, cutting tools may be used to assist in the separation and to ensure the decorative motif is not damaged.

[0063] In another aspect of the present invention, the locking mechanisms may be incorporated within the board substrate 40 after the embossing pattern is imparted to the surface of the board substrate 40 in registration with the decorative motif. Accordingly, a board substrate 40 having relatively large dimensions of, for example, 4'x8', may be embossed by the press 54. Next, the resulting embossed-in-registration substrate may be cut into a plurality of individual embossed-in-registration flooring planks 60. In one aspect of the present invention, edges of the individual embossed-in-registration flooring planks 60 may have smooth edges and precise dimensions. In one aspect of the present invention, the cutting may be performed using shaping tools, milling tools, cutting tools, breaking tools, etc. In one aspect of the present invention, the board substrate may be cut by the press machine. Accordingly, the board substrate 40 may be cut into units (e.g., strips) having dimensions of, for example, 300 x 300 mm, 400 x 400 mm, 600 x 600 mm, 1,200 x 300 mm, 1,200 x 400 mm, etc. Next, the locking mechanisms may be incorporated within the individual embossed-in-registration flooring planks 60. In one aspect of the present invention, the locking mechanisms may be hidden beneath the surface of the flooring planks or they may be visible.

[0064] According to the principles of the present invention, the locking mechanisms may be incorporated within the individual embossed-in-registration flooring planks 60 by aligning the at least one of the board edges, alignment marks, decorative motifs, and surface textures of the flooring plank with a milling tool. By aligning the milling tool with any of the aforementioned alignable features, locking mechanisms may be milled into the sides of the board substrates 40 such that, when flooring planks 60 are joined together the at least a portion of the decorative motifs form a continuous pattern and at least a portion of the embossed-in-registration patterns form a substantially continuous surface texture across adjacent flooring planks.

[0065] According to the principles of the present invention, the embossed-in-registration flooring plank 60 may include a locking mechanism 64 (e.g., at least one of a tongue and groove locking system, a snap-together locking system, etc.) extending along all four sides of the embossed-in-registration laminate 60. For example, a snap-together locking system may be added to all four sides of the embossed-in-registration flooring plank 60 and used to connect multiple embossed-in-registration flooring planks 60 into an embossed-in-registration flooring system 300 (as shown in Figure 8). The number and location of locking mechanisms may depend on the desired configuration of the embossed-in-registration flooring system. For example, when an embossed-in-registration flooring system abuts a corner, only two locking mechanisms are required (along the sides).

[0066] Referring to Figure 8, the embossed-in-registration flooring planks A and B may, for example, include locking mechanisms along four sides (e.g., along joints J1, J2, J3, and J4). Embossed-in-registration flooring planks C and D may, for example, include

locking mechanisms along four sides (e.g., along joints J1, J2, J3, and another joint not shown).

**[0067]** Embossed-in-registration flooring planks including the aforementioned locking mechanisms may be securely attached together with or without glue to form an embossed-in-registration laminate system 300. Multiple embossed-in-registration flooring planks may be joined together to obtain any desired shape for flooring, planking, or the like. The embossed-in-registration flooring planks may be joined to each other such that at least portions of embossed-in-registration patterns of adjacent flooring planks are substantially aligned with each other and form a substantially continuous image and embossed surface texture across flooring planks within a flooring system.

**[0068]** Figures 8 and 9 illustrate an exemplary embossed-in-registration flooring system 300 incorporating one type of locking mechanism on each of the individual embossed-in-registration flooring planks 60. Figure 9 illustrates an exemplary embossed-in-registration flooring system including flooring planks incorporating a snap-type tongue and groove locking mechanism. In one aspect of the present invention, the snap-type tongue and groove locking mechanism may be integrated into the sidewalls of each embossed-in-registration laminate 60 so as to ensure that embossed-in-registration patterns of adjacent flooring planks are substantially aligned with each other and substantially continuous within the flooring system.

**[0069]** Figure 9 illustrates a cross sectional view of Figure 8 taken along line 9-9. As shown, the locking mechanism may be fabricated by forming a groove 230, a tongue 200, a channel 210, and a lip 220 along the edges of the embossed-in-registration flooring planks 60. The locking mechanisms on the embossed-in-registration flooring planks 60 may be joined

together by inserting the tongue 200 into the groove 230 of an adjacent embossed-in-registration flooring plank 60. Subsequently, the lip 220 is secured within channel 210, thereby joining adjacent embossed-in-registration flooring planks 60 into an embossed-in-registration flooring system 300. In one aspect of the present invention, the embossed-in-registration flooring planks 60 labeled A, B, C and D may be joined together with or without glue. It should be appreciated that other types of locking mechanisms may be incorporated within the sides of the individual embossed-in-registration flooring planks 60.

[0070] Referring back to Figure 8, each of the embossed-in-registration flooring planks 60 may, for example, exhibit an embossed-in-registration ceramic plank motif G1. The ceramic plank motif may comprise a plurality of planks in the shape of squares, rectangles, triangles, circles, ovals, any other shape or design that are separated by grout lines. In one aspect of the present invention, widths of grout lines  $W_h$ ,  $W_v$ , and the intraboard grout width  $W$  may be substantially equal. When incorporating the snap-type tongue and groove locking mechanism into the embossed-in-registration flooring planks 60 the grout width adjacent the joints J1, J2, J3, and J4 on each embossed-in-registration laminate A, B, C, and D are approximately one-half the intraboard grout width  $W$ . For example, the vertical plank grout width ( $W_v$ ) across joint J1 is made up of grout lines on embossed-in-registration laminates A, B, C and D, such that when the embossed-in-registration laminates A, B, C, and D are joined at J1 the vertical grout width ( $W_v$ ) is approximately equal to ( $W$ ). Accordingly, the grout width on any individual embossed-in-registration flooring plank 60 adjacent a joint is one-half of intraboard grout width ( $W$ ). In another aspect of the present invention, the horizontal and vertical grout widths  $W_h$  and  $W_v$  may be controlled such they are substantially equal to the dimensions of the intraboard grout

width W. It should be appreciated, however, that the dimensions of the grout widths in the embossed-in-registration flooring planks depend on the type of locking mechanism incorporated and the decorative motif exhibited.

[0071] In addition to grout lines, many other decorative motifs may be used in the embossed-in-registration flooring system of the present invention. Referring to Figures 10 and 11, a decorative motif exhibiting, for example, a wood grain surface G2 substantially aligned across joints J5 and J6 of adjacent flooring planks may be provided. According to the principles of the present invention, wood grain patterns generally include more elements (e.g., wood grain lines, wood knot 423, etc.) that extend to the perimeters of the flooring planks that need to be aligned than ceramic plank motifs. Accordingly, aligning the wood grain motif is generally more difficult than aligning grout line portions of the ceramic plank motifs. For example, aligning a first portion of a wood knot 423 on embossed-in-registration flooring plank E with a second portion of the wood knot 423 on embossed-in-registration flooring plank F is generally more complex than aligning grout line widths across joints of adjacent flooring planks. Accordingly, when fabricating a locking mechanism, consideration of all the graphic elements (e.g., wood grains lines and wood knots 423) must be considered to ensure a realistic embossed-in-registration flooring system 400. In one aspect of the present invention, at least one portion of the decorative motif may be used as an alignment marks ensuring consistent alignment of adjacent flooring planks.

[0072] In another aspect of the present invention, individual flooring planks within the embossed-in-registration flooring system 400 may be joined together with a snap-type mechanical system as illustrated in Figure 11 depicting a cross sectional view of Figure 10 along line 11-11. Again, alignment techniques used in the fabrication of the locking

mechanism such that the embossed-in-registration laminate system 400 has a surface texture surface 423 that is substantially continuous across joints, J5 and J6. Optionally, the embossed-in-registration laminates 60 have a protective padding layer 70 under the base sheet 48.

[0073] Figures 12A and 12B illustrate schematic views of a flooring plank in accordance with the principles of the present invention.

[0074] Referring to Figures 12A and 12B, an upper surface at the perimeter, P, of each embossed-in-registration flooring plank may be recessed below an upper surface at the portions of the flooring plank surrounded by the perimeter. An object O (e.g., a users shoe, a wheel, etc.) contacting the major surface, Ms, of a flooring plank does not generally contact the surface of the perimeter, Ps, due to the perimeter's recessed surface. In one aspect of the present invention, the perimeter may include a portion of the flooring plank extending from the edge of the flooring plank approximately 3.175 mm toward the center of the flooring plank. In another aspect of the present invention, the depth to which the surface of the perimeter of the flooring plank is recessed is approximately 0.794 mm. In another aspect of the present invention, the surface of at least one portion of the perimeter of a flooring plank may not be recessed, as will be discussed in greater detail below with reference to Figure 13.

[0075] Accordingly, the embossed-in-registration pattern may be provided to the edges of the flooring plank and may be aligned with embossed-in-registration patterns formed on adjacent flooring planks while the edges of each individual flooring plank may be prevented from prematurely wearing.

[0076] Although it has been shown in Figures 8 and 10 that individual flooring planks within a flooring system are substantially the same size and shape and are joined to each

other such that each side of each flooring plank is joined to only one adjacent flooring plank, it should be appreciated that individual flooring planks within a flooring system may vary in size (e.g., width and/or length) and shape (e.g., rectangular, square, triangular, hexagonal, etc.). In one aspect of the present invention, individual flooring planks may have complementary shapes capable of being assembled similar to a puzzle or mosaic. Further, one aspect of the present invention contemplates that sides of individual flooring planks may contact more than one adjacent flooring plank.

[0077] In accordance with the principles of the present invention, flooring planks within a flooring system may be arranged such that at least one side of each plank includes at least one sub-panel adjacent at least two other sub-panels. In another aspect of the present invention, each plank may include, either entirely or partially, at least one sub-panel, as will be described in greater detail below.

[0078] In Figure 13A, for example, partial sub-panel 134A of plank 130A may be a complementary sub-panel with respect to neighboring partial sub-panel 136B of plank 130B, adjacent plank 130A. With this arrangement, the partial sub-panels 134A and 136B may be made to appear as one unitary sub-panel.

[0079] Still referring to Figure 13A, each of the planks 130A-F may comprise at least three sub-panels wherein at least one of the sub-panels is a unitary sub-panel and at least two of the sub-panels are partial sub-panels. For example, 132A is a unitary sub-panel and 134A and 136A are partial sub-panels.

[0080] In one aspect of the present invention, the unitary sub-panel 132A may provide a complete decorative motif with or without an embossed surface texture that may or may not be in registration with the decorative motif. In another aspect of the present

invention, the partial sub-panels 134A and 136A of a plank may provide separated, incomplete decorative motifs with or without embossed surface textures that may or may not be in registration with the decorative motifs. In one aspect of the present invention, neighboring partial sub-panels of adjacent planks may be complementary to each other such that they provide a substantially complete decorative motif and/or surface texture and appear as a substantially continuous, unitary sub-panel. In one aspect of the present invention, complementary partial sub-panels may have complementary decorative motifs and/or embossed surface textures. Accordingly, when complementary partial sub-panels of adjacent planks are properly aligned, a substantially continuous (i.e., complete) decorative motif and/or embossed surface texture may be formed across neighboring complementary partial sub-panels. In one aspect of the present invention, sub-panels within a plank may or may not comprise substantially the same decorative motif and/or embossed surface texture.

[0081] Figure 13B illustrates a schematic view of an exemplary plank 130 such as that shown in Figure 13A.

[0082] In one aspect of the present invention, portions of the perimeter surface of each plank may be recessed at locations where neighboring sub-panels are not complementary. In another aspect of the present invention, portions of the perimeter surface of each plank may be non-recessed at locations where neighboring sub-panels are complementary. Referring to Figure 13B, portions of the upper surface of the perimeter "P" of each of the planks 130 indicated by reference numeral 138a may be slightly recessed compared to the major surface of each of the planks (see also Figure 12B) to prevent premature wear of each of the planks. Further, portions of the upper surface of the perimeter of each of the planks 130 indicated by reference numeral 138b may be non-recessed and

substantially coplanar with the major surface of the sub-panels. Recessing only portions of the perimeter surface of each of the planks at positions not occupied by the decorative motifs and/or embossed surface textures of partial sub-panels of a plank allows complementary partial sub-panels to appear as a part of a unitary sub-panel while not significantly detracting from the overall durability of each of the planks. In yet another aspect of the present invention, portions of the surface of each plank may be recessed at locations where sub-panels of a plank are adjacent one another. Referring to Figure 13B, portions of the upper surface of each of the planks 130 indicated by reference numeral 138c may be slightly recessed compared to the major surface of each of the planks (see also Figure 12B) to provide a visual and textural effect that each of the sub-panels of the plank are not a part of the same plank.

[0083] Figures 14A-14C illustrate an exemplary plank of a flooring system in still another aspect of the present invention.

[0084] Referring to Figures 14A-14C, similar to the plank shown in Figures 13A and 13B, portions of the upper surface of the perimeter "P" of each of the planks 130 indicated by reference numeral 138a may be beveled to prevent premature wear of each of the planks. Further, portions upper surface of the perimeter of each of the planks 130 indicated by reference numeral 138b may not be beveled such that they are substantially coplanar with the major surface of the sub-panels. Beveling the perimeter surface of each of the planks at positions corresponding to the decorative motifs and/or embossed surface textures of partial sub-panels of a plank allows complementary partial sub-panels to appear as a part of a unitary sub-panel while not significantly detracting from the overall durability of each of the planks.

In yet another aspect of the present invention, portions of the surface of each plank may be provided with a groove at locations where sub-panels of a plank are adjacent to one another.

**[0085]** Figures 14B and 14C illustrate cross-sectional views of plank 130 taken across lines I-I' and II-II', respectively. Referring to Figures 14B and 14C, portions of the upper surface of each of the planks 130 indicated by reference numeral 138c may be beveled to form a groove. This groove may also prevent premature wear of each of the planks. Thus, the groove provides a visual and textural effect that sub-panels of a plank are separate. In one aspect of the present invention, the bevel at 138c may produce a groove having a substantially V-shaped groove. It is appreciated, however, that the bevel may produce other groove topographies (e.g., U-shaped grooves, etc.). In one aspect of the present invention, the beveling of each of the planks 130 at perimeter surface portion 138a creates a groove between adjacent planks. Accordingly, the groove formed between adjacent ones of the planks, via beveling at 138a, has substantially the same width and topography as grooves formed within the planks, via beveling at 138c.

**[0086]** The motif and/or surface texture present at the recessed surface of the perimeter of each plank may or may not correspond to the motif/surface texture present at the main surface of a corresponding plank. Thus, a substantially continuous motif and/or surface texture may or may not be present across the surfaces of the perimeter and the interior of any individual plank. Alignment marks or markings (not shown) can be used to self-align a decorative motif on the planks. In one aspect of the present invention, the embossed in-registration pattern may be a free form or custom design. It is to be understood that substantially any embossed-in-registration pattern and any decorative motif may be realized by applying the principles of the present invention. In one aspect of the present invention,

alignment of the planks may be done visually upon joining them together. Accordingly, alignment of the planks 130 may be performed using the decorative motif and/or embossed surface texture of each of the planks.

[0087] While it has been illustrated that the planks in Figures 13A, 13B, and 14A-14C are substantially rectangular, the principles of the present invention allow the planks within the flooring system to have other shapes and sizes (e.g., geometric, freeform, etc.) or different or similar dimensions such that the flooring planks may be assembled in a “mosaic”-type arrangement or other regular, semi-repetitious, or random arrangement of panels. Further, while it is illustrated that each plank comprises an identical sub-panel layout, the principles of the present invention allow the planks within the flooring system to have other sub-panel layouts (e.g., other sub-panel shapes, sizes, etc.) The individual planks within the flooring system may be cut from a board such that joints between the flooring panels of the flooring system are not visible. Further, the planks within the flooring system illustrated in Figures 13 and 14 may be joined together with or without glue. Still further, while it has been discussed that the embossed surface texture is substantially aligned with an underlying decorative motif, it is to be understood that substantially any embossed surface texture may be imparted to the planks of the present invention, regardless of the underlying decorative motif. Still further, the decorative motifs and/or the embossed surface texture of one plank may not be aligned or even be remotely similar in appearance and/or texture to decorative motifs and/or embossed surface textures of adjacent planks.

[0088] According to the principles of the present invention, any of the aforementioned decorative motifs and/or embossed surface textures that may or may not be embossed in registration with the decorative motifs (collectively referred to herein as

“patterns”) may be applied to any of the aforementioned planks to form a substantially continuous pattern across adjacent planks arranged along a predetermined direction by forming each of the plank patterns using at least one bulk pattern and at least one edge pattern.

[0089] In one aspect of the present invention, each edge pattern may be present at a perimeter portion of the plank extending along at least a portion of at least one edge of each plank. In another aspect of the present invention, each edge pattern may extend to a predetermined distance (e.g., about one millimeter, about one inch, etc.) into the interior of the plank, away from the perimeter of the plank. In another aspect of the present invention, at least one bulk pattern may be arranged adjacent at least one edge pattern, wherein a pattern present at the edge of the bulk pattern adjacent the edge pattern may form a substantially continuous visual/textural pattern with a pattern present at the edge of the edge pattern adjacent the bulk pattern.

[0090] In one aspect of the present invention, patterns of individual planks, arranged adjacent each other along a predetermined direction within a flooring system, may complement patterns of adjacent planks (i.e., form substantially continuous patterns across adjacent planks) when edge patterns of the adjacent planks form a substantially continuous pattern. Where the flooring system described above comprises a plurality of adjacent planks arranged along the predetermined direction, and where the edges of each plank are arranged adjacent to edge patterns of other planks along the predetermined direction, edge patterns of adjacent planks are identical or substantially identical. The identical or substantially identical edge patterns of adjacent planks enable a continuous pattern to be formed across the adjacent planks.

[0091] For example, referring to Figure 15A, an exemplary plank pattern of plank 150 may comprise two edge patterns 152 substantially identical to each other and a bulk pattern 154. As shown in Figure 15A, the two substantially identical edge patterns 152 are present at a perimeter portion of the plank 150, extend along a portion of the opposite edges of the plank, and extend a predetermined distance into the interior of the plank 150. Still referring to Figure 15A, the pattern present at the edge of the bulk pattern 154 adjacent the edge patterns 152 forms a substantially continuous pattern with the pattern present at the edge patterns 152 adjacent the bulk pattern.

[0092] Referring now to Figure 15B, a plurality of planks 150A, 150B, 150C, etc., such as those illustrated in Figure 15A may be arranged adjacent each other within a flooring system along a predetermined direction such that edges of each plank are arranged adjacent to the edges of other planks along the predetermined direction (e.g., an edge of plank 150A is adjacent an edge of plank 150B, an edge of plank 150C is adjacent an edge of plank 150D, etc.). As mentioned above, a substantially continuous pattern may be formed across an individual plank 150 because the bulk pattern 154 is substantially aligned with the edge patterns 152.

[0093] In an embodiment of the invention, the predetermined direction in which the planks are arranged is based on the adjacent edge patterns 152 in the planks, such that only by arranging the planks in the predetermined direction will the pattern formed be continuous and natural-looking. In this embodiment, reversing a plank or flipping a plank over will result in a discontinuous pattern. However, it is understood that in another embodiment, the edge patterns along a portion of the perimeter may be selected such that reversing, flipping or otherwise rearranging planks does not disrupt the pattern, i.e. the pattern is continuous.

[0094] In another embodiment, the predetermined direction is based on the interlocking mechanism that joins adjacent planks, such that the planks will not fit together properly if they are arranged in a direction other than the predetermined direction. One example of such a interlocking mechanism is a glueless tongue and groove system, in which the tongue is formed along at least one edge of the plank and the groove formed along the opposite edge. In yet another embodiment, the predetermined direction is based on both the edge patterns 152 and the glueless locking mechanism.

[0095] According to the principles of the present invention, bulk patterns 154A-154F may or may not be the same. In one aspect of the present invention, each of the bulk patterns 154 within a flooring system may be unique. Further, according to the principles of the present invention, edge patterns of individual planks may be substantially identical. Therefore, edge patterns of adjacent planks in a flooring system, across which a substantially continuous pattern is formed along the predetermined direction, are also substantially identical. A substantially continuous pattern may be provided across plank 150A because bulk pattern 154A and edge patterns 152A are aligned with each other to produce a substantially continuous pattern. Substantially continuous patterns may be individually provided across planks 150B, 150C, etc., because their respective bulk patterns 154B, 154C, etc., and edge patterns 152B, 152C, etc. are similarly aligned with each other to produce a substantially continuous pattern.

[0096] Because the edge patterns of planks 150A-150F within the flooring system illustrated in Figure 15B are identical, edge pattern 152A forms a substantially continuous pattern with edge pattern 152B, edge pattern 152C forms a substantially continuous pattern with edge pattern 152D, and so on. Accordingly, a substantially continuous pattern may be

formed across planks 150A and 150B, across planks 150C and 150D, and so on. The boundary or joint between the edge pattern 152A and the edge pattern 152B is substantially not visible, or the appearance of the presence of the boundary or joint is minimized. Similarly, the boundary or joint between the edge pattern 152C and the edge pattern 152D is substantially not visible, or the appearance of the presence of the boundary or joint is minimized. The boundary or joint between the edge pattern 152E and the edge pattern 152F is substantially not visible, or the appearance of the presence of the boundary or joint is minimized.

[0097] In one embodiment of the present invention, in which the edge patterns 152 are all substantially identical, any of the planks 150A-150F may replace any other plank within the flooring system while still maintaining the presence of a substantially continuous pattern across planks arranged adjacent each other along the predetermined direction. This is because all bulk patterns of a plank are substantially aligned with their respective edge patterns to form substantially continuous patterns within a plank and because all edge patterns of planks adjacent each other within a flooring system are identical, forming form substantially continuous patterns across planks adjacent each other along the predetermined direction.

[0098] In another embodiment, planks may have adjacent right and left edge patterns 152 substantially identical, while opposite left and right edge patterns 152 are not.

[0099] For example, in Figure 15C, the unitary sub-panel 132 of plank 150 may have a pattern provided by a bulk pattern 154G, partial sub-panel 134 may have a pattern provided by bulk pattern 154I and edge pattern 152, and partial sub-panel 136 may have a pattern provided by bulk pattern 154H and edge pattern 152, wherein the bulk patterns 154G-154I

may or may not be the same. As mentioned above, however, the edge pattern 152, present at the perimeter of the partial sub-panel portions 134 and 136 of the plank 150 and extending along a portion of the edges of the plank 150, are identical to each other. Accordingly, in view of Figure 13A, when, for example, planks 130A and 130B are arranged adjacent each other along a predetermined direction, edge patterns 152 of complementary partial sub-panels 134A and 136B are substantially identical to each other and a substantially continuous pattern may be formed across adjacent planks, wherein the bulk patterns of the complementary partial-sub panels become a part of a substantially continuous pattern, appearing, visually and/or texturally as a unitary sub-panel.

**[00100]** Furthermore, referring now to Figures 15C and 15D, flooring systems incorporating planks such as those illustrated in Figures 13A-14C may be provided with substantially continuous patterns across planks adjacent each other along predetermined directions by applying the techniques described above with reference to Figures 15A and 15B. Figure 15D shows the planks having a woodgrain pattern in the arrangement shown in Figure 15B. Because the edge pattern 152A is substantially identical to the adjacent edge pattern 152B, planks 150A and 150B have the appearance of a substantially continuous woodgrain pattern running uninterrupted across the boundary or joint between edge pattern 152A and edge pattern 152B of the adjacent plank.

**[00101]** In addition, because the edge patterns 152A and 152B do not run along the entire length of the boundary or joint between planks 150A and 150B, but only along the portion corresponding to the height of the partial board on the bottom half of the planks, the pattern is not continuous across that portion of the boundary between planks 150A and 150B corresponding to the height of the complete boards on the top half of the planks.

**[00102]** As mentioned above, within the flooring system incorporating the planks illustrated in Figures 13A-14C and 15C, the bulk patterns within the sub-panels of the planks may or may not be the same. In one aspect of the present invention, each of the bulk patterns within the flooring system may be unique.

**[00103]** Fig. 15E shows an embodiment of the invention in which the edge patterns of the planks are identical (or substantially identical) in every plank. Specifically, Fig. 15E shows four planks, 150A, 150B, 150C, and 150D arranged such that plank 150A is adjacent the left edge of plank 150B and adjacent to a top edge of plank 150C. Plank 150D is adjacent to the right edge of plank 150C and adjacent to the bottom edge of 150B.

**[00104]** In this embodiment, the décor paper of each plank has a wood design. However, it is understood that other natural looking designs other than wood are contemplated by this invention as well. The wood design in plank 150A includes, for example, a complete board or strip 155A on a top half of the board, a short incomplete board 151A and a long incomplete board 153A. Each of the boards has a woodgrain pattern. In addition, the short and long incomplete boards 151A and 153A have an edge pattern 152 running along a portion of the perimeter of the plank corresponding to the width of the incomplete boards 151A and 153A, and may extend a small distance (such as one centimeter, for example) into the interior of the boards. The edge patterns 152 of incomplete boards 151A and 153A are identical. The edge patterns 152 may also not extend into the interior of the boards.

**[00105]** Similarly, planks 150B, 150C, and 150D have complete boards 155B, 155C, and 155D, respectively, running the length of the plank, and short boards 151B, 151C, and 151D which are adjacent to long boards 153B, 153C, and 153D, respectively. Each of

the short and long boards may have an identical edge pattern 152 along a portion of the perimeter of the plank corresponding to the width of the short and long boards.

**[00106]** All short boards 151A-D, long boards 153 A-D, and complete boards 155A-D have woodgrain patterns that are different from each other or some identical to each other. Only the edge patterns 152 in the incomplete boards are identical in this particular example. Furthermore, the edge pattern and interior woodgrain pattern of each incomplete board form a continuous pattern. In other words, there is a continuous overall woodgrain pattern on each of the short boards and long boards that are all different from one another, despite the fact that the edge patterns 152 are the same.

**[00107]** When planks 150A and 150B are placed adjacent to one another as shown in Fig. 15E, complete boards 155A and 155B will be adjacent to each other, and long board 153A and short board 151B will be adjacent. Complete boards 155A and 155B appear as separate boards and the woodgrain pattern is discontinuous across them, because the adjacent edges of the complete boards are different. But because the edge patterns 152 in long board 153A and short board 151B are the same, the unique woodgrain patterns of 153A and 151B appear to form a single continuous board with a unique woodgrain pattern running across the planks 150A and 150B. Furthermore, the appearance of a complete and continuous board with a unique woodgrain pattern running in boards 153A and 151B across the planks minimizes the visibility or appearance of the joint or boundary between the planks. Similarly, the woodgrain pattern across boards 153C and 151D is continuous.

**[00108]** In a further embodiment, the planks 150A, 150B, 150C, and 150D may have a surface texture that is embossed in registration with the wood design on the décor paper. Because edge patterns 152 are part of that wood design and may be the same or

substantially identical in every plank, the embossed surface texture will appear to be continuous along the incomplete boards of adjacent planks in the manner discussed above. In still another embodiment, the embossed in registration surface texture may include bevels to imitate seams between boards, such that in plank 150A, for example, the complete board 155A would have a bevel running along its perimeter, including the boundary between board 155A and incomplete boards 151A and 153A. The incomplete boards 151A and 153A would have a bevel where they are adjacent, but the incomplete boards would not have a bevel along the portion of the perimeter of the plank 150A where the edge patterns 152 are located. In this way, a continuous wood grain pattern and corresponding embossed in registration surface texture can run continuously across planks 150A and 150B uninterrupted by a bevel. This would further reduce the appearance of the boundary between planks.

[00109] By having all edge patterns 152 to be identical, the present invention allows any planks to be fit together in the predetermined direction in which a long board 153 is adjacent a short board 151 of another plank, because the edge patterns 152 will always line up to form the appearance of a continuous wood grain pattern running across the adjacent long and short boards of the two planks. For example, if the positions of planks 150A and 150B were reversed (such that plank 150B was adjacent a top edge of plank 150C), the edge pattern 152 of long board 153B would match or be aligned with the edge pattern of short board 151A, forming a continuous wood grain pattern in the boards 153B and 151A across planks 150B and 150A.

[00110] The present invention reduces the complexity involved in installing a laminated floor, because it does not matter which planks are placed adjacent to one another in the predetermined direction. The patterns will be aligned. In a further embodiment, the

planks 150 are provided with a glueless interlocking tongue and groove system in which the tongue is formed on two adjacent perimeter edges of the plank and the groove is formed in the opposite two adjacent perimeter edges so that the planks can only be fit together in the direction that will align long boards 153 with short boards 151, for example, where edge patterns 152 meet.

[00111] In the exemplary embodiment discussed above, the decorative motifs and design pattern elements such as wood strips run across separate adjacent planks. However, the wood strip motif has a length equal to that of the length of the plank, in order to allow for the interchangeability of planks, ensuring an easy installation.

[00112] Figure 16 illustrates an exemplary embodiment of a flooring design using floor panels according to the present invention. In this exemplary embodiment, the flooring design includes a decorative tile motif wherein an overall flooring design has a periodic pattern that is repeated every four tiles of the decorative motif. In this embodiment the overall flooring pattern may be made of a number of identical floor planks, each of the floor planks having an identical design pattern on the surface thereof. In the specific exemplary embodiment illustrated in Figure 16, the floor design pattern has a diamond shape 110 formed at the intersection of four subtiles 112, 114, 116 and 118. In addition, the edges of subtiles 112, 114, 116 and 118 have a bar motif on the outer edge away from the sides that had a portion of the diamond motif 110. Furthermore, while the diamond motif and surrounding bar patterns are repeated every four subtiles in a horizontal direction, the diamond motif and surrounding bars are repeated every two subtiles in a vertical direction. The overall pattern is actually offset by one sub-tile in the vertical direction in the second tile between repeating diamond motifs. In other words, while the diamond motif will repeat after

four subtiles in a horizontal direction, after two tiles in that direction and one tile in the vertical direction, there is also another diamond shaped motif. To illustrate the repetition of the design motifs within the overall flooring pattern Figure 16 includes a square motif 120 that includes a square formed four tiles bounded by the bar pattern around the edges with a diamond motif 110 in the center. The overall square motif 120 repeats every four tiles in the horizontal direction and every two tiles in the vertical direction. However, it is offset in the vertical direction by one tile every two tiles in the horizontal direction.

**[00113]** This creates a flooring design with square motifs 120 that are staggered in the vertical direction and provide for a repeating pattern that repeats with much less frequency over the entire floor. In an aspect of this embodiment of the present invention, only a number of identically designed flooring planks with a decorative motif formed thereon are needed to be repeated in order to form the overall flooring pattern illustrated in Figure 16. In other words, by having all of the floor planks in the floor shown in Figure 16 with an identical decorative motif, a complex repeating floor pattern such as that illustrated in Figure 16 can be created using only a single flooring plank. The flooring plank according to the decorative motif with the decorative motif according to the exemplary embodiment of Figure 16 is illustrated in greater detail in Figure 17.

**[00114]** Figure 17 illustrates that flooring plank according to a first aspect of the first exemplary embodiment of the present invention. In this aspect of the embodiment a flooring plank is four tiles in length and one tile high and includes all of the features of the overall flooring pattern along the surface of the flooring plank 200. Specifically, flooring plank 200 includes a lower right corner portion 201 on the upper left corner of the first tile 210 of the flooring plank 200. It includes the lower left portion of the diamond motif 110 in

the upper right corner of the fourth tile 214 of the plank 200. It includes the upper left portion 203 of the diamond motif 110 on the lower right corner of the second tile 211 and includes the upper right portion 204 of the diamond motif 110 in the lower left corner of the third tile 212 of the plank 200. In addition, the bar patterns of subtiles 112, 114, 116 and 118 shown in Figure 16 also reproduced in the plank 200. Specifically, the lower right corner bar arrangement 220 is included along the bottom edge of the first tile 210 of the plank 200 and along and between the first and second tiles 210 and 211 of the plank 200. The upper left corner 221 is formed with the bar pattern between the first and second tiles 210 and 211 respectively of the plank 200 that is shared with the lower right bar arrangement 220 but also includes a top bar pattern on the second tile 211.

**[00115]** In other words, the lower right portion 220 of the square pattern 120 shares a pattern element with the upper left portion 221 of the square pattern 120 continuing the upper right portion 222 is formed with a top bar along the upper edge of the third tile 212 and with a bar between the third tile 212 and the fourth tile 214. The bottom left portion 223 of the square pattern 120 include the same bar portion between the third plank 212 and the fourth plank 214 but also includes a bar along the bottom edge of the fourth tile 214. Furthermore, the bar patterns along the edges of the tiles at the edge of the planks are half of the width of the bar patterns of the overall square pattern 120. Thus, in the plank 200 neither of the diamond motif 110 or the square pattern 120 are included intact anywhere in the decorative motif included on plank 200.

**[00116]** The flooring plank 200 is able to reproduce the flooring pattern shown in Figure 16 by laying identical planks 200 adjacent to each other in a horizontal direction such that the forth tile 214 of a first plank 200 is adjacent to the first tile 210 of another plank

200. In addition, flooring planks are placed in a vertical direction offset by a distance of two tiles in the horizontal direction. Thus, the flooring plank 200 adjacent to the bottom edge of a first flooring plank 200 is offset by two tiles such that the first tile 210 of a second flooring plank 200 is placed adjacent the top edge of the third tile 212 of the first flooring plank 200. Thus, in the vertical direction first tile 210 and third tiles 212 are adjacent to one another and second tiles 211 and third tiles 214 are adjacent to one another in the vertical direction. In this manner it can be seen that because of the placement of the pattern elements in the flooring plank 200 the overall flooring design shown in Figure 16 can be reproduced with a single flooring plank such as that shown in Figure 17. Specifically, the upper left corner 203 and the upper left portion of the diamond motif 110 (element 203) in the bottom right corner of the second tile 211 is adjacent in a vertical direction the bottom left portion 202 of the decorative motif 110 in the upper right corner of the fourth tile 216.

**[00117]** By placing floor planks 200 adjacent one another in the horizontal direction and offset by two tiles in the horizontal direction in the vertical direction, the entire flooring design may be reproduced. Figure 18 illustrates a flooring plank 200 illustrates schematically the arrangement of alignment points on the flooring plank 200. The flooring plank 300 is required to reproduce a flooring design pattern having a certain arrangement of pattern elements that can be reproduced by placing aligning points in the flooring plank 300 as follows: the diagrammatic representation of the flooring plank 300 includes a number of tile sections a flooring plank reproducing a number of ceramic tiles, in this case four, and a number of design motifs.

**[00118]** In the flooring pattern shown in Figure 16 there are two essential design motifs. First, is the diamond motif 110 and the second is the square bar motif 120.

Represented diagrammatically in Figure 18 on plank 300 the flooring design may be abstracted to two design motifs A and B. Any flooring plank 300 may reproduce the flooring design of Figure 16 provided it has aligning points corresponding to portions of the design motifs of the foreign pattern of Figure 16 in the following arrangement. In flooring plank 300 there is an edge motif C1 and C2 formed at the outer edges 301 and 302 of the flooring plank 300. Furthermore, alignment point C1 is on the outer edge of the first tile of the flooring plank 300 while alignment point C2 is on the outer edge of the fourth tile of the flooring plank 300. Furthermore, it is understood that when alignment point C1 is placed adjacent alignment point C2 or alignment point C2 is placed adjacent alignment point C1, they form a complete decorative motif or a larger completed portion of a decorative motif. Furthermore, a number of different alignment points are placed along the upper edges of the four tiles corresponding to the upper edge of the plank 300.

[00119] The upper edge of the first tile includes an alignment point A1, the upper edge of the second flooring tile, the second tile contains an alignment point B1, the upper edge of the third tile includes an alignment point B2 and the upper edge of the fourth tile includes an alignment point A2. The lower edge of the first tile includes an alignment point B2, the lower edge of the second tile includes an alignment point A2, the lower edge of the third tile includes an alignment point A1 and the lower edge of the first of the fourth tile includes an alignment point B1. Alignment points A1 may be placed adjacent one another and alignment points A2 may be placed adjacent one another, respectively, to form more completed portions of design motifs found in the flooring pattern in Figure 16. However, elements A1 and A2 are not to be placed adjacent one another if the flooring pattern shown in Figure 16 is to be reproduced. Likewise, alignment points B1 may be placed adjacent one

another and alignment points B2 may be placed adjacent one another to form four completed portions of design motifs found in the flooring pattern of Figure 16.

**[00120]** By creating design elements on the surface of the flooring plank 300 to correspond to the positions of alignment points A1, A2, B1, B2 and C1 and C2 the flooring plank 300 can be used to create a flooring design pattern with the frequency of repetition of design motifs in the horizontal and vertical directions as well as with the offset in the vertical direction every half period in the horizontal direction that is illustrated in the particular exemplary embodiment in Figure 16. In other words, using the diagram of a flooring pattern 300 a number of flooring designs may be created with the same pattern, repetition and frequency of that of Figure 16 but with entirely different design elements and motifs.

**[00121]** The flooring plank 300 can also be used to schematically represent the decorative elements and alignment points in the flooring plank 200 shown in Figure 17. Specifically, alignment points A1 correspond to right side corner portions of the diamond motif 110 shown in the flooring pattern of Figure 16. Note that it is not relevant whether the bottom right or top right corner portion is represented by the alignment point A1 because in the flooring plank of 200 shown in Figure 17 the bottom right corner portion of the design motif 110 and the top right corner portion of the designer motif 110 are designed to align in the vertical direction only. That is, there is no horizontal alignment that is possible between portions of the design motif and the vertical direction. Similarly, alignment point A2 corresponds to left side portions 203 and 202 of the diamond motif 110 shown in Figure 16. Alignment points B1 correspond to half-height portions of the bar motif found on the top edge of the second tile 211 and the bottom edge of the forth tile 214 of the flooring plank 200. Again, it is not relevant that the bar pattern has a vertical bar extending from it on either

the left side or the right side, merely that the bar pattern are designed to be aligned in a vertical direction. Furthermore, alignment points B2 correspond to the half bar portions on the bottom edge of the first tile 210 and the top edge of the third tile 212.

**[00122]** In a further aspect of this particular exemplary embodiment, alignment point A2 may also include continuous edge alignment patterns that continue a décor pattern of the diamond motif from one plank to the next. For example, the décor pattern may be a wood grain, marble, or stone pattern.

**[00123]** Using the abstracted diagram of a flooring plank 300 shown in Figure 18, an overall flooring pattern can be created simply by assigning decorative motif elements to the alignment points of a single flooring plank knowing with confidence that identical flooring planks can be placed adjacent to one another in both the horizontal and vertical direction such that they are offset by two tiles in the horizontal direction with confidence that an overall repetitive flooring pattern will be created.

**[00124]** A fourth flooring plank illustrating a further embodiment of the present invention is illustrated in Figure 19. If planks have the same length as those illustrated in Figures 1-3, then Figure 19 illustrates a diamond pattern that repeats every half-plank length and every two plank widths in the vertical direction. Because the periodicity of the pattern in the vertical and horizontal directions is substantially the same and equal to twice the width of the plank, two distinct planks are required to reproduce the pattern. The first plank 401 includes decorative motifs 403 along a first long edge 400. Each decorative motif 403 includes a continuous edge pattern 404 for continuing a décor pattern of the decorative motif 403 across to an adjacent plank. The remaining portions of the first long edge 400 have a

discontinuous edge pattern 405 thereon which creates a discontinuity between patterns in the interior of two adjacent planks.

**[00125]** In addition, the plank 401 may include discontinuous edge patterns on the remaining three sides of the plank. In the alternative, the plank 401 may include continuous edge patterns along portions of the edges of the two short sides 406 and 407.

**[00126]** The second plank 402 includes decorative motifs 406 that include continuous edge patterns 404 along a second long edge 407 that correspond to the continuous edge patterns 404 in the decorative motifs 403 along the first long edge 400 of the first plank 401. The remaining portions of the second long edge 407 have a discontinuous edge pattern 405 thereon which creates a discontinuity between patterns in the interior of two adjacent planks.

**[00127]** When multiple first and second planks 401 and 402 are placed adjacent in the vertical direction and offset in the horizontal direction, the décor patterns of the decorative motifs 403 continues from the first plank across the edges of the planks to the second plank. This embodiment of the present invention allows a flooring design including a combination of repeating patterns and continuous patterns (such as wood grain, stone, marble, or the like) using a minimum number of planks. The flooring design having a width substantially equal to twice the width of the plank may be accomplished with two planks having continuous edge patterns and discontinuous edge patterns along an edge of each plank such that the continuous edge patterns of separate planks are adjacent.

**[00128]** It should also be noted that the flooring planks having four tiles illustrated in Figure 17, 18, and 19 are merely exemplary embodiments of what is possible using the present invention. The present invention is adaptable to and contemplates flooring

planks having any number of tiles or no tiles at all, but rather simply has alignment points corresponding to design elements placed around the edges of flooring plank in the manner similar to that illustrated in Figure 18.

**[00129]** In a more abstract approach, a single flooring plank can be used to create a complex flooring design pattern provided that the design elements for the alignment points and a design element that correspond to them along half of the top edge of the flooring plank match the alignment points on the bottom half of the opposite bottom half of that flooring plank and vice versa such that decorative elements need only be selected for one side edge and either the entire length of the top edge or half the length of the top edge and half the length of the bottom edge directly opposite that half of the top edge and then these pattern elements simply repeated on opposite halves of the other side of the plank. In this manner, patterns may be constructed but appear one natural unless structured than the tile based pattern motifs illustrated in Figures 16 and 17.

**[00130]** It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

**WHAT IS CLAIMED IS:**

1. A flooring system for reproducing a flooring design having a periodic pattern, said flooring system comprising:

a flooring plank having at least a portion of said flooring design thereon;

the length of said plank approximately equal to the period of said pattern;

the width of said plank approximately equal to one half the height of said pattern;

a first alignment pattern on a first edge and a second edge of said plank, said first and second edges being opposite each other; and

a second alignment pattern on a third edge and a fourth edge of said of said plank,

wherein said second alignment pattern on said third edge is offset in a horizontal direction from said second alignment pattern on said fourth edge by a distance approximately equal to one half the length of the plank.

2. The flooring system of claim 1, further comprising:

a tongue and groove joint for attaching adjacent planks,

wherein said tongue runs along two adjacent edges and wherein said groove runs along two adjacent edges other than said edges along which said tongue runs.

3. The flooring system of claim 1, wherein a plurality of said distinct planks placed adjacent one another form said periodic pattern having a period equal to the length of the plank in the horizontal direction and twice the width of the plank in the vertical direction.

4. A flooring system comprising:

a plurality of substantially similar flooring planks;

each of said flooring planks having a first portion of a first decorative motif along first and second adjacent edges, a second portion of a first decorative motif along second and third adjacent edges opposite said first two adjacent edges, a third portion of a first decorative motif along a fourth edge at a distance of approximately one half the length of the plank away from the first or third edges.

5. A building panel system, comprising:

a plurality of building planks each having a first and second side opposite each other;

a first building plank of said plurality having at least one continuous edge pattern for continuing a décor pattern across separate but adjacent planks along at least a portion of the first side;

said first building plank having a discontinuous pattern for creating a discontinuity between décor patterns of adjacent planks along a portion of the second side of said first building plank directly opposite said continuous edge patterns.

6. The building panel system of claim 5, further comprising:

a third side of said building planks adjacent to said first and second sides and a fourth side adjacent said first and second sides opposite said third side; and

said first building plank further comprising a continuous edge pattern on a portion of the third side of said first plank and a continuous edge patterns on a portion of the fourth side of said first plank,

wherein said continuous edge pattern on said third side is adjacent a continuous edge pattern on the first side and the continuous edge pattern on the fourth side is adjacent a continuous edge patterns on the first side.

7. The building panel system of claim 5, further comprising:

at least a second building plank of said plurality having at least one continuous edge pattern along at least a portion of the second side;

said second building plank having a discontinuous pattern for creating a discontinuity between décor patterns of adjacent planks along a portion of the first side of said second building plank directly opposite said continuous edge patterns on said second side,

wherein said first and second plank are adjacent each other, whereby a continuous edge pattern on the first side of the first plank and a continuous edge pattern on the second side of the second plank are adjacent and opposite each other.

8. The building panel system of claim 5, wherein a surface texture is embossed onto the surface of a plank, said surface texture embossed in registration with the décor pattern, wherein a portion of the surface texture embossed over the discontinuous edge patterns, whereby the surface height of the portion of the plank corresponding to the discontinuous patterns is lower than the surface height of a portion of the plank corresponding to the décor pattern.

9. The building panel of claim 8, wherein the continuous edge patterns are embossed with a surface texture that aligns with the surface texture of the continuous edge patterns on an adjacent plank.

10. The building panel system of claim 5, wherein multiple continuous edge patterns on the first plank have said discontinuous pattern there between.

11. The building panel system of claim 5, wherein said building panels are flooring panels, and said planks are flooring planks.

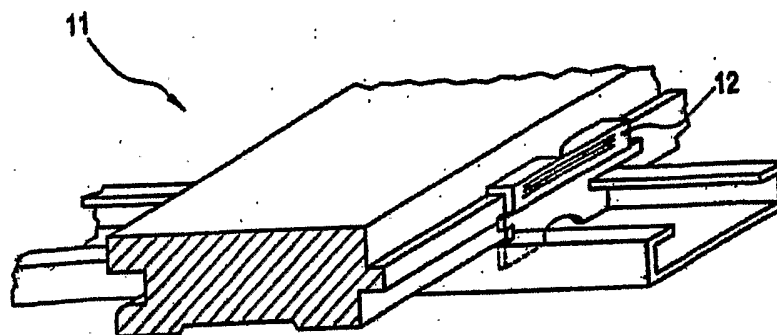
12. The building panel system of claim 5, wherein said building panels are wall panels, and said planks are wall planks.

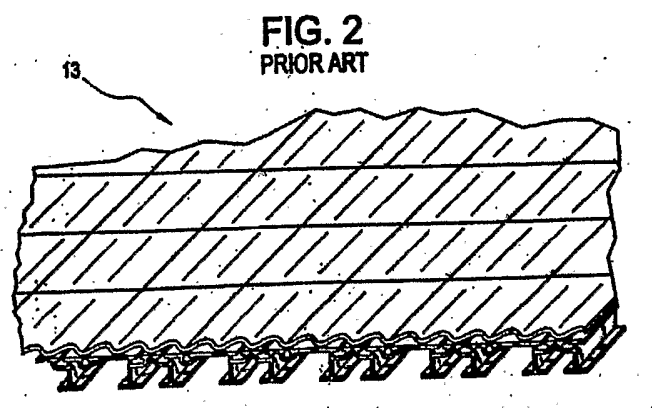
13. The building panel system of claim 11, wherein said flooring planks are laminate flooring.

14. The building panel system of claim 11, wherein said flooring planks are laminate flooring having a hardwood veneer on the surface.

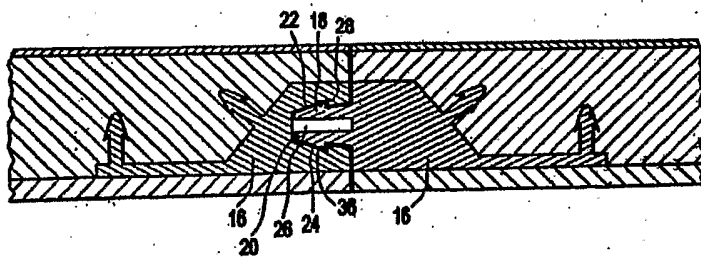
15. The building panel system of claim 11, wherein said flooring planks are wood flooring.

**FIG. 1**  
**PRIOR ART**





**FIG. 3**  
PRIOR ART



**FIG. 4**  
**PRIOR ART**

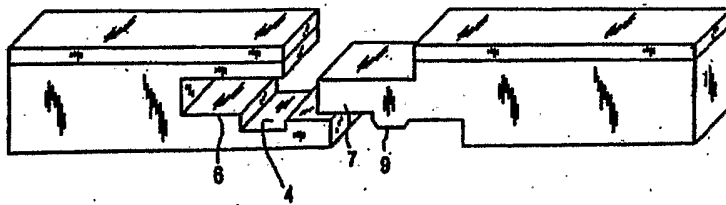


FIG. 5

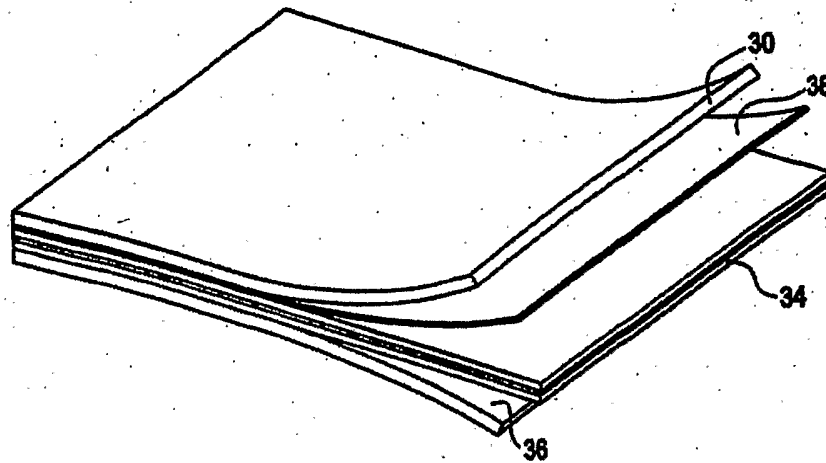


FIG. 6

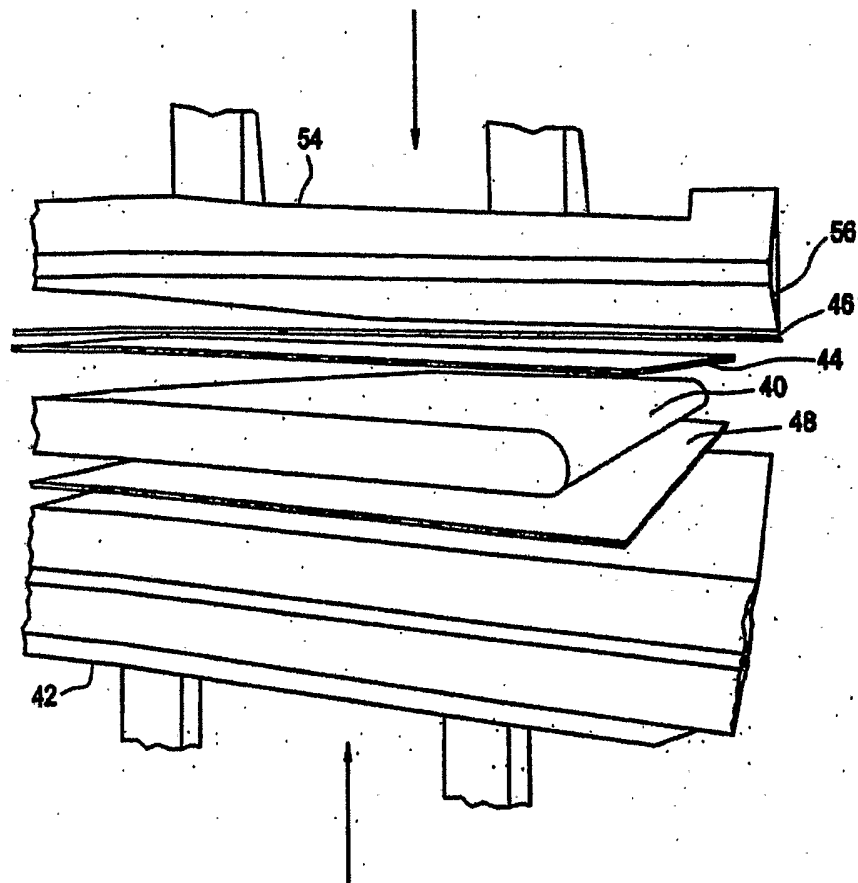


FIG. 7

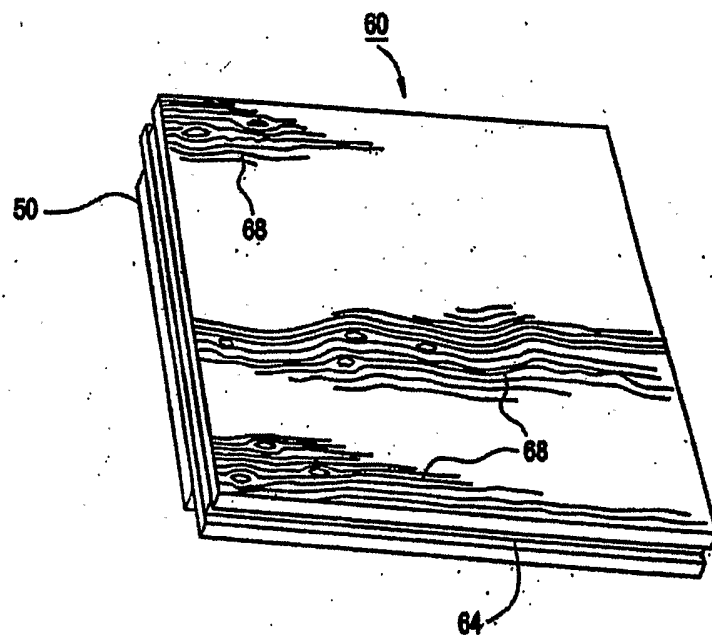


FIG. 8

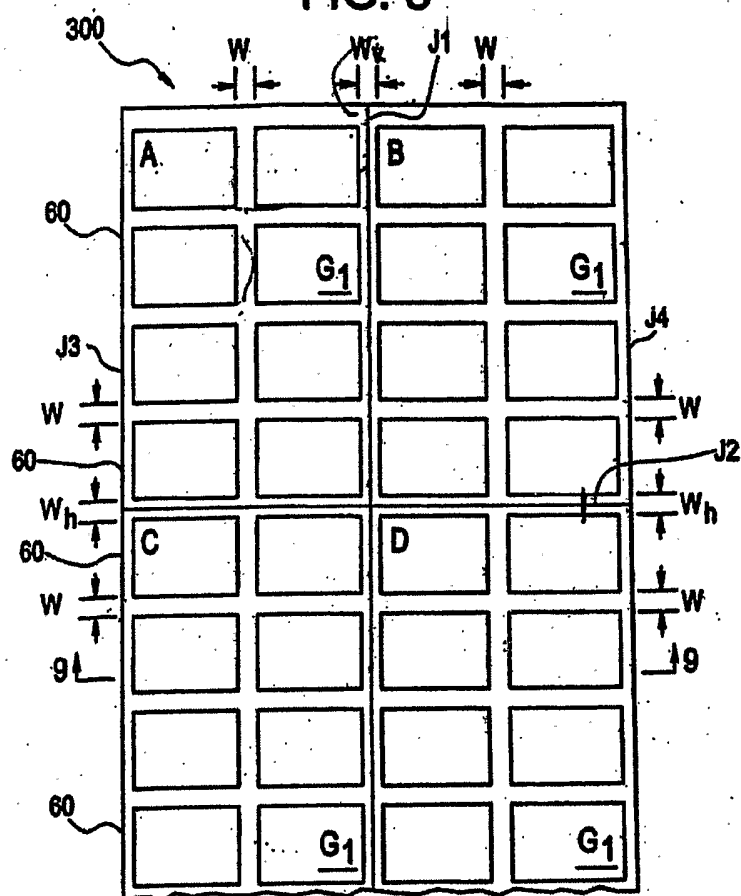


FIG. 9

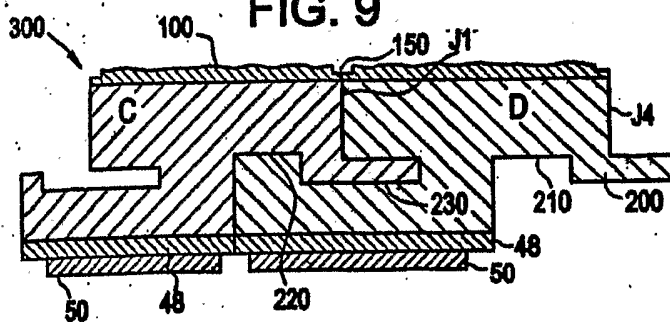


FIG. 10

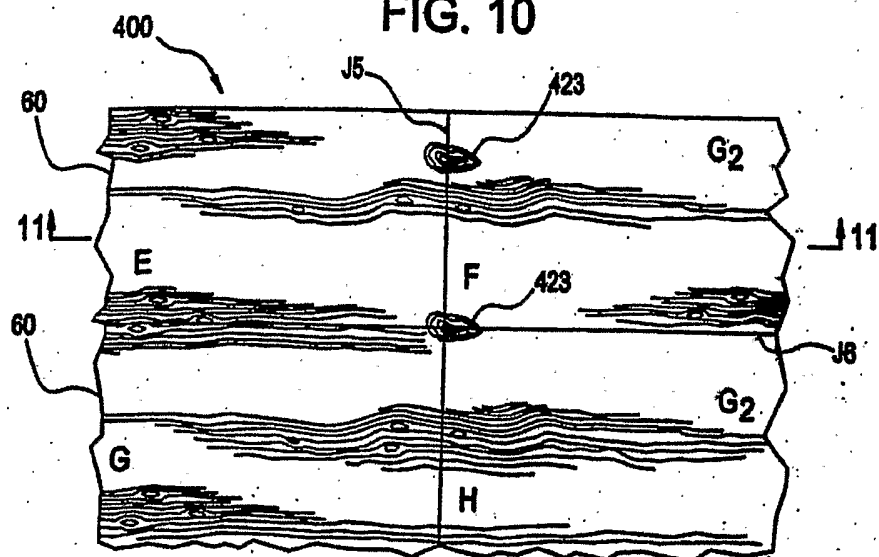


FIG. 11

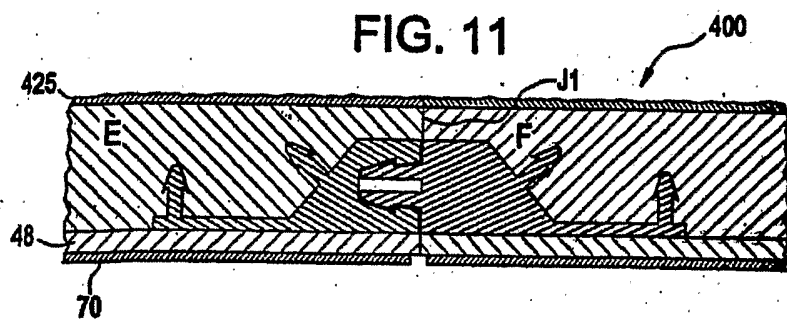


Figure 12A

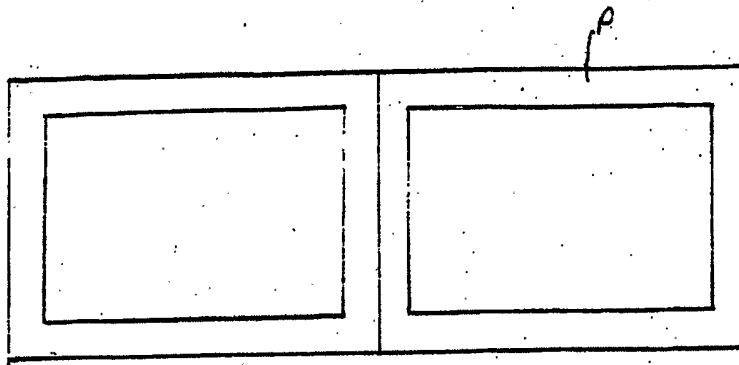


Figure 12B

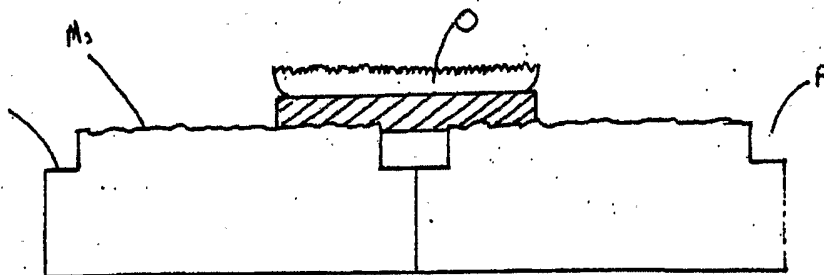


Figure 13A

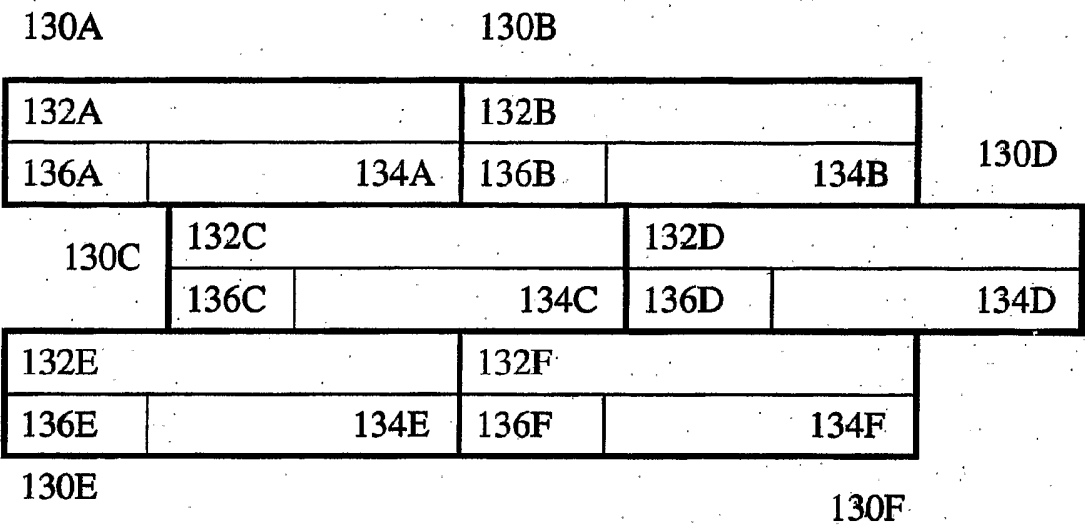


Figure 13B

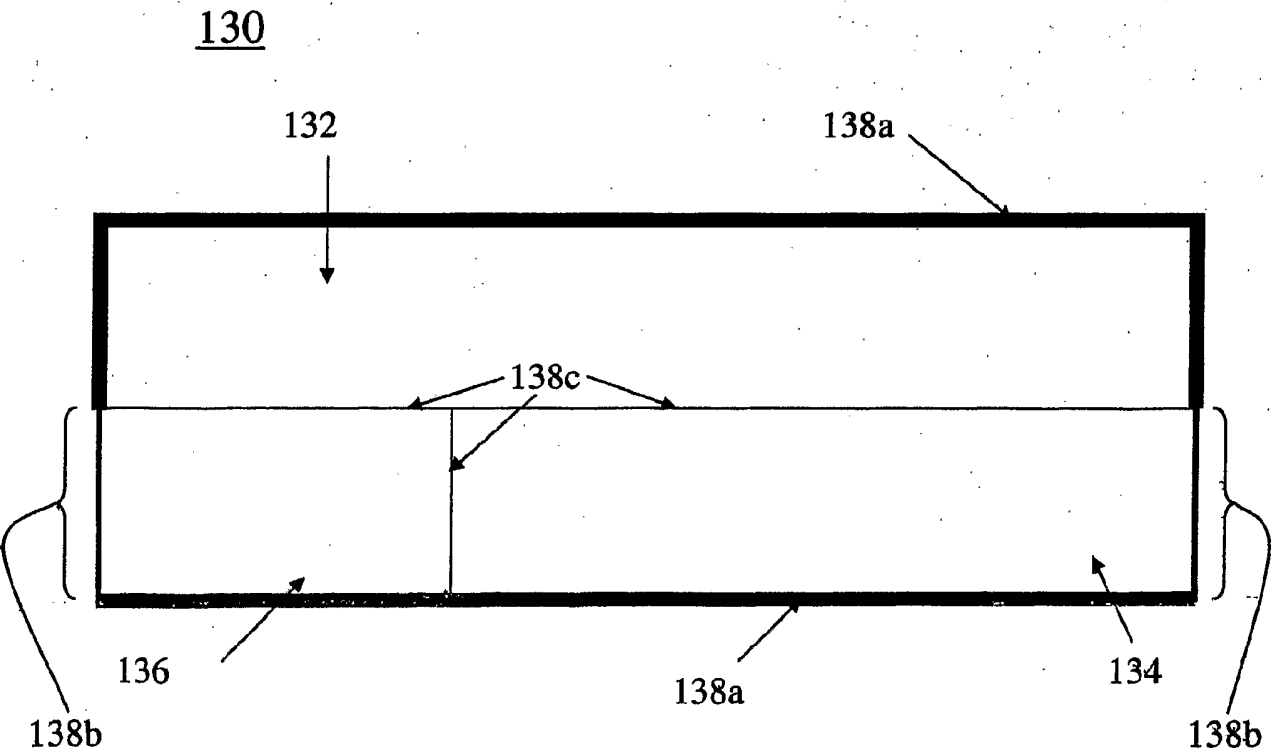


Figure 14A

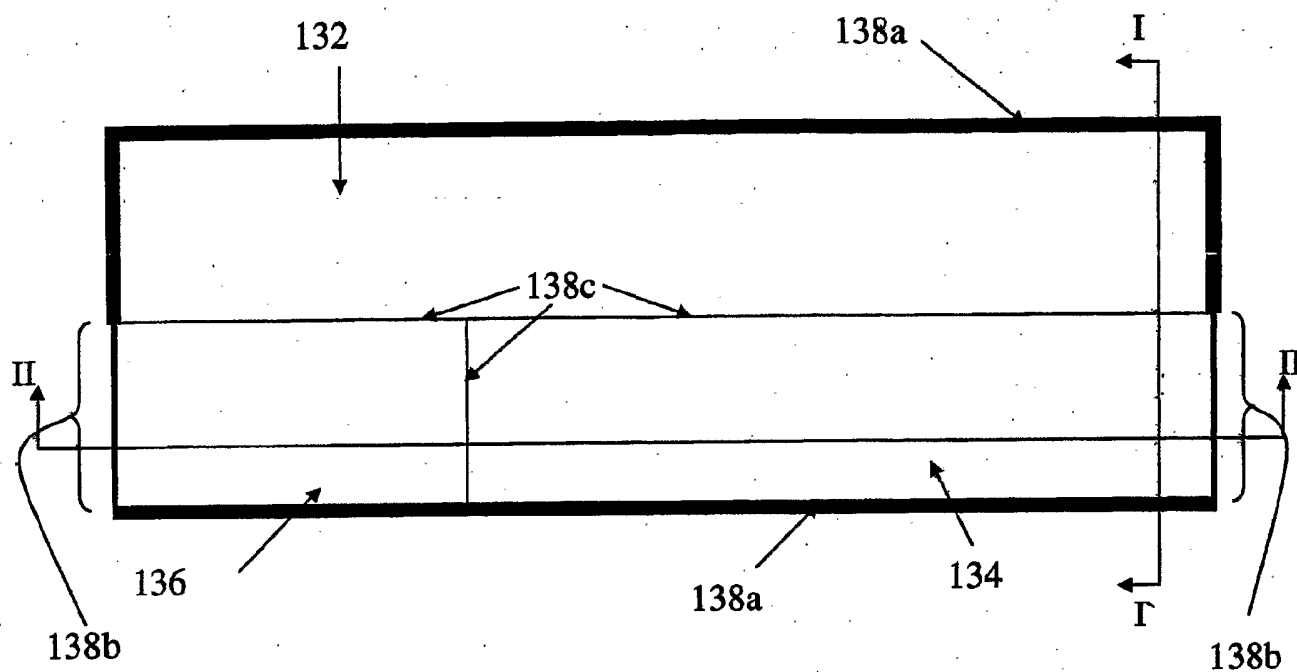


Figure 14B

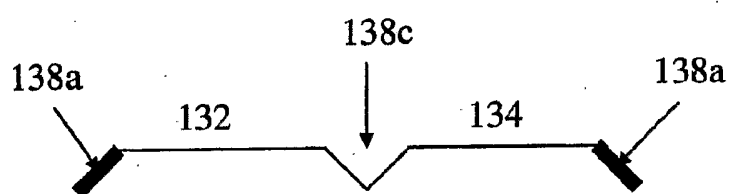


Figure 14C

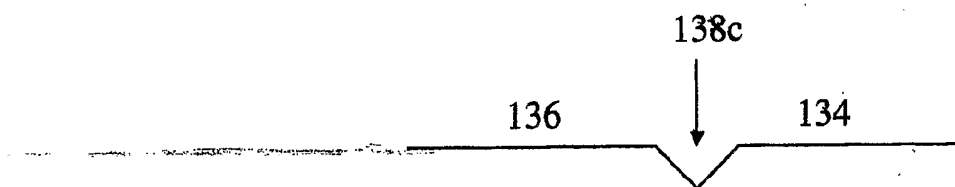


Figure 15A

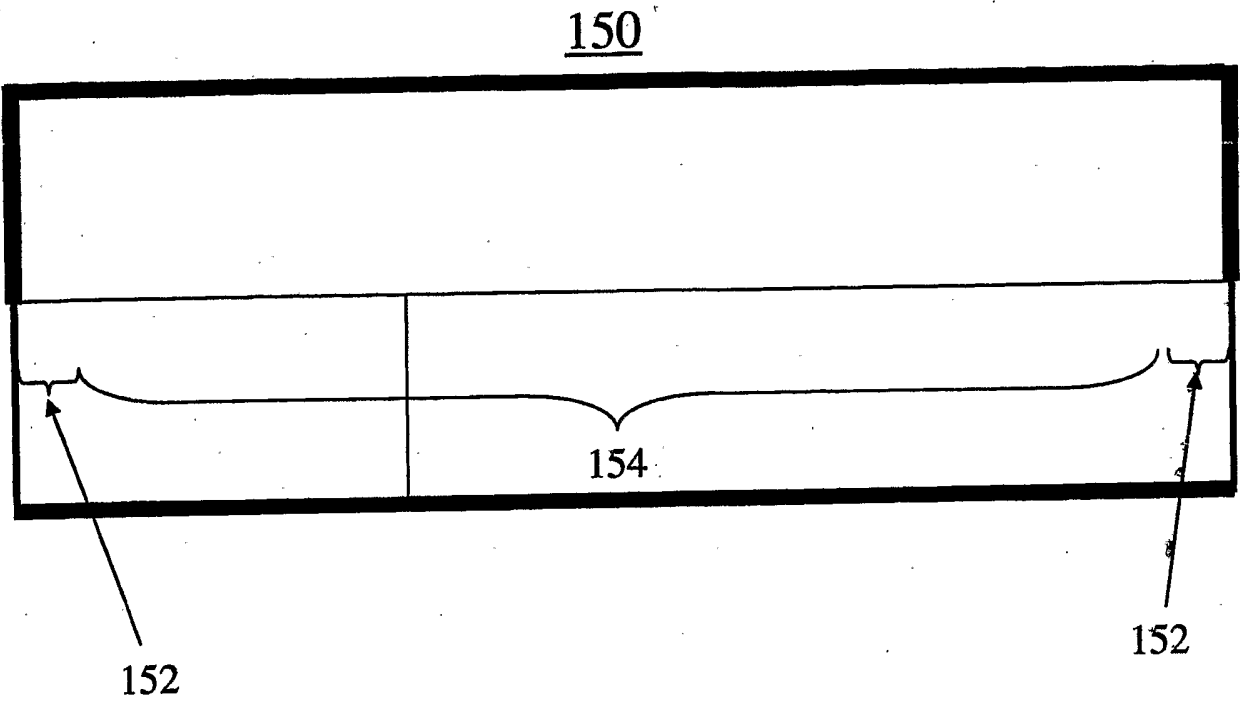


Figure 15B

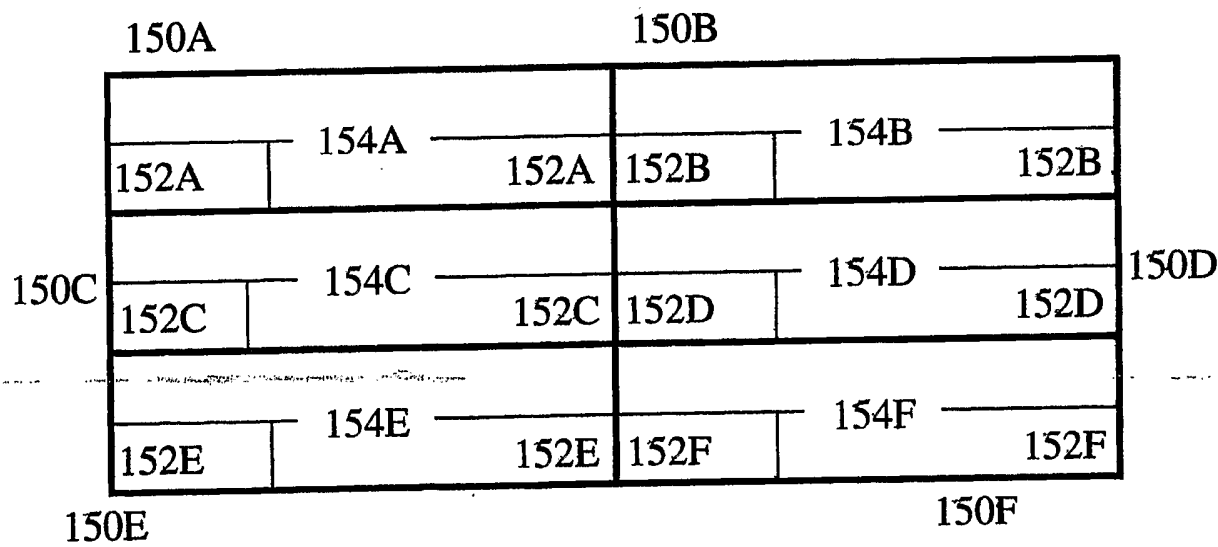


Figure 15C

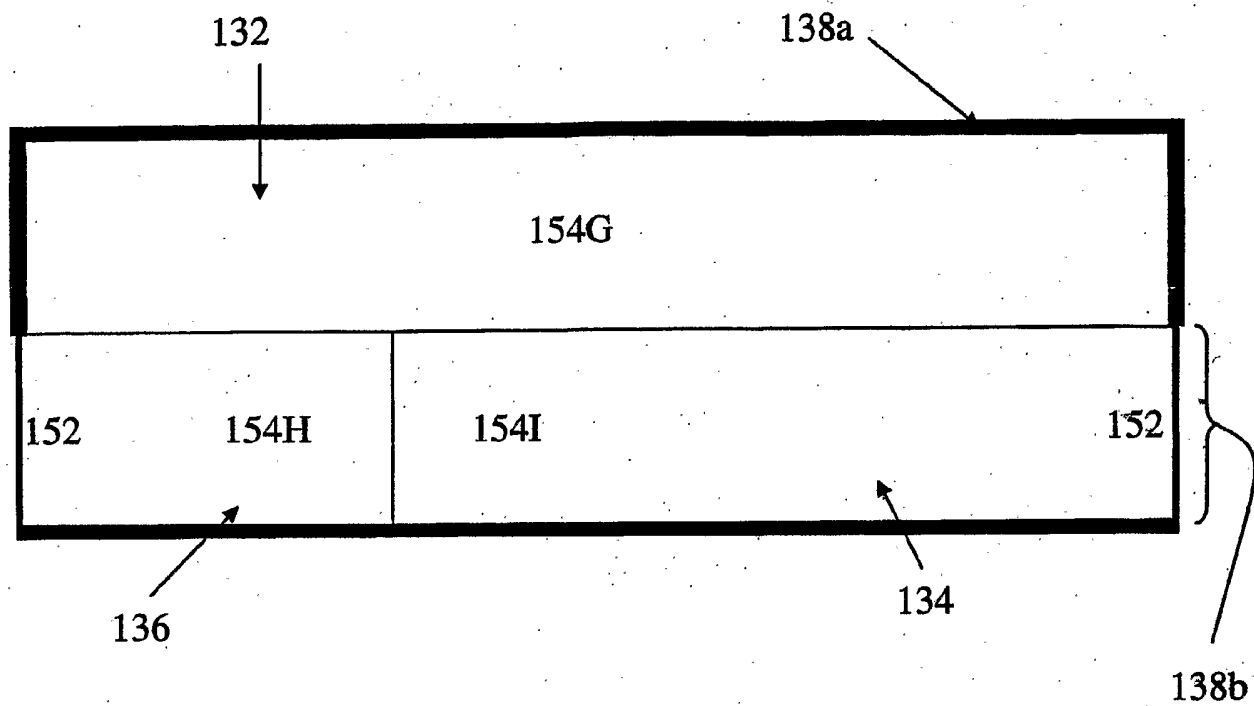


FIG. 15D

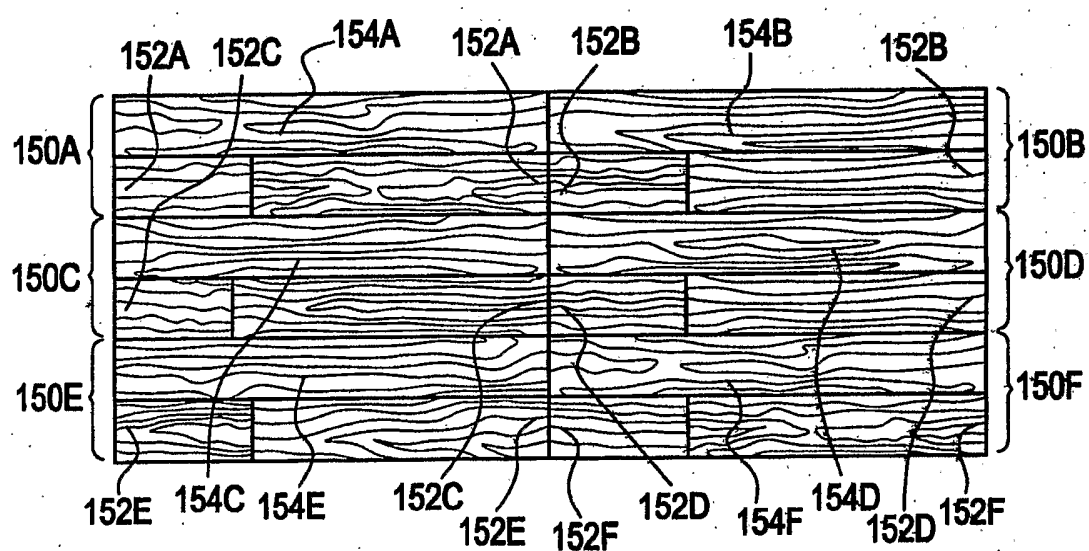
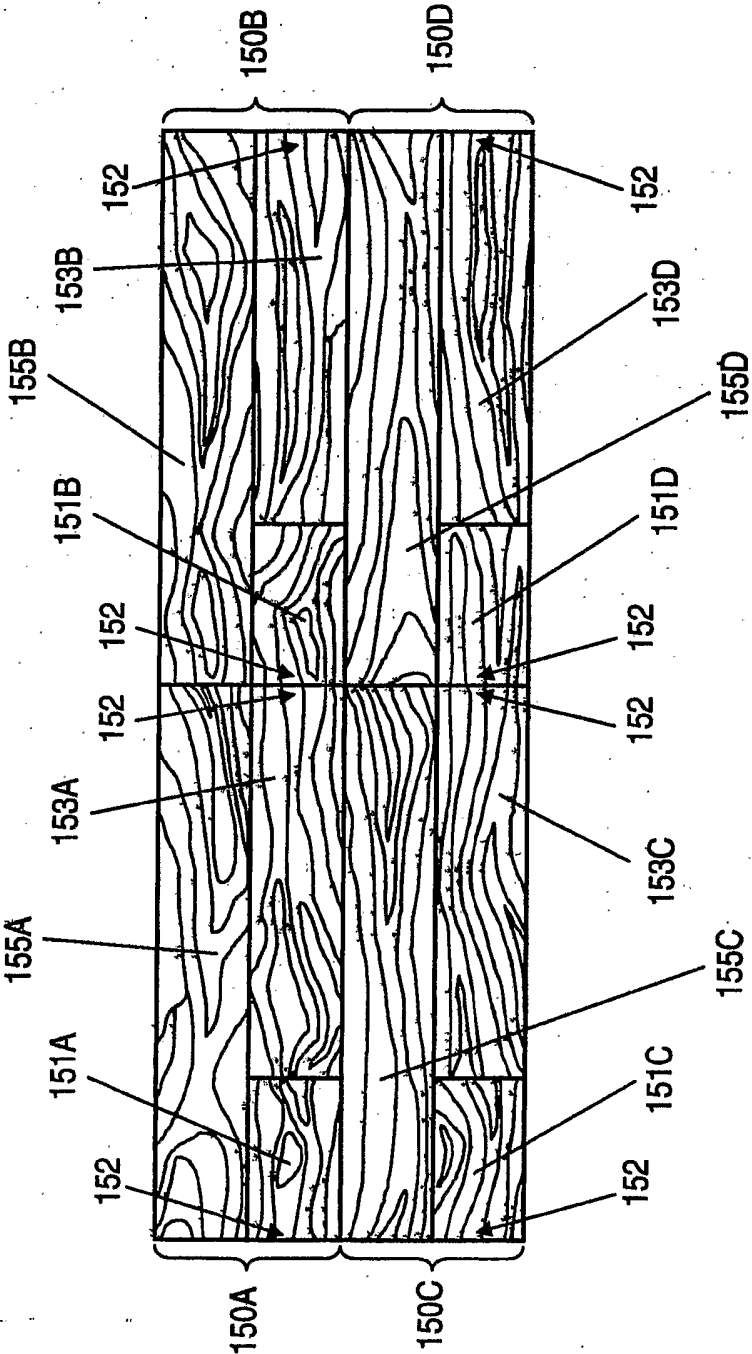
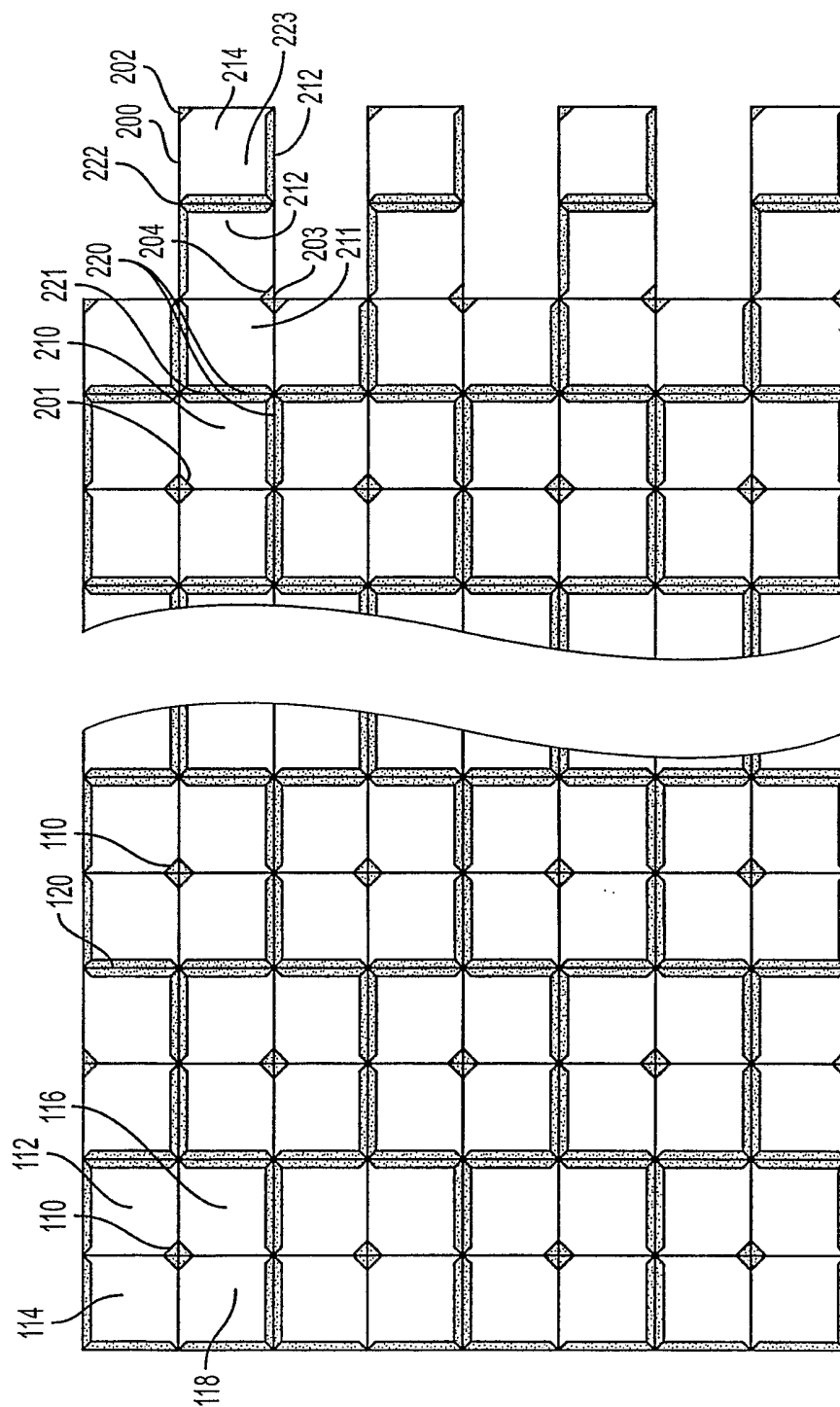


FIG. 15E





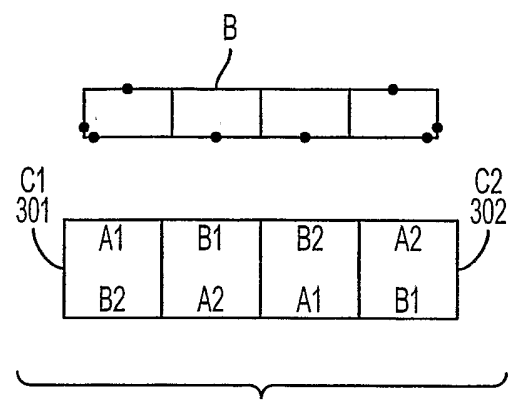


FIG. 18

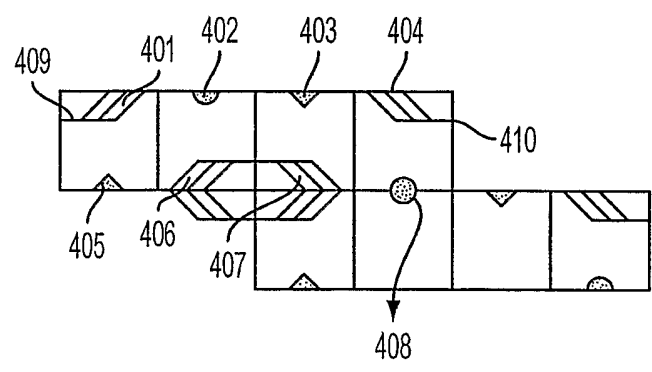


FIG. 19