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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
08 March 2018 (08.03.2018)

WIPO | PCT

(10) International Publication Number
WO 2018/044962 A1

(51) International Patent Classification:
D05B 63/00 (2006.01) *E02B 3/12* (2006.01)
D05B 87/00 (2006.01) *E02D 17/20* (2006.01)
D05B 87/02 (2006.01)

(21) International Application Number:
PCT/US2017/049243

(22) International Filing Date:
30 August 2017 (30.08.2017)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
62/381,041 30 August 2016 (30.08.2016) US

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(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, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,

(54) Title: YARN GUIDE SYSTEM AND YARN REPAIR FOR EROSION CONTROL BLANKETS

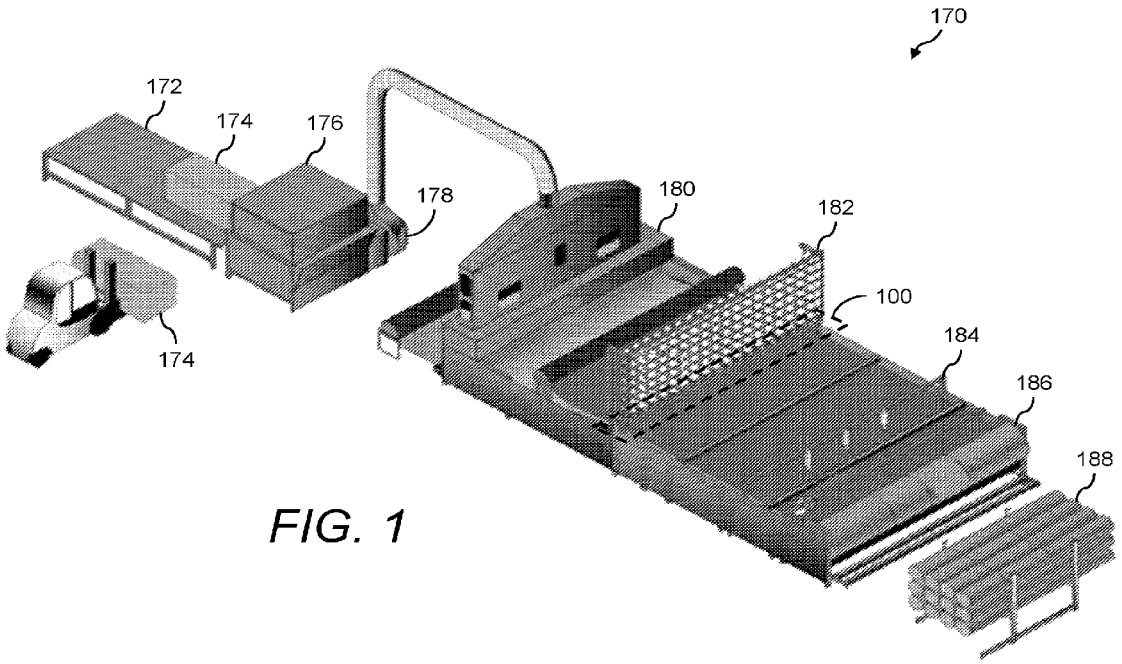

FIG. 1

(57) Abstract: A yarn (or thread) guide system for and methods of quick yarn change and yarn repair for manufacture of erosion control blankets (ECB) and/or other similar composites is disclosed. The yarn guide system includes a set of yarn guide tubes through which the respective yarns (or threads) are passed using a swift burst of compressed air is applied to the top of the tube. Further, yarn guide system includes pneumatic cylinders and an actuator valve for lifting up the needle aperture plate to prevent and/or clear jams. Additionally, methods are provided of (1) initially threading yarn into the sewing portion of an ECB mat machine, (2) re-threading yarn (e.g., broken yarn) into the sewing portion of an ECB mat machine, and (3) clearing debris from and/or preventing debris from jamming the sewing portion of an ECB mat machine.

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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))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

YARN GUIDE SYSTEM FOR AND METHODS OF QUICK YARN CHANGE AND YARN REPAIR FOR MANUFACTURE OF EROSION CONTROL BLANKETS

CROSS-REFERENCE TO RELATED APPLICATIONS

The presently disclosed subject matter is related to and claims priority to U.S. Provisional Patent Application No. 62/381,041 entitled "Yarn Guide System for and Methods of Quick Yarn Change and Yarn Repair for Manufacture of Erosion Control Blankets" filed on August 30, 2016, the entire disclosure of which is incorporated herein by reference.

TECHNICAL FIELD

The presently disclosed subject matter relates generally to manufacturing processes for making environmental matting and more particularly to a yarn (or thread) guide system for and methods of quick yarn change and yarn repair for manufacture of erosion control blankets (ECB).

BACKGROUND

For environmental protection reasons, it is desirable to grow vegetation on bare earth areas on slopes or flat lands. Soil erosion on bare surfaces inhibits vegetation sprouting and growth. To alleviate this problem, it is common practice to cover these areas with material commonly known as erosion control blankets (ECB). ECBs manufactured by North American Green (NAG) is an example of such technology.

The ECBs are manufactured using fibrous material, such as synthetic or natural fibers, sandwiched between layers of open structured netting or grid type of material. Components of this composite are held together by synthetic yarns sewn into the composite structure during the manufacturing process. The net or grid type structure may be present on one side or both sides of the composite structure. The ECBs are packaged into rolled form and shipped to the jobsite as bundles of rolls.

At the jobsite, the ECBs are unrolled, laid side-by-side, and secured to each other and to the ground using synthetic, metal, or wood anchoring devices. Care is taken to

minimize the opening at the point of overlap between the parallel sides of the adjacent blankets, such that water erosion at the overlap is minimal.

The ECBs create multiple interstitial openings through which vegetation is allowed to grow. Depending on the material of construction, the ECBs may or may not biodegrade over a period of time. The ECBs can be designed to serve various functions as desired by the customer and suited to particular jobsite.

In one example, the ECB structure is held together by thread or yarn. In this example, the manufacturing process for making ECBs includes a sewing operation (e.g., the sewing portion of an ECB mat machine). However, there are certain drawbacks to the sewing operation with respect to making ECBs. For example, broken sewing yarn can compromise the structural integrity of the ECB and can result in the entrapped fibrous material being blown away during the manufacturing process, shipping, or installation process. Therefore, when the yarn breaks during the sewing operation, it is important to re-thread the yarn and ensure that the continuity of the yarns is maintained during the manufacturing process.

Further, when there is a breakage in the sewing yarn, the machine is stopped to re-thread the yarn. This results in unnecessary downtime and markedly reduced overall equipment efficiency (OEE). This re-threading process also puts the machine operator in close proximity to sharp objects within a restricted work space, which presents a high risk of injury to the machine operator.

BRIEF DESCRIPTION OF THE DRAWINGS

Having thus described the presently disclosed subject matter in general terms, reference will now be made to the accompanying Drawings, which are not necessarily drawn to scale, and wherein:

FIG. 1 illustrates a perspective view of the presently disclosed yarn (or thread) guide system in relation to the sewing portion of an ECB mat machine;

FIG. 2 illustrates a perspective view showing more details of an example of the presently disclosed yarn (or thread) guide system integrated into the sewing portion of the ECB mat machine;

FIG. 3 illustrates a perspective view of the presently disclosed yarn (or thread) guide system and including a catwalk spanning the width thereof;

FIG. 4A illustrates a perspective view of a portion of the presently disclosed yarn (or thread) guide system wherein the aperture plate is in a lowered position for normal operation;

FIG. 4B illustrates a perspective view of a portion of the presently disclosed yarn (or thread) guide system wherein the aperture plate is in a raised position for easily clearing debris therefrom;

FIG. 5 illustrates a perspective view of a portion of the yarn guide tube assembly of the presently disclosed yarn (or thread) guide system;

FIG. 6 through FIG. 19A, 19B, 19C illustrate various views of one specific example of the yarn (or thread) guide system shown in FIG. 1 through FIG. 5.

FIG. 20 illustrates a flow diagram of an example of a method of using the presently disclosed yarn (or thread) guide system to initially thread yarn into the sewing portion of an ECB mat machine;

FIG. 21 illustrates a flow diagram of an example of a method of using the presently disclosed yarn (or thread) guide system to re-thread yarn (e.g., broken yarn) into the sewing portion of an ECB mat machine;

FIG. 22 illustrates a flow diagram of an example of a method of using the presently disclosed yarn (or thread) guide system to clear debris from and/or prevent debris from jamming the sewing portion of an ECB mat machine;

FIG. 23 illustrates a perspective view of another embodiment of the presently disclosed yarn (or thread) guide system that includes the yarn guide tubes only, absent the lifter assemblies;

FIG. 24 illustrates a perspective view of yet another embodiment of the presently disclosed yarn (or thread) guide system that includes the lifter assemblies only, absent the yarn guide tubes; and

FIG. 25, FIG. 26, FIG. 27, and FIG. 28 show photos of examples of the presently disclosed yarn (or thread) guide system installed in the sewing portion of an ECB mat machine.

DETAILED DESCRIPTION

The presently disclosed subject matter now will be described more fully hereinafter with reference to the accompanying Drawings, in which some, but not all embodiments of the presently disclosed subject matter are shown. Like numbers refer to like elements throughout. The presently disclosed subject matter may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Indeed, many modifications and other embodiments of the presently disclosed subject matter set forth herein will come to mind to one skilled in the art to which the presently disclosed subject matter pertains having the benefit of the teachings presented in the foregoing descriptions and the associated Drawings. Therefore, it is to be understood that the presently disclosed subject matter is not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims.

In some embodiments, the presently disclosed subject matter provides a yarn (or thread) guide system for and methods of quick yarn change and yarn repair for manufacture of erosion control blankets (ECB) and/or other similar composites. The presently disclosed yarn guide system can be integrated into the sewing process of any manufacturing process for making ECBs. In one example, the presently disclosed yarn guide system can be integrated into the sewing portion of an ECB mat machine. Further, the presently disclosed yarn guide system provides features that allow continuous and safe operation of the machine.

The presently disclosed yarn guide system includes a set of yarn guide tubes through which the respective yarns (or threads) are passed. The tubes keep the yarns separate from one another thereby reducing or entirely eliminating interference between adjacent yarns. In so doing, the risk of yarn breakage due to interference between adjacent yarns is reduced or entirely eliminated.

In the event that a yarn does break, the machine operator can safely traverse to the exact location of the yarn breakage via a catwalk. The machine operator then re-inserts the yarn into the guide tube using a swift burst of compressed air applied to the top of the guide tube to push the yarn further down into the pathway. Subsequently, the sewing

needle captures the yarn and the sewing process continues without machine downtime and without endangerment to the operator.

Accordingly, an aspect of the presently disclosed yarn guide system and method is that it provides mechanisms that allow the machine operator to easily thread and/or re-thread the yarn while maintaining a safe distance from sharp objects and/or dangerous machine components.

Another aspect of the presently disclosed yarn guide system and method is that it provides mechanisms that allow the machine operator to easily thread and/or re-thread the yarn without stopping the machine, thereby enhancing overall equipment efficiency (OEE) of the machine and providing more efficient use of labor and material.

Further, the presently disclosed yarn guide system includes pneumatic cylinders and an actuator valve for lifting up the needle aperture plate to prevent and/or clear jams. For example, if there is any material embedded in the fibrous mat of the ECB that might cause a jam in the sewing portion of the machine due to entanglement with the needles and yarns, the frame that holds the needle aperture plate can be lifted up quickly using the pneumatic cylinders and actuator valve. Once the potential jamming material passes through the sewing portion of the machine, the frame can be lowered quickly and the sewing operation continues without any downtime occurrence.

Accordingly, yet another aspect of the presently disclosed yarn guide system and method is that it provides mechanisms that prevent debris from jamming the sewing operations of the machine and/or that allow the machine operator to easily clear debris from and/or prevent debris from jamming the sewing operations without stopping the machine, thereby enhancing OEE of the machine and providing more efficient use of labor and material.

In some embodiments, the presently disclosed yarn guide system and method provides both the guide tubes for guiding the yarns or thread and the pneumatic cylinders and actuator valve for lifting up the needle aperture plate to prevent and/or clear jams.

In another embodiment, the presently disclosed yarn guide system and method provides the guide tubes for guiding the yarns or thread only, and is absent the pneumatic cylinders and actuator valve for lifting up the needle aperture plate to prevent and/or clear jams.

In yet another embodiment, the presently disclosed yarn guide system and method provides the pneumatic cylinders and actuator valve for lifting up the needle aperture plate to prevent and/or clear jams only, and is absent the guide tubes for guiding the yarns or thread.

Referring now to FIG. 1 is a perspective view of the presently disclosed yarn (or thread) guide system 100 in relation to the sewing portion of an ECB mat machine 170. The presently disclosed yarn (or thread) guide system 100 is not limited to installation in the exact type of ECB mat machine 170 shown in FIG. 1. The presently disclosed yarn (or thread) guide system 100 can be implemented in any manufacturing process for making ECBs, using any type, brand, and/or model of manufacturing equipment. For example, the ECB mat machine 170 shown in FIG. 1 is an ECB mat machine supplied by MST Maschinenbau GmbH (Twistringen, Germany), which is but one example of a manufacturing process for making ECBs. However, another supplier of ECB mat machines is A.H. Meyer Maschinenfabrik GmbH (Twistringen, Germany).

For example, ECB mat machine 170 includes in order a feed table 172 for receiving bales of fibrous material 174, a bale opener 176, a conveying fan 178, a fleece laying machine 180, a stitching machine 182, a cutting system 184, and a winder 186. The output of ECB mat machine 170 is ECB rolls 188. Fibrous material 174 can be a fiber matrix material, such as coconut fibers and/or straw. In ECB mat machine 170, a layer of fibrous material 174 in combination with netting material (not shown) passes through stitching machine 182. In so doing, needles and thread are used to sew together fibrous material 174 and the netting material (e.g., a top and/or bottom netting), to form the ECB structure, wherein the netting acts as a substrate for holding fibrous material 174. In other words, typically the netting enters before the sewing section.

In this example, the presently disclosed yarn guide system 100 is integrated into stitching machine 182 of ECB mat machine 170, which is the sewing portion of the machine. Referring now to FIG. 2 is a perspective view showing more details of an example of yarn guide system 100 integrated into the sewing portion (e.g., stitching machine 182) of an ECB mat machine (e.g., ECB mat machine 170).

Stitching machine 182 of ECB mat machine 170 includes, for example, a horizontal frame member 190 the spans the width of ECB mat machine 170. A set of

bobbins 192 on a yarn bobbin frame (not shown) are arranged above frame member 190, wherein each of the bobbins 192 is used to spool out a strand of yarn (or thread) 194.

Yarn guide system 100 includes one or more lifter assemblies 110 attached to frame member 190. In one example, yarn guide system 100 includes three lifter assemblies 110 (e.g., lifter assemblies 110a, 110b, 110c). Namely, a lifter assembly 110 at each end of frame member 190 and a lifter assembly 110 about midway of frame member 190.

Each of the lifter assemblies 110 includes a pneumatic cylinder housing 112 for housing a pneumatic cylinder member 114. The distal ends of the three pneumatic cylinder members 114 of lifter assemblies 110a, 110b, 110c are mechanically connected to an aperture plate 116, wherein lifter assemblies 110 can be used to move aperture plate 116 up and down with respect to the fibrous material 174 passing beneath aperture plate 116 (see FIG. 4A and FIG. 4B). Namely, in each of the lifter assemblies 110, an actuator valve (not shown) within pneumatic cylinder housing 112 is used to actuate pneumatic cylinder member 114. An actuator switch 115 mounted, for example, on frame member 190, can be used to trigger the actuator valves and actuate pneumatic cylinder members 114 for raising and lowering aperture plate 116. In one example, actuator switch 115 is a pushbutton toggle switch.

Aperture plate 116 spans the width of ECB mat machine 170. Aperture plate 116 includes a base plate 118 and an angled plate 120. Namely, angled plate 120 is coupled to the upstream edge of base plate 118, wherein angled plate 120 captures and gathers fibrous material 174 for feeding under base plate 118. A plurality of apertures 122 is provided on the downstream portion of base plate 118, wherein each aperture 122 corresponds to a strand of yarn 194 and a needle 196. Namely, the needles 196 move up and down from beneath (and through) fibrous material 174 to capture the strands of yarn 194 and perform the sewing function. Aperture plate 116 can be a standard component of any ECB mat machine, which is then adapted to yarn (or thread) guide system 100.

Yarn guide system 100 also includes a first rail 124 and a second rail 125 for holding a plurality of yarn guide tubes 126 therebetween. In one example, first rail 124 and second rail 125 are made of a length of angle iron. Each of the yarn guide tubes 126 can be any flexible hollow tube, such as any plastic, rubber, light metallic, or fabric tube.

The proximal ends (relative to bobbins 192) of yarn guide tubes 126 are mated and fastened to openings in first rail 124. Similarly, the distal ends (relative to bobbins 192) of yarn guide tubes 126 are mated and fastened to openings in second rail 125. First rail 124 and a second rail 125 are arranged such that yarn guide tubes 126 are substantially perpendicular to the surface of fibrous material 174 passing beneath aperture plate 116. The number and positions of yarn guide tubes 126 correspond to the number and positions of the strands of yarn 194 and of apertures 122 in aperture plate 116.

Further, first rail 124 is mounted in a fixed position with respect to aperture plate 116, while second rail 125 is moveable side-to-side with respect to aperture plate 116. Namely, second rail 125 and thus the distal ends (relative to bobbins 192) of yarn guide tubes 126 are coupled to a mechanism by which second rail 125 and the distal ends of yarn guide tubes 126 oscillate from side-to-side in relation to apertures 122 in aperture plate 116 and corresponding to the movement of needles 196. More details of first rail 124, second rail 125, and yarn guide tubes 126 are shown and described hereinbelow with reference to FIG. 5.

In yarn guide system 100, the yarn pathway from the creel (yarn bobbin frame) is such that, after the tensioning mechanism (not shown), each strand of yarn (or thread) 194 passes through one of the yarn guide tubes 126, wherein each yarn guide tube 126 acts as a guide for the yarn and encompasses the yarn completely. Yarn guide tubes 126 keep the strands of yarn (or thread) 194 separate from one another thereby reducing or entirely eliminating interference between adjacent yarns. In so doing, the risk of yarn breakage due to interference between adjacent yarns is reduced or entirely eliminated as compared with standard ECB manufacturing processes that do not include yarn guide system 100.

Referring now to FIG. 3 is a perspective view of the presently disclosed yarn (or thread) guide system 100 and including a catwalk 130 spanning the width thereof and passing in proximity to stitching machine 182 of ECB mat machine 170. Namely, catwalk 130 can be any type of platform capable of safely supporting the weight of one or more machine operators 140. Catwalk 130 allows quick and safe access to yarn bobbins and other components included in the yarn pathway of stitching machine 182 of ECB mat

machine 170. In yarn (or thread) guide system 100, the machine operator 140 also has a compressed air source 142, such as an aerosol can of compressed air.

In the event that a strand of yarn (or thread) 194 breaks, the machine operator 140 safely traverses to the exact location of the yarn breakage via catwalk 130. Then, machine operator 140 re-inserts the end of the strand of yarn (or thread) 194 into the top of the yarn guide tube 126. Then, machine operator 140 uses compressed air source 142 to deliver a swift burst of air to the top of the yarn guide tube 126. In so doing, the strand of yarn (or thread) 194 is pushed down into and all the way through the pathway in yarn guide tube 126. Then, when the end of the strand of yarn (or thread) 194 emerges from the lower end of the yarn guide tube 126, needle 196 captures the yarn and the sewing process continues without machine downtime and without endangerment to the operator.

Yarn guide system 100 is designed in such a way that if there is any material embedded in the fibrous mat of the ECB that might cause a jam in the sewing operation (e.g., in stitching machine 182) due to entanglement with the needles and yarns, aperture plate 116 can be lifted up quickly using pneumatic cylinder members 114 of lifter assemblies 110. As soon as the potential jamming material passes through, for example, stitching machine 182, aperture plate 116 can be lowered quickly and the sewing operation continues without any downtime occurrence. For example, FIG. 4A shows a perspective view of a portion of yarn guide system 100 wherein aperture plate 116 is in a lowered position for normal operation. By contrast, FIG. 4B shows a perspective view of a portion of yarn guide system 100 wherein aperture plate 116 is in a raised position for easily clearing debris (e.g., debris 189) therefrom or for allowing potential jamming material (e.g., debris 189) to pass therethrough.

FIG. 5 illustrates a perspective view of a portion of the yarn guide tube assembly of the presently disclosed yarn (or thread) guide system 100. Again, first rail 124 is mounted in a fixed position with respect to aperture plate 116, while second rail 125 is moveable side-to-side with respect to aperture plate 116. For example, first rail 124 is mounted to a fixed frame member, while second rail 125 is coupled to an oscillating arm mechanism 198. Using oscillating arm mechanism 198, second rail 125 and the distal ends of yarn guide tubes 126 oscillate from side-to-side in relation to apertures 122 in

aperture plate 116 and corresponding to the movement of needles 196. The flexibility of yarn guide tubes 126 allows this oscillation.

FIG. 1 through FIG. 5 show simplified illustrations of the presently disclosed yarn (or thread) guide system 100 in which mounting components and fasteners are not shown. However, FIG. 6 through FIG. 19A, 19B, 19C show more details of a specific example of the presently disclosed yarn guide system 100. Namely, FIG. 6 through FIG. 19A, 19B, 19C show a yarn guide system 200, which is one specific example of yarn guide system 100 shown in FIG. 1 through FIG. 5.

Referring now to FIG. 6 is various views of yarn guide system 200 and in particular one example instantiation of lifter assembly 110. Namely, FIG. 6 shows a side view and a back view of yarn guide system 200 in its entirety. FIG. 6 also shows a bottom view and a side view of the aperture plate portion only of yarn guide system 200.

In yarn guide system 200, a mounting plate 210 is used to mount pneumatic cylinder housing 112 to frame member 190. Other views of mounting plate 210 are shown in FIG. 7 and example dimensions of mounting plate 210 are shown in FIG. 8. Further, a pair of support plates 212 is used to secure mounting plate 210 to frame member 190. Namely, one support plate 212 at the top of frame member 190 and another support plate 212 at the bottom of frame member 190. Other views of support plate 212 with example dimensions are shown in FIG. 9.

In this example, pneumatic cylinder housing 112 supports three pneumatic cylinder members 114. The ends of the three pneumatic cylinder members 114 are coupled to an adaptor plate 214. Additionally, certain fittings 220 are provided on the face of pneumatic cylinder housing 112 and function as an air intake and exhaust for the cylinder. Other views of pneumatic cylinder housing 112 are shown in FIG. 10.

Aperture plate 116 is coupled to an I-beam member 216, wherein adaptor plate 214 of lifter assembly 110 can be coupled to I-beam member 216 via a mounting plate 218. Other views of mounting plate 218 are shown in FIG. 11 and example dimensions of mounting plate 210 are shown in FIG. 12.

Yarn guide system 200 also includes the yarn guide tubes 126 arranged between first rail 124 and second rail 125, wherein first rail 124 is held by one or more fixed

frame members 222. There is an eyelet 226 in each end of yarn guide tube 126, such as ceramic eyelets.

A yarn (or thread) rack member 224 guides yarn (or thread) 194 toward yarn guide tube 126, wherein yarn 194 is feed into the upper eyelet 226, through yarn guide tube 126, and exits the lower eyelet 226 toward aperture plate 116.

Referring now to FIG. 13 is another side view of lifter assembly 110 shown in FIG. 6 and shown in its entirety. FIG. 14 shows a side view of a portion of lifter assembly 110 shown in FIG. 13 showing some of the standard components (e.g., frame member 190, aperture plate 116) of an ECB mat machine (e.g., ECB mat machine 170) and the absent the certain components of lifter assembly 110 (e.g., pneumatic cylinder housing 112, pneumatic cylinder members 114, mounting plate 210, support plates 212, mounting plate 218, yarn guide rails 124/125, and yarn guide tubes 126). FIG. 14 also shows fastening hardware 228, such as bolts, nuts, washers. By contrast, FIG. 15 shows another side view of a portion of lifter assembly 110 shown in FIG. 13 showing certain components of lifter assembly 110 (e.g., pneumatic cylinder housing 112, pneumatic cylinder members 114, mounting plate 210, support plates 212, mounting plate 218, yarn guide rails 124/125, and yarn guide tubes 126) and the absent some of the standard components (e.g., frame member 190, aperture plate 116) of an ECB mat machine (e.g., ECB mat machine 170).

Referring now to FIG. 16 is another back view of lifter assembly 110 shown in FIG. 6 and shown in its entirety. FIG. 17 shows a back view of a portion of lifter assembly 110 shown in FIG. 16 showing some of the standard components (e.g., frame member 190, aperture plate 116) of an ECB mat machine (e.g., ECB mat machine 170) and the absent the certain components of lifter assembly 110 (e.g., pneumatic cylinder housing 112, pneumatic cylinder members 114, mounting plate 210, support plates 212, mounting plate 218, yarn guide rails 124/125, and yarn guide tubes 126). FIG. 17 also shows fastening hardware 228, such as bolts, nuts, washers. By contrast, FIG. 18 shows another back view of a portion of lifter assembly 110 shown in FIG. 16 showing certain components of lifter assembly 110 (e.g., pneumatic cylinder housing 112, pneumatic cylinder members 114, mounting plate 210, support plates 212, mounting plate 218, yarn guide rails 124/125, and yarn guide tubes 126) and the absent some of the standard

components (e.g., frame member 190, aperture plate 116) of an ECB mat machine (e.g., ECB mat machine 170).

Referring now to FIG. 19A is another bottom view and side view of the aperture plate portion only of lifter assembly 110 shown in FIG. 6 and shown in its entirety. FIG. 19B shows a bottom view and side view of a portion of lifter assembly 110 shown in FIG. 19A showing some of the standard components (e.g., I-beam member 216) of an ECB mat machine (e.g., ECB mat machine 170) and absent the certain components of lifter assembly 110 (e.g., adaptor plate 214, mounting plate 218). FIG. 19B also shows fastening hardware 228, such as bolts, nuts, washers. By contrast, FIG. 19C shows another bottom view and side view of a portion of lifter assembly 110 shown in FIG. 19A showing certain components of lifter assembly 110 (e.g., adaptor plate 214, mounting plate 218) and absent some of the standard components (e.g., I-beam member 216) of an ECB mat machine (e.g., ECB mat machine 170).

Referring now to FIG. 20 is a flow diagram of an example of a method 2000 of using the presently disclosed yarn (or thread) guide system 100 to initially thread the yarn into the sewing portion of an ECB mat machine (e.g., ECB mat machine 170). Method 2000 includes, but is not limited to, the following steps.

At a step 2010, the machine operator activates the sewing portion of the ECB mat machine. For example, machine operator 140 activates stitching machine 182 of ECB mat machine 170. In so doing, fibrous material 174 and any other material for making ECBs passes beneath aperture plate 116 and needles 196 are activated.

At a step 2015, the machine operator accesses the sewing portion of the ECB mat machine via catwalk 130 of yarn (or thread) guide system 100. For example, machine operator 140 accesses stitching machine 182 of ECB mat machine 170 via catwalk 130 of yarn (or thread) guide system 100. For machine operator 140, catwalk 130 allows quick and safe access to yarn bobbins and other components included in the yarn pathway of stitching machine 182 of ECB mat machine 170.

At a step 2020, the machine operator uses a blast of air to thread one of the yarns (or threads) into the sewing portion of the ECB mat machine. For example, machine operator 140 selects the first yarn (or thread) 194 in the line and then places the end of the yarn (or thread) 194 in and/or near the top opening of its corresponding yarn guide tube

126. Then, using compressed air source 142 (e.g., an aerosol can of compressed air), machine operator 140 uses a blast of air to push yarn (or thread) 194 into and through the yarn guide tube 126. When yarn (or thread) 194 emerges from the lower end of yarn guide tube 126, the corresponding needle 196 captures or engages yarn (or thread) 194 and the sewing process begins for the selected yarn (or thread) 194.

At a step 2025, the step 2020 is repeated for each yarn (or thread) 194 in the line until all of the yarns (or threads) 194 are threaded into the sewing portion (e.g., stitching machine 182) of the ECB mat machine (e.g., ECB mat machine 170).

Referring now to FIG. 21 is a flow diagram of an example of a method 2100 of using the presently disclosed yarn (or thread) guide system 100 to re-thread the yarn into the sewing portion of an ECB mat machine (e.g., ECB mat machine 170). Method 2100 includes, but is not limited to, the following steps.

At a step 2110, while the sewing portion of the ECB mat machine is running, the machine operator accesses the sewing portion of the ECB mat machine via catwalk 130 of yarn (or thread) guide system 100 and approaches the broken yarn (or thread). For example, while stitching machine 182 of ECB mat machine 170 is running, machine operator 140 accesses stitching machine 182 of ECB mat machine 170 via catwalk 130 of yarn (or thread) guide system 100. Then, machine operator 140 approaches the broken yarn (or thread) 194.

At a step 2115, the machine operator uses a blast of air to re-thread the broken yarns (or thread) into the sewing portion of the ECB mat machine. For example, machine operator 140 places the end of the broken yarn (or thread) 194 in and/or near the top opening of its corresponding yarn guide tube 126. Then, using compressed air source 142 (e.g., an aerosol can of compressed air), machine operator 140 uses a blast of air to push yarn (or thread) 194 into and through the yarn guide tube 126. When yarn (or thread) 194 emerges from the lower end of yarn guide tube 126, the corresponding needle 196 captures or engages yarn (or thread) 194 and the sewing process begins for the selected yarn (or thread) 194.

Referring now to FIG. 22 is a flow diagram of an example of a method 2200 of using the presently disclosed yarn (or thread) guide system 100 to clear debris from

and/or to prevent debris from jamming the sewing portion of an ECB mat machine (e.g., ECB mat machine 170). Method 2200 includes, but is not limited to, the following steps.

At a step 2210, while the ECB mat machine is running, the machine operator observes debris in and/or approaching the sewing portion of the ECB mat machine, wherein the debris is causing a jam or could potentially cause a jam in the sewing process. For example, while stitching machine 182 of ECB mat machine 170 is running, machine operator 140 observes debris (e.g., debris 189 shown in FIG. 4B) in and/or approaching stitching machine 182, wherein the debris is causing a jam or could potentially cause a jam in stitching machine 182 of ECB mat machine 170.

At a step 2215, while the ECB mat machine is running, the aperture plate is raised using the pneumatic cylinders of yarn (or thread) guide system 100, thereby allowing the debris to be cleared and/or to pass unobstructed past the aperture plate. For example, aperture plate 116 is raised using lifter assemblies 110 of yarn (or thread) guide system 100. Namely, while stitching machine 182 of ECB mat machine 170 is running, machine operator 140 uses actuator switch 115 to actuate the actuator valves (not shown) within lifter assemblies 110. In so doing, pneumatic cylinder members 114 are actuated and aperture plate 116 is raised up a suitable distance that allows the debris (e.g., debris 189 shown in FIG. 4B) to be cleared and/or to pass unobstructed past aperture plate 116.

At a step 2220, while the ECB mat machine is running, once the hazard or potential hazard is cleared, the aperture plate is lowered using the pneumatic cylinders of yarn (or thread) guide system 100, thereby allowing normal sewing operations to resume without interrupting the ECB manufacturing process flow. For example, aperture plate 116 is lowered using lifter assemblies 110 of yarn (or thread) guide system 100. Namely, while stitching machine 182 of ECB mat machine 170 is running, machine operator 140 uses actuator switch 115 to actuate the actuator valves (not shown) within lifter assemblies 110. In so doing, pneumatic cylinder members 114 are actuated and aperture plate 116 is lowered, thereby allowing normal sewing operations to resume without interrupting the ECB manufacturing process flow.

Referring now to FIG. 23 is a perspective view of another embodiment of the presently disclosed yarn (or thread) guide system 100 that includes the yarn guide tubes 126 only, absent lifter assemblies 110. In this embodiment, yarn (or thread) guide system

100 includes the feature of being able to easily thread and/or re-thread yarn (or thread), even when the ECB mat machine is running. However, this embodiment of yarn (or thread) guide system 100 is absent the feature of being able to easily clear and/or avoid jams due to debris in the sewing portion of the ECB mat machine. Namely, this embodiment of yarn (or thread) guide system 100 is absent the ability to raise and lower aperture plate 116.

Referring now to FIG. 24 is a perspective view of yet another embodiment of the presently disclosed yarn (or thread) guide system 100 that includes the lifter assemblies 110 only, absent the yarn guide tubes 126. In this embodiment, yarn (or thread) guide system 100 includes the feature of being able to easily clear and/or avoid jams due to debris in the sewing portion of the ECB mat machine, even when the ECB mat machine is running. However, this embodiment of yarn (or thread) guide system 100 is absent the feature of being able to easily thread and/or re-thread yarn (or thread).

Referring now to FIG. 25, FIG. 26, FIG. 27, and FIG. 28 are photos of examples of the presently disclosed yarn (or thread) guide system 100 installed in the sewing portion (e.g., stitching machine 182) of an ECB mat machine.

Following long-standing patent law convention, the terms “a,” “an,” and “the” refer to “one or more” when used in this application, including the claims. Thus, for example, reference to “a subject” includes a plurality of subjects, unless the context clearly is to the contrary (e.g., a plurality of subjects), and so forth.

Throughout this specification and the claims, the terms “comprise,” “comprises,” and “comprising” are used in a non-exclusive sense, except where the context requires otherwise. Likewise, the term “include” and its grammatical variants are intended to be non-limiting, such that recitation of items in a list is not to the exclusion of other like items that can be substituted or added to the listed items.

For the purposes of this specification and appended claims, unless otherwise indicated, all numbers expressing amounts, sizes, dimensions, proportions, shapes, formulations, parameters, percentages, quantities, characteristics, and other numerical values used in the specification and claims, are to be understood as being modified in all instances by the term “about” even though the term “about” may not expressly appear

with the value, amount or range. Accordingly, unless indicated to the contrary, the numerical parameters set forth in the following specification and attached claims are not and need not be exact, but may be approximate and/or larger or smaller as desired, reflecting tolerances, conversion factors, rounding off, measurement error and the like, and other factors known to those of skill in the art depending on the desired properties sought to be obtained by the presently disclosed subject matter. For example, the term "about," when referring to a value can be meant to encompass variations of, in some embodiments, ± 100% in some embodiments ± 50%, in some embodiments ± 20%, in some embodiments ± 10%, in some embodiments ± 5%, in some embodiments ±1%, in some embodiments ± 0.5%, and in some embodiments ± 0.1% from the specified amount, as such variations are appropriate to perform the disclosed methods or employ the disclosed compositions.

Further, the term "about" when used in connection with one or more numbers or numerical ranges, should be understood to refer to all such numbers, including all numbers in a range and modifies that range by extending the boundaries above and below the numerical values set forth. The recitation of numerical ranges by endpoints includes all numbers, e.g., whole integers, including fractions thereof, subsumed within that range (for example, the recitation of 1 to 5 includes 1, 2, 3, 4, and 5, as well as fractions thereof, e.g., 1.5, 2.25, 3.75, 4.1, and the like) and any range within that range.

Although the foregoing subject matter has been described in some detail by way of illustration and example for purposes of clarity of understanding, it will be understood by those skilled in the art that certain changes and modifications can be practiced within the scope of the appended claims.

WHAT IS CLAIMED IS:

1. A method for threading a fibrous material into an erosion control blanket, the method comprising:
    a. positioning a guide system at a predetermined location, said guide system comprising a plurality of guide tubes, each guide tube comprising a first guide tube end and a second guide tube end;
    b. directing a first end of a substantially continuous fibrous material to a first end of a guide tube;
    c. directing a flow of gas from a gas source under pressure into the guide tube;
    d. positioning a needle proximate to the second end of the guide tube;
    e. engaging a leading end of the fibrous material with the needle; and
    f. directing the leading end of the fibrous material to a predetermined location on the erosion control blanket.

2. A method for maintaining a substantially continuous material-fastening operation for an erosion control blanket comprising:
    a. providing a lifter assembly to a threading apparatus, said lifter assembly comprising:
        i. a thread guide system;
        ii. at least one needle in communication with the thread guide system, said needle configured to receive a first end of a fibrous material;
        iii. an aperture plate in communication with the thread guide system;
        iv. at least one pneumatic cylinder in communication with the aperture plate; and
        v. an actuator valve in communication with the pneumatic cylinder;
    b. detecting debris located proximate to the aperture plate;
    c. actuating the actuating valve and the pneumatic cylinder;

d. moving the aperture plate from a first position adjacent to the erosion control blanket to a second position, said second position a predetermined distance from the erosion control blanket; and

e. re-actuating the actuating valve and the pneumatic cylinder to return the aperture plate to the first position adjacent to the erosion control blanket.

3. The method of claim 2, further comprising, before the step of re-actuating the actuating valve and the pneumatic cylinder to return the aperture plate to the first position adjacent to the erosion control blanket, positioning the aperture plate to avoid contact between the aperture plate and an amount of debris located on the erosion control blanket, while substantially continuing the material-fastening operation.

4. An apparatus for threading a fibrous material into an erosion control blanket, the apparatus comprising:

a. a guide system at a predetermined location, said guide system comprising a plurality of guide tubes, each guide tube comprising a first guide tube end and a second guide tube end, said guide tube configured to receive a first end of a substantially continuous fibrous material to the first end of a guide tube;

b. a source of gas under pressure; and

c. at least one needle proximate to the second end of the guide tube;

wherein the source of gas under pressure is configured to release gas under pressure into the guide tube, and to direct the continuous fibrous through the guide tube and into contact with the needle.

5. The apparatus of claim 4, wherein the substantially continuous fibrous material comprises yarn or thread.

6. The apparatus of claim 4, wherein the source of gas under pressure comprises a source of compressed air.

7. An apparatus for maintaining a substantially continuous material-fastening operation for an erosion control blanket comprising:
    a. a lifter assembly, said lifter assembly comprising:
        i. a thread guide system;
        ii. at least one needle in communication with the thread guide system, said needle configured to receive a first end of a fibrous material;
        iii. an aperture plate in communication with the thread guide system;
        iv. at least one pneumatic cylinder in communication with the aperture plate; and
        v. an actuator valve in communication with the pneumatic cylinder.

8. The apparatus of claim 7, wherein the actuator valve is configured to actuate the pneumatic cylinder.

9. The apparatus of claim 7, wherein the pneumatic cylinder is configured to direct the aperture plate from a first aperture position proximate to an erosion control blanket to a second position at a predetermined distance from the erosion control blanket.

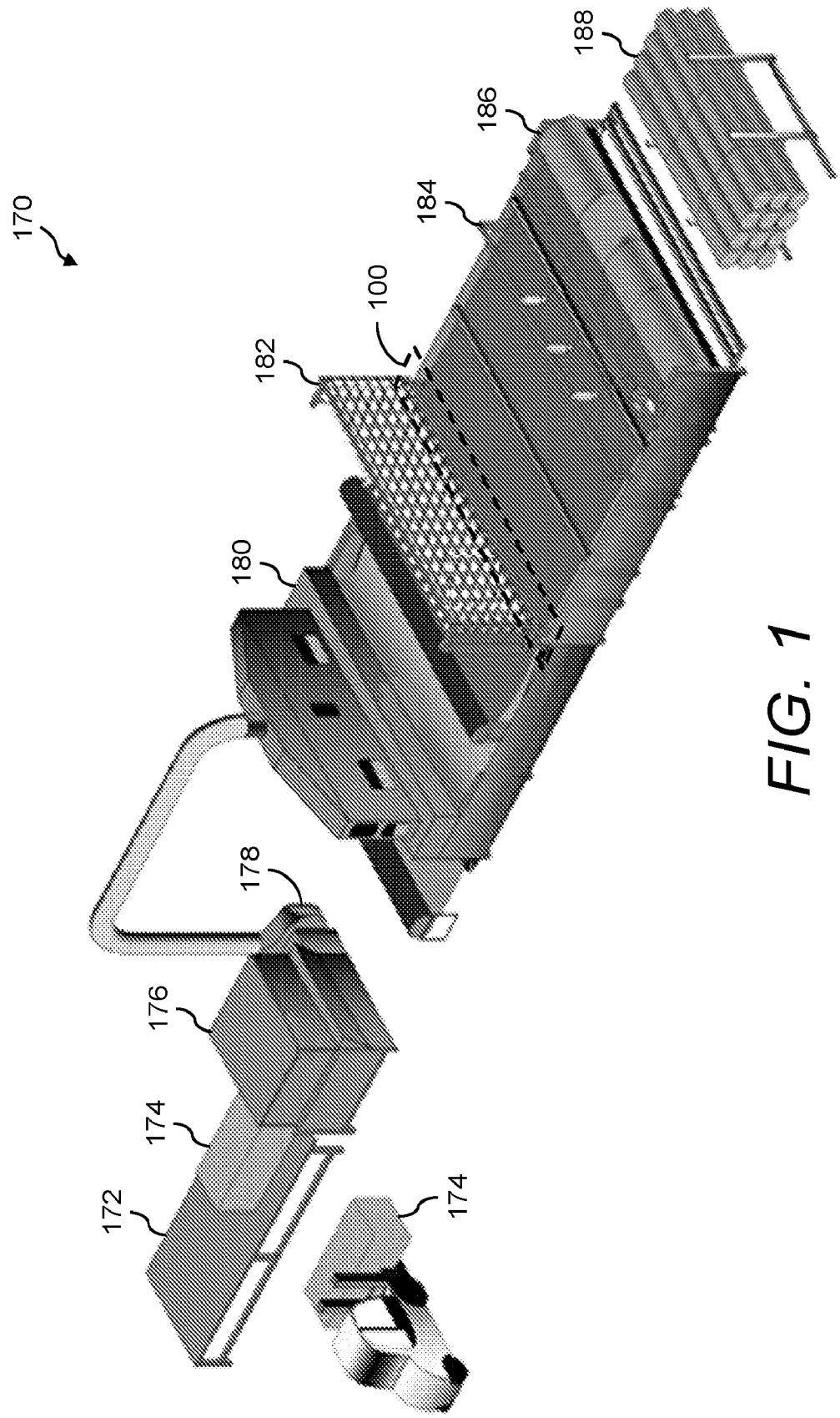


FIG. 1

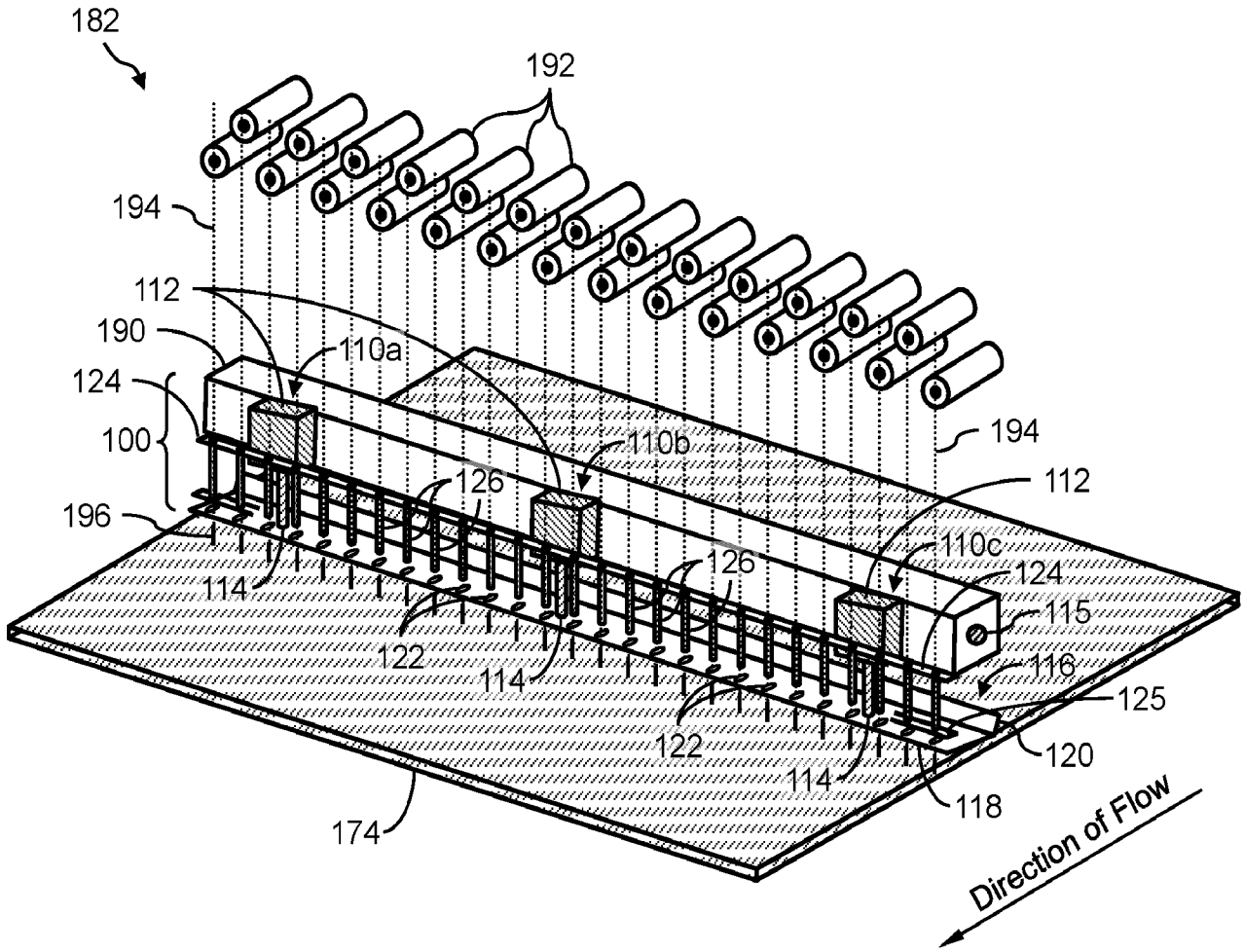

182
192
194
112
190
110a
124
100
196
110b
126
114
122
110c
115
116
125
120
118
174
Direction of Flow

FIG. 2

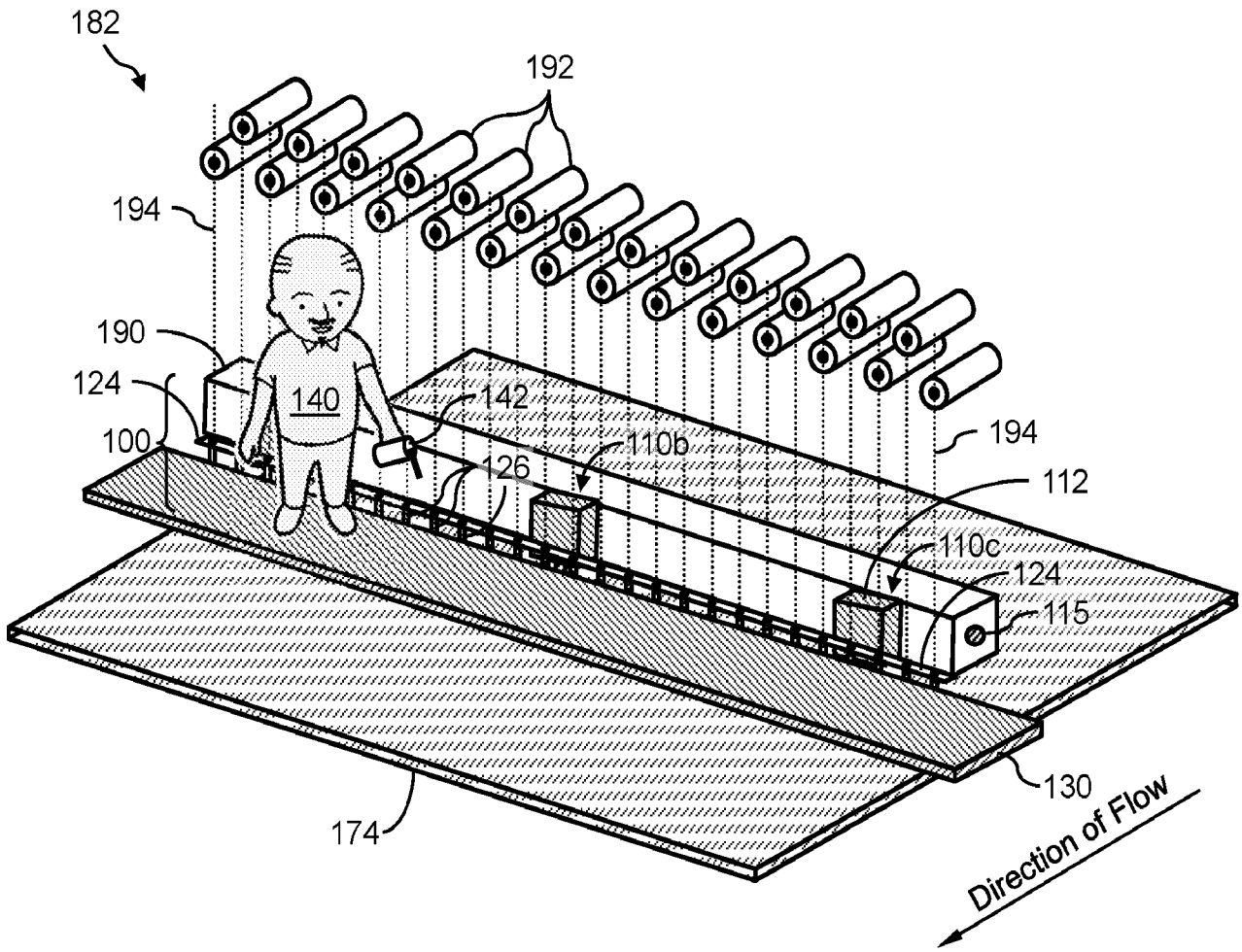

182
192
194
190
124
100
140
142
110b
126
194
112
110c
124
115
130
174
Direction of Flow

FIG. 3

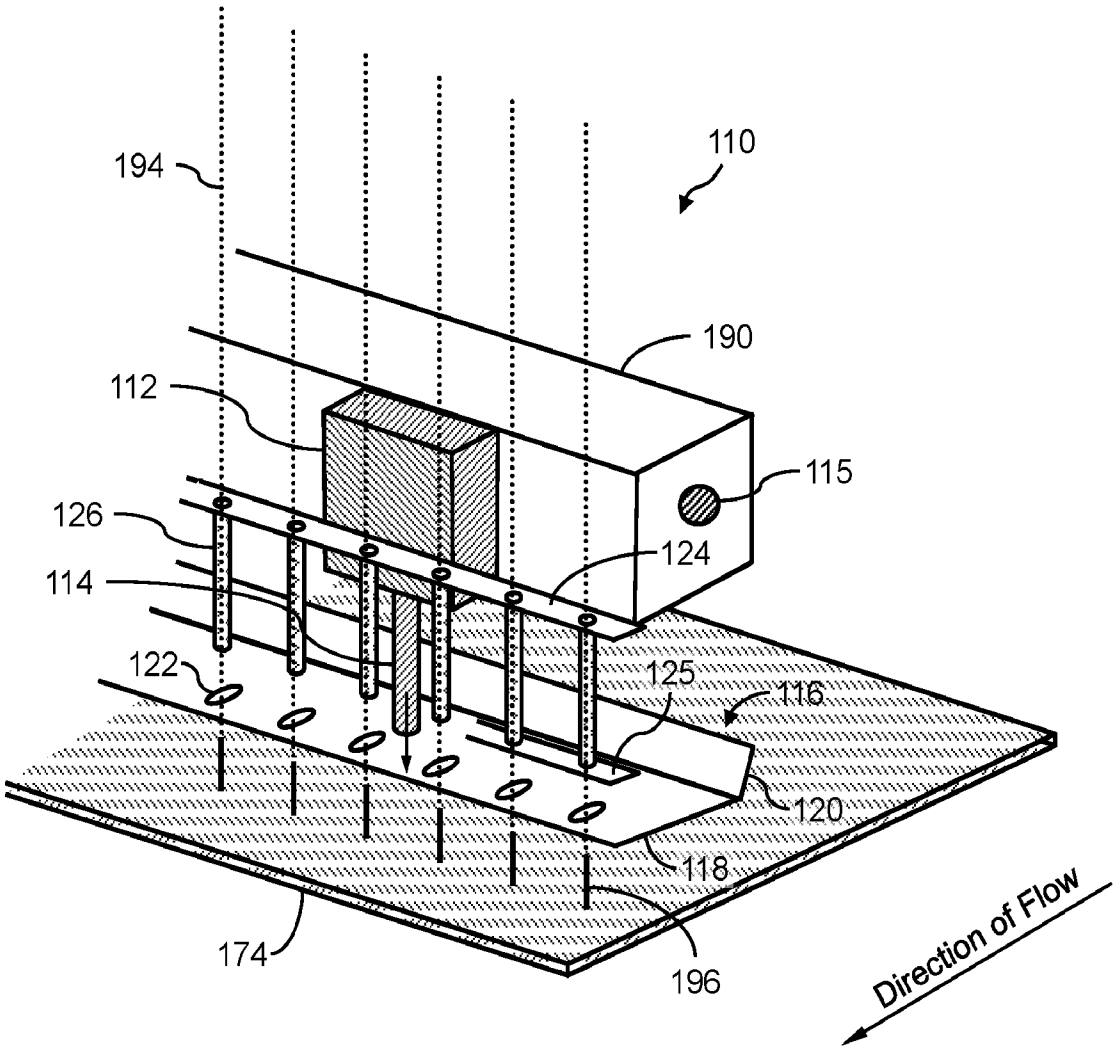

194
110
190
112
115
126
124
114
122
125
116
120
118
174
196
Direction of Flow

FIG. 4A

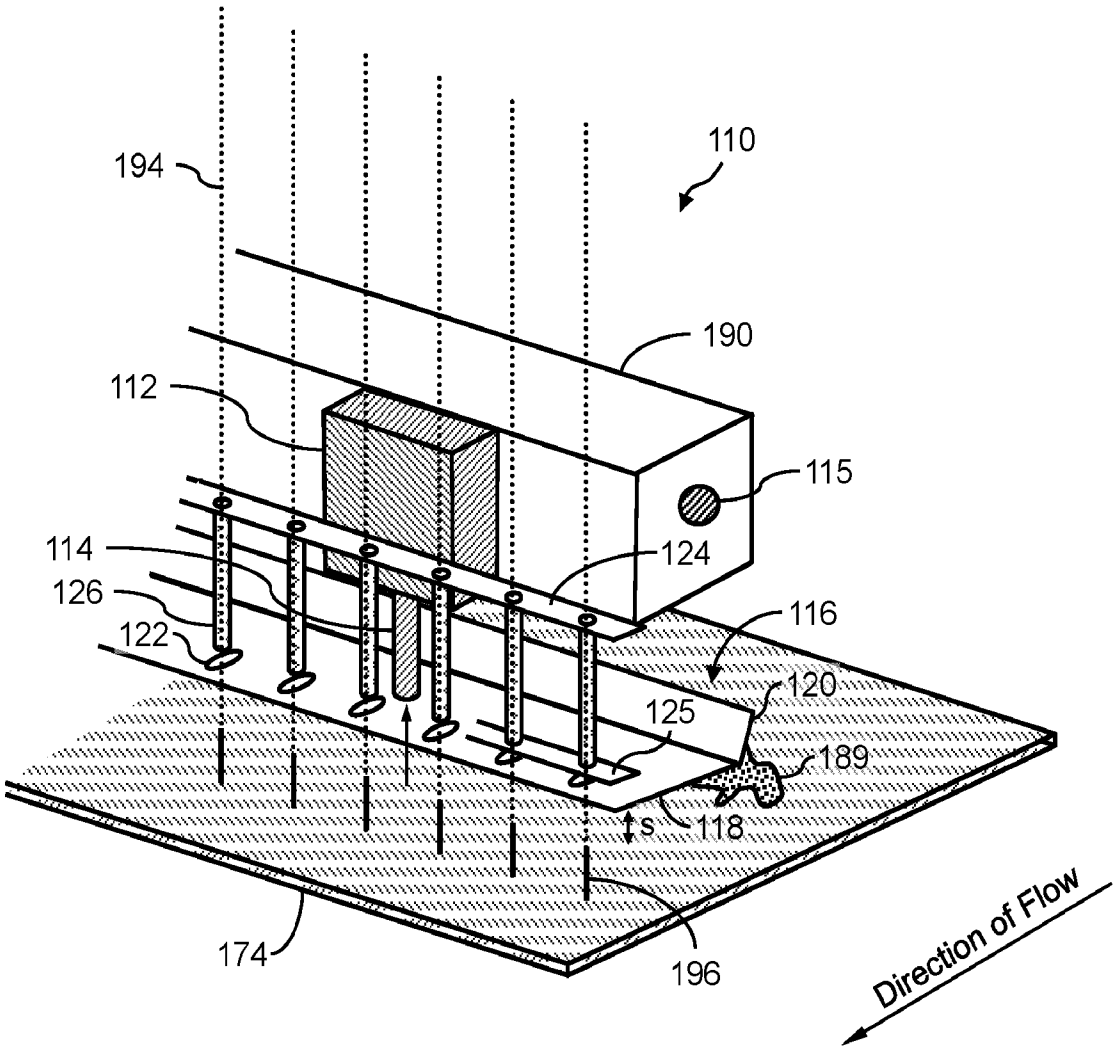

194
110
190
112
115
114
124
126
116
122
120
125
189
s
118
174
196
Direction of Flow

FIG. 4B

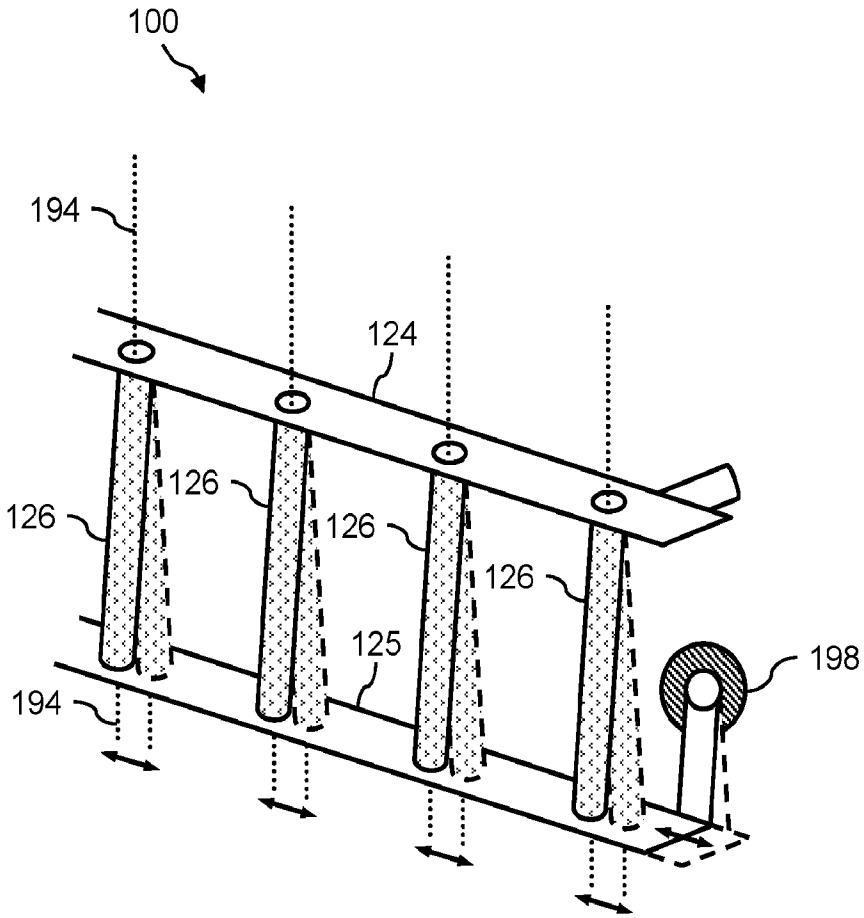


FIG. 5

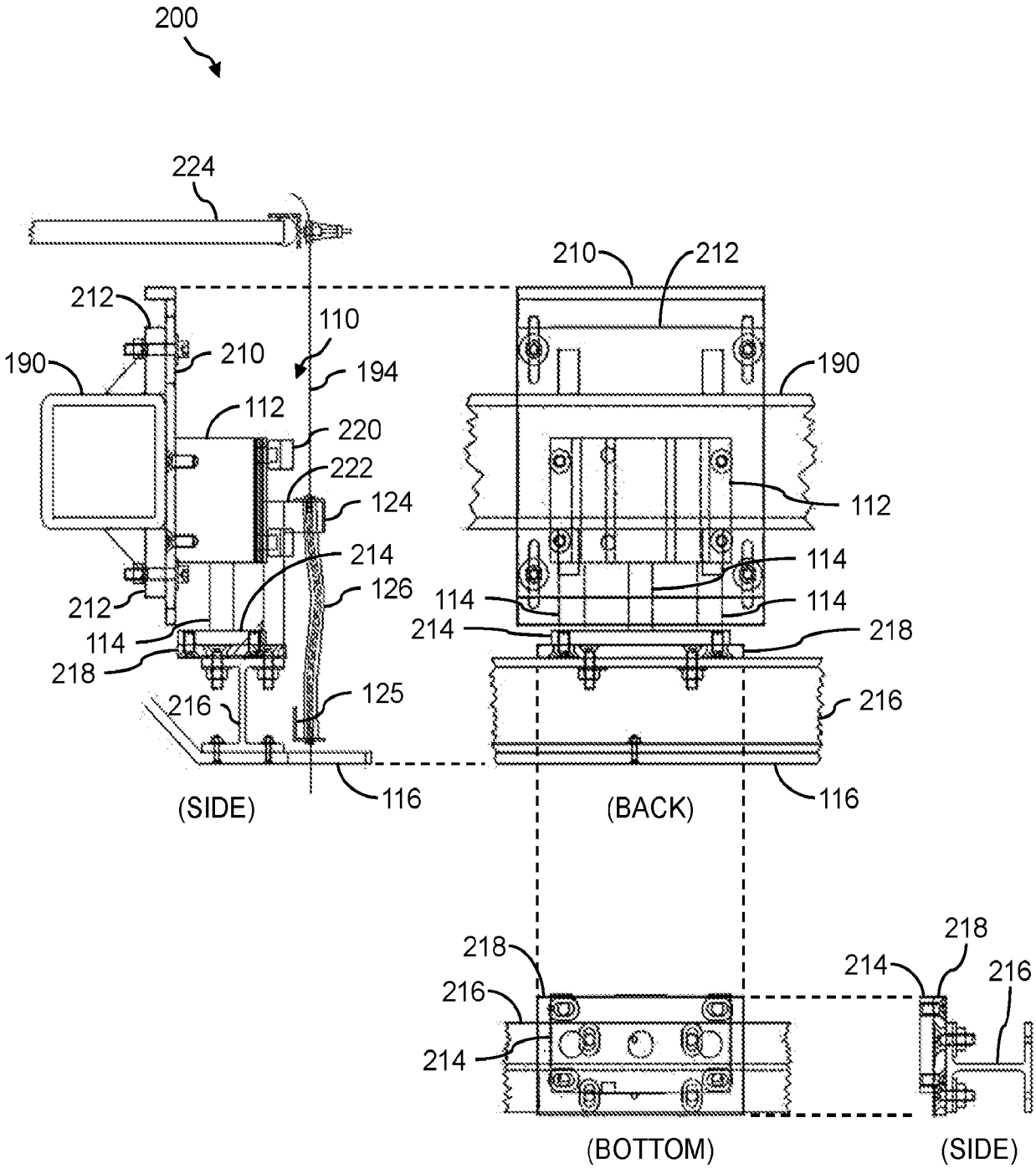

200
224
212
210
190
110
194
112
220
222
124
214
126
212
114
218
216
125
116
(SIDE)
210
212
190
112
114
114
114
214
218
216
116
(BACK)
218
214
216
218
216
214
(BOTTOM)
(SIDE)

FIG. 6

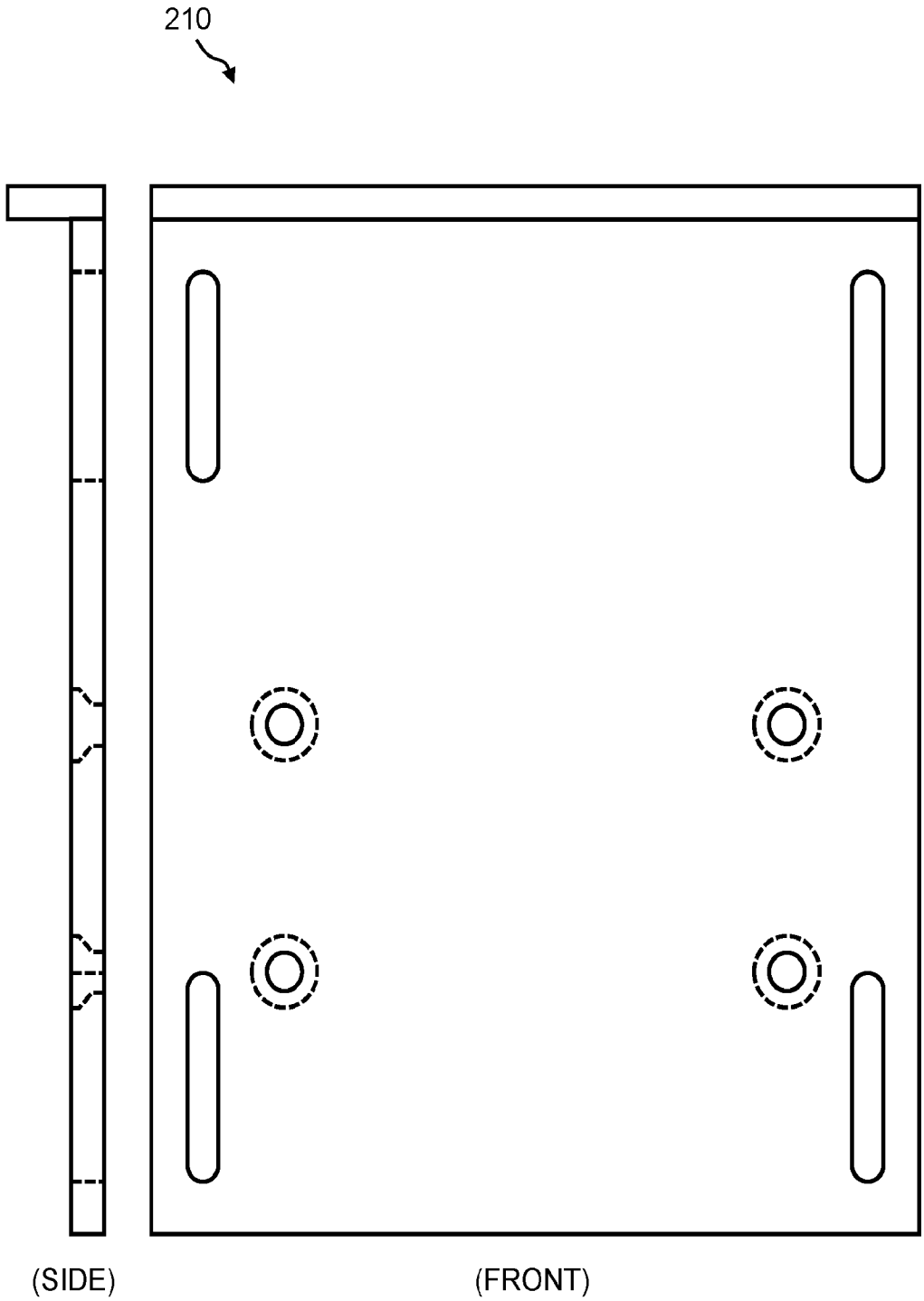


FIG. 7

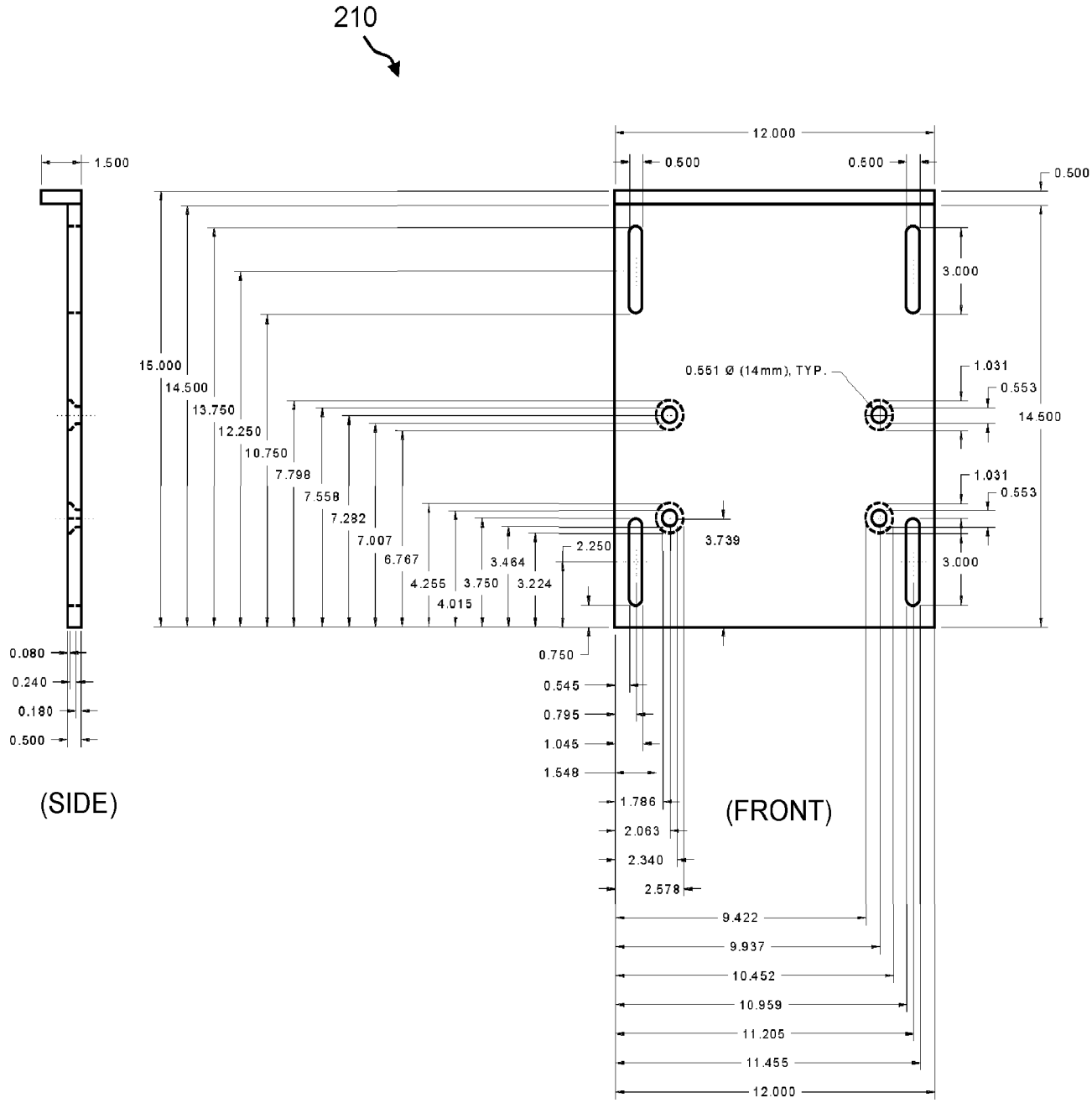

210
1.500
0.080
0.240
0.180
0.500
(SIDE)
12.000
0.500
0.500
0.500
3.000
15.000
14.500
13.750
12.250
10.750
7.798
7.558
7.282
7.007
6.767
4.255
3.750
3.224
4.015
3.464
2.250
3.739
0.551 Ø (14mm), TYP.
1.031
0.553
14.500
1.031
0.553
3.000
0.750
0.545
0.795
1.045
1.548
1.786
2.063
2.340
2.578
(FRONT)
9.422
9.937
10.452
10.959
11.205
11.455
12.000

FIG. 8

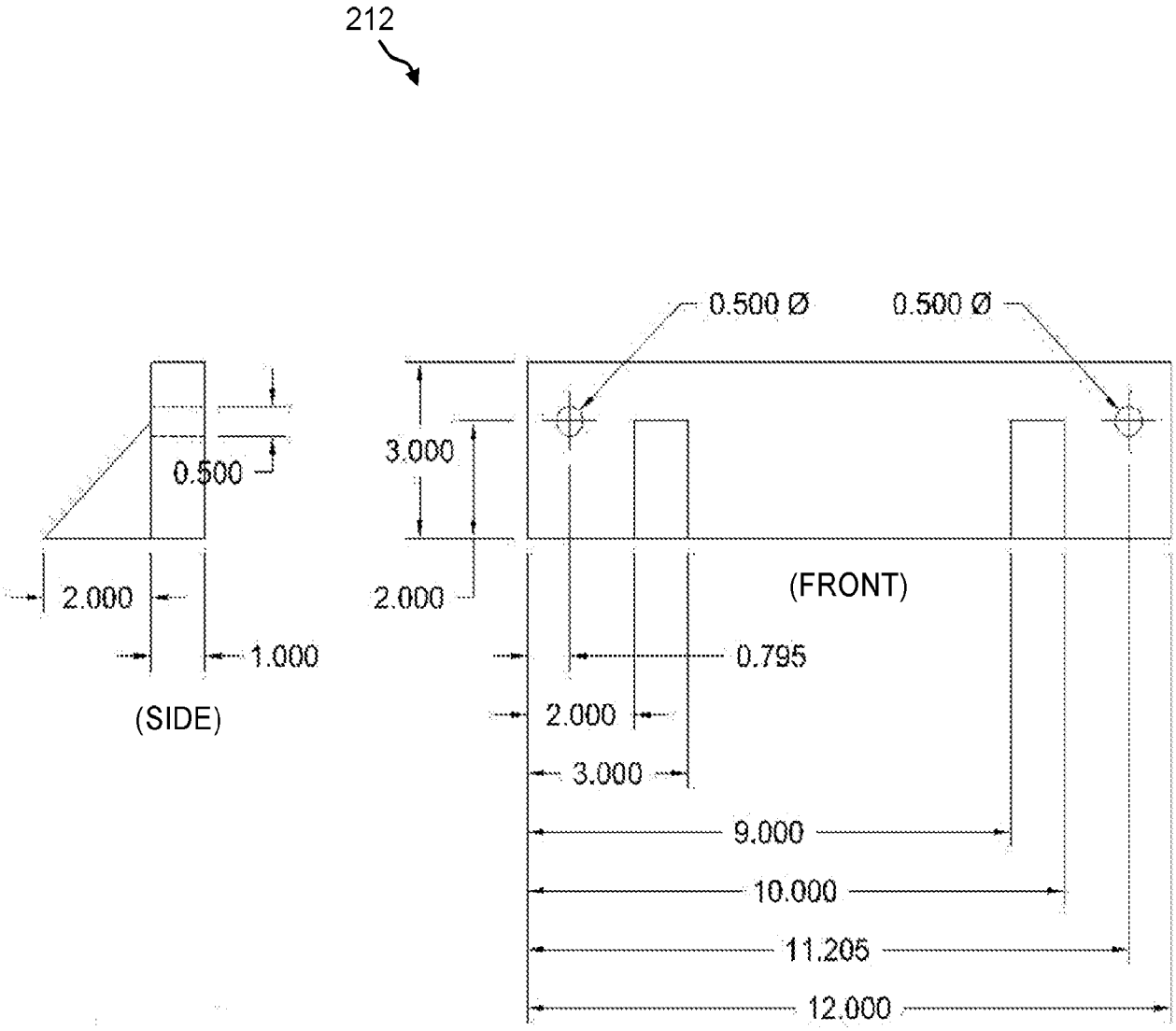

212
0.500 Ø
0.500 Ø
0.500
3.000
2.000
2.000
1.000
(SIDE)
(FRONT)
0.795
2.000
3.000
9.000
10.000
11.205
12.000

FIG. 9

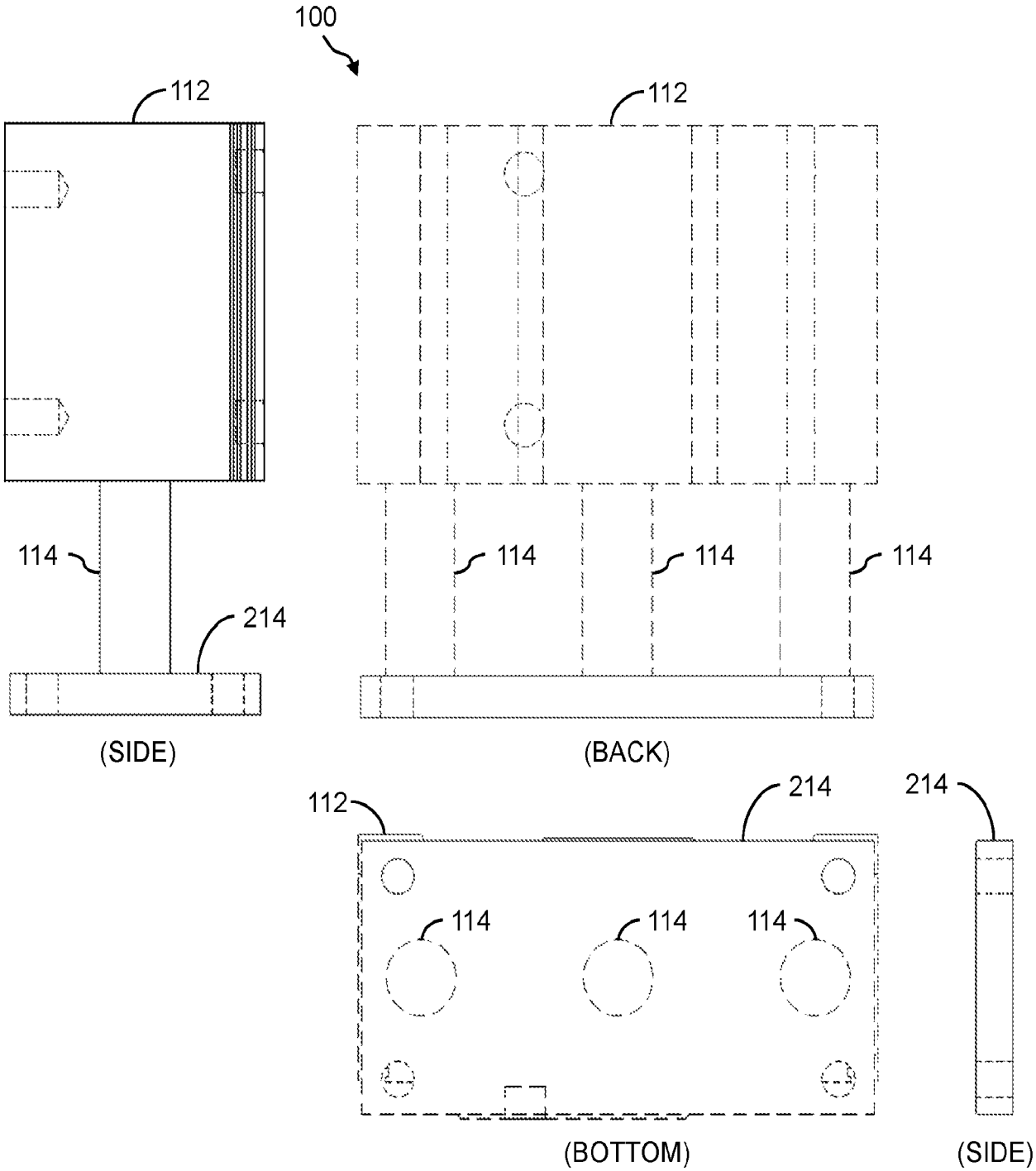

100
112
112
114
214
114
114
114
(SIDE)
(BACK)
112
214
214
114
114
114
(BOTTOM)
(SIDE)

FIG. 10

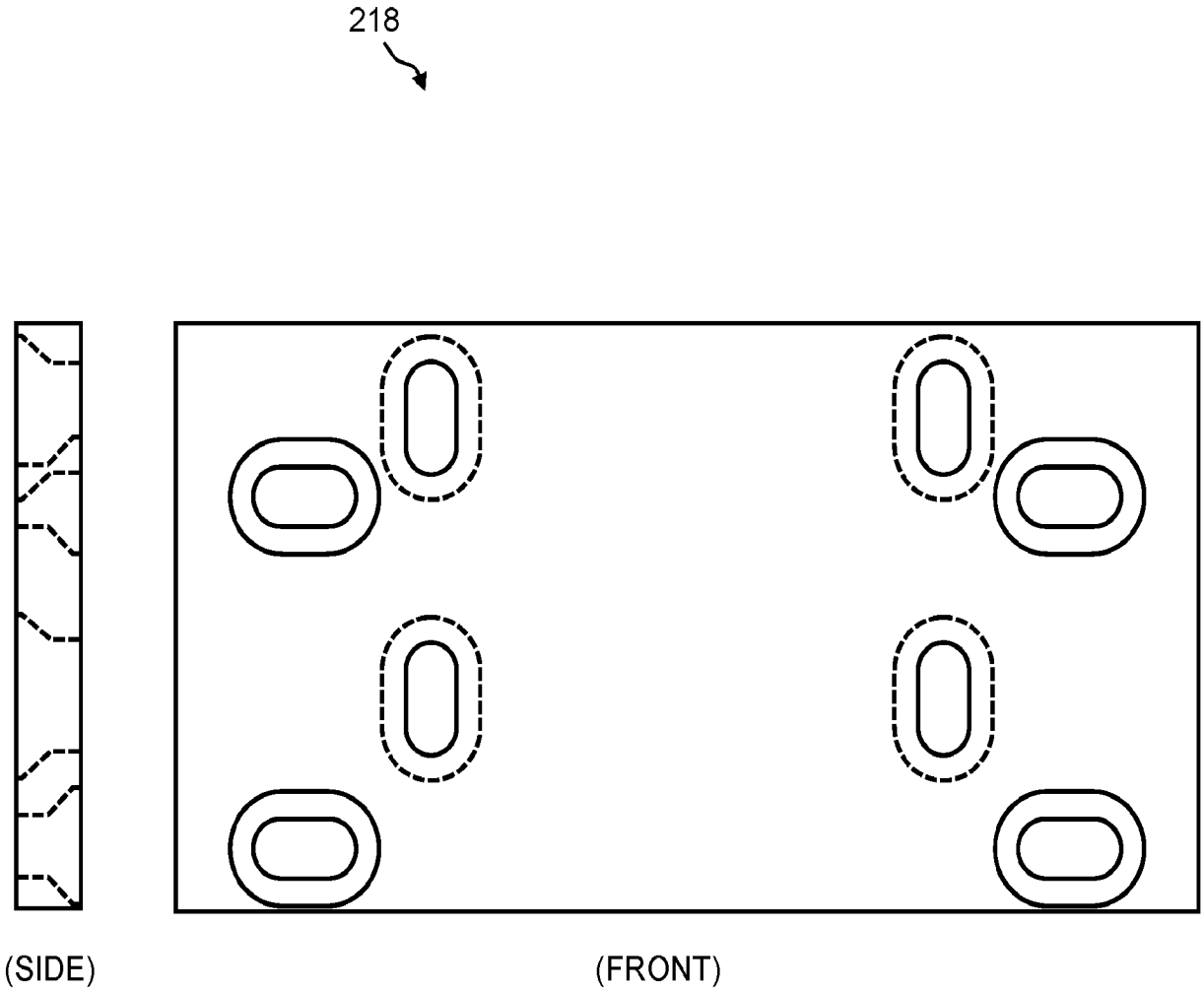


FIG. 11

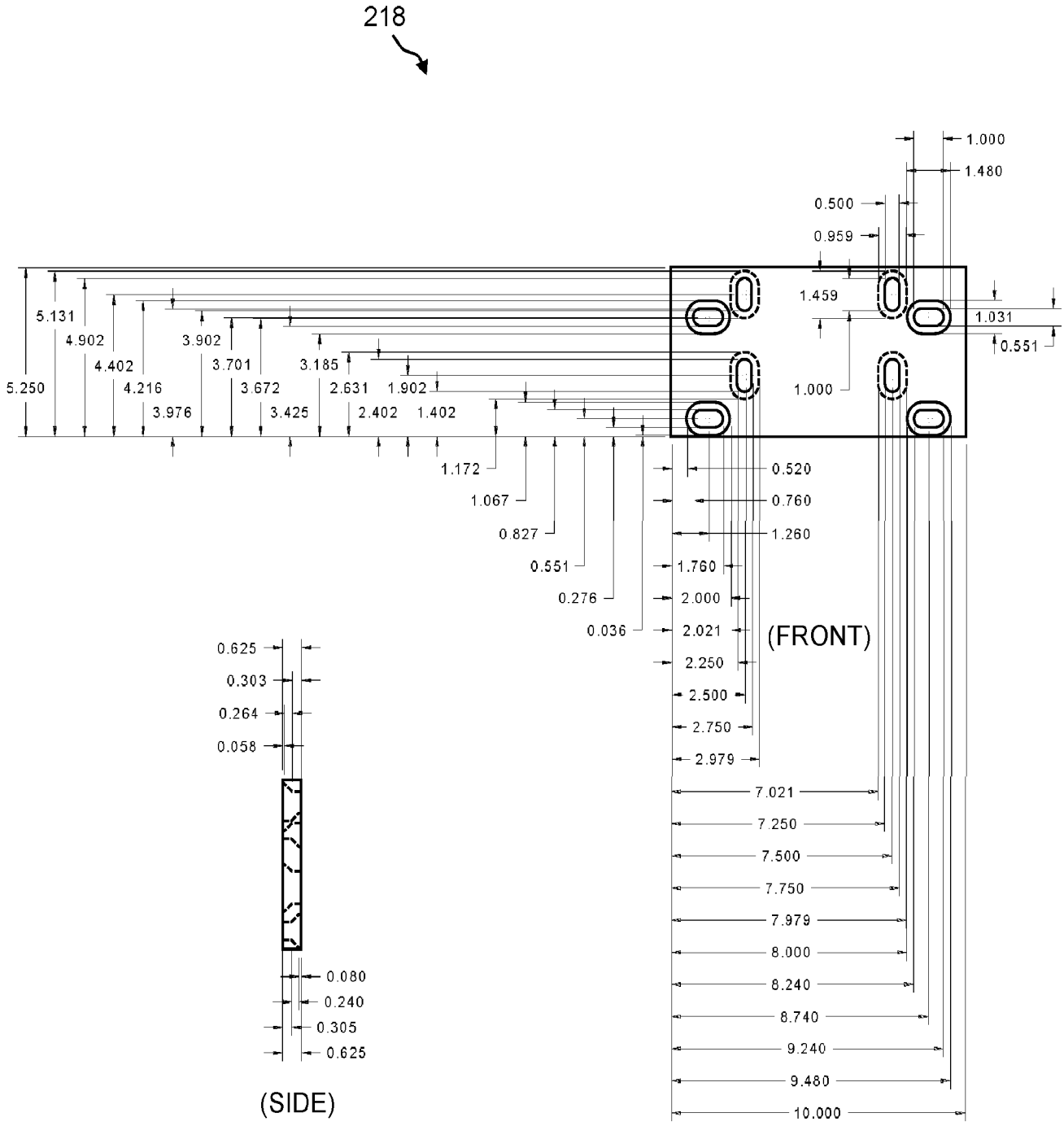
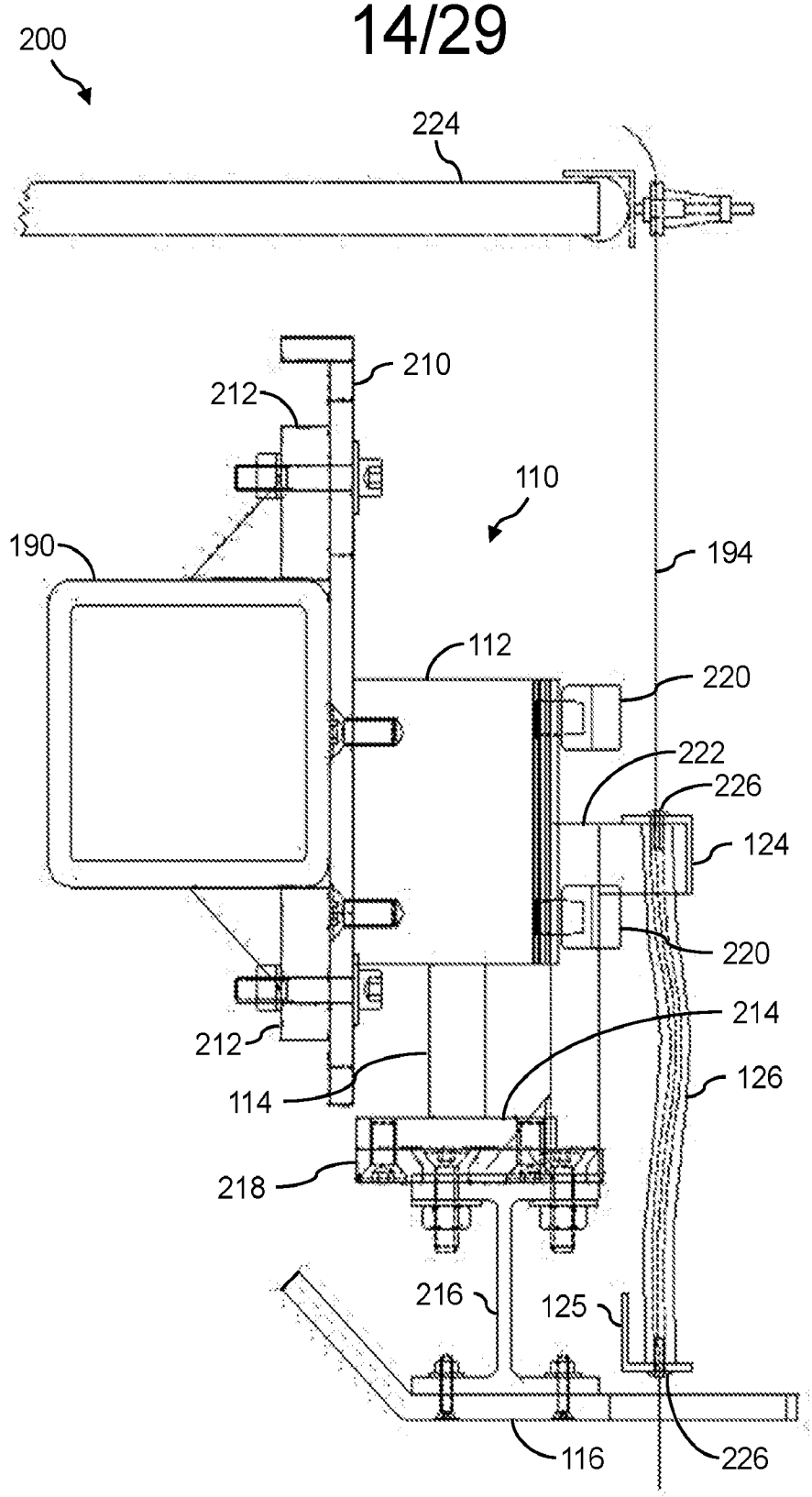

218
1.000
1.480
0.500
0.959
1.459
1.031
0.551
1.000
5.131
4.902
4.402
3.902
3.701
3.185
5.250
4.216
3.672
2.631
1.902
3.976
3.425
2.402
1.402
1.172
1.067
0.827
0.551
0.276
0.036
0.520
0.760
1.260
1.760
2.000
2.021
2.250
2.500
2.750
2.979
7.021
7.250
7.500
7.750
7.979
8.000
8.240
8.740
9.240
9.480
10.000
(FRONT)
0.625
0.303
0.264
0.058
0.080
0.240
0.305
0.625
(SIDE)

FIG. 12


200
224
210
212
110
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194
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226
124
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216
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116
226

FIG. 13

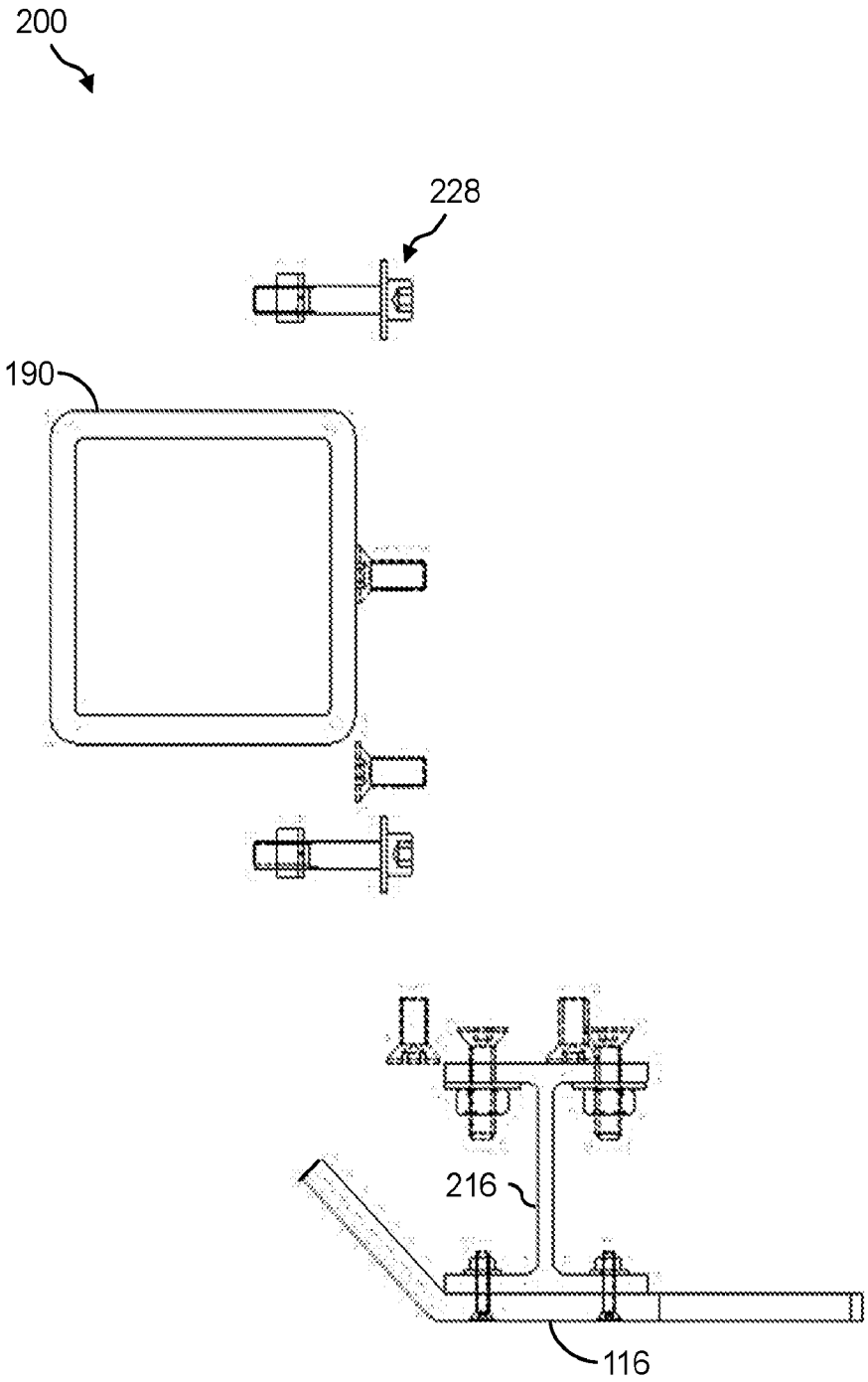
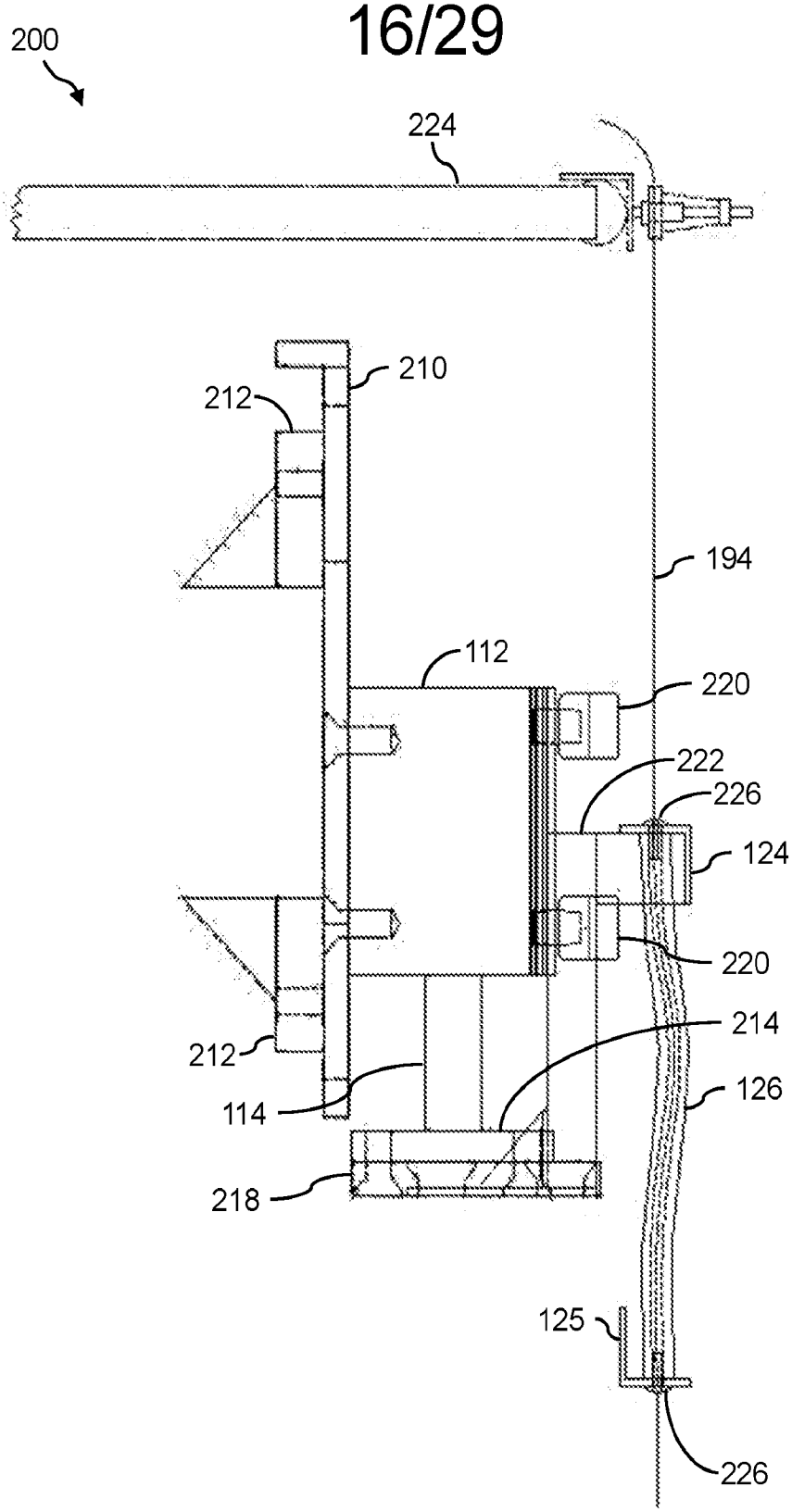


FIG. 14


200
224
210
212
194
112
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222
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124
220
214
212
126
114
218
125
226

FIG. 15

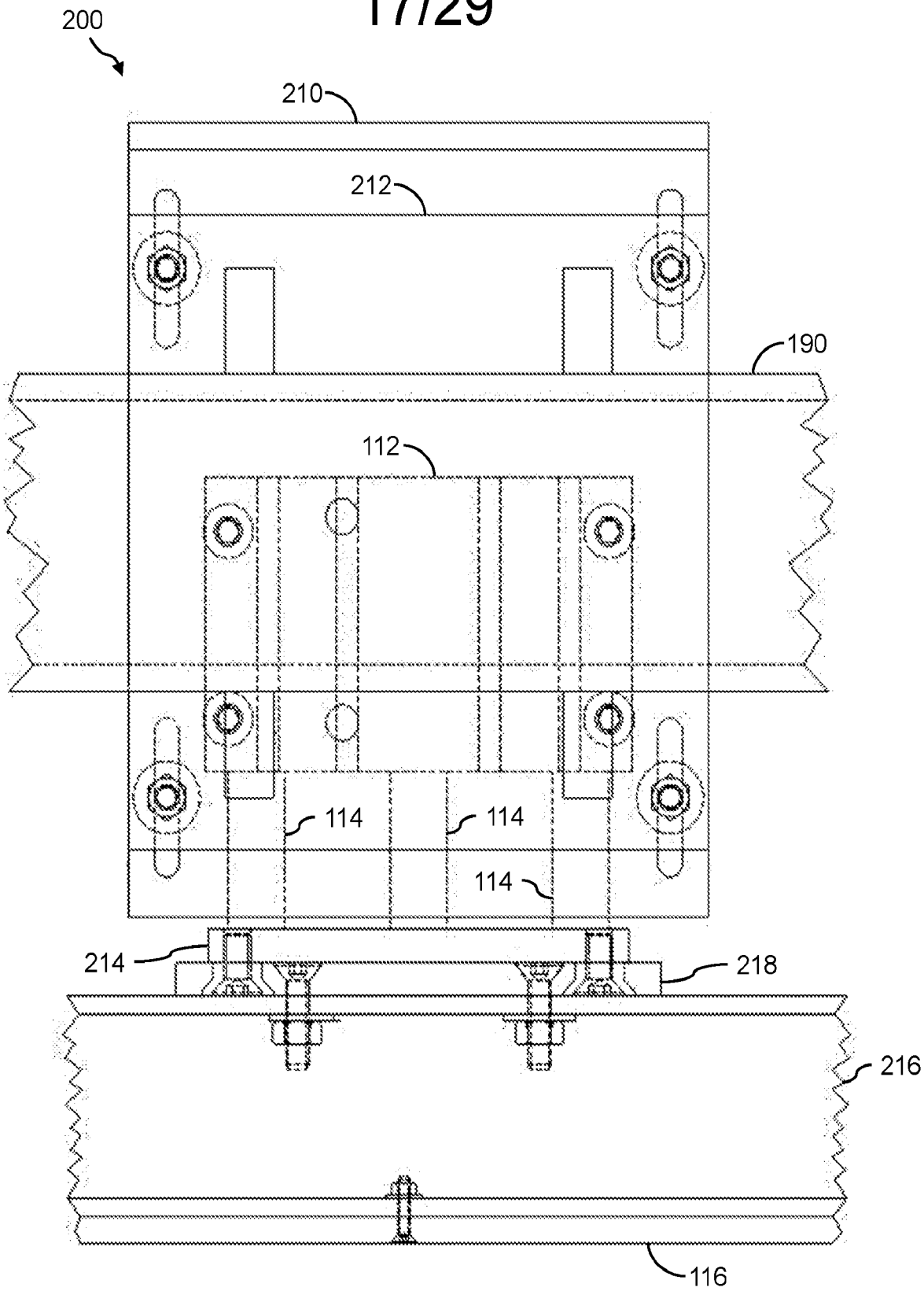

FIG. 16

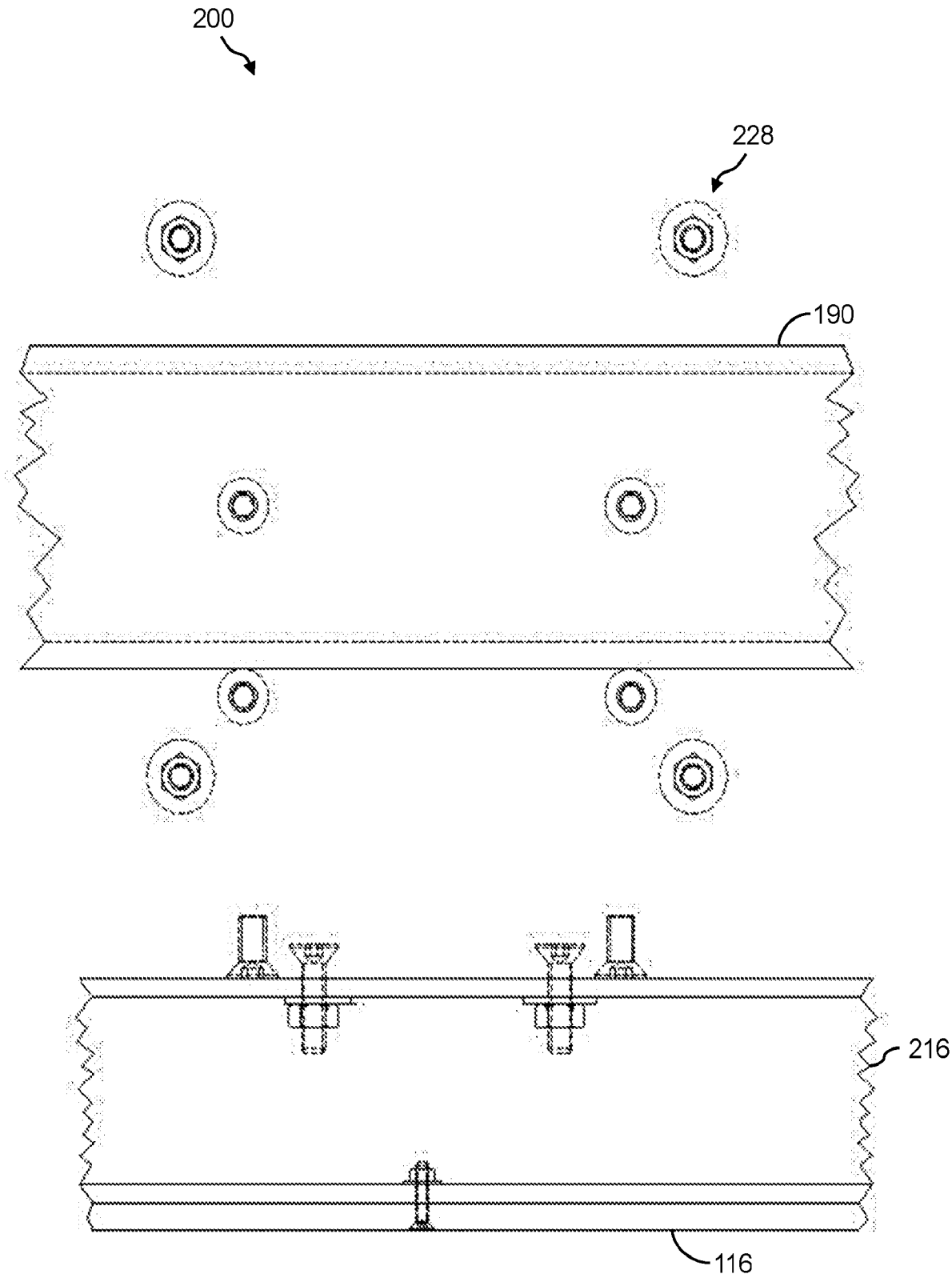

FIG. 17

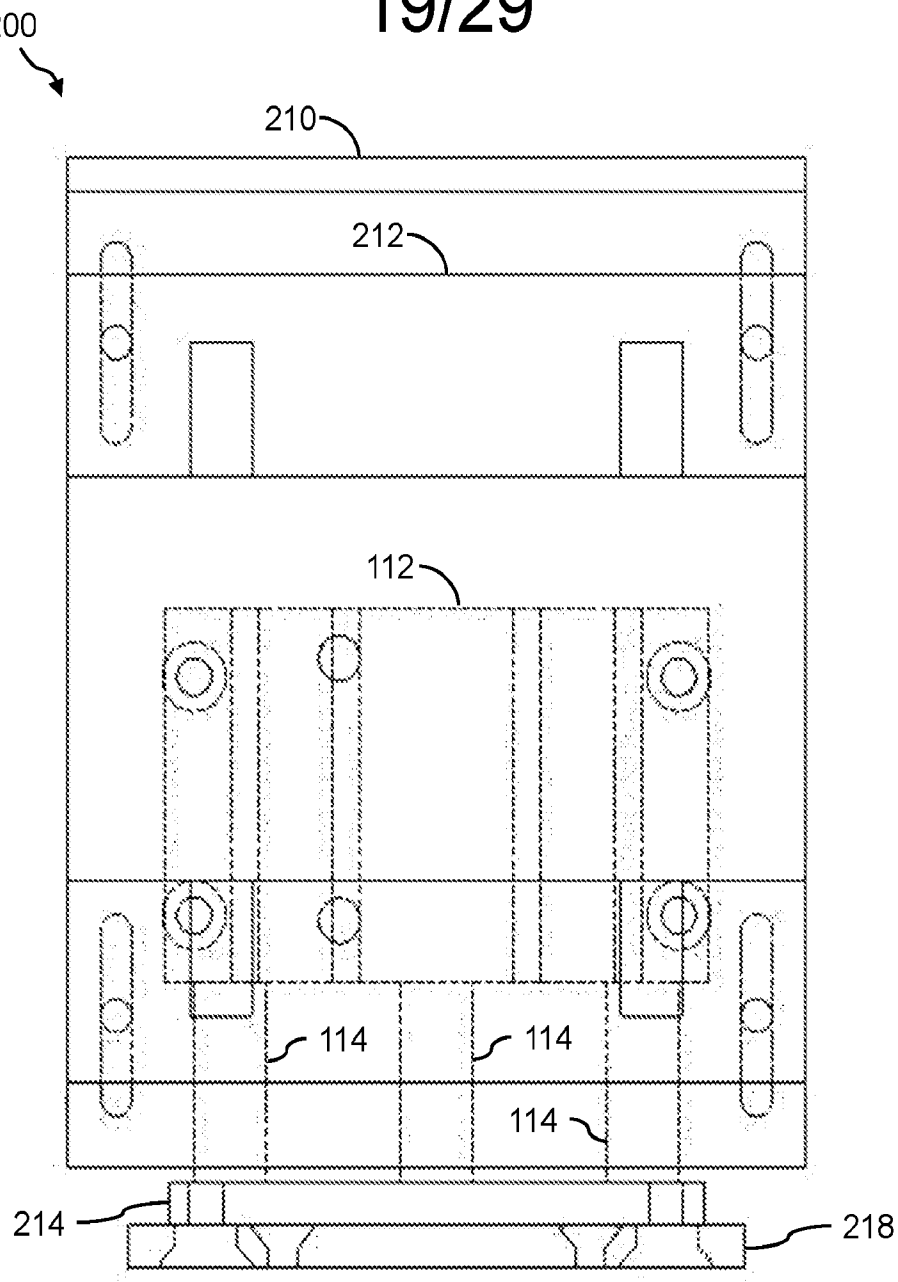

FIG. 18

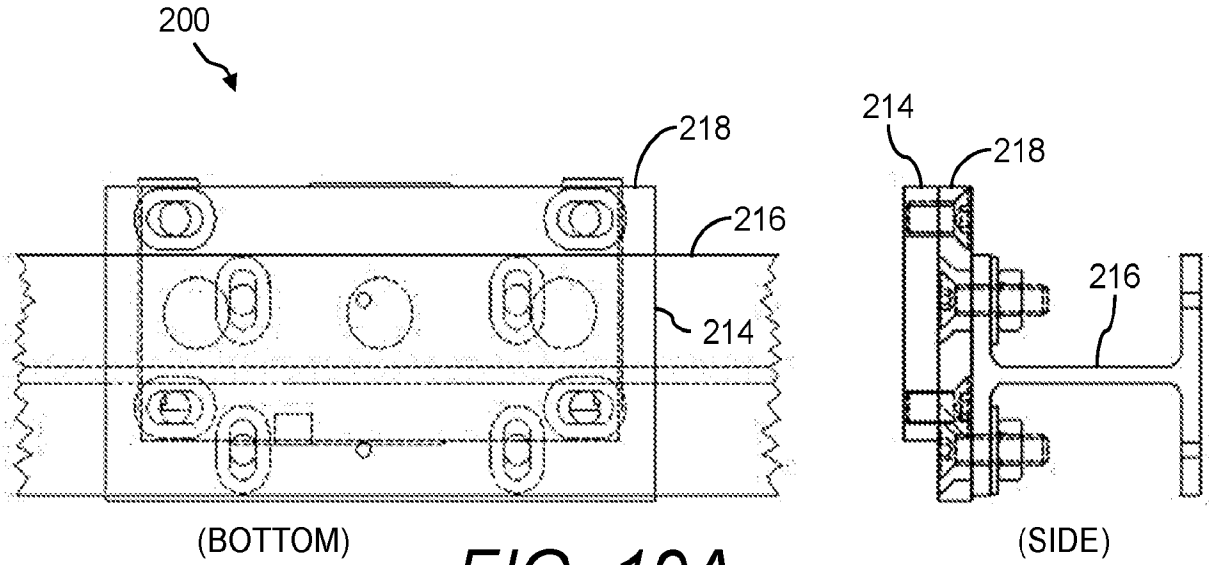

FIG. 19A

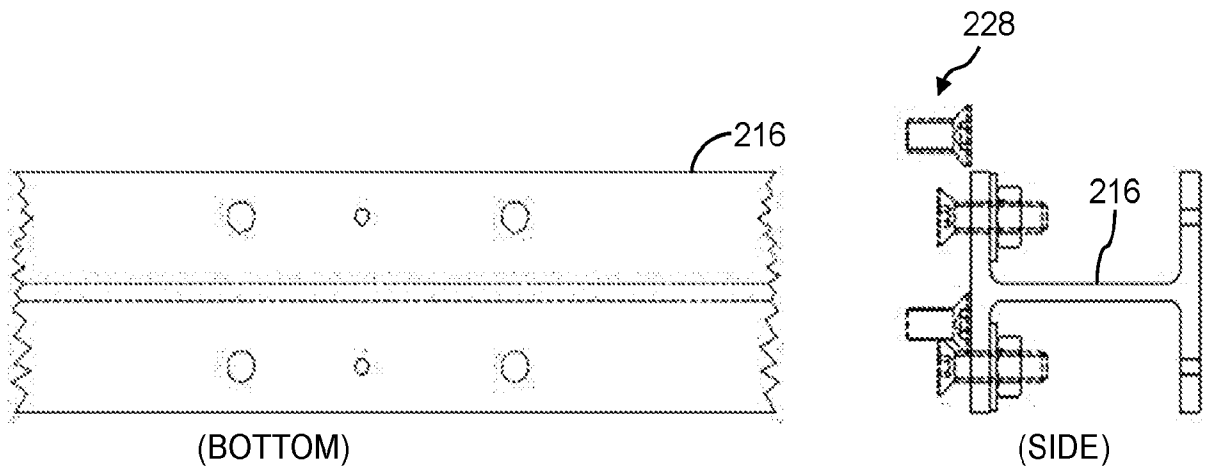

FIG. 19B

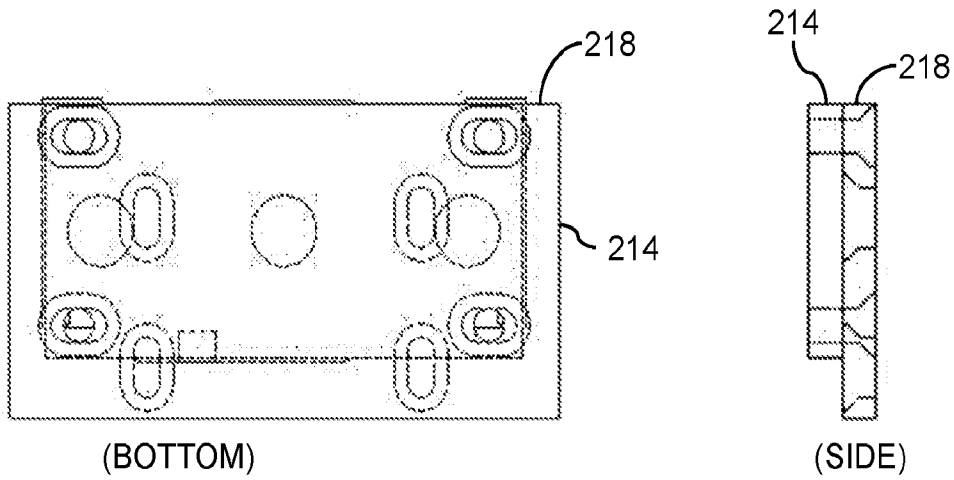

FIG. 19C

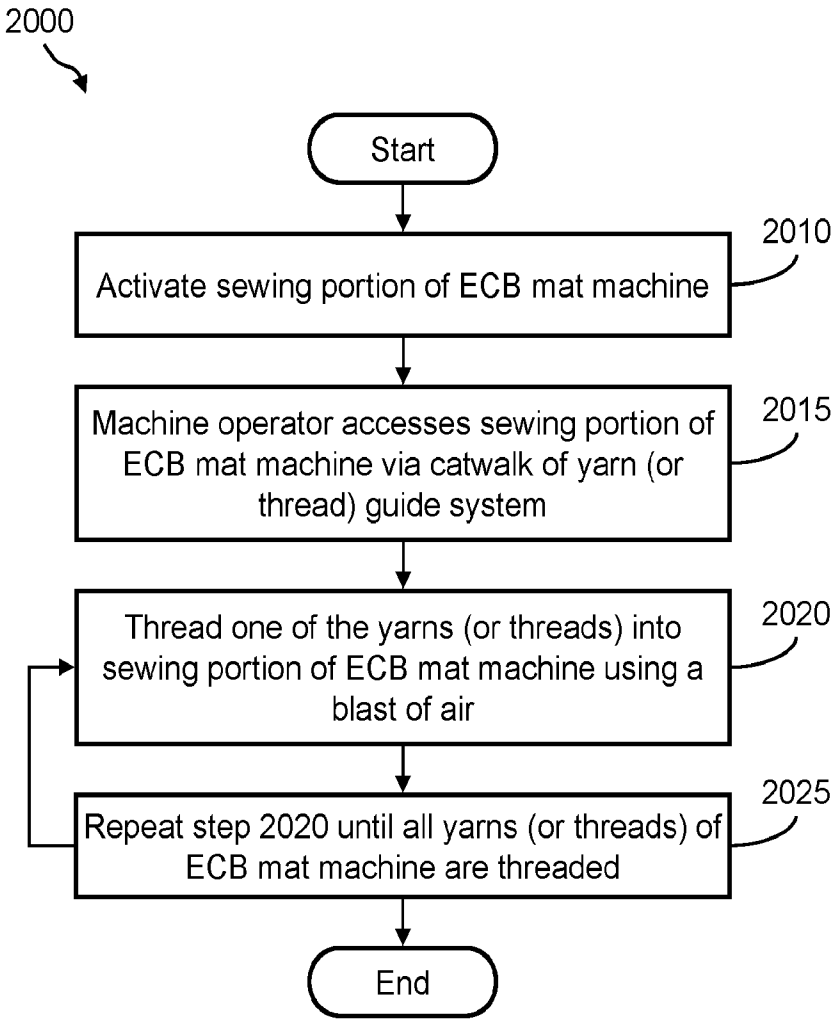
2000
Start
Activate sewing portion of ECB mat machine
2010
Machine operator accesses sewing portion of ECB mat machine via catwalk of yarn (or thread) guide system
2015
Thread one of the yarns (or threads) into sewing portion of ECB mat machine using a blast of air
2020
Repeat step 2020 until all yarns (or threads) of ECB mat machine are threaded
2025
End

FIG. 20

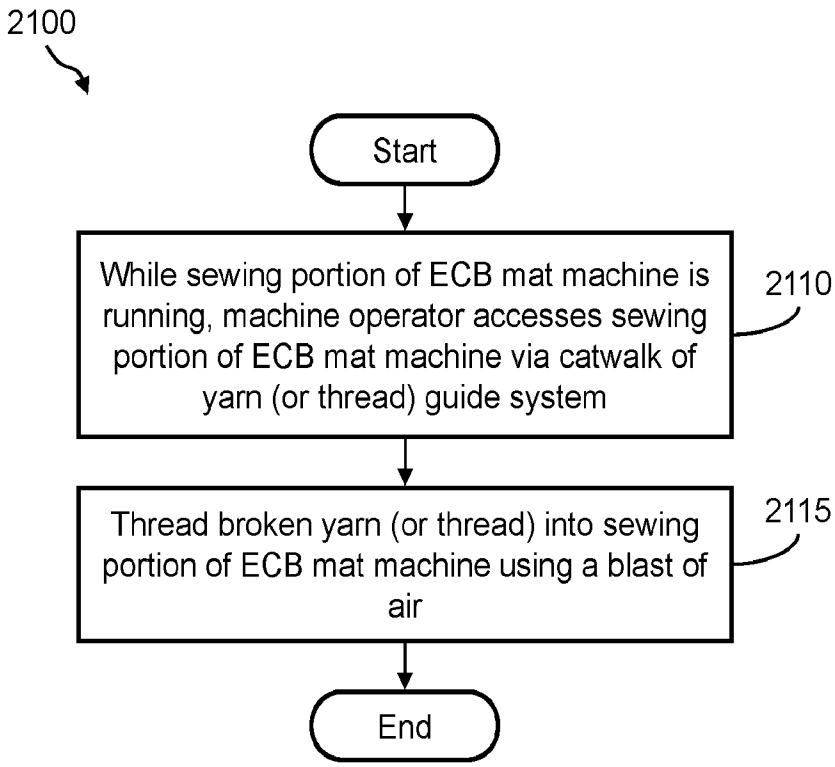
2100
Start
While sewing portion of ECB mat machine is running, machine operator accesses sewing portion of ECB mat machine via catwalk of yarn (or thread) guide system
2110
Thread broken yarn (or thread) into sewing portion of ECB mat machine using a blast of air
2115
End

FIG. 21

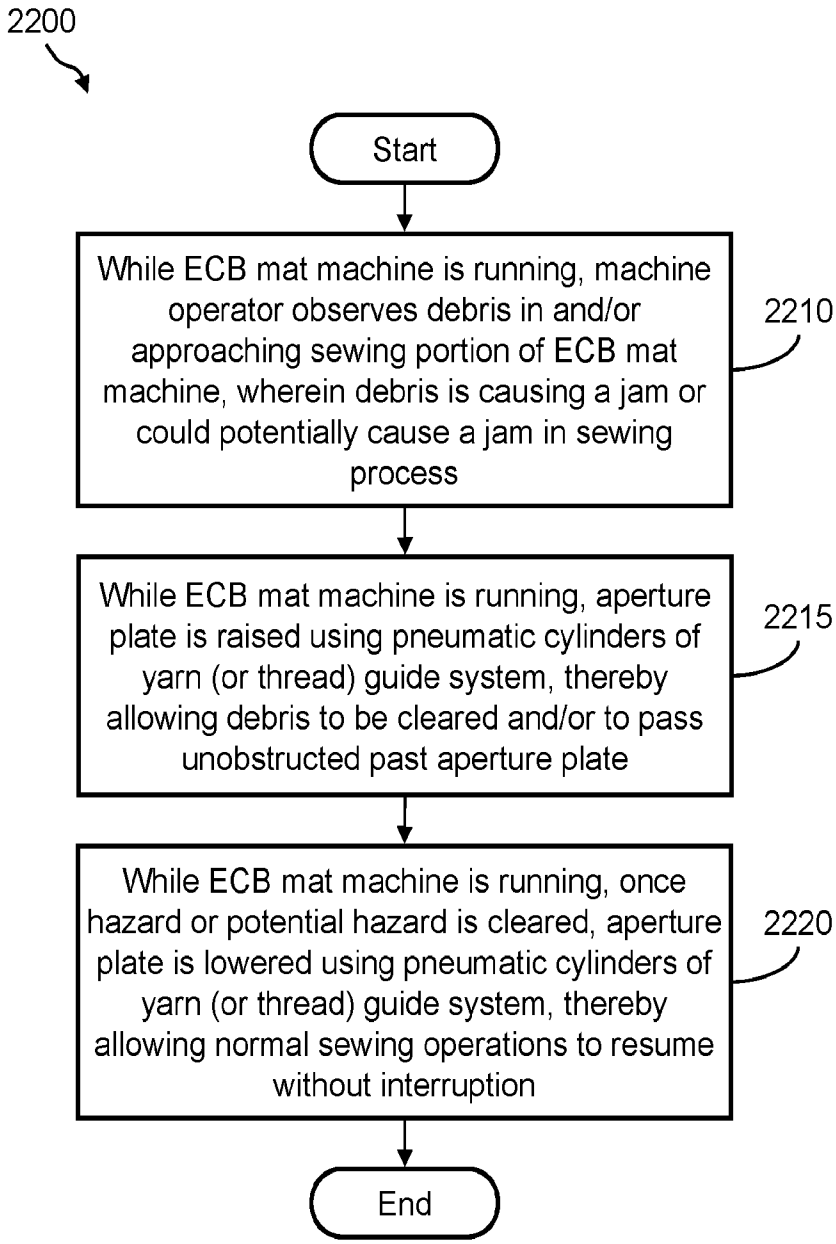
2200
Start
While ECB mat machine is running, machine operator observes debris in and/or approaching sewing portion of ECB mat machine, wherein debris is causing a jam or could potentially cause a jam in sewing process
2210
While ECB mat machine is running, aperture plate is raised using pneumatic cylinders of yarn (or thread) guide system, thereby allowing debris to be cleared and/or to pass unobstructed past aperture plate
2215
While ECB mat machine is running, once hazard or potential hazard is cleared, aperture plate is lowered using pneumatic cylinders of yarn (or thread) guide system, thereby allowing normal sewing operations to resume without interruption
2220
End

FIG. 22

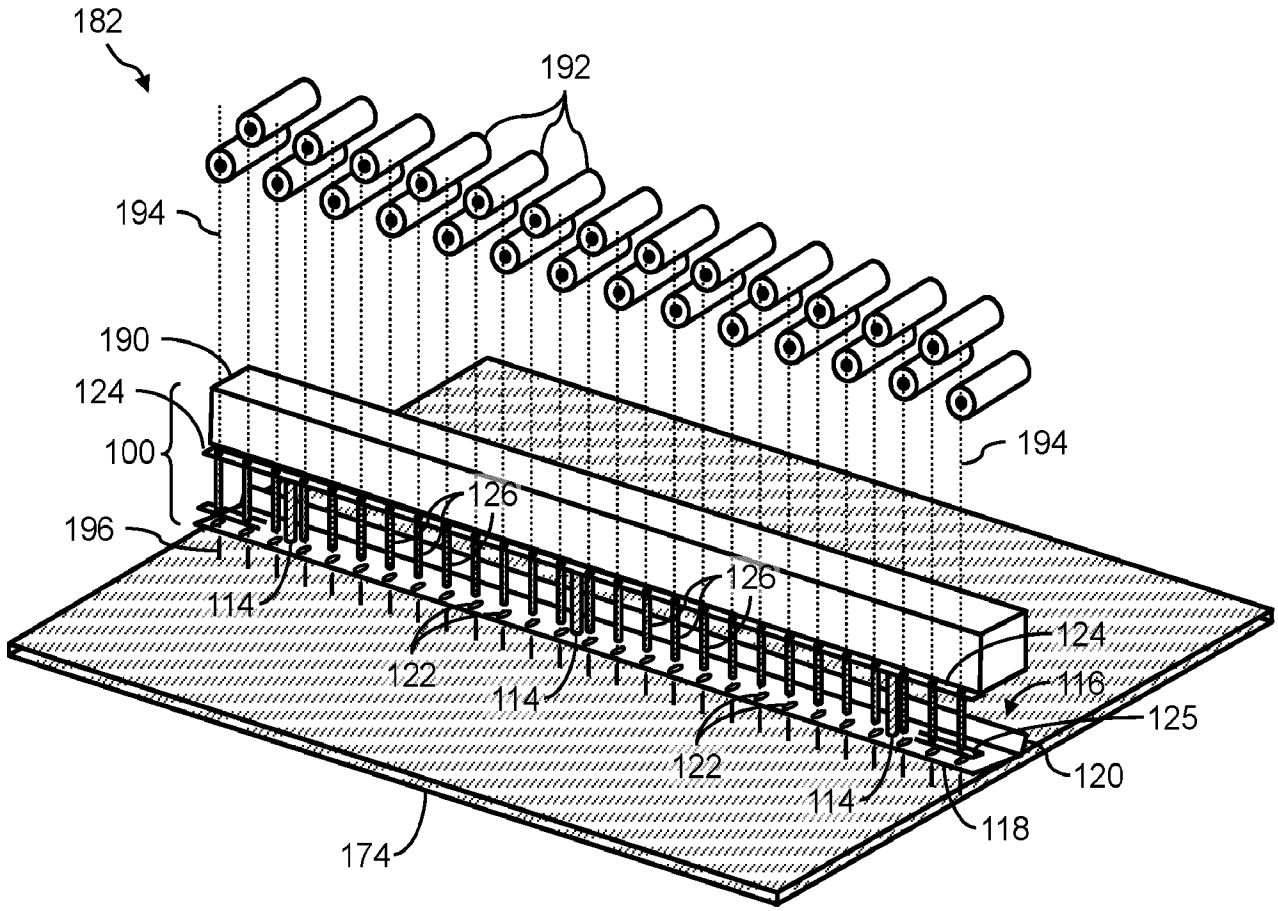
182
192
194
190
124
100
196
126
114
122
126
114
124
116
125
120
122
114
118
194
174

FIG. 23

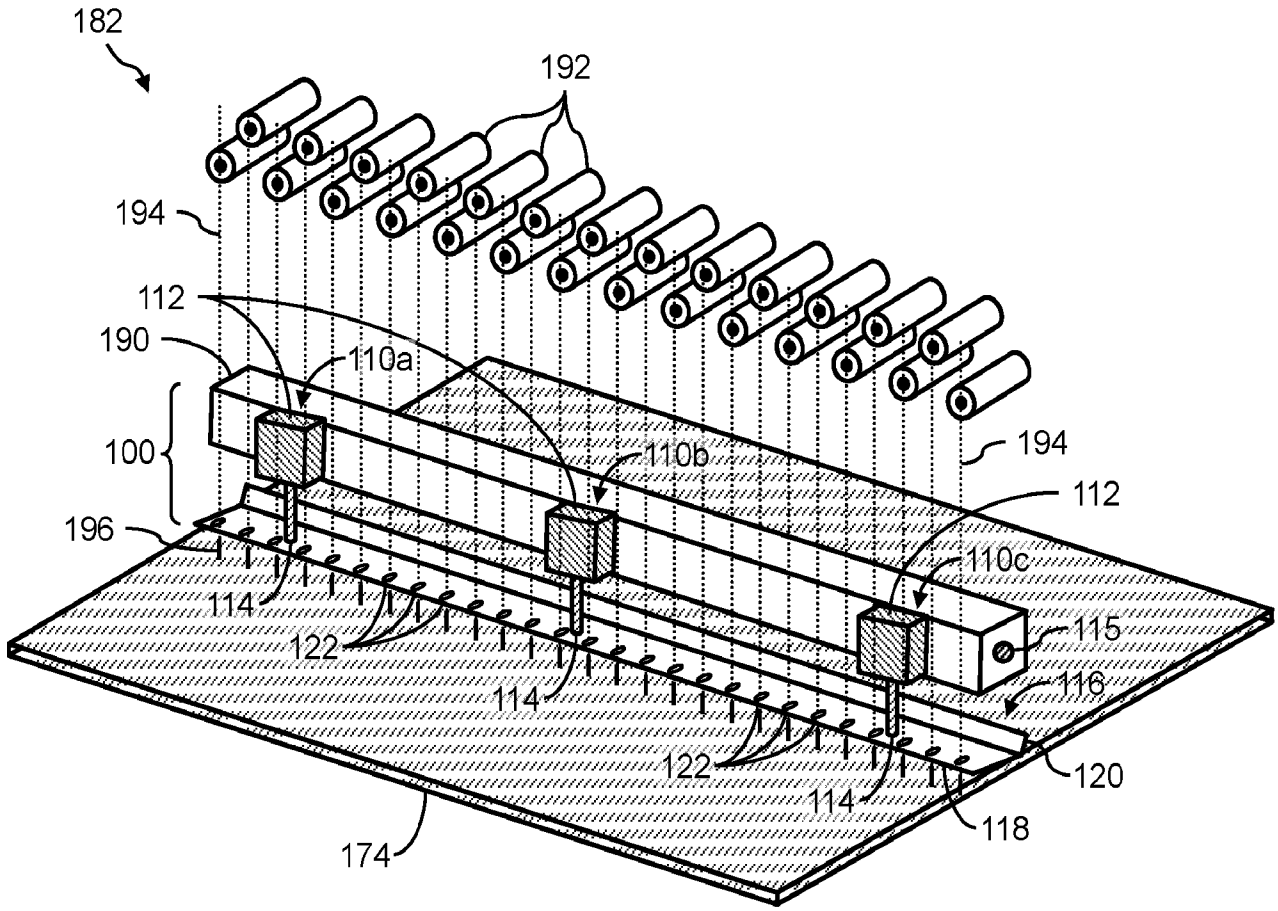
182
192
194
112
190
110a
100
110b
196
194
112
110c
114
122
115
116
114
122
120
114
118
174

FIG. 24

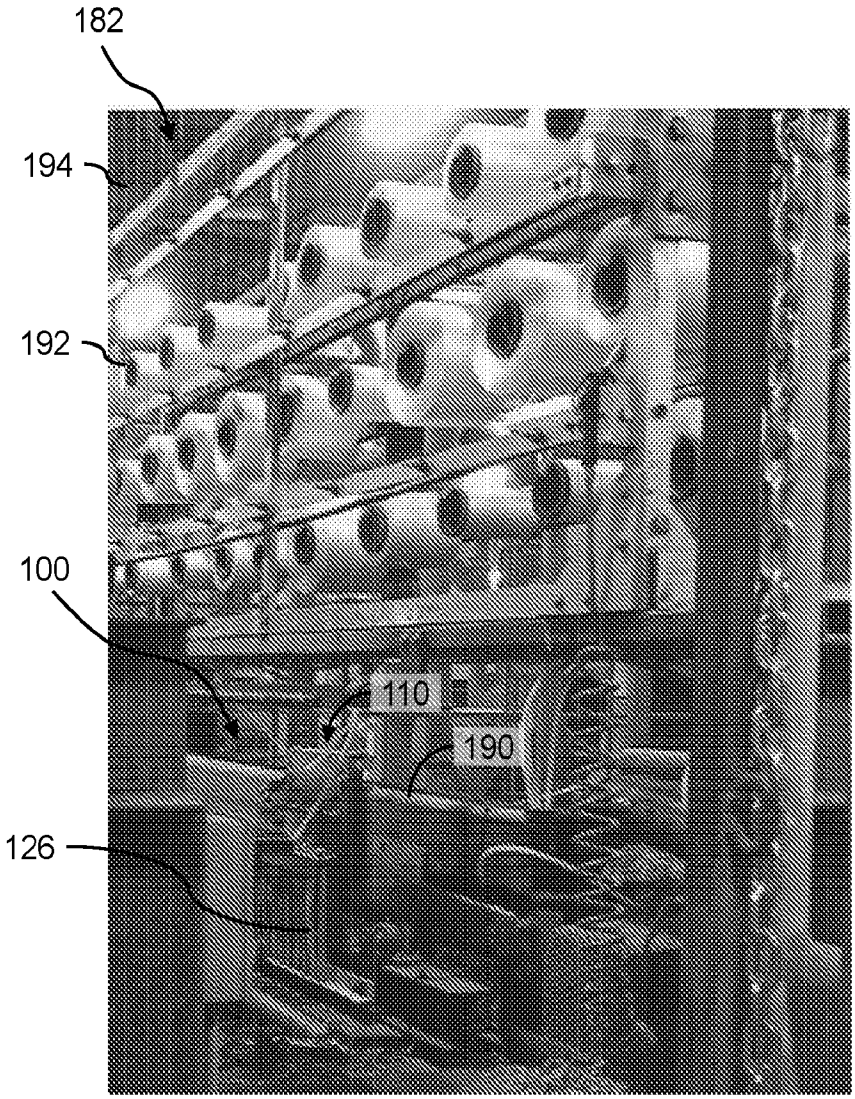

FIG. 25

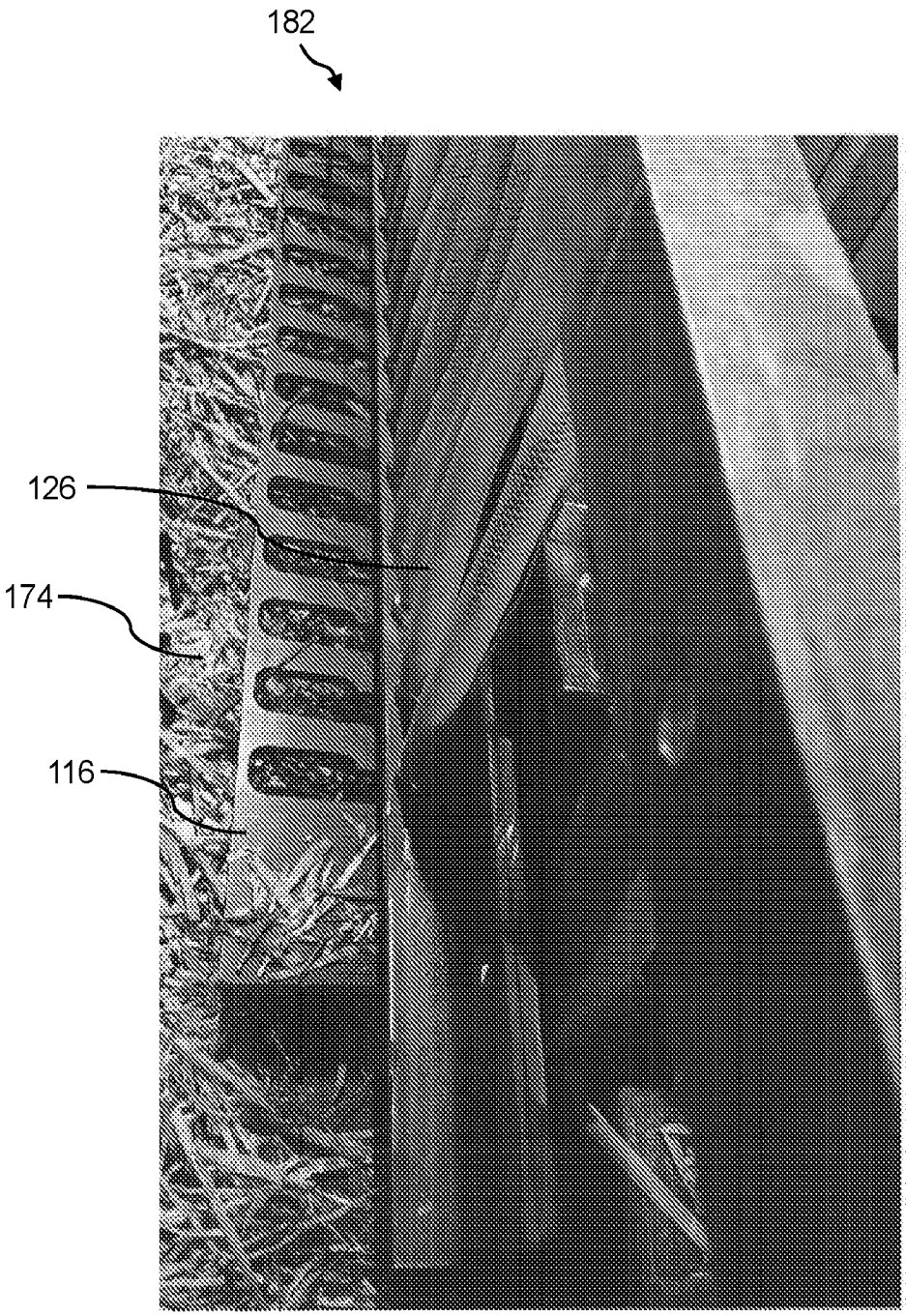

FIG. 26

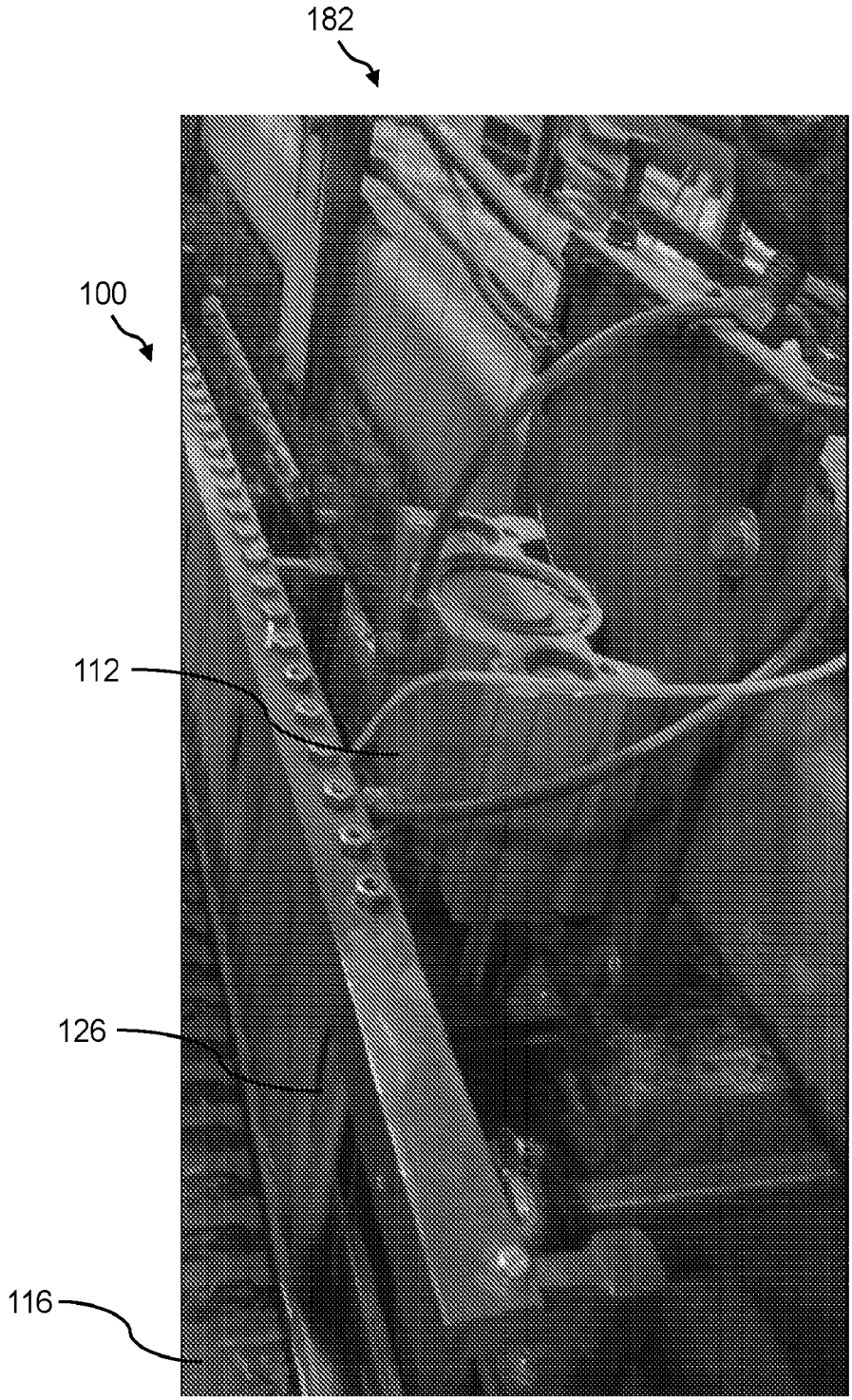

FIG. 27

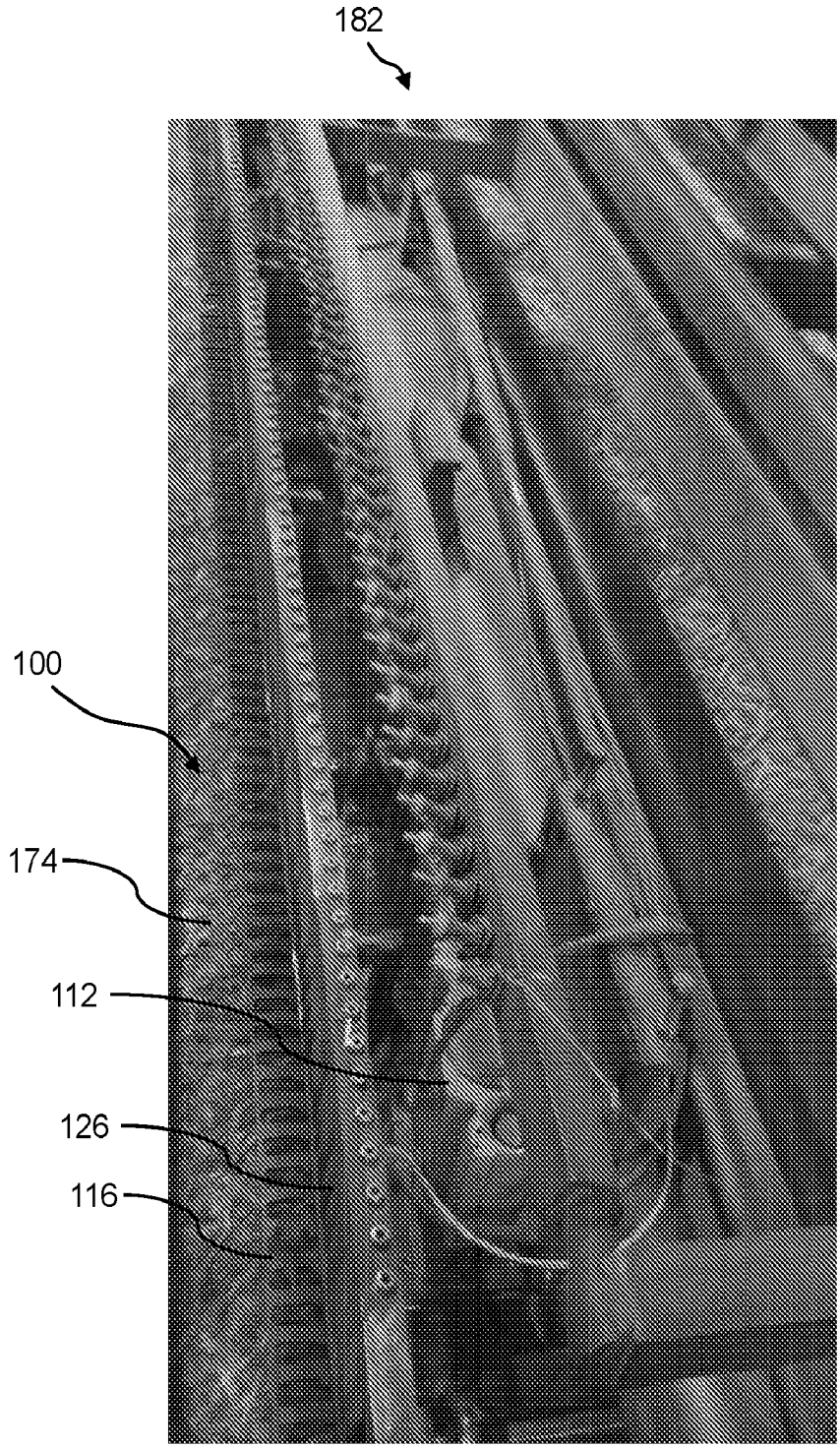

FIG. 28

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US17/49243

A. CLASSIFICATION OF SUBJECT MATTER

IPC - D05B 63/00, 87/00, 87/02; E02B 3/12; E02D 17/20 (2017.01)

CPC - D05B 63/00, 87/00, 87/02; E02B 3/12, 3/122, 3/123, 3/125, 3/126; E02D 17/20, 17/202

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)
See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3,824,939 A (SPANEL A. N. et al.) July 23, 1974; figures 1, 3-17; column 4, lines 50-67; column 5, lines 1-62	1, 4-6
A	US 3,937,158 A (SPANEL A. N.) February 10, 1976; entire document	1, 4-6
A	US 4,075,959 A (ZOCHER J.) February 28, 1978; entire document	1, 4-6
A	US 4,393,793 A (BEASLEY M. M.) July 19, 1983; entire document	1, 4-6

☐ 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 another 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
05 October 2017 (05.10.2017)	09 JAN 2018
Name and mailing address of the ISA/ Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US17/49243

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.:
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:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III 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:
-***-Please See Within the Next Supplemental Box-***-

1. ☐ As all required additional 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 additional fees, this Authority did not invite payment of additional fees.

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.:
1 AND 4-6

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/US17/49243

-***-Continued from Box No. III Observations where unity of invention is lacking-***-

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: Claims 1 AND 4-6 are directed toward a method and an apparatus for threading a fibrous material into an erosion control blanket, the method and the apparatus comprising: directing a flow of gas from a gas source under pressure into the guide tube.

Group II: Claims 2-3 AND 7-9 are directed toward a method and an apparatus for maintaining a substantially continuous material-fastening operation for an erosion control blanket comprising: an aperture plate in communication with the thread guide system; at least one pneumatic cylinder in communication with the aperture plate; and v. an actuator valve in communication with the pneumatic cylinder.

The inventions listed as Groups I-II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Group I include a method and an apparatus for threading a fibrous material into an erosion control blanket, the method and apparatus comprising: a. positioning a guide system at a predetermined location, said guide system comprising a plurality of guide tubes, each guide tube comprising a first guide tube end and a second guide tube end; b. directing a first end of a substantially continuous fibrous material to a first end of a guide tube; c. directing a flow of gas from a gas source under pressure into the guide tube; d. positioning a needle proximate to the second end of the guide tube; and f. directing the leading end of the fibrous material to a predetermined location on the erosion control blanket, which are not present in Group II.

Group II include a method and an apparatus for maintaining a substantially continuous material-fastening operation for an erosion control blanket comprising: a. providing a lifter assembly to a threading apparatus, said lifter assembly comprising: iii. an aperture plate in communication with the thread guide system; iv. at least one pneumatic cylinder in communication with the aperture plate; and v. an actuator valve in communication with the pneumatic cylinder; b. detecting debris located proximate to the aperture plate; c. actuating the actuating valve and the pneumatic cylinder; d. moving the aperture plate from a first position adjacent to the erosion control blanket to a second position, said second position a predetermined distance from the erosion control blanket; and e. re-actuating the actuating valve and the pneumatic cylinder to return the aperture plate to the first position adjacent to the erosion control blanket, which are not present in Group I.

The common technical features of Groups I and II are a method and apparatus for threading a fibrous material into an erosion control blanket, the method and apparatus comprising: providing a thread guide system; providing at least one needle in communication with the thread guide system, said needle engaging/receiving a leading end of a fibrous material.

These common technical features are disclosed by US 3,824,939 A (SPANEL). Spanel discloses a method and apparatus for threading a fibrous material into an erosion control blanket (method and apparatus for implanting yarn into backing material B, i.e., configured for implanting yarn into an erosion control blanket; abstract; figure 1 and 3-17; column 5, lines 43-45), the method and apparatus comprising: providing a thread guide system (32, 34, collectively; figure 1); providing at least one needle (22) in communication with the thread guide system (needle 22 receives yarn that has passed through Venturi block 32 and tubes 34; figure 1; column 4, line 50 – column 5, line 10), said needle engaging/receiving a leading end of a fibrous material (the first end of the yarn is threaded through the eye 24 of the needle 22 as shown; figures 1, 3-6; column 5, lines 43-65).

Since the common technical features are previously disclosed by the Spanel reference, the common features are not special and so Groups I and II lack unity.