(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
17 October 2013 (17.10.2013)

WIPO | PCT

(10) International Publication Number
WO 2013/154940 A1

(51) International Patent Classification:
E04F 15/022 (2006.01)

(21) International Application Number:
PCT/US20 13/035469

(22) International Filing Date:
5 April 2013 (05.04.2013)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/622,903 11 April 2012 (11.04.2012) US

(71) Applicant *(for all designated States except US):* **CERTAINTEED CORPORATION** [US/US]; 750 East Swedesford Road, Valley Forge, Pennsylvania 19482 (US).

(72) Inventors: **GILBERT, Thomas C ;** 8348 S. Jackson Road, Clarklake, Michigan 49234 (US). **BATTLES, Robert E.;** 14 Lakeview Drive, Marshall, Illinois 62441 (US). **STEELE, David H.;** 4091 Spring Arbor Road, Jackson, Michigan 49201 (US).

(74) Agents: **ABEL LAW GROUP, LLP** et al; 891 1 N. Capital of Texas Hwy, Bldg 4, Suite 4200, Austin, Texas 78759 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available):* AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available):* ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17 :

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.1 7(H))*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.1 7(in))*

[Continued on next page]

(54) Title: SYSTEM, METHOD AND APPARATUS FOR FIBER CEMENT UNDERLAYMENT OR BACKERBOARD

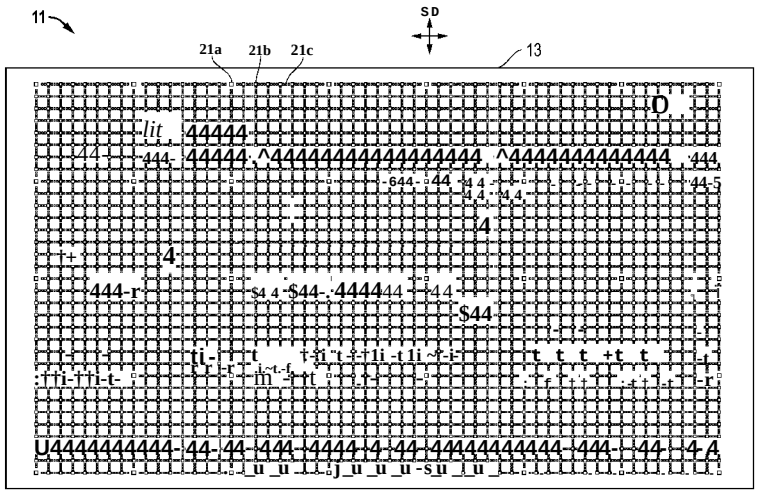

FIG. 3

(57) Abstract: A building sheet includes a substantially flat board having a front surface, a back surface and a thickness defined therebetween. At least one of the front and back surfaces defines a surface direction. The thickness defines a thickness direction that is substantially perpendicular to the surface direction. Recesses are formed in at least one of the front and back surfaces. The recesses have a maximum dimension in the surface direction of less than 3/8 inch, such that each recess is too small to receive a head of the fastener.

WO 2013/154940 A1

Published:

— *with international search report (Art. 21(3))*

— *with amended claims (Art. 19(1))*

SYSTEM, METHOD AND APPARATUS FOR FIBER CEMENT UNDERLAYMENT OR BACKERBOARD

BACKGROUND OF THE INVENTION

Field of the Disclosure

The present invention relates in general to building sheets and, in particular, to a system, method and apparatus for a fiber cement underlayment or backerboard.

Description of the Related Art

Building sheets made of fiber cement and other materials are often used as backerboards for floors, countertops, walls, etc. For example, backerboards for ceramic tiles are used for countertops to provide the water resistant, relatively rigid, dimensionally-stable foundation over which the tile is bonded during the installation. Conventionally, the backerboard is laid over an exterior grade sheet of plywood and adhered thereto using an adhesive such as a dry-set portland cement mortar or latex-modified portland cement mortar thinset. The backerboard is also fastened to the plywood subfloor using nails or screws. Once the backerboard is in place, ceramic tile is laid over the backerboard and adhered thereto using a modified thinset or other suitable tile adhesives. Backerboards are installed in a similar manner for a number of other applications, such as tile backer for floor installations and wallboard installations where the material is installed direct to stud or exterior sheathing or paneling applications.

For these and other applications, building sheets must generally be sized and cut to an appropriate dimension for installation. For example, tile backerboards must be appropriately sized and cut before placement over plywood subfloor. This can be a time consuming and labor-intensive process, requiring a number of different tools and great precision to size and cut a board to the desired dimension. Cutting of a backerboard typically requires using a straight edge and scoring knife to score the backerboard on one side, and then snapping the backerboard up against the edge of the straight edge to break

the board along the score mark. It is often difficult, particularly for long cuts, to hold the straight edge in a fixed relationship to the material with one hand, and perform the scoring or cutting with the other hand. Resultant slippage can reduce the accuracy of the resulting cut. Alternatively, a circular saw with a carbide tipped blade or shears have also been used to cut backerboards.

To assist in determining a desired cut location, backerboards have been known to contain marker locations, for example markers six inches apart marked in ink, to indicate fastening locations for nails or drills. These markers can also provide a visual aid to enable a cutter to more easily locate a desired cutting location. U.S. Pat. No. 5,673,489 to Robell describes a gridded measurement system for construction materials such as wallboards wherein a plurality of horizontal and vertical unit measurement markings are positioned around the perimeter of the construction material surface to provide quick dimensional reference for sizing of the construction material. The construction material surface is filled with horizontal and vertical grid markings between the numbered unit measurement markings.

Construction boards with markings as described above, though generally assisting in visualizing cut locations, still do not significantly decrease the time and labor for installation. This is due in part to the fact that boards with markings still require the use of a straight edge or other tool to guide a cut mark across the board. Other designs use grooves and large nail head recesses.

Thus, there is a need for an affordable cutting and/or scoring reference for installers of backerboards and underlayment fiber cement boards. There is also a need to reduce the weight of these products and allow nails or screw fasteners to be driven flush with the surface of the sheet during installation. Improvements in building sheets continue to be of interest.

SUMMARY

Embodiments of a system, method and apparatus for a building sheet are disclosed. For example, a building sheet may comprise a substantially flat board having a

front surface, a back surface and a thickness defined therebetween. At least one of the front and back surfaces defines a surface direction. The thickness defines a thickness direction that is substantially perpendicular to the surface direction. Recesses are formed in said at least one of the front and back surfaces. The recesses have a maximum dimension in the surface direction of less than 3/8 inch. At least some of the recesses may be configured to receive a tip of a fastener, but all of the recesses are too small to receive a head of the fastener.

Embodiments of a method of installing a building sheet may comprise providing a building sheet having a front surface, a back surface and a thickness defined therebetween, at least one of the front and back surfaces defines a surface direction and the thickness defines a thickness direction that is substantially perpendicular to the surface direction. The method may further comprise providing recesses in said at least one of the front and back surfaces, the recesses having a maximum dimension in the surface direction of less than 3/8 inch, such that the recesses are too small to receive heads of fasteners. The method may then comprise placing the building sheet adjacent a support structure; and securing the building sheet to the support structure with fasteners in at least some of the recesses, such that the fasteners deform the building sheet at said at least some of the recesses.

Embodiments of a method of forming a texture on a building sheet may comprise forming a building sheet having a front surface, a back surface and a thickness defined therebetween, at least one of the front and back surfaces defines a surface direction and the thickness defines a thickness direction that is substantially perpendicular to the surface direction. The method also may comprise forming recesses in said at least one of the front and back surfaces, the recesses having a maximum dimension in the surface direction of less than 3/8 inch, such that the recesses are too small to receive heads of fasteners.

The foregoing and other objects and advantages of these embodiments will be apparent to those of ordinary skill in the art in view of the following detailed description, taken in conjunction with the appended claims and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

So that the manner in which the features and advantages of the embodiments are attained and can be understood in more detail, a more particular description may be had by reference to the embodiments thereof that are illustrated in the appended drawings. However, the drawings illustrate only some embodiments and therefore are not to be considered limiting in scope as there may be other equally effective embodiments.

FIGS. 1 and 2 are schematic isometric and enlarged isometric views of an embodiment of a building sheet;

FIGS. 3 and 4 are plan and enlarged plan view of another embodiment of a building sheet;

FIG. 5 is a schematic sectional side view of the embodiment of the building sheet ofFIGS. 3 and 4;

FIGS. 6a and 6b are sequential schematic sectional views of an embodiment of a building sheet being installed; and

FIG. 7 is a side view of an embodiment of a roller used for forming recesses in building sheets.

The use of the same reference symbols in different drawings indicates similar or identical items.

DETAILED DESCRIPTION

Embodiments of a system, method and apparatus for a building sheet are disclosed. For example, the building sheet may comprise a fiber cement product, such as a backer board or an underlayment. Other embodiments relate to a building sheet or backerboard for flooring or other surface treatments such as ceramic tile, countertops,

walls and the like. However, it will be appreciated that the embodiments disclosed herein may be adapted and applied to other types of building sheets including but not limited to interior wallboard, wall panels, exterior sheathing, panel flooring, decking, ceiling panels, soffit panels, facade panels and general building and furniture flat panels.

Before being sized and cut to its desired dimension for installation, the building sheet is preferably a substantially flat, rectangular board. The building sheet may be formed from a fiber cement material, although other materials, such as plywood, hardboard, oriented strand board (OSB), engineered wood, fiber-matte-reinforced cement substrate sheets, cement boards, gypsum based wallboards and cement-bonded particle boards may also be used.

The fiber cement material may comprise about 20% to 60% portland cement, about 20% to 70% ground silica sand, about 0% to 12% cellulose fiber, and about 0% to 6% select additives such as mineral oxides, mineral hydroxides and water. Platelet or fibrous additives, such as, for example, wollastonite, mica, glass fiber or mineral fiber, may be added to improve the thermal stability of the fiber cement. The dry density fiber cement sheet is typically about 0.8 g/cm^3 (low density) to about 1.3 g/cm^3 (medium density) to about 1.8 g/cm^3 or more (high density). Density can be modified by addition of density modifiers such as unexpanded or expanded vermiculite, perlite, clay, shale or low bulk density (about 0.06 to 0.7 g/cm^3) calcium silicate hydrates. The moisture content of the fiber cement is preferably from about 1% to about 30%.

Typical building sheet sizes may include 3'χ5', 4'x4', and 4'x8' having thicknesses of preferably 1/4" or greater. Other nominal thicknesses of 3/8, 7/16, 1/2 and 5/8 inches also may be used.

As shown in the schematic drawing of FIG. 1 (not to scale), a building sheet 11 may comprise a substantially flat board 13 having a front surface 15, a back surface 17 and a thickness 19 defined therebetween. Backer boards and underlayments typically have a thickness 19 of about ¼ inch to about ½ inch. At least one of the front and back surfaces 15, 17 may define a surface direction SD. In the embodiment of FIG. 1, front surface 15 defines the SD. The thickness 19 defines a thickness direction TD that is

substantially perpendicular to the surface direction SD. Thus, as depicted by the Cartesian coordinate system in FIG. 1, the SD extends in an x-y plane, and the TD extends along the z-axis.

Building sheet 11 also has recesses 21 formed in at least one of the front and back surfaces 15, 17. The recesses 21 may be arrayed in a symmetrical pattern (e.g., a rectilinear pattern), and may have three-dimensional shapes such as the square pyramids depicted in FIG. 1. Recesses 21 also may comprise other pyramidal shapes (e.g., rectangular, triangular, etc.), semi-spherical shapes, conical shapes, or any combination thereof. The recesses 21 may have bases that are substantially flush with the at least one of the front and back surfaces 15, 17. The recesses 21 may taper in shape in the thickness direction TD from their bases to their bottoms. The recesses 21 may have non-flat bottoms. At least some of the recesses may be configured to receive a tip of a fastener therein to substantially center the tip of the fastener in the recess.

As shown in the enlarged view of FIG. 2, the recesses 21 may have a maximum dimension MD in the surface direction SD of less than 3/8 inch (i.e., 0.375 inch). At least some of the recesses 21 may be configured to receive a fastener therein. However, none of the recesses 21 are large enough to receive a head of the fastener. For example, in the square pyramid embodiment of FIGS. 1 and 2, each recess 21 has a side S having a length of about ¼ inch. Thus, the diagonal MD across recess 21 is about 0.354 inch. In contrast, typical backer screws have heads with nominal diameters of 3/8 inch, which is typically an actual size range of about 0.380 inch to about 0.385 inch). When nails are used to secure such building sheets, generally roofing nails with head diameters of about ½ inch are employed. The recesses 21 may be configured to be crushed upon installation of fasteners therein, such that heads of the fasteners are substantially flush with the board in the surface direction upon installation.

In FIG. 1, the recesses 21 are discontinuous but substantially completely cover the front surface 15 in the surface direction SD and extend adjacent to the perimeter of the board 13. Thus, there are only very small spaces between adjacent ones of the recesses.

However, as shown in FIGS. 3 - 5, the recesses 21 also are discontinuous but may be spaced apart from each other by flats F (FIG. 4) that extend in the surface direction SD. Moreover, the recesses 21 may be spaced apart from a perimeter of the board (FIG. 3) by a distance of at least about ¼ inch to about 2 inches.

The recesses 21 may be configured in more than one size. For example, in FIGS. 3 - 5, the recesses comprise large recesses 21a (e.g., ¼ inch sides), medium recesses 21b (e.g., 3/16 inch sides), and small recesses 21c (e.g., 1/8 inch sides). Embodiments of these recesses may be spaced apart from each other by flats F measuring about 0.095 inch (about 0.090 inch to about 0.100 inch between recesses 21b and 21c), about 0.313 inch (about 0.300 inch to about 0.325 inch between recesses 21a and 21c), or about 0.126 inch (about 0.120 inch to about 0.130 inch between recesses 21c).

Centers of the recesses may be spaced apart from each other by about ¼ inch (between recesses 21c), or about 8 inches to about 12 inches (between recesses 21a). At least some of the recesses may comprise the medium or second type of recess 21b having a maximum dimension in the surface direction of no more than about 0.270 inches (e.g., 3/16 inch sides). The second type of recesses 21b may be arrayed in a grid pattern comprising substantially perpendicular rows and columns. Centers of adjacent ones of the second type of recesses 21b may be spaced apart from each other by about one inch.

At least some of the recesses may comprise the small or third type of recess 21c having a maximum dimension in the surface direction of no more than about 0.180 inches (e.g., 1/8 inch sides). The third type of recesses 21c may be arrayed in a grid pattern comprising substantially perpendicular rows and columns. Centers of adjacent ones of the rows and columns may be spaced apart from each other by about ¼ inch to about 2 inches (e.g., one inch in the embodiment shown). Centers of the second and third types of recesses 21b, 21c may be spaced apart from each other by at least about ¼ inch.

Centers of the recesses 21a having the maximum dimension in the surface direction of less than 3/8 inch may be spaced apart from centers of the second type of recesses 21b by at least about 1 inch, and may be spaced apart from centers of the third type of recesses 21c by at least about ½ inch. This configuration is best shown in FIG. 4,

wherein each recess 21a is spaced apart from the next recess 21c by a larger flat F. Such designs facilitate the machinability of rollers used to form the recesses.

In addition, the recesses may be provided with a depth in the thickness direction TD of no more than about 0.088 inch (for recesses 21a), or no more than about 0.066 inch (for recesses 21b), or no more than about 0.044 inch (for recesses 21c). In some embodiments, only the largest of the recesses may be configured to receive fasteners, but again not the heads of the fasteners.

In some embodiments, the recesses are formed in both of the front and back surfaces, which facilitates weight reduction of the building sheet. Moreover, a pattern of the recesses formed in the front surface may differ from a pattern of the recesses in the back surface. In addition, all of the recesses may be oriented in a same direction as shown in the drawings. Alternatively, at least some of the recesses may be oriented in a different direction than other ones of the recesses. For example, some of the recesses may be oriented at a 45 degree angle relative to other ones of the recesses. Thus, when the recesses are square pyramids, the rotated recesses would appear as diamond shapes while the other recesses would appear as square shapes. Such a configuration facilitates easier recognition of fastener locations and the like.

Embodiments of a method of installing a building sheet may comprise providing a building sheet having a front surface, a back surface and a thickness defined therebetween, at least one of the front and back surfaces defines a surface direction and the thickness defines a thickness direction that is substantially perpendicular to the surface direction. The method may further comprise providing recesses in said at least one of the front and back surfaces, the recesses having a maximum dimension in the surface direction of less than 3/8 inch, such that the recesses are too small to receive heads of fasteners.

As shown in FIG. 6, the method may then comprise placing the building sheet 11 adjacent a support structure 61; and securing the building sheet to the support structure with fasteners 63 in at least some of the recesses 21 (FIG. 6a), such that the fasteners 63 deform the building sheet 11 at said at least some of the recesses 21 (FIG. 6b).

Thereafter tile 65 or other products may be secured to building sheet 11, such as with adhesive 67.

Heads of the fasteners may be substantially flush with the building sheet in the surface direction after installation. The heads are not necessarily required to be flush if the adhesive thickness used to bond tile (or other materials) to the building sheet is sufficient to cover the heads.

Embodiments of a method of forming a texture on a building sheet may comprise forming a building sheet having a front surface, a back surface and a thickness defined therebetween, at least one of the front and back surfaces defines a surface direction and the thickness defines a thickness direction that is substantially perpendicular to the surface direction. The method also may comprise forming recesses in said at least one of the front and back surfaces, the recesses having a maximum dimension in the surface direction of less than 3/8 inch, such that the recesses are too small to receive heads of fasteners.

The recesses may be formed while the building sheet is still wet and uncured, and then the building sheet is dried and cured. The building sheet may be formed with sheet build-up, the recesses may be formed in the building sheet by a patterned secondary roll 71 (FIG. 7) or belt system that is downstream from sheet build-up, and the patterned secondary roll or belt may use protrusions 73 to press the recesses into said at least one of the front and back surfaces. Alternatively, the recesses may be impressed into the building sheet by a flat press system.

In another embodiment, the building sheet may comprise a plurality of layers and may be formed on an accumulator roll in a sheet build-up process. The accumulator roll may have a pattern to form the recesses while the building sheet is being built-up in layers.

In still other embodiments, the recesses may be formed after the building sheet is dry and cured. For example, the recesses may be formed by laser burning, mechanical cutting, gang drilling or heated brand burning.

The building sheet may comprise extruded fiber cement. The recesses may be formed while the building sheet is wet or after the building sheet is dry. In addition, the building sheet may be formed as a single layer rather than a plurality of layers.

Embodiments may utilize a texture comprising indentations in the top and/or bottom surfaces of fiber cement backer boards and underlayment products. The impressed pattern may comprise a series of inverted pyramids. The size and depth of the inverted pyramids may be optimized for the properties desired. For example, the inverted pyramids may be about 1/16 inch-square at the base, tapering downward at 45 degree angles, with a depth of about 1/32 inch. Such a design may provide adequate nail/screw penetration. Other dimensions such as 3/16 inch or ¼ inch inverted pyramid bases may be more appropriate for better penetration of tapered or bugle head type screws.

The inverted pyramid bases may be grouped close together, or separated by small dimensions or flats (e.g., 0.050 inches) to provide an outer plane for bearing the weight of the sheets or product above it. In addition, the outer plane would provide for standard thickness measuring of the sheets where a typical ¼" micrometer tip face width may span across the bases of the inverted pyramids. Rows of parallel and perpendicular inverted pyramids may be aligned with the edges of the sheet or product. The shape of the indentions is not be limited to square pyramids, but may take the form of pyramids of other shapes, cones, half-spheres, or any number or combination of geometric shapes. In some embodiments, the indentions do not have a flat bottom to facilitate the starting and installation of fasteners. Thus, at least some of the recesses are configured to receive a tip of a fastener therein and substantially center the tips of the fasteners in the recesses. In other embodiments, all of the recesses may be configured to receive the tips of fasteners therein.

The surface texture formed by the recesses or indentations may not cover the entire surface of the product, as it may have a ¼ inch to 2 inch perimeter around the edge without the texture. In other embodiments text or logos such as a company name or other information may be added within the texture.

Beneficially, the indentations may be used as a reference for installers who cut or score the products. The indentations may provide a visual aid for scoring or cutting parallel to the sheet edges. The installer can measure where the product is to be cut and the rows may provide visual lines they can cut or score from for reducing the product to the desired size. Another benefit is the weight reduction of the product since the process of forming or impressing inverted pyramids displaces material at each indentation. The embodiments are also beneficial for increasing surface exposure for improved bonding of adhesives and mortars either to the substrate, or to the tiles installed over the backers or both. In addition, when nails or screw fasteners are applied through the sheet, the bases of the inverted pyramids may crush under the nailing or screwing force allowing the fastener heads to be driven substantially flush with the product surface. This design reduces issues with protruding nail or screw heads that may interfere with application of tiles to the underlayment surface.

With method embodiments, the surface texture may be formed during the sheet build up process with the pattern built unto the accumulator roll where the pattern will be transferred to the final sheet. The texture also may be formed by a secondary roll or belt system that is downstream of the sheet build-up and is pressed into the surface by a patterned roll. This roll or belt could be any number of materials including, but not limited to metals, silicone or other polymer or composite. The texture also may be impressed unto the sheet surfaces by pressure through a press system or other mechanical device capable of applying adequate pressures. In addition, the surface texture may be added by laser burning, mechanical cutting, gang drilling or heated brand burning.

This written description uses examples to disclose the embodiments, including the best mode, and also to enable those of ordinary skill in the art to make and use the invention. The patentable scope is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal languages of the claims.

Note that not all of the activities described above in the general description or the examples are required, that a portion of a specific activity may not be required, and that one or more further activities may be performed in addition to those described. Still further, the order in which activities are listed are not necessarily the order in which they are performed.

In the foregoing specification, the concepts have been described with reference to specific embodiments. However, one of ordinary skill in the art appreciates that various modifications and changes can be made without departing from the scope of the invention as set forth in the claims below. Accordingly, the specification and figures are to be regarded in an illustrative rather than a restrictive sense, and all such modifications are intended to be included within the scope of invention.

As used herein, the terms "comprises," "comprising," "includes," "including," "has," "having" or any other variation thereof, are intended to cover a non-exclusive inclusion. For example, a process, method, article, or apparatus that comprises a list of features is not necessarily limited only to those features but may include other features not expressly listed or inherent to such process, method, article, or apparatus. Further, unless expressly stated to the contrary, "or" refers to an inclusive-or and not to an exclusive-or. For example, a condition A or B is satisfied by any one of the following: A is true (or present) and B is false (or not present), A is false (or not present) and B is true (or present), and both A and B are true (or present).

Also, the use of "a" or "an" are employed to describe elements and components described herein. This is done merely for convenience and to give a general sense of the scope of the invention. This description should be read to include one or at least one and the singular also includes the plural unless it is obvious that it is meant otherwise.

Benefits, other advantages, and solutions to problems have been described above with regard to specific embodiments. However, the benefits, advantages, solutions to problems, and any feature(s) that may cause any benefit, advantage, or solution to occur or become more pronounced are not to be construed as a critical, required, or essential feature of any or all the claims.

After reading the specification, skilled artisans will appreciate that certain features are, for clarity, described herein in the context of separate embodiments, may also be provided in combination in a single embodiment. Conversely, various features that are, for brevity, described in the context of a single embodiment, may also be provided separately or in any subcombination. Further, references to values stated in ranges include each and every value within that range.

WHAT IS CLAIMED IS:

1. A building sheet, comprising:

a substantially flat board having a front surface, a back surface and a thickness defined therebetween, at least one of the front and back surfaces defines a surface direction and the thickness defines a thickness direction that is substantially perpendicular to the surface direction; and

recesses formed in said at least one of the front and back surfaces, the recesses have a maximum dimension in the surface direction of less than 3/8 inch, such that each recess is too small to receive a head of a fastener.

2. A method of installing a building sheet, comprising:

providing a building sheet having a front surface, a back surface and a thickness defined therebetween, at least one of the front and back surfaces defines a surface direction and the thickness defines a thickness direction that is substantially perpendicular to the surface direction;

providing recesses in said at least one of the front and back surfaces, the recesses having a maximum dimension in the surface direction of less than 3/8 inch, such that the recesses are too small to receive heads of fasteners;

placing the building sheet adjacent a support structure; and

securing the building sheet to the support structure with fasteners in at least some of the recesses, such that the fasteners deform the building sheet at said at least some of the recesses.

3. A method of forming a texture on a building sheet, comprising:

forming a building sheet having a front surface, a back surface and a thickness defined therebetween, at least one of the front and back surfaces defines a surface direction and the thickness defines a thickness direction that is substantially perpendicular to the surface direction; and

forming recesses in said at least one of the front and back surfaces, the recesses having a maximum dimension in the surface direction of less than 3/8 inch, such that the recesses are too small to receive heads of fasteners.

4. The building sheet according to any of the preceding claims, wherein the recesses are discontinuous and spaced apart from each other by flats that extend in the surface direction.

5. The building sheet according to any of the preceding claims, wherein the recesses are configured to be crushed upon installation of fasteners therein, such that heads of the fasteners are substantially flush with the board in the surface direction upon installation.

6. The building sheet according to any of the preceding claims, wherein the building sheet is a fiber cement product.

7. The building sheet according to any of the preceding claims, wherein the building sheet is a backer board or an underlayment, and the thickness is about ¼ inch to about ½ inch.

8. The building sheet according to any of the preceding claims, wherein the recesses have three-dimensional shapes comprising pyramidal shapes, semi-spherical shapes, conical shapes, or any combination thereof.

9. The building sheet according to any of the preceding claims, wherein the recesses have bases that are substantially flush with said at least one of the front and back surfaces, and the recesses taper in shape in the thickness direction to bottoms.

10. The building sheet according to any of the preceding claims, wherein the recesses have non-flat bottoms, and at least some of the recesses are configured to receive a tip of a fastener therein to substantially center the tip of the fastener in the recess.

11. The building sheet according to any of the preceding claims, wherein the recesses are arrayed in a symmetrical pattern.

12. The building sheet according to any of the preceding claims, wherein centers of the recesses are spaced apart from each other by about ¼ inch to about 12 inches, or about ¼ inch to about 8 inches.

13. The building sheet according to any of the preceding claims, wherein the recesses are spaced apart from each other by flats measuring about 0.090 inch to about 0.100 inch, about 0.300 inch to about 0.325 inch, or about 0.120 inch to about 0.130 inch.

14. The building sheet according to any of the preceding claims, wherein at least some of the recesses are located adjacent to a perimeter of the board.

15. The building sheet according to any of the preceding claims, wherein all of the recesses are spaced apart from a perimeter of the board by a distance of at least about ¼ inch to about 2 inches.

16. The building sheet according to any of the preceding claims, wherein the recesses have a depth in the depth direction of no more than about 0.088 inch, or no more than about 0.066 inch, or no more than about 0.044 inch.

17. The building sheet according to any of the preceding claims, wherein the recesses comprise at least two sizes of recesses.

18. The building sheet according to Claim 17, wherein at least some of the recesses comprise a second type of recess having a maximum dimension in the surface direction of no more than about 0.270 inches.

19. The building sheet according to Claim 18, wherein the second type of recesses is arrayed in a grid pattern comprising substantially perpendicular rows and columns, and

centers of adjacent ones of the second type of recesses are spaced apart from each other by about 1 inch.

20. The building sheet according to Claim 18, wherein at least some of the recesses comprise a third type of recess having a maximum dimension in the surface direction of no more than about 0.180 inches.

21. The building sheet according to Claim 20, wherein the third type of recesses is arrayed in a grid pattern comprising substantially perpendicular rows and columns, and centers of adjacent ones of the rows and columns are spaced from each other by about ¼ inch to about 2 inches.

22. The building sheet according to Claim 20, wherein centers of the recesses having the maximum dimension in the surface direction of less than 3/8 inch are spaced apart from centers of the second type of recesses by at least about 1 inch, and are spaced apart from centers of the third type of recesses by at least about ½ inch.

23. The building sheet according to Claim 20, wherein centers of the second and third types of recesses are spaced apart from each other by at least about ¼ inch.

24. The building sheet according to any of the preceding claims, wherein all of the recesses are oriented in a same direction.

25. The building sheet according to any of claims 1-23, wherein at least some of the recesses are oriented in a different direction than other ones of the recesses.

26. The building sheet according to any of the preceding claims, wherein the recesses are formed in both of the front and back surfaces.

27. The building sheet according to Claim 26, wherein a pattern of the recesses formed in the front surface differs from a pattern of the recesses in the back surface.

28. The building sheet according to any of the preceding claims, wherein the recesses are formed while the building sheet is still wet and uncured, and then the building sheet is dried and cured.

29. The building sheet according to any of the preceding claims, wherein the building sheet is formed with sheet build-up, the recesses are formed in the building sheet by a patterned secondary roll or belt system that is downstream from sheet build-up, and the patterned secondary roll or belt presses the recesses into said at least one of the front and back surfaces.

30. The building sheet according to any of the preceding claims, wherein the recesses are impressed into the building sheet by a flat press system.

31. The building sheet according to any of the preceding claims, wherein the building sheet comprises a plurality of layers and is formed on an accumulator roll in a sheet build-up process, and the accumulator roll has a pattern to form the recesses while the building sheet is being built-up in layers.

32. The building sheet according to any of the preceding claims, wherein the recesses are formed after the building sheet is dry and cured.

33. The building sheet according to any of the preceding claims, wherein the recesses are formed by laser burning, mechanical cutting, gang drilling or heated brand burning.

34. The building sheet according to any of the preceding claims, wherein the building sheet is extruded fiber cement, and the recesses are formed while the building sheet is wet or after the building sheet is dry.

35. The building sheet according to any of the preceding claims, wherein the building sheet is formed as a single layer.

AMENDED CLAIMS
received by the International Bureau on 04 September 2013 (04.09.2013)

1. A building sheet, comprising:

a substantially flat board having a front surface, a back surface and a thickness defined therebetween, at least one of the front and back surfaces defines a surface direction and the thickness defines a thickness direction that is substantially perpendicular to the surface direction; and

recesses formed in said at least one of the front and back surfaces, the recesses have a maximum dimension in the surface direction of less than 3/8 inch, such that each recess is too small to receive a head of a fastener.

2. A method of installing a building sheet, comprising:

providing a building sheet having a front surface, a back surface and a thickness defined therebetween, at least one of the front and back surfaces defines a surface direction and the thickness defines a thickness direction that is substantially perpendicular to the surface direction;

providing recesses in said at least one of the front and back surfaces, the recesses having a maximum dimension in the surface direction of less than 3/8 inch, such that the recesses are too small to receive heads of fasteners;

placing the building sheet adjacent a support structure; and

securing the building sheet to the support structure with fasteners in at least some of the recesses, such that the fasteners deform the building sheet at said at least some of the recesses.

3. A method of forming a texture on a building sheet, comprising:

forming a building sheet having a front surface, a back surface and a thickness defined therebetween, at least one of the front and back surfaces defines a surface direction and the thickness defines a thickness direction that is substantially perpendicular to the surface direction; and forming recesses in said at least one of the front and back surfaces, the recesses having a maximum dimension in the surface

direction of less than 3/8 inch, such that the recesses are too small to receive heads of fasteners.

4. The building sheet according to any one of the preceding claims, wherein the recesses are discontinuous and spaced apart from each other by flats that extend in the surface direction.

5. The building sheet according to any one of the preceding claims, wherein the recesses are configured to be crushed upon installation of fasteners therein, such that heads of the fasteners are substantially flush with the board in the surface direction upon installation.

6. The building sheet according to any one of the preceding claims, wherein the building sheet is a fiber cement product.

7. The building sheet according to any one of the preceding claims, wherein the building sheet is a backer board or an underlayment, and the thickness is about ¼ inch to about ½ inch.

8. The building sheet according to any one of the preceding claims, wherein the recesses have three-dimensional shapes comprising pyramidal shapes, semi-spherical shapes, conical shapes, or any combination thereof.

9. The building sheet according to any one of the preceding claims, wherein the recesses have bases that are substantially flush with said at least one of the front and back surfaces, and the recesses taper in shape in the thickness direction to bottoms.

10. The building sheet according to any one of the preceding claims, wherein the recesses have non-flat bottoms, and at least some of the recesses are configured to receive a tip of a fastener therein to substantially center the tip of the fastener in the recess.

11. The building sheet according to any one of the preceding claims, wherein the recesses are arrayed in a symmetrical pattern.

12. The building sheet according to any one of the preceding claims, wherein centers of the recesses are spaced apart from each other by about ¼ inch to about 12 inches, or about ¼ inch to about 8 inches.

13. The building sheet according to any one of the preceding claims, wherein the recesses are spaced apart from each other by flats measuring about 0.090 inch to about 0.100 inch, about 0.300 inch to about 0.325 inch, or about 0.120 inch to about 0.130 inch.

14. The building sheet according to any one of the preceding claims, wherein at least some of the recesses are located adjacent to a perimeter of the board.

15. The building sheet according to any one of the preceding claims, wherein all of the recesses are spaced apart from a perimeter of the board by a distance of at least about ¼ inch to about 2 inches.

16. The building sheet according to any one of the preceding claims, wherein the recesses have a depth in the depth direction of no more than about 0.088 inch, or no more than about 0.066 inch, or no more than about 0.044 inch.

17. The building sheet according to any one of the preceding claims, wherein the recesses comprise at least two sizes of recesses.

18. The building sheet according to Claim 17, wherein at least some of the recesses comprise a second type of recess having a maximum dimension in the surface direction of no more than about 0.270 inches.

19. The building sheet according to Claim 18, wherein the second type of recesses is arrayed in a grid pattern comprising substantially perpendicular rows and columns, and

centers of adjacent ones of the second type of recesses are spaced apart from each other by about 1 inch.

20. The building sheet according to Claim 18, wherein at least some of the recesses comprise a third type of recess having a maximum dimension in the surface direction of no more than about 0.180 inches.

21. The building sheet according to Claim 20, wherein the third type of recesses is arrayed in a grid pattern comprising substantially perpendicular rows and columns, and centers of adjacent ones of the rows and columns are spaced from each other by about ¼ inch to about 2 inches.

22. The building sheet according to Claim 20, wherein centers of the recesses having the maximum dimension in the surface direction of less than 3/8 inch are spaced apart from centers of the second type of recesses by at least about 1 inch, and are spaced apart from centers of the third type of recesses by at least about ½ inch.

23. The building sheet according to Claim 20, wherein centers of the second and third types of recesses are spaced apart from each other by at least about ¼ inch.

24. The building sheet according to any one of the preceding claims, wherein all of the recesses are oriented in a same direction.

25. The building sheet according to any one of claims 1-23, wherein at least some of the recesses are oriented in a different direction than other ones of the recesses.

26. The building sheet according to any one of the preceding claims, wherein the recesses are formed in both of the front and back surfaces.

27. The building sheet according to Claim 26, wherein a pattern of the recesses formed in the front surface differs from a pattern of the recesses in the back surface.

28. The building sheet according to any one of the preceding claims, wherein the recesses are formed while the building sheet is still wet and uncured, and then the building sheet is dried and cured.

29. The building sheet according to any one of the preceding claims, wherein the building sheet is formed with sheet build-up, the recesses are formed in the building sheet by a patterned secondary roll or belt system that is downstream from sheet build-up, and the patterned secondary roll or belt presses the recesses into said at least one of the front and back surfaces.

30. The building sheet according to any one of the preceding claims, wherein the recesses are impressed into the building sheet by a flat press system.

31. The building sheet according to any one of the preceding claims, wherein the building sheet comprises a plurality of layers and is formed on an accumulator roll in a sheet build-up process, and the accumulator roll has a pattern to form the recesses while the building sheet is being built-up in layers.

32. The building sheet according to any one of the preceding claims, wherein the recesses are formed after the building sheet is dry and cured.

33. The building sheet according to any one of the preceding claims, wherein the recesses are formed by laser burning, mechanical cutting, gang drilling or heated brand burning.

34. The building sheet according to any one of the preceding claims, wherein the building sheet is extruded fiber cement, and the recesses are formed while the building sheet is wet or after the building sheet is dry.

35. The building sheet according to any one of the preceding claims, wherein the building sheet is formed as a single layer.

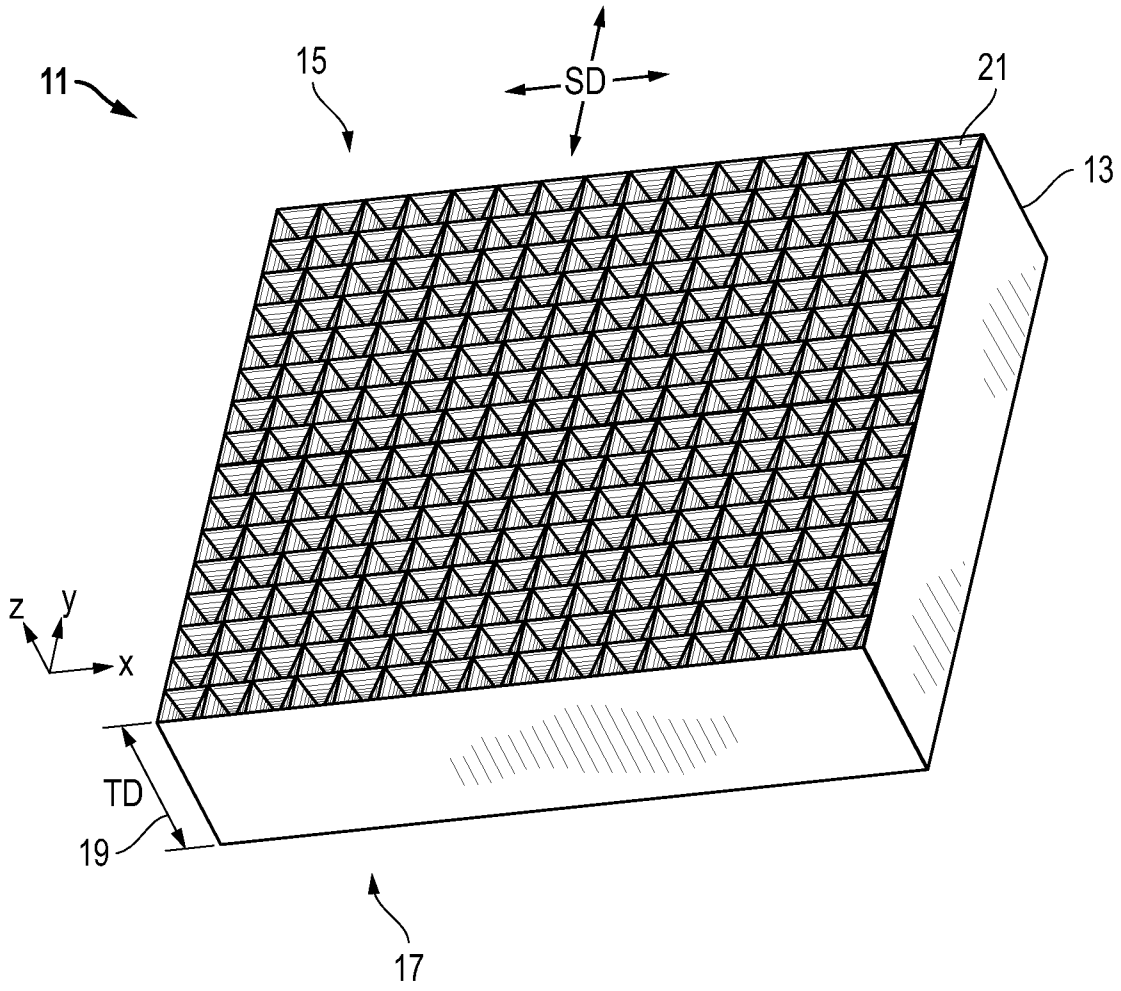

FIG. 1

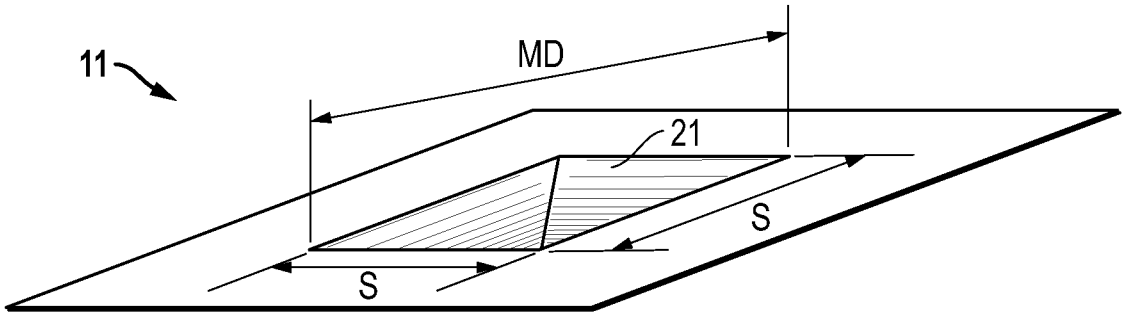

FIG. 2

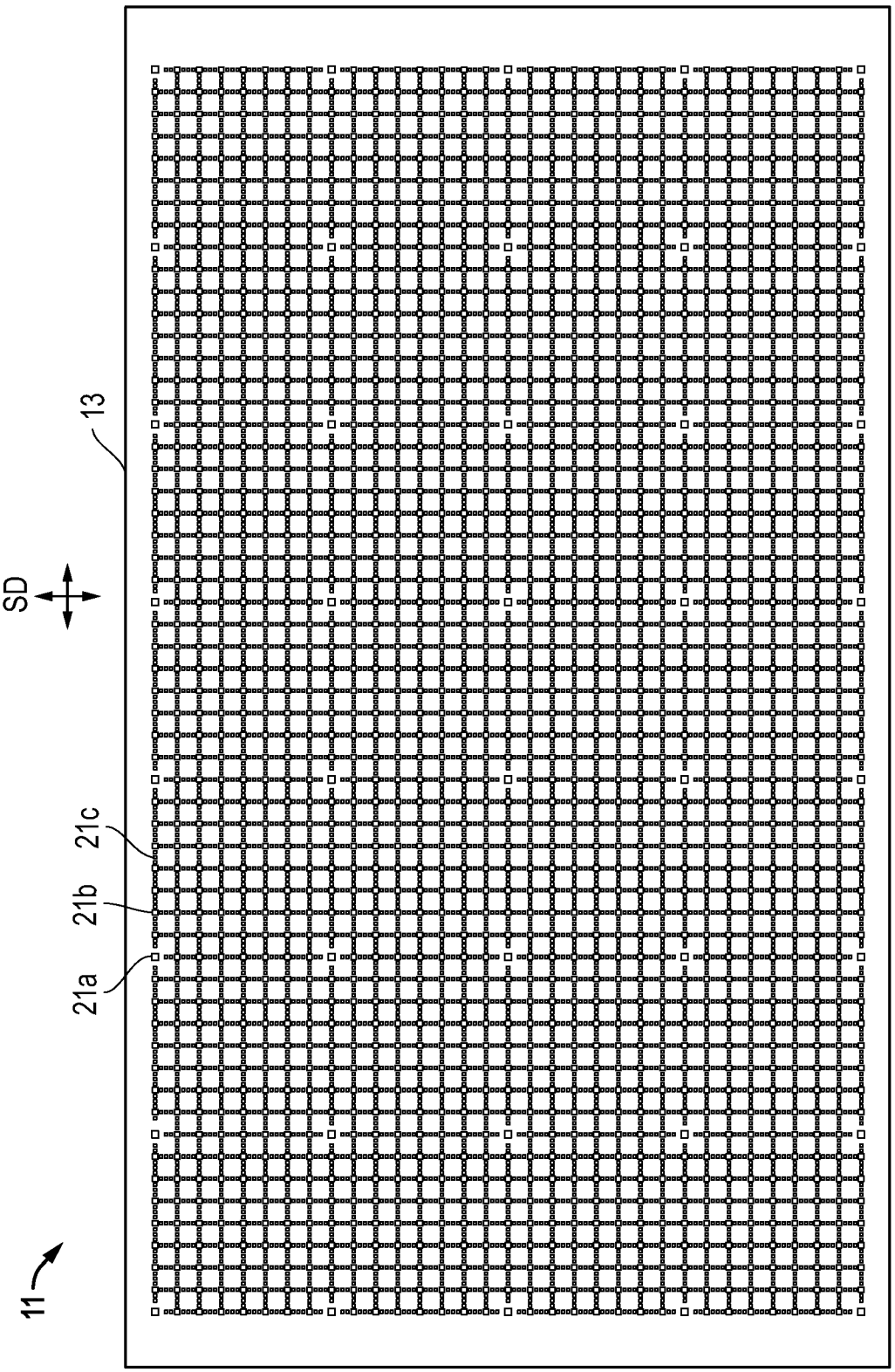

FIG. 3

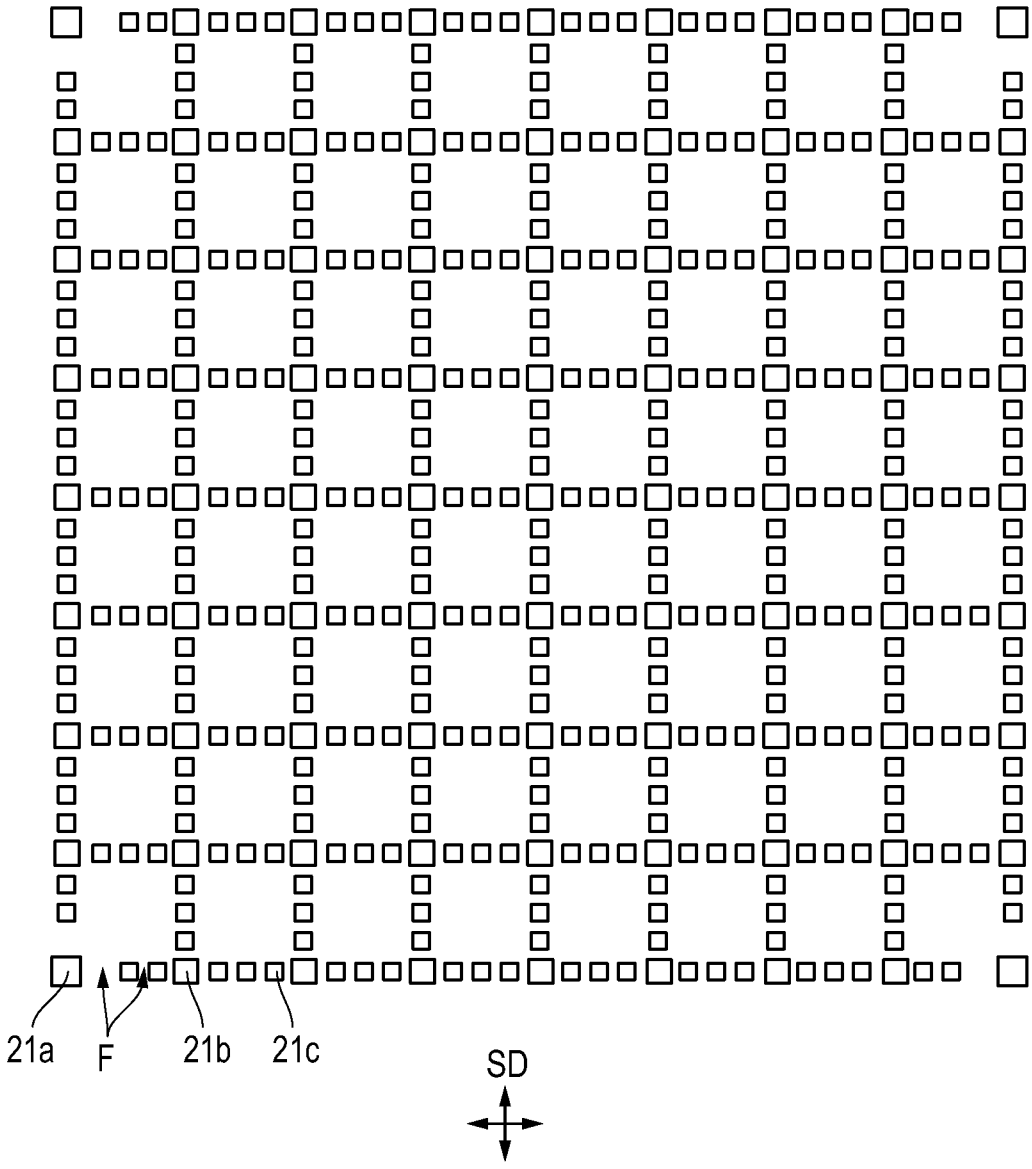

FIG. 4

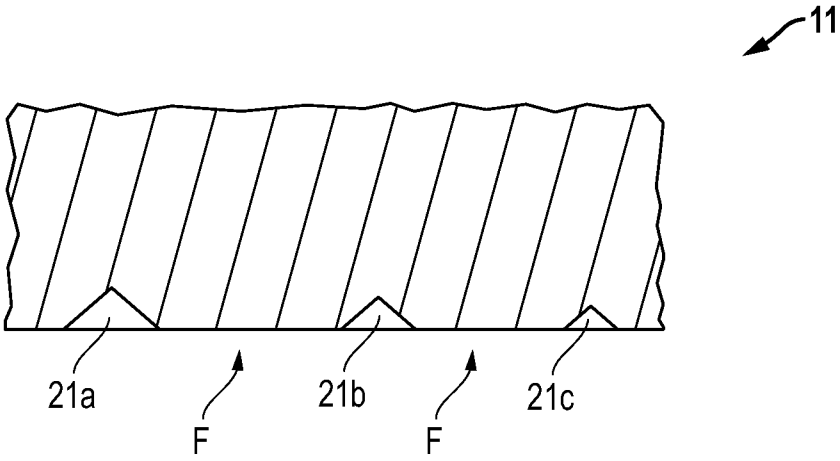

FIG. 5

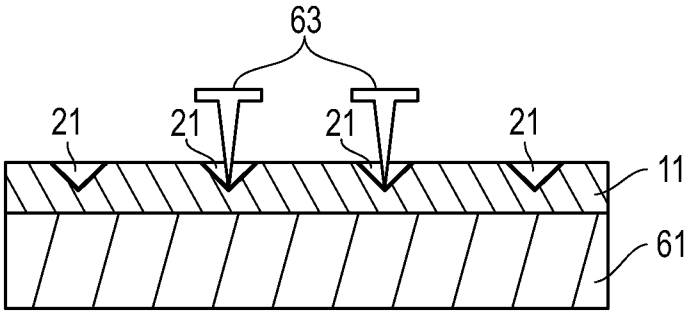

FIG. 6A

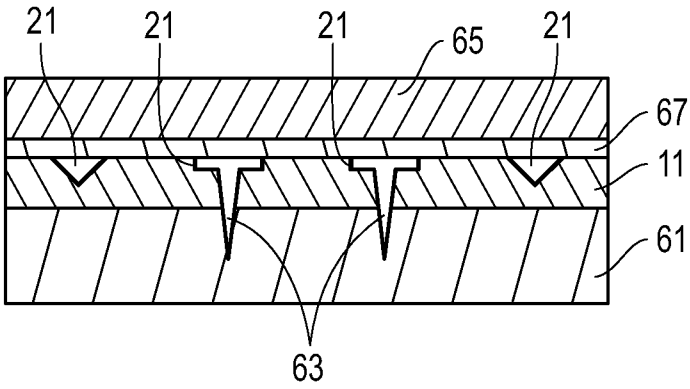

FIG. 6B

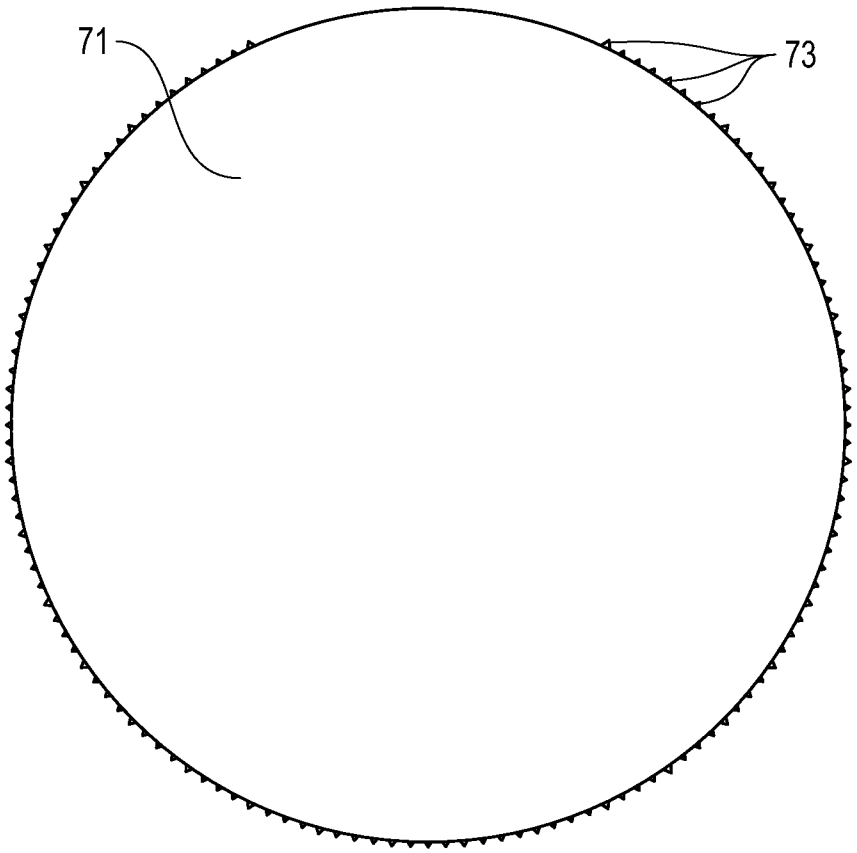

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/035469

A. CLASSIFICATION OF SUBJECT MATTER

E04F 15/022(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E04F 15/022; E04B 1/00; G01B 3/00; E04C 2/32; E04C 2/04; E04F 15/02; E04C 2/20

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: building sheet, flat board, recess, fastener, support structure, surface direction, and thickness direction

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6539643 B1 (GLEESON, JAMES ALBERT) 01 April 2003 See column 4, line 40 - column 10, line 28 and figures 1, 13A.	1-4
A	US 6161353 A (NEGOLA et al.) 19 December 2000 See column 7, lines 13-35 and figure 1.	1-4
A	KR 10-2003-0087509 A (BLUE FLOOR CO., LTD.) 14 November 2003 See page 3, line 25 - page 4, line 21 and figures 1-2.	1-4
A	JP 07-268952 A (SONODA SEISAKUSHO: K.K.) 17 October 1995 See paragraphs [0026]-[0029] and figures 5, 8.	1-4
A	WO 00-08271 A1 (BACCHIELLI, PAOLO) 17 February 2000 See page 3, lines 21-31 and figure 2.	1-4

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 July 2013 (12.07.2013)	**12 July 2013 (12.07.2013)**

Name and mailing address of the ISA/KR
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City, 302-701, Republic of Korea
Facsimile No. +82-42-472-7140

Authorized officer
CHOI Hyun Goo
Telephone No. +82-42-481-8288

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/035469

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 18-23,27
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
Claims 18-23 and 27 are unclear, because they respectively refer to multiple dependent claims 17 and 26 which do not comply with PCT Rule 6.4(a). Therefore, claims 18-23 and 27 do not meet the requirement of PCT Article 6.

3. ☒ Claims Nos.: 5-17,24-26,28-35
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. Ill Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required addtional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2013/035469

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6539643 Bl	01/04/2003	AT 530719 T	15/11/2011
		AU 2001-29665 Al	12/09/2001
		AU 2001-29665 B2	16/02/2006
		BR 0108717 A	03/12/2002
		CA 2401143 Al	07/09/2001
		CN 100449086 C	07/01/2009
		CN 1419624 A	21/05/2003
		cz 20022889 A3	14/05/2003
		EP 1264053 Al	11/12/2002
		EP 1264053 Bl	26/10/2011
		JP 04-647873 B2	17/12/2010
		JP 2003-525367 A	26/08/2003
		JP 4647873 B2	09/03/2011
		KR 10-0913262 Bl	21/08/2009
		MX PA02008237 A	05/04/2004
		MY 141908 A	30/07/2010
		NZ 520286 A	28/05/2004
		NZ 532212 A	30/09/2005
		PL 357419 Al	26/07/2004
		Tff 473587 A	21/01/2002
		Tff 473587 B	21/01/2002
		us 2003-0167649 Al	11/09/2003
		us 2004-0255480 Al	23/12/2004
		us 6760978 B2	13/07/2004
		us 7325325 B2	05/02/2008
		Wo 01-65021 Al	07/09/2001
US 06161353 A	19/12/2000	None	
KR 10-2003-0087509 A	14/11/2003	KR 10-0469471 Bl	02/02/2005
JP 07-268952A	17/10/1995	JP 2593408 B2	26/03/1997
Wo 00-08271 Al	17/02/2000	AU 1999-37245 Al	28/02/2000
		IT 1306421 Bl	06/06/2001
		IT PS980015 Al	07/02/2000
		PL 339671 Al	02/01/2001