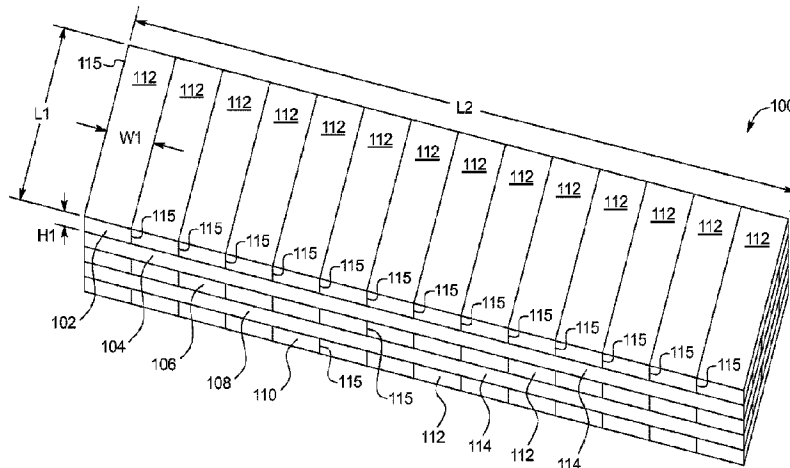




(86) Date de dépôt PCT/PCT Filing Date: 2015/11/04
(87) Date publication PCT/PCT Publication Date: 2017/02/09
(45) Date de délivrance/Issue Date: 2023/09/26
(85) Entrée phase nationale/National Entry: 2018/02/02
(86) N° demande PCT/PCT Application No.: US 2015/058990
(87) N° publication PCT/PCT Publication No.: 2017/023347
(30) Priorités/Priorities: 2015/08/03 (US62/200,508);
2015/08/28 (US62/211,651)

(51) Cl.Int./Int.Cl. *E01C 5/14* (2006.01)
(72) Inventeurs/Inventors:
STERLING, CARTER, US;
STERLING, COOPER, US;
O'CONNELL, MICHAEL, US;
STERLING, CHRISTIAN, US;
STERLING, CARSON, US;
STERLING, JOHN, US;
RAKE, JOHN, US
(73) Propriétaire/Owner:
STERLING SITE ACCESS SOLUTIONS, LLC, US
(74) Agent: OSLER, HOSKIN & HARCOURT LLP

(54) Titre : PLATELAGE DE GRUE ET PROCEDE DE FABRICATION
(54) Title: CRANE MAT AND METHOD OF MANUFACTURE



(57) **Abrégé/Abstract:**

A crane mat is disclosed having a plurality of panels of lumber positioned in alternating transverse directions with respect to one another, where the top and bottom panels are oriented parallel to the direction of vehicular traffic. The top and bottom panels may include a plurality of spaced apart grooves extending longitudinally from a first longitudinal end of the crane mat to a second longitudinal end of the crane mat for enhancing traction of a vehicle when traversing across the crane mat by transporting rain or moisture off the mat, or for receiving mud or other debris. The crane mat may include a plurality of edge protectors positioned on respective sides of the crane mat to protect the crane mat from handling damage. In various embodiments, the crane mat may be manufactured using either softwood, hardwood, or any combination of softwood and hardwood.



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

(19) World Intellectual Property
Organization
International Bureau

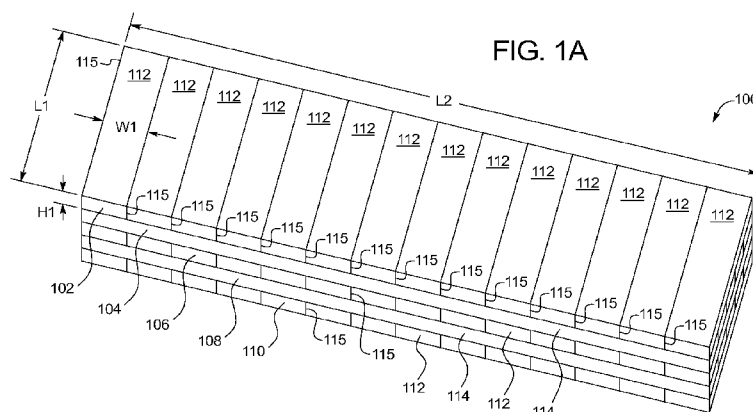


(10) International Publication Number
WO 2017/023347 A1

(43) International Publication Date
9 February 2017 (09.02.2017)

- (51) International Patent Classification:
E01C 5/14 (2006.01)
- (21) International Application Number:
PCT/US2015/058990
- (22) International Filing Date:
4 November 2015 (04.11.2015)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
62/200,508 3 August 2015 (03.08.2015) US
62/211,651 28 August 2015 (28.08.2015) US
- (71) Applicant: **STERLING LUMBER COMPANY**
[US/US]; 501 E. 151st Street, Phoenix, IL 60426 (US).
- (72) Inventors: **STERLING, Carter**; 12021 S. 86th Avenue, Palos Park, IL 60464 (US). **STERLING, Cooper**; 12607 S. 82nd Avenue, Palos Park, IL 60464 (US). **O'CONNELL, Michael**; 1409 Fallcreek Court, Naperville, IL 60565 (US). **STERLING, Christian**; 117 Augusta Drive, Palos Heights, IL 60463 (US). **STERLING, Carson**; 428 Banbury Place, Valparaiso, IN 46385 (US). **STERLING, John**; 8117 W. 126th Street, Palos Park, IL 60464 (US). **RAKE, John**; 658 W. Roscoe St., Unit 3E, Chicago, IL 60657 (US).
- (74) Agents: **WILLIAMS, Thomas E.** et al.; Neal, Gerber & Eisenberg LLP, 2 North LaSalle Street, Suite 1700, Chicago, IL 60602 (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, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, 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, SA, 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, ST, 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, KM, ML, MR, NE, SN, TD, TG).
- Published:
— with international search report (Art. 21(3))

(54) Title: CRANE MAT AND METHOD OF MANUFACTURE



(57) Abstract: A crane mat is disclosed having a plurality of panels of lumber positioned in alternating transverse directions with respect to one another, where the top and bottom panels are oriented parallel to the direction of vehicular traffic. The top and bottom panels may include a plurality of spaced apart grooves extending longitudinally from a first longitudinal end of the crane mat to a second longitudinal end of the crane mat for enhancing traction of a vehicle when traversing across the crane mat by transporting rain or moisture off the mat, or for receiving mud or other debris. The crane mat may include a plurality of edge protectors positioned on respective sides of the crane mat to protect the crane mat from handling damage. In various embodiments, the crane mat may be manufactured using either softwood, hardwood, or any combination of softwood and hardwood.

WO 2017/023347 A1

CRANE MAT AND METHOD OF MANUFACTURE

[0001]

BACKGROUND

[0002] This application relates generally to the field of temporary roadways and/or ground protection, and more particularly to crane mats and methods and systems for their manufacture.

SUMMARY

[0003] An embodiment of a crane mat is disclosed comprising a plurality of panels positioned in alternating transverse directions with respect to one another. Each of the panels is laminated to an adjacent one of the panels, and each of the panels comprise a plurality of lumber members positioned sided by side. The plurality of lumber members of each panel are oriented in either a longitudinal direction or a transverse direction of the crane mat. The plurality of lumber members in a top panel and a bottom panel of the crane mat are oriented in the transverse direction, which is parallel to a direction of travel of vehicular traffic thereon. In some embodiments, the top and bottom panels include a plurality of spaced apart grooves extending longitudinally from a first longitudinal end of the crane mat to a second longitudinal end of the crane mat for enhancing traction of a vehicle when traversing across the crane mat. The plurality of grooves are positioned longitudinally along a portion of the top and bottom panels of the crane mat. In some embodiments, the crane mat includes an edge protector removably

positioned along at least a portion of respective longitudinal sides of the crane mat. The edge protector includes a U-shaped cross section and a plurality of longitudinal protrusions engaging a plurality of grooves in the top and bottom panels.

[0004] The plurality of panels may include a softwood species, a hardwood species, or any combination of the softwood and the hardwood species. At least one of the plurality of lumber members in the top and bottom panels may include a hardwood species. At least one of the plurality of lumber members in at least one of the panels positioned between the top and bottom panels may include a softwood species. The hardwood species may include at least one of oak, maple, hickory, hackberry, and cherry, and the softwood species may include at least one of spruce, pine, fir, southern yellow pine, and hemlock.

[0005] The plurality of lumber members in at least one of the panels may include a plurality of different widths of lumber positioned side-by-side. At least one of the plurality of lumber members may include a plurality of wooden members fingerjointed together.

[0006] The spaced apart grooves in the top and bottom panels may comprise a depth up to at least approximately one half of a thickness of a respective one of the top and bottom panel. The depth of the spaced apart grooves may vary from the first longitudinal end of the crane mat to the second longitudinal end of the crane mat. At least one of the spaced apart grooves comprises a depth that may vary from the first longitudinal end of the crane mat to the second longitudinal end of the crane mat.

[0007] The edge protector may include a plastic. The edge protector may include a chamfer positioned along top and bottom longitudinal edges. Each of the longitudinal protrusions of the edge protector may include a trapezoidal cross section to ease installation and removal of the edge protector on the top and bottom panels of the crane mat.

[0008] Another embodiment of a crane mat having a longitudinal length is disclosed, including: (a) a first panel comprising a plurality of lumber positioned side by side, the plurality of lumber oriented transverse to the longitudinal length of the crane mat, (b) a second panel positioned on top of the first panel, the second panel comprising a plurality of lumber positioned side by side and transverse to the plurality of lumber of the first panel, the second panel being glued to the first panel, (c) a third panel positioned on top of the second panel, the third panel comprising a plurality of lumber positioned side by side and transverse to the plurality of lumber of the second panel, the third panel being glued to the second panel, (d) a fourth panel positioned on top of the third panel, the fourth panel comprising a plurality of lumber positioned side by side and transverse to the plurality of lumber of the third panel, the fourth panel being glued to the third panel, and (e) a fifth panel positioned on top of the fourth panel, the fifth panel comprising a plurality of lumber positioned side by side and transverse to the plurality of lumber of the fourth panel, the fifth panel being glued to the fourth panel.

[0009] Another embodiment of a crane mat having a longitudinal length is disclosed, including: (a) a first panel comprising a plurality of lumber positioned side by side, the plurality of lumber oriented transverse to the longitudinal length of the crane mat, (b) a second panel positioned on top of the first panel, the second panel comprising a plurality of lumber positioned side by side and transverse to the plurality of lumber of the first panel, the second panel being glued to the first panel, (c) a third panel positioned on top of the second panel, the third panel comprising a plurality of lumber positioned side by side and transverse to the plurality of lumber of the second panel, the third panel being glued to the second panel, (d) a fourth panel positioned on top of the third panel, the fourth panel comprising a plurality of lumber positioned side by side and transverse to the plurality of lumber of the third panel, the fourth panel being glued to the third panel, and (e) a fifth panel positioned on top of the fourth panel, the fifth panel comprising a plurality of lumber positioned side by side and transverse to the plurality of lumber

of the fourth panel, the fifth panel being glued to the fourth panel. In this embodiment, the first and fifth panels include a plurality of spaced apart grooves extending longitudinally from a first longitudinal end of the crane mat to a second longitudinal end of the crane mat for transporting rain or moisture, or for receiving mud or other debris therein.

[0010] Another embodiment of a crane mat having a longitudinal length is disclosed, including: (a) a first panel comprising a plurality of lumber positioned side by side, the plurality of lumber oriented transverse to the longitudinal length of the crane mat, (b) a second panel positioned on top of the first panel, the second panel comprising a plurality of lumber positioned side by side and transverse to the plurality of lumber of the first panel, the second panel being glued to the first panel; (c) a third panel positioned on top of the second panel, the third panel comprising a plurality of lumber positioned side by side and transverse to the plurality of lumber of the second panel, the third panel being glued to the second panel; (d) a fourth panel positioned on top of the third panel, the fourth panel comprising a plurality of lumber positioned side by side and transverse to the plurality of lumber of the third panel, the fourth panel being glued to the third panel; (e) a fifth panel positioned on top of the fourth panel, the fifth panel comprising a plurality of lumber positioned side by side and transverse to the plurality of lumber of the fourth panel, the fifth panel being glued to the fourth panel, and (f) an edge protector removably positioned along respective longitudinal sides of the crane mat, the edge protector comprising a U-shaped cross section and a plurality of longitudinal protrusions engaging a plurality of grooves in the first and fifth panels, the plurality of grooves positioned along a portion of respective longitudinal sides of the first and fifth panels.

[0011] Another embodiment of a crane mat having a longitudinal length is disclosed, including: (a) a first panel comprising a plurality of lumber positioned side by side, the plurality of lumber oriented transverse to the longitudinal length of the crane mat, (b) a second panel positioned on top of the first panel, the second panel comprising a plurality of lumber positioned

side by side and transverse to the plurality of lumber of the first panel, the second panel being glued to the first panel, (c) a third panel positioned on top of the second panel, the third panel comprising a plurality of lumber positioned side by side and transverse to the plurality of lumber of the second panel, the third panel being glued to the second panel, (d) a fourth panel positioned on top of the third panel, the fourth panel comprising a plurality of lumber positioned side by side and transverse to the plurality of lumber of the third panel, the fourth panel being glued to the third panel, and (e) a fifth panel positioned on top of the fourth panel, the fifth panel comprising a plurality of lumber positioned side by side and transverse to the plurality of lumber of the fourth panel, the fifth panel being glued to the fourth panel. In this embodiment, the first, second, third, fourth, and fifth panels comprise softwood, hardwood, or any combination of softwood and hardwood species.

[0012] Other embodiments of a crane mat, and variations thereto, are disclosed herein. All of the embodiments of a crane mat disclosed herein may be positioned on the ground for use in the creation of a temporary roadway or platform for vehicles, cranes, construction equipment, and other mobile or stationary machinery. To accommodate relatively wide widths of cranes or other vehicles, crane mats of the instant disclosure are configured for placement on the ground with the long side of each crane mat positioned transverse to the direction of travel of the crane or vehicle thereon. Additional crane mats of the instant disclosure may be positioned in the same orientation with respect to one another, with respective long sides of adjacent crane mats lying adjacent to one another. Crane mats of the instant disclosure may be combined with other mats of different configurations to account for variations in the stability of the ground. For example, crane mats of the instant disclosure may be positioned across timber mats to account for relatively unstable terrain.

[0013] An offset pattern can also be created in the field where crane mats of the instant disclosure are all oriented in the same direction but are positioned in a laterally overlapping

manner with longitudinal ends of adjacent crane mats positioned offset to one another. The relatively shorter side of the crane mats of the instant disclosure being oriented in the direction of travel of the crane or vehicle best approximates the contour of the ground. As a result, tilting or other undesired movement of each crane mat will be minimized as a crane, for example, travels over a temporary roadway formed from a plurality of crane mats of the instant disclosure. Positioning successive crane mats on the ground with the long sides of each mat positioned adjacent one another and the short sides of each mat oriented in the direction of travel makes it easy for a forklift or crane to quickly install each crane mat sequentially in front of one another by using the prior laid crane mat as the roadway or support for the traversing forklift or crane to enable the forklift or crane to position the next one in line. Crane mats positioned in this orientation on the ground allows for the safe and comfortable passage of cranes and other vehicles on undeveloped ground.

[0014] By contrast, orienting multiple crane mats of the instant disclosure side by side to obtain the necessary width to accommodate wide vehicles while orienting the long side of the crane mats in the direction of travel would lead to undesirable tilting, deflection and/or movement of the crane mats as the crane or vehicle travels over the temporary roadway, particularly on ground that slopes upwardly or downwardly in the direction of travel. This orientation will not allow for the safe and comfortable passage of cranes and other vehicles across undeveloped ground.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] Fig. 1A illustrates one embodiment of a crane mat of the instant disclosure.

[0016] Fig. 1B illustrates a side end view of the embodiment shown in Fig. 1A.

[0017] Fig. 1C illustrates another embodiment of a crane mat of the instant disclosure.

- [0018] Fig. 1D illustrates a side end view of the embodiment shown in Fig. 1C.
- [0019] Fig. 1E illustrates another embodiment of a crane mat of the instant disclosure.
- [0020] Fig. 1F illustrates a side end view of the embodiment shown in Fig. 1E.
- [0021] Fig. 2A illustrates another embodiment of a crane mat of the instant disclosure.
- [0022] Fig. 2B illustrates a side end view of the embodiment shown in Fig. 2A.
- [0023] Fig. 3A illustrates a partial exploded view of another embodiment of a crane mat of the instant disclosure.
- [0024] Fig. 3B illustrates an unexploded view of the embodiment shown in Fig. 3A.
- [0025] Fig. 3C illustrates a cross sectional view of the embodiment shown in Fig. 3B.
- [0026] Figs. 4A and 4B illustrate a block diagram of a method of manufacturing one embodiment of a crane mat of the instant disclosure.

DETAILED DESCRIPTION

[0027] Although the figures and the instant disclosure describe one or more embodiments of a crane mat, one of ordinary skill in the art would appreciate that the teachings of the instant disclosure would not be limited to these embodiments. For example, the instant disclosure can also apply to access mats and other temporary roadway or ground protection devices.

[0028] Turning now to the drawings wherein like reference numerals refer to like elements, Figs. 1A-1F, 2A-2B, 3A-3C, and 4A-4B illustrate exemplary embodiments and methods of manufacture of a crane mat comprising a plurality of panels for use in the creation of a

temporary roadway or platform for vehicles, cranes, construction equipment, and other mobile or stationary machinery.

[0029] As shown in the embodiment of Figs. 1A-1B, crane mat **100** includes panels **102, 104, 106, 108, 110**. In other embodiments, crane mat **100** may be configured with any number of panels from a minimum of one panel to a maximum of thirteen panels to provide a desired strength and/or operating performance. In this embodiment, panel **102** is positioned on top of panel **104**, which is positioned on top of panel **106**, which is positioned on top of panel **108**, which is positioned on top of panel **110**. In other embodiments, panel **110** may be positioned on top of panel **108**, which may be positioned on top of panel **106**, which may be positioned on top of panel **104**, which may be positioned on top of panel **102**. In use, crane mat **100** may be fully reversible, with either of panels **102** or **110** acting as the working surface for receiving vehicles, cranes, construction equipment or other mobile or stationary machinery, and with the other of panels **102** or **110** being configured for placement on, for example, the ground, a roadway, a ramp, a platform or other crane mat or object.

[0030] In this embodiment, panel **102** is glued to panel **104**, panel **104** is glued to panel **106**, panel **106** is glued to panel **108**, and panel **108** is glued to panel **110**. In other embodiments, panels **102, 104, 106, 108, and 110** are connected to one another using bolts, screws, straps, clips, or other fastening or joining techniques or any combination of them. In this embodiment, each of panels **102, 106, 110** is oriented in a first direction and panels **104, 108** are oriented in a second direction approximately 90 degrees relative to panels **102, 106, 110**. In other embodiments, panels **102, 104, 106, 108, and 110** may be oriented at any angle relative to one another, including all panels lying in the same direction, to provide a desired strength and/or operating performance of crane mat **100**. In one embodiment, at least two adjacent panels of the crane mat are aligned in approximately the same direction (see, e.g., Figs. 1C-1F). The

overall strength and rigidity of crane mat **100** is likely maximized, however, by alternating the direction of respective adjacent panel layers.

[0031] In this embodiment, each of panels **102,106,110** includes a plurality of members **112** positioned side-by-side along respective side ends **115**. Each member **112**, and particularly each side end **115** of each member **112**, is oriented in the first direction. For purposes of this disclosure, the first direction is oriented parallel to the general direction of travel of vehicular traffic on crane mat **100**. As shown in Figs. 1A-1B, the length “L1” of each member **112** is longer than a width “W1” of each member **112**, and the width of each member **112** is longer than a depth or height “H1” of each member **112**. Although members **112** are shown in the figures as being of the same length “L1,” in other embodiments, for each member **112**, the length “L1” thereof may comprise a plurality of separate members that together result in achieving the length “L1” for each member **112**. In addition, it should be understood that the combination of members that form each member **112** may vary in length from one to another. Such combination of members forming each member **112** in such other embodiments may be spliced or joined together using any number of techniques, including fingerjointing, lap jointing, rabbit jointing, tongue and groove jointing, miter joining and the like, or they may simply be positioned adjacent one another to form a butt joint. In this way, pieces of lumber having differing lengths can be pieced together to form each member **112**.

[0032] In this embodiment, each of panels **104,108** includes a plurality of members **114** positioned side-by-side along respective side ends **117**. Each member **114**, and particularly each side end **117** of each member **114**, is oriented in the second direction. As shown in Figs. 1A-1B, the length “L2” of each member **114** is longer than a width “W2” of each member **114**, and the width of each member **114** is longer than a depth or height “H2” of each member **114**. Consequently, in this embodiment, the length of each member **114** of each of panels **104,108** is oriented in the second direction, which is 90 degrees relative to the first direction and transverse

to the general direction of travel of vehicular traffic on crane mat **100**. In addition, as shown in Figs. 1A-1B, in this embodiment, the length of members **114** is greater than the length of members **112**, whereas the width and height of members **114** and members **112** are approximately the same as one another. Although members **114** are shown in the figures as being of the same length “L2,” in other embodiments, for each member **114**, the length “L2” thereof may comprise a plurality of separate members that together result in achieving the length “L2” for each member **114**. In addition, it should be understood that the combination of members that form each member **114** may vary in length from one to another. Such combination of members forming each member **114** in such other embodiments may be spliced or joined together using any number of techniques, including fingerjointing, lap jointing, rabbit jointing, tongue and groove jointing, miter joining and the like, or they may simply be positioned adjacent one another to form a butt joint. In this way, pieces of lumber having differing lengths can be pieced together to form each member **114**.

[0033] In this embodiment, members **114** are generally aligned in a longitudinal direction (i.e., the second direction) of crane mat **100**, and members **112** are generally aligned transverse (i.e., in the first direction) to members **114**. Thus, in this embodiment, the length of members **114** defines the longitudinal length of crane mat **100**, and the length of members **112** defines the transverse width of crane mat **100**, where length “L2” is longer than length “L1”. For vehicular traffic moving across crane mat **100** in the first direction and transverse to the longitudinal direction of crane mat **100**, members **112** of panel **102** (or panel **110** if oriented upside down as compared to the orientation shown in Figs. 1A-1B) will be oriented to maximize resistance to wear and damage that may be caused by vehicular traffic over crane mat **100**, resulting in longer crane mat life and reduced costs. In other words, vehicular traffic coming upon crane mat **100** will strike a longitudinal end of various members **112** in panel **102** (or panel **110** if oriented upside down) where the end grain of the lumber is exposed. The end grain of

members **112** provides superior resistance to wear and tear from vehicle traffic, and particularly in comparison to vehicle movement in the second, longitudinal direction of crane mat **100**. In addition, because the majority of the panels in crane mat **100** comprise members **112** having length “L1” that is shorter than members **114** having length “L2”, crane mat **100** may contour to the actual surface of the ground, and will result in a lower weight crane mat that reduces shipping costs.

[0034] In one embodiment, crane mat **100** is configured to be approximately 4 feet wide in the first, transverse direction and 16 feet long in the second, longitudinal direction. In another embodiment, crane mat **100** is configured to be approximately 4 feet wide in the first, transverse direction and 18 feet long in the second, longitudinal direction. In another embodiment, crane mat **100** is configured to be approximately 4 feet wide in the first, transverse direction and 20 feet long in the second, longitudinal direction. In another embodiment, crane mat **100** is configured to be approximately 4 feet wide in the first, transverse direction and 22 feet long in the second, longitudinal direction. In yet another embodiment, crane mat **100** is configured to be approximately 4 feet wide in the first, transverse direction and 24 feet long in the second, longitudinal direction. In other embodiments, crane mat **100** may have a width that is smaller or larger than 4 feet and a length that is shorter or longer than 16 feet. In use, multiple crane mats **100** may be abutted adjacent one another or attached to one another along the long side of crane mat **100** to orient the short side of crane mat **100** and particularly members **112** so as to be positioned in the direction of vehicle movement. In this way, the long side of the crane mat is positioned to accommodate wide vehicles traveling parallel to the orientation of members **112**.

[0035] In some embodiments, members **112** are glued or otherwise adhered to one another along respective side ends **115**, and members **114** are glued or otherwise adhered to one another along respective side ends **117**. In other embodiments, members **112** are connected to

one another, and members **114** are connected to one another, using bolts, screws, straps, clips, or other fastening or joining techniques or any combination of them.

[0036] In this embodiment, each of members **112** is approximately the same geometry as one another in terms of width, depth, and length. In other embodiments, the width, depth and/or length of members **112** may vary from one to another but may be machined to form finished panels **102,106,110** for crane mat **100**. In this embodiment, each of members **114** is approximately the same geometry as one another in terms of width, depth, and length. In some embodiments, the width, depth and/or length of members **114** may vary from one to another but may be machined to form finished panels **104,108** for crane mat **100**.

[0037] In some embodiments, members **112,114** may include dimensional lumber, including 1x4, 1x6, 1x8, 1x10, 1x12, 2x4, 2x6, 2x8, 2x10, and 2x12. In some embodiments, for any given panel, members **112,114** may comprise the same width of lumber positioned side-by-side to create the panel. In other embodiments, for any given panel, members **112,114** may comprise different or variable widths of lumber positioned side-by-side to create the panel. In yet other embodiments, for any given panel, members **112,114** may comprise any combination of the same and different widths of lumber positioned side-by-side to create the panel. Members **112,114** of one or more panels of crane mat **100** may include softwood lumber comprising, for example, spruce, pine, fir, southern yellow pine, or hemlock, hardwood lumber comprising, for example, oak, maple, hickory, hackberry, or cherry, or any combination of softwood or hardwood. For any given member **112,114**, a hardwood species, such as oak, may lie adjacent to a different hardwood species, such as hickory, and a softwood species, such as pine, may lie adjacent to a different softwood species, such as fir. In some embodiments, a hardwood panel comprising members **112** or **114** may comprise hardwood lumber 1 inch thick with lumber comprising different widths positioned side-by-side. In other embodiments, a softwood panel comprising members **112** or **114** may comprise softwood lumber 2 inches thick with lumber

comprising different widths positioned side-by-side. In some embodiments, a panel made of one or more hardwood species of lumber may be positioned adjacent above or below and glued to a panel made of one or more softwood species of lumber. In other embodiments, members **112,114** may include any material in any stock dimension suitable for creating a temporary roadway, including a plastic, a composite, or a metal.

[0038] Turning to Figs. 1C-1D, there is shown another embodiment of crane mat **100**. In particular, panel **106** is replaced by panel **111** having a plurality of members **114** positioned side-by-side along respective side ends **117**. Each member **114** of panel **111** is oriented in a longitudinal direction (i.e., the second direction) of crane mat **100**. However, as shown in Fig. 1D, each of members **114** of panel **111** are positioned laterally offset in the first direction relative to respective members **114** in adjacent panels **104,108**. The offset side ends **117** of members **114** of respective panels **104,111,108** provide enhanced lateral stiffness of crane mat **100** in the first direction while permitting enhanced longitudinal flexibility in the second direction than the embodiment of crane mat **100** shown in Figs. 1A-1B.

[0039] Figs. 1E-1F show yet another embodiment of crane mat **100**. In this embodiment, panels **106,108** are replaced in their entirety by panel **111** having a plurality of members **114** positioned side-by-side along respective side ends **117** to form a four panel embodiment of crane mat **100**. Like the embodiment shown in Figs. 1C-1D, each member **114** of panel **111** is oriented in a longitudinal direction (i.e., the second direction) of crane mat **100**. Similarly, each of members **114** of panel **111** are positioned laterally offset in the first direction relative to respective members **114** in adjacent panel **104**. The offset side ends **117** of members **114** of respective panels **104,111** provide enhanced lateral stiffness of crane mat **100** while permitting enhanced longitudinal flexibility than the embodiment of crane mat **100** shown in Figs. 1C-1D. In addition, in applications where increased longitudinal flexibility is desired over the embodiment shown in Figs. 1C-1D, the embodiment of Figs. 1E-1F provides the added benefits

of: (1) reduced fabrication costs due to less material and fewer manufacturing processes needed to produce crane mat **100**; (2) reduced transportation costs due to lighter weight finished product and smaller finished product volume, which permits shipping more crane mat units in a single freight transportation container, and (3) easier handling by users due to lighter weight of the finished product.

[0040] Turning to Figs. 2A-2B, there is shown another embodiment of a crane mat. Crane mat **200** includes all of the same features, characteristics, and variations described above for crane mat **100** with the addition of a plurality of slots or grooves **201** disposed on the top panel **202** and/or bottom panel **210** of crane mat **200** for enhancing vehicle traction when traversing across crane mat **200** parallel to the orientation of members **212**. In this embodiment, panels **202,204,206,208,210** of crane mat **200** are identical to panels **102,104,106,108,110** of crane mat **100** except that panel **202** is shown as including grooves **201** disposed thereon. In some embodiments, crane mat **100** may include grooves **201** as described in more detail below.

[0041] As best shown in Fig. 2B, grooves **201** may comprise generally vertical opposing sidewalls **205** and a generally horizontal bottom wall **203**. In other embodiments, grooves **201** may comprise a U-shape (with or without a rounded bottom wall), a V-shape, a trapezoidal shape, a semi-circular shape, or any other shape or combination thereof that enhances vehicle traction. In this embodiment, crane mat **200** includes 9 slots or grooves **201** positioned on top panel **202** (and bottom panel **210** to provide reversibility of crane mat **200**), though a greater or fewer quantity of grooves **201** are possible.

[0042] Grooves **201** may comprise any width and any spacing that permits a desired number of grooves **201** to be positioned on panel **202,210**. Grooves **201** may comprise any depth up to at least approximately one half of the thickness of panel **202**. In one embodiment, grooves **201** comprise a depth from about 0.100" to about 0.75". In one embodiment, grooves

201 comprise a depth of about 0.25" +/- 0.150". In another embodiment, grooves **201** comprise a depth of about 0.50". In another embodiment, grooves **201** comprise a depth of about 0.75". Grooves may vary in depth from one end of crane mat **200** to another end of crane mat to enhance drainage of water from crane mat **200**. Grooves **201** may also vary in depth from any point along crane mat **200** relative to any other point along crane mat **200**. For example, the depth of grooves **201** may be more shallow in the middle of crane mat **200** and progressively deeper toward the periphery to enhance drainage of water from crane mat **200**.

[0043] In this embodiment, grooves **201** are generally aligned in a longitudinal direction of crane mat **200** and transverse to members **212**, which are generally aligned transverse to members **214**. In this embodiment, the length of members **214** defines the longitudinal length of crane mat **200**, and the length of members **212** define the transverse width of crane mat **200**. For vehicular traffic moving across crane mat **200** parallel to the orientation of members **212** (i.e., in the first direction) and transverse to the longitudinal direction of crane mat **200**, transversely aligned members **212** of panel **202** (or panel **210** if grooves **201** are also positioned thereon and if panel **210** is oriented upside down as compared to the orientation shown in Figs. 2A-2B) will be oriented to maximize resistance to wear and damage that may be caused by vehicular traffic over crane mat **200** while grooves **201** provide for rain, moisture, mud or other debris to collect therein and drain therefrom to enhance traction of the vehicle. In other embodiments, grooves **201** may be oriented in any angle on panel **202** and/or **210**. In some embodiments, the angle of grooves **201** relative to other grooves **201** form a pattern on panel **202** and/or **210**.

[0044] Turning to Figs. 3A-3C there is shown another embodiment of a crane mat. Crane mat **300** includes all of the same features, characteristics, and variations described above for crane mat **100** with the addition of a plurality of slots or grooves **301,311** disposed on the top panel **302** and/or bottom panel **310** of crane mat **300**. In this embodiment, panels

302,304,306,308,310 of crane mat **300** are identical to panels **102,104,106,108,110** of crane mat **100** except that panel **302** is shown as including grooves **301,311** disposed thereon. In some embodiments, crane mat **100** may include grooves **301,311** as described in more detail below.

[0045] In this embodiment, grooves **301** are disposed along the first and last members **312** on top panel **302** and/or the first and last members **312** on bottom panel **310** near the periphery of crane mat **300**. Grooves **301** provide a means for attaching accessories for joining adjacent mats together and for handling and manipulation of crane mat **300** at, for example, the job site. Grooves **301** may also provide a means for engaging with an embodiment of protectors **350** (discussed below) for protecting at least a portion of a longitudinal end of crane mat **300** during handling and use. In this embodiment, grooves **301** are shown as extending along a portion of members **312**. In other embodiments, grooves **301** may extend from one end to the other end of member **312**.

[0046] In this embodiment, grooves **311** are disposed on top panel **302** and bottom panel **310** longitudinally and transverse to members **312**, which are generally aligned transverse to members **314**, near the periphery of crane mat **300**. Grooves **311** extend along a portion of the periphery of crane mat **300** for limiting the longitudinal motion of protectors **350** (discussed below) when engaged thereto.

[0047] Grooves **311** may comprise generally vertical opposing sidewalls **305** and a generally horizontal bottom wall **303**. In other embodiments, grooves **311** may comprise a U-shape (with or without a rounded bottom wall), a V-shape, a trapezoidal shape, a semi-circular shape, or any other shape or combination thereof that enables engagement with protrusions **355** of protectors **350**. Grooves **311** may comprise any depth up to approximately one half of the thickness of panel **302,310**. In one embodiment, grooves **311** comprise a depth from about

0.100" to about 0.75". In one embodiment, grooves **311** comprise a depth of about 0.25" +/- 0.150". In another embodiment, grooves **311** comprise a depth of about 0.50". In another embodiment, grooves **311** comprise a depth of about 0.75".

[0048] In this embodiment, crane mat **300** also includes protectors **350** that are removably positionable along the longitudinal sides of crane mat **300**. Protectors **350** are configured for protecting at least a portion of a longitudinal side of crane mat **300** during handling and use. In this embodiment, crane mat **300** includes two protectors **350**. In other embodiments, crane mat **300** may include a greater or fewer number of protectors **350**, and crane mat **300** may include a greater or fewer number of grooves **311**. Protectors **350** may include a longitudinal chamfer **360** of sufficient size along top and bottom outer edges to permit, for example, a forklift operator to easily insert a forklift blade between two adjacently positioned crane mats **300** having protectors **350** thereon and to separate the two crane mats **300** for subsequent lifting or handling operations.

[0049] Protectors **350** may comprise a U-shape to mount over at least a portion of a longitudinal side of crane mat **300**. In other embodiments, protectors **350** may be configured to mount over at least a portion of a transverse side of crane mat **300**. In such embodiments, protectors **350** may be configured to engage with grooves **301**. In this embodiment, protectors **350** are configured for attachment to crane mat **300** via protrusions **355** that are configured to engage with grooves **311**. In other embodiments, protectors **350** are configured for attachment to crane mat **300** via an interference fit with crane mat **300**.

[0050] In this embodiment, protrusions **355** are configured with at least one longitudinal chamfer **365** to permit relatively easy installation and removal of protectors **350** from crane mat **300** when, for example, damage to protector **350** occurs necessitating its replacement. In some embodiments, protrusions **355** have a trapezoidal cross sectional shape.

[0051] Protectors **350** may be fabricated from any plastic, including polyethylene, polypropylene, polystyrene, polyamide, polyvinyl chloride, and polycarbonate. Protectors **350** may be fabricated from any metal, including steel and aluminum. Protectors **350** may be fabricated from any composite material, including fiber reinforced plastics and metal composites. Protectors **350** may be fabricated from extrusions, injection moldings, stampings, laminations, forgings, castings, and the like.

[0052] Turning to Figs. 4A- 4B, there is shown one embodiment of a method of making a crane mat of the present disclosure comprising an apparatus or system **400**. It should be understood that other types of vehicle or ground protection mats, including access mats, can be manufactured by system **400** using the method disclosed herein. In various embodiments, one or more aspects of system **400** can be merged with one another, omitted, or made part of additional apparatuses or system components. These systems may be configured to fabricate a crane mat billet, which may be further cut or trimmed to meet customer specifications.

[0053] Dimensional lumber is loaded into or by system **400** at Step **410** of system **400**. One or more surfaces of the lumber are planed by a planar apparatus at Step **412** of system **400**. System **400** is configured to stack lumber at Step **414** according to size for later retrieval. At Step **416**, system **400** loads a composite sheet for a carrier apparatus of system **400**, after which lumber is loaded side-by-side for a bottom panel of a crane mat at Step **418**.

[0054] System **400** may be configured to apply glue to a top surface of the bottom panel in a manner that minimizes adhesive material cost, which may otherwise be a significant expense in the construction of a crane mat. In some embodiments, the panel is moved or conveyed under a stationary glue dispensing apparatus while glue is dispensed from the glue dispensing apparatus onto the panel. In other embodiments, the panel is held stationary while the glue dispensing apparatus traverses over the panel and dispenses glue onto the panel. In some

embodiments, a continuous (or in some embodiments a discontinuous) ribbon of glue is applied along the perimeter of a given panel while a solid or a stitched pattern of rows of adhesive is applied to the interior, central area of the top surface of the panel. In one embodiment, system **400** includes stationary adhesive nozzles (or other glue dispensing apparatus) positioned in a row transverse to the longitudinal orientation of the panel. As the panel is conveyed longitudinally by a conveyor, system **400** at Step **420** applies a solid glue line along the lateral and longitudinal perimeter of the top surface of the bottom panel while system **400** at Step **422** simultaneously applies a solid and/or a stitched or intermittent glue line along the central area of the top surface of the bottom panel. If a stitched or intermittent glue line is applied, the interval between glue dots or dashes in the central area is dependent on the speed at which the panel is conveyed under the nozzles as well as the pulse duration of the dispensing of glue from the nozzles. In another embodiment, system **400** includes traversing adhesive nozzles (or other glue dispensing apparatus) positioned in a row transverse to the longitudinal orientation of the panel. As the adhesive nozzles traverse over the stationary panel, system **400** at Step **420** applies a solid glue line along the lateral and longitudinal perimeter of the top surface of the bottom panel while system **400** at Step **422** simultaneously applies a solid and/or a stitched or intermittent glue line along the central area of the top surface of the bottom panel. If a stitched or intermittent glue line is applied, the interval between glue dots or dashes in the central area is dependent on the speed at which the adhesive nozzles traverse over the panel as well as the pulse duration of the dispensing of glue from the nozzles.

[0055] At Step **424**, the same glue application technique is performed by system **400** to the next succeeding panel, which will be oriented transverse to the bottom panel, and which is stacked upon the bottom panel. The load, stacking, and gluing process of Steps **418**, **420**, **422**, and **424** is repeated at Steps **426** and **428** for the additional panels that will be stacked to form the desired crane mat. An assembled plurality of laminated, composite panels of a crane mat

are then stacked on top of an additional plurality of composite panels of separate crane mats at Steps **430**, **432**, **434**, and **436** and all are pressed in a press system of system **400** at Step **438**. In some embodiments, 3 or 4 sets of crane mats may be pressed at one time in this way. In other embodiments, a greater or fewer number of crane mats may be pressed at the same time.

[0056] At Steps **440**, **442**, and **444** the composite panels are removed from the press system of system **400** and separated from one another. At Step **446**, the composite panels of a particular crane mat are cut by one or more cutting machines of system **400** to a desired finished length and width. At Step **448**, the various edges of the crane mat may optionally be beveled by system **400**. For various embodiments of crane mats, at Step **450** one or more routers or plunge cutters of system **400** are configured to cut optional grooves **301,311** discussed above on either or both of the top or bottom surfaces of the crane mat. For various embodiments of crane mats, at Step **452** one or more routers or plunge cutters of system **400** are configured to cut optional grooves **201** on either or both of the top or bottom surfaces of the crane mat. At Step **454**, system **400** is configured to optionally paint or seal one or more sides of the crane mat. At Step **456**, the completed crane mat having the desired configuration is moved to inventory.

[0057] One or more aspects of system **400** are operable by one or more computers and/or one or more programmable logic controllers (PLC's). The computers and/or PLC's may be coupled with one or more sensors configured for reporting position, measurements, status, and other data regarding elements of system **400** and the crane mats being fabricated, and motors, actuators and the like for controlling the operation of one or more aspects of system **400**. The computers and/or PLC's may be connected to one another and to other computers or devices via a wired or wireless network. These devices may be connected to one or more remote computers and/or web servers via a wired or wireless connection to the Internet.

[0058] The computers and one or more PLC's include a processor, such as a central processing unit (CPU), for executing software, particularly software stored in memory or on any computer readable medium, for use by or in connection with any computer related system or method.

[0059] A computer readable medium includes any electronic, magnetic, optical, or other physical device or apparatus that can contain or store a computer program for use by or in connection with a computer related system or method. Memory can include any one or a combination of volatile memory elements (e.g., random access memory (RAM, such as DRAM, SRAM, SDRAM, etc.)) and nonvolatile memory elements (e.g., ROM, hard drive, tape, CDROM, etc.). Moreover, memory may incorporate electronic, magnetic, optical, and/or other types of storage media. Memory can have a distributed architecture where various components are situated remote from one another, but are still accessed by a processor.

[0060] The software may include one or more separate programs comprising ordered listings of executable instructions for implementing logical functions. The software stored in memory or on any computer readable medium may include one or more computer programs, each including executable instructions executed by the processor. An operating system may control the execution of other computer programs and can provide scheduling, input-output control, file and data management, memory management, and communication control and related services.

[0061] In one embodiment, the PLC may include a computer processor such as a central processing unit (CPU), memory, operating software stored in memory, and various input and output (I/O) devices or data paths. The I/O devices may include input devices, such as a keyboard, mouse, touch screen, and/or any other user interface. The I/O devices may also include output devices, such as a computer display, a modem, a router, serial and parallel wired

and wireless communication components and any other elements needed to connect to, for example, another computer or device via a local network or the Internet whether wired or wirelessly. The I/O devices may further include any element or device in a feedback control system for controlling the operation and performance of any aspect of system **400**.

[0062] While specific embodiments have been described in detail, it will be appreciated by those skilled in the art that various modifications and alternatives to those details could be developed in light of the overall teachings of the disclosure. Accordingly, the disclosure herein is meant to be illustrative only and not limiting as to its scope and should be given the full breadth of the appended claims and any equivalents thereof.

The embodiments of the present invention for which an exclusive property or privilege is claimed are defined as follows:

1. A crane mat, comprising:

a plurality of panels positioned in alternating transverse directions with respect to one another, each of the panels laminated to an adjacent one of the panels and comprising a plurality of lumber members positioned side by side, the plurality of lumber members of each panel oriented in either a longitudinal direction or a transverse direction of the crane mat, wherein the plurality of lumber members in a top panel and a bottom panel of the crane mat are oriented in the transverse direction.

2. The crane mat of claim 1, wherein the plurality of panels comprise a softwood species, a hardwood species, or any combination of the softwood and the hardwood species.

3. The crane mat of claim 1, wherein at least one of the plurality of lumber members in the top and bottom panels comprises the hardwood species, and wherein at least one of the plurality of lumber members in at least one of the panels positioned between the top and bottom panels comprises the softwood species.

4. The crane mat of claim 3, wherein the hardwood species comprises at least one of oak, maple, hickory, and hackberry.

5. The crane mat of claim 3, wherein the softwood species comprises at least one of spruce, pine, fir, southern yellow pine, and hemlock.

6. The crane mat of claim 1, wherein the plurality of lumber members in at least one of the panels comprises a plurality of different widths of lumber positioned side-by-side.

7. The crane mat of claim 1, wherein at least one of the plurality of lumber members comprises a plurality of wooden members finger jointed together.

FIG. 1A

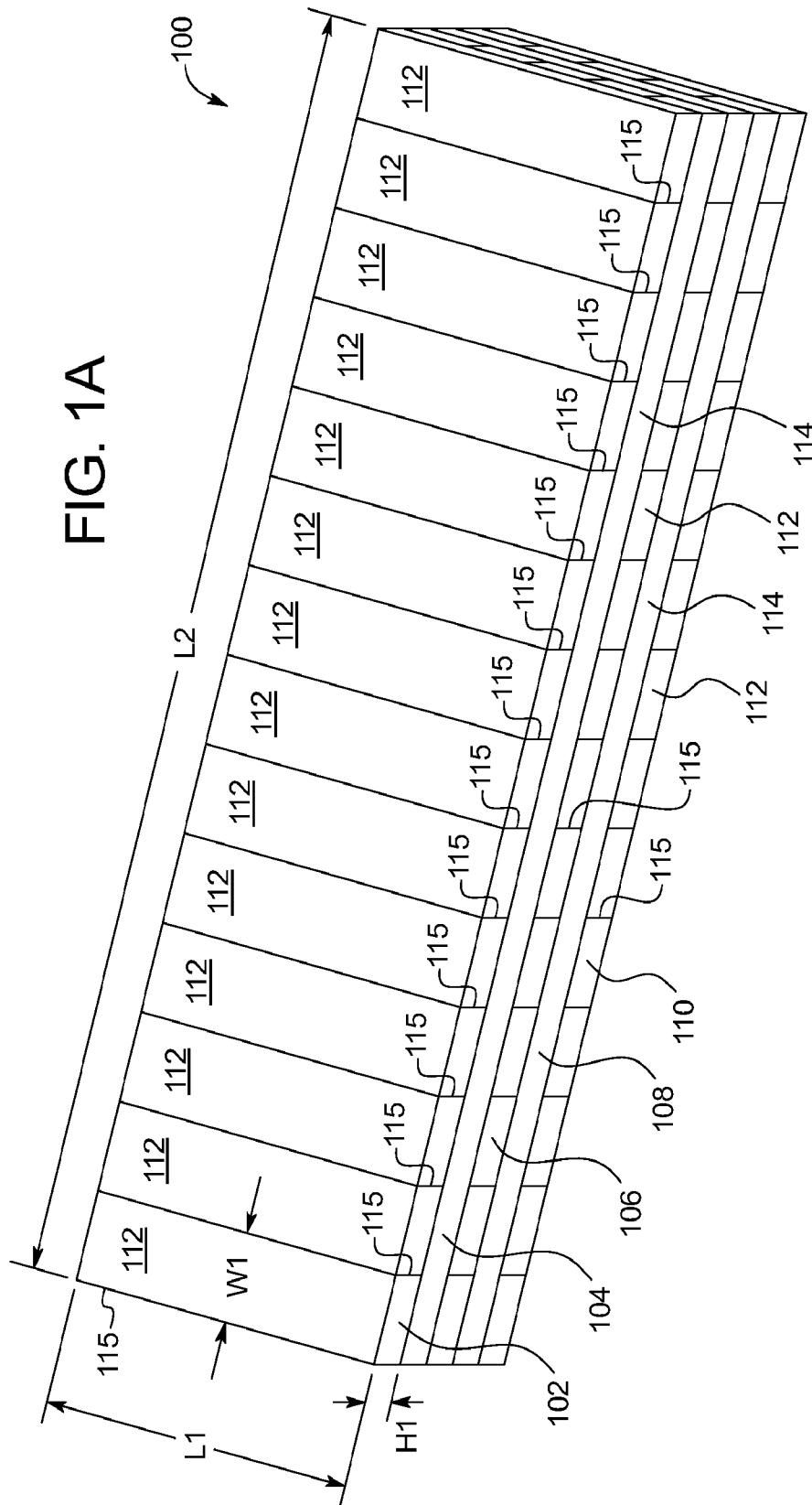


FIG. 1B

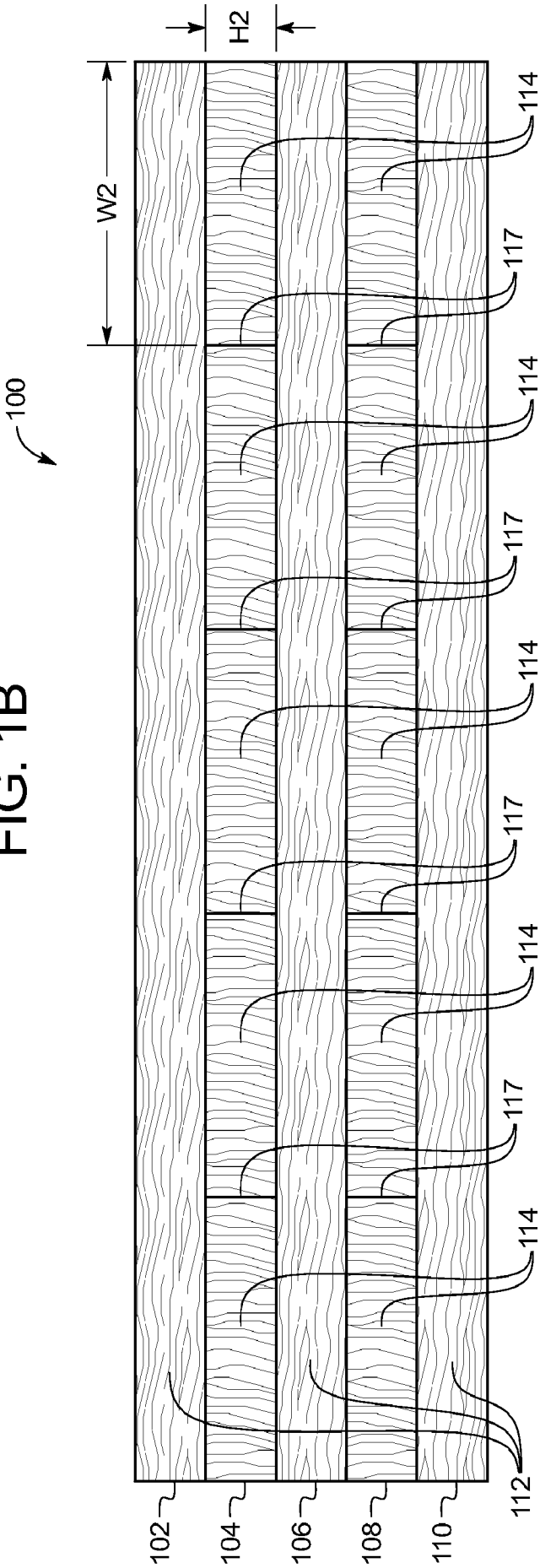


FIG. 1C

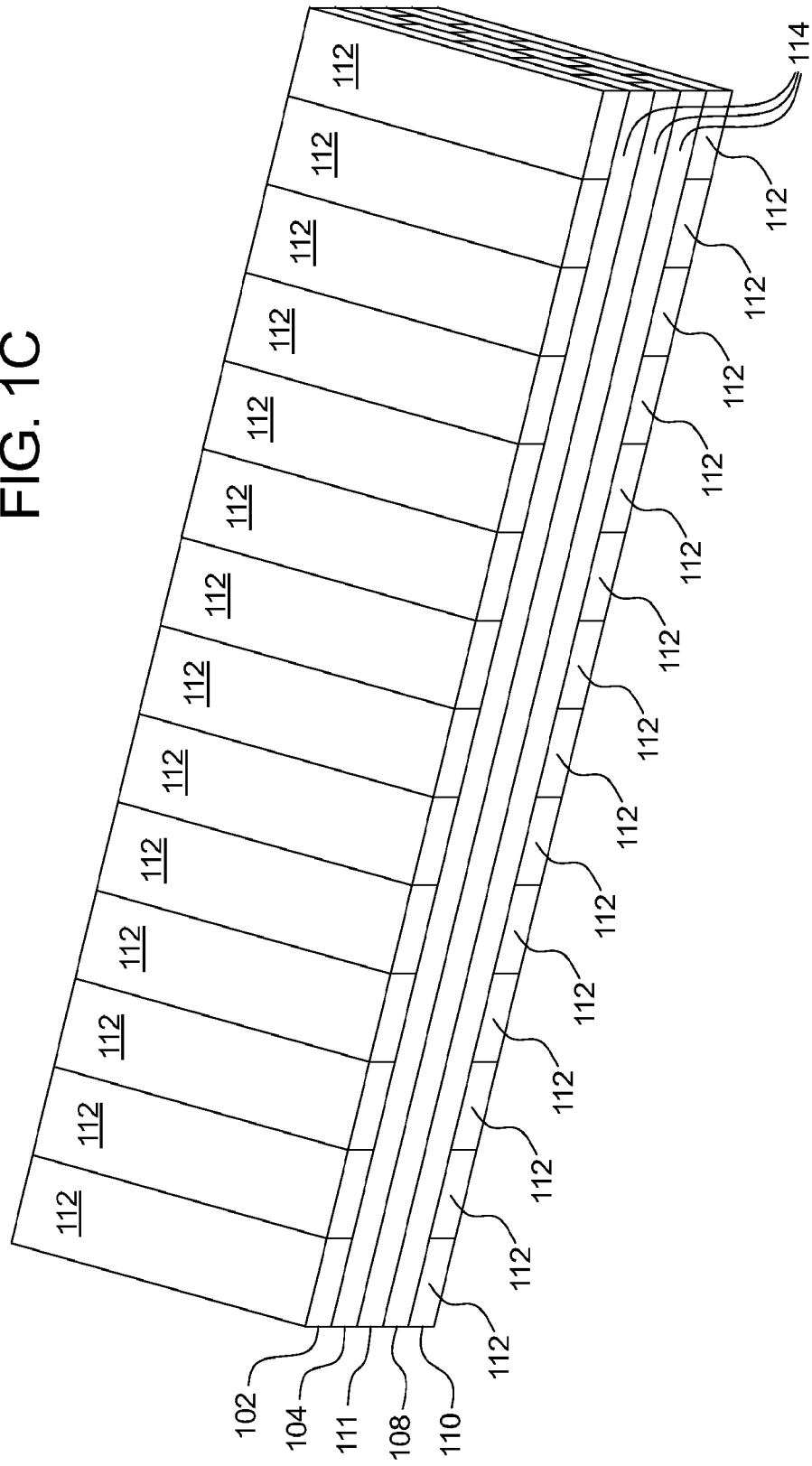


FIG. 1D

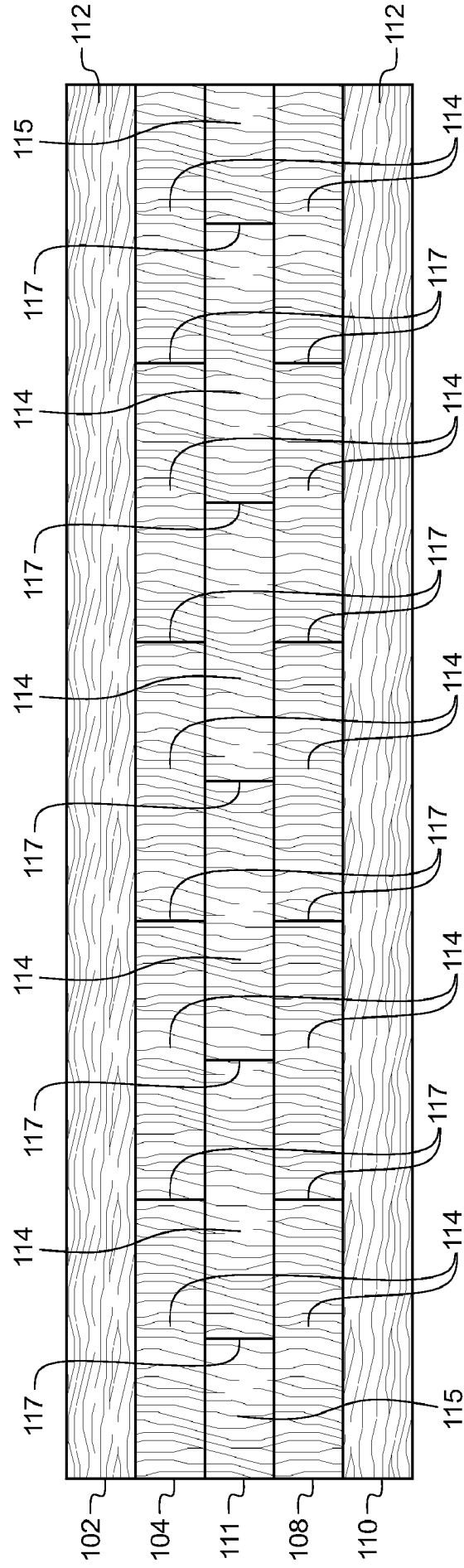


FIG. 1E

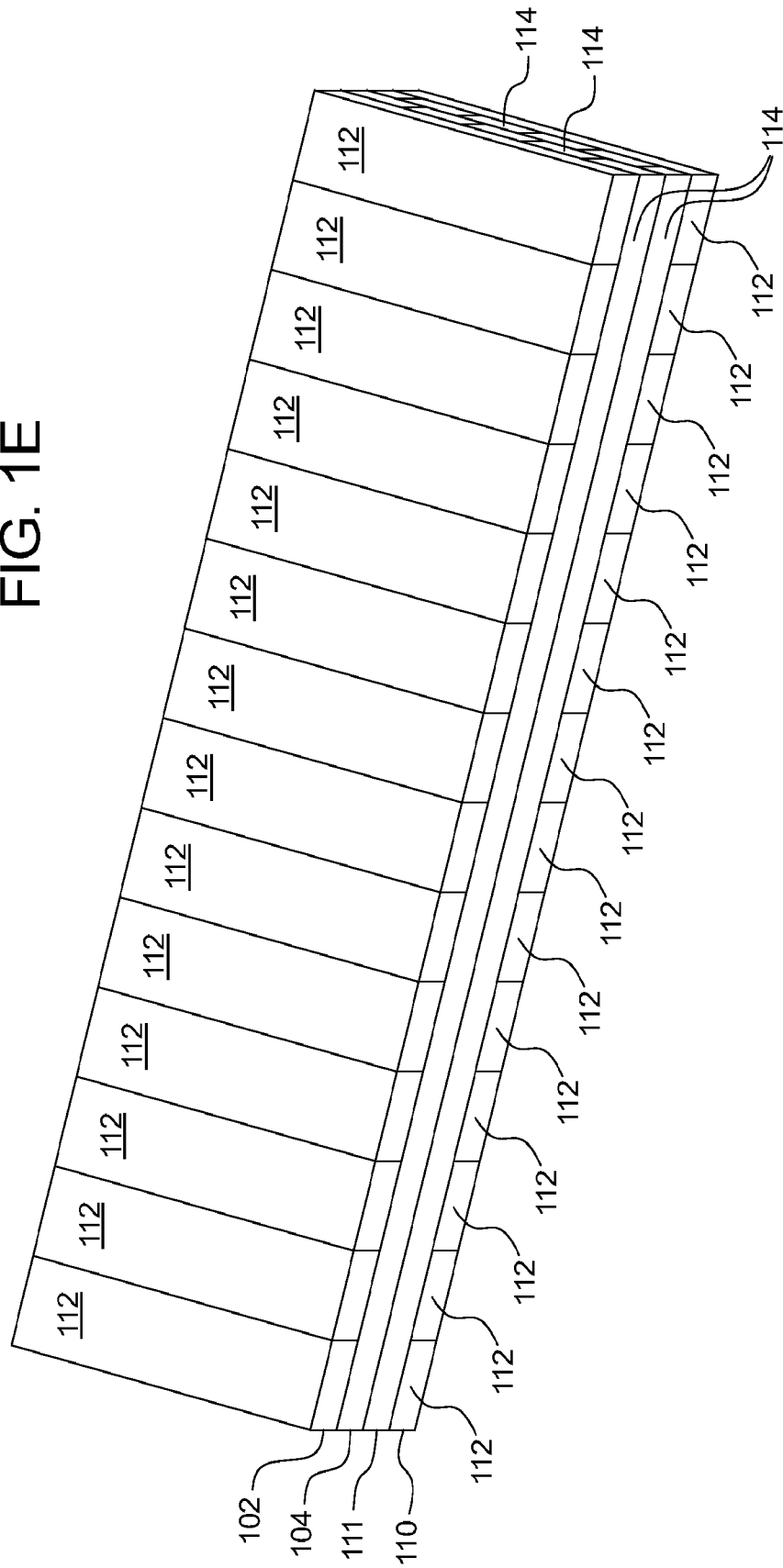
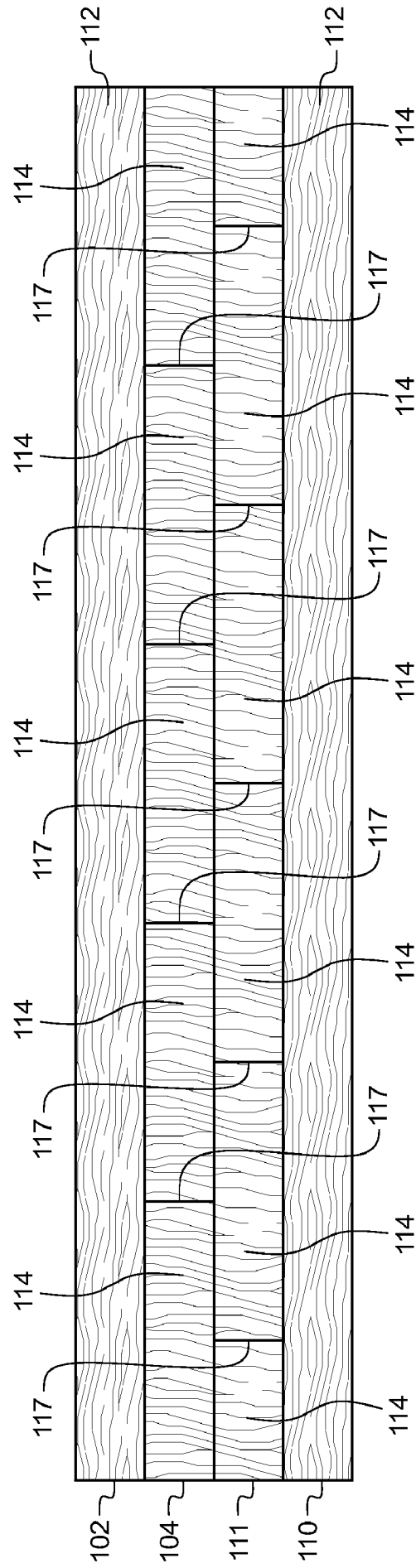
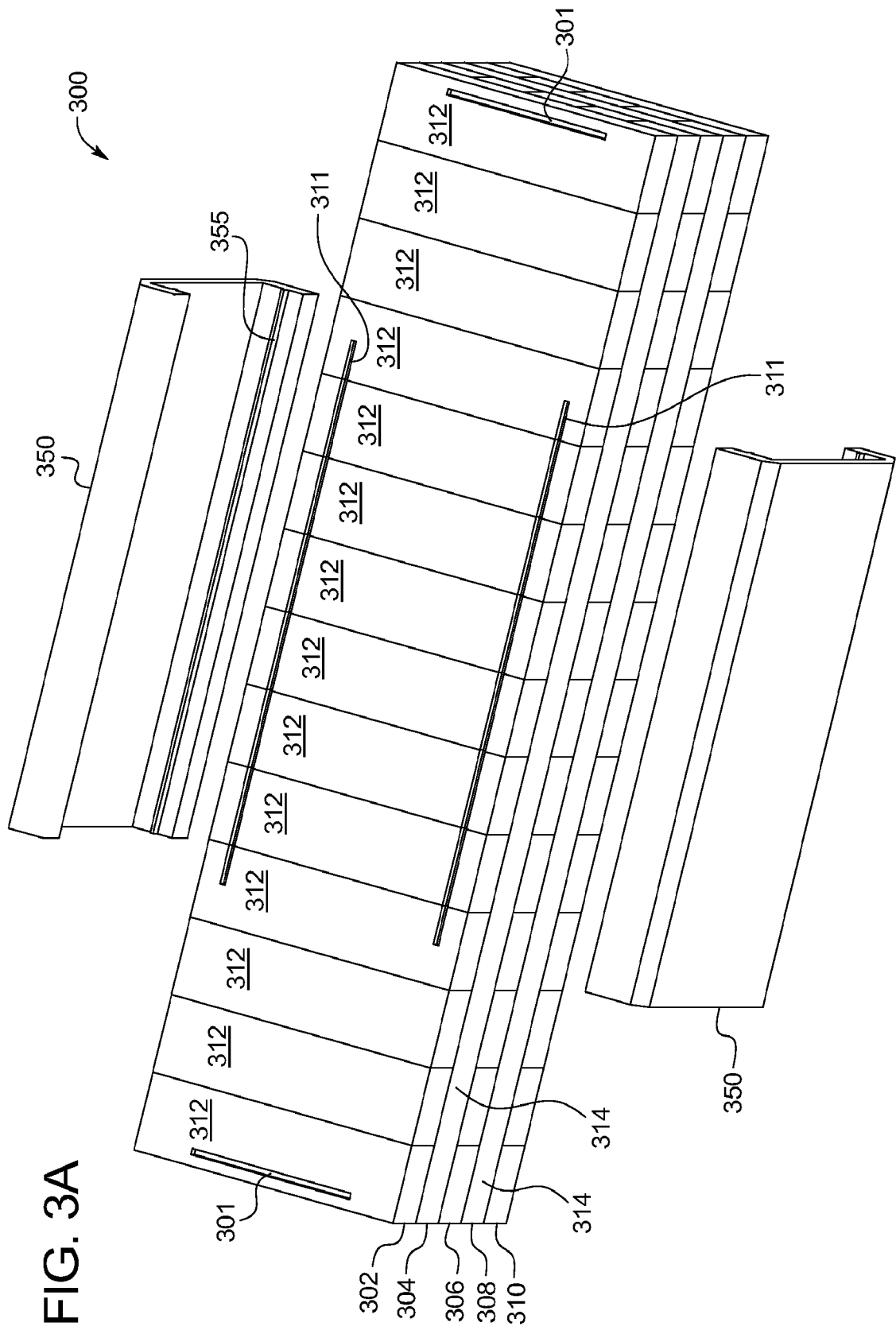
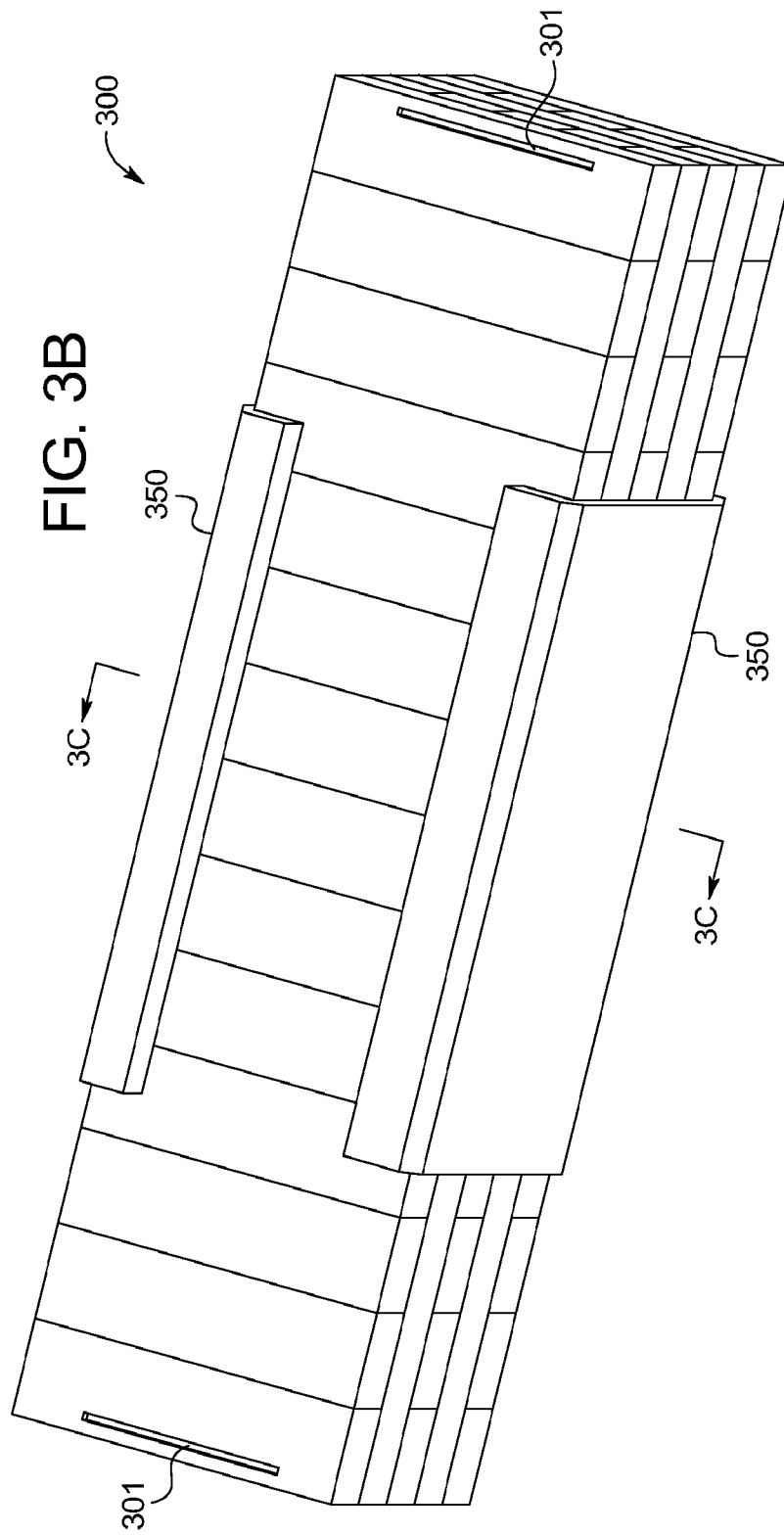
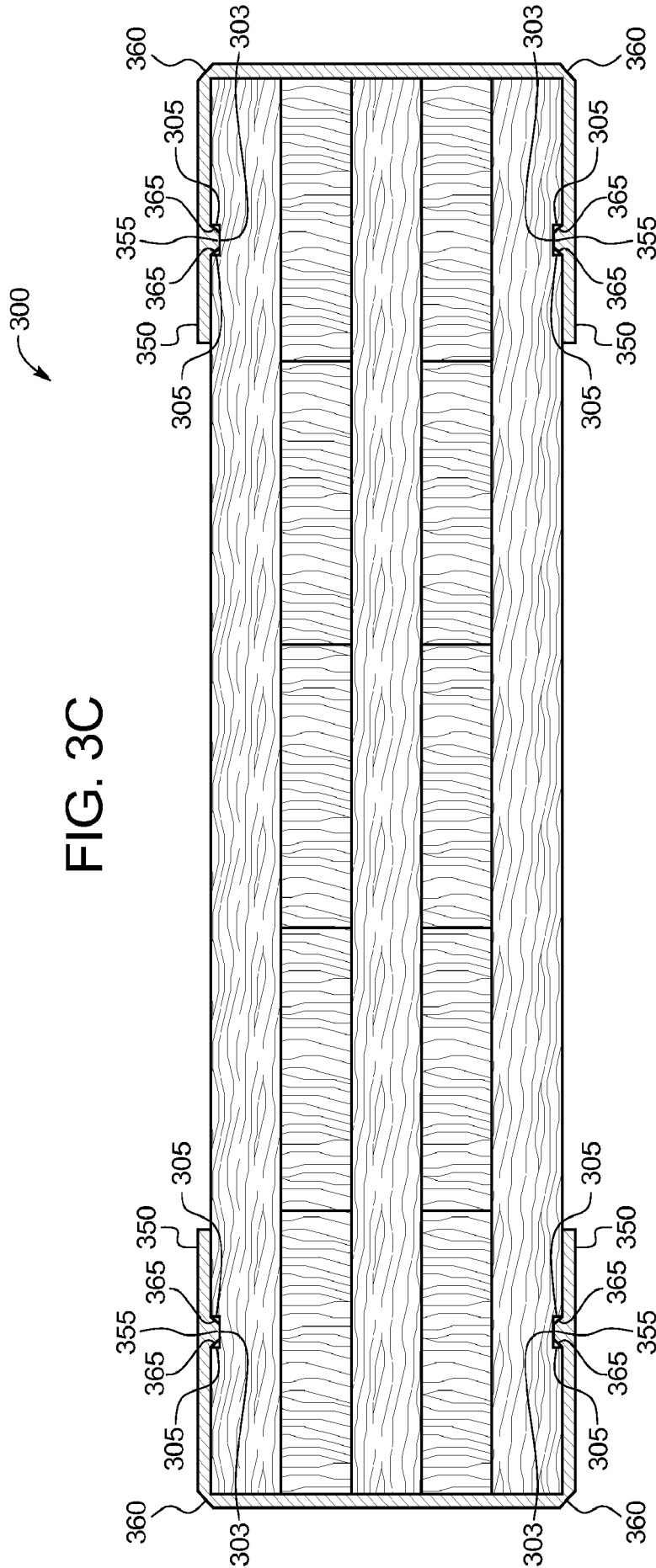


FIG. 1F









11/12

FIG. 4A

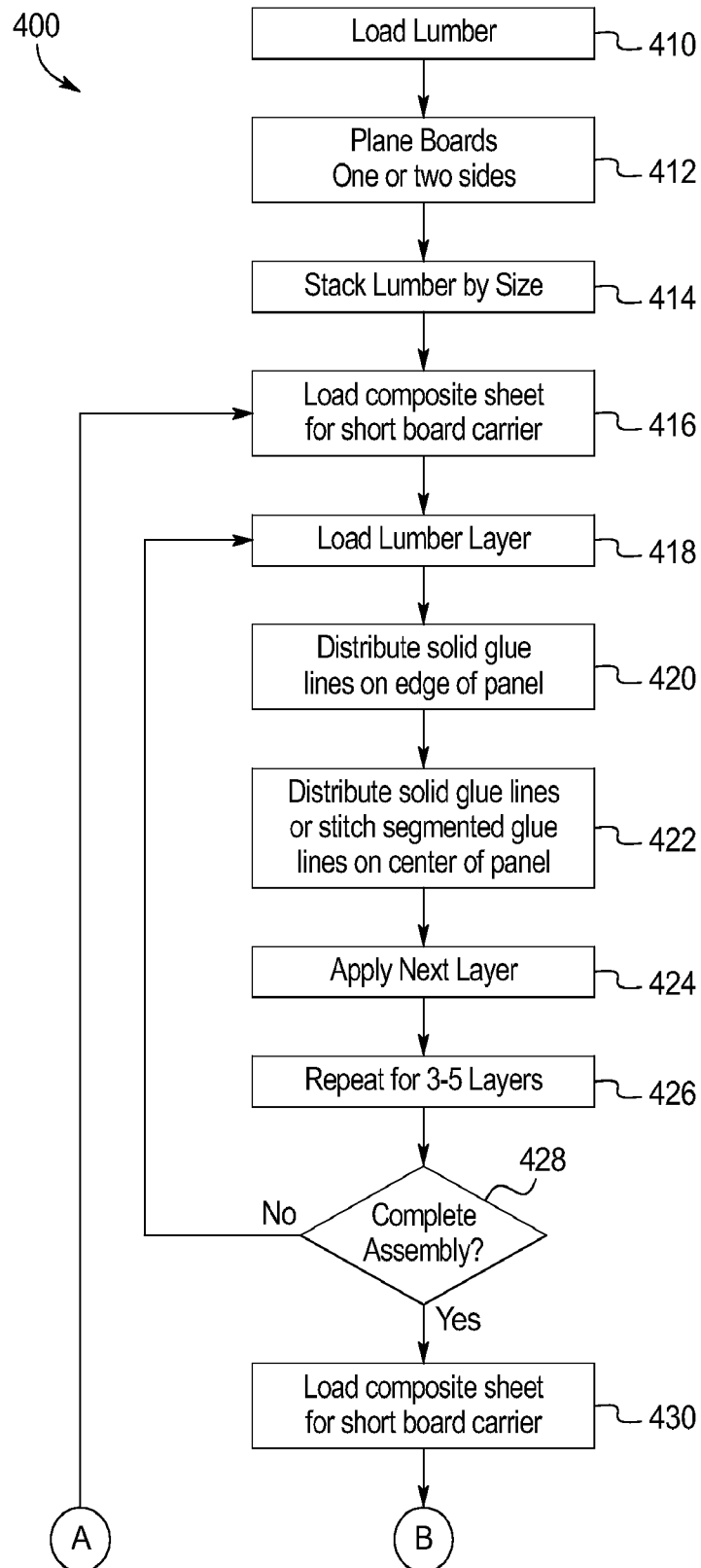


FIG. 4B

