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Adkins et al.

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(54) **BRACE ASSEMBLY FOR A GEOSYNTHETIC WRAPPED SYSTEM USED TO CONSTRUCT STABILIZED EARTH WALLS AND SLOPES**

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E02D 17/20 (2006.01)
E02D 29/02 (2006.01)

(52) **U.S. Cl.**

CPC ***E02D 17/202*** (2013.01); *E02D 2300/0015* (2013.01); *E02D 2300/0087* (2013.01); *E02D 2600/20* (2013.01); *E02D 2600/40* (2013.01)

(58) **Field of Classification Search**

CPC E02D 17/202; E02D 29/0225; E02D 29/0241; E02D 2300/0015; E02D 2300/0087; E02D 2600/20; E02D 2600/40

See application file for complete search history.

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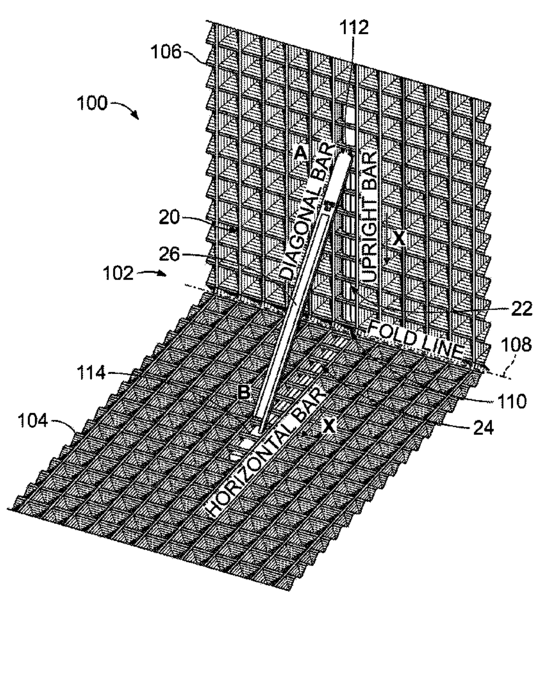
(57) **ABSTRACT**

A bracing assembly for a geosynthetic wrapped system is provided. The bracing assembly includes a standing brace bar, a bottom brace bar, and a cross brace bar having different configurations to facilitate both easy and mistake free assembly of the bracing assembly. Furthermore, the standing brace bar and the bottom brace bar include guide tips that are sized and shaped to direct insertion of the standing brace bar and the bottom brace bar respectively into a weave of a geotextile fabric material such that a first connector of the bottom brace bar and a first connection slot of the standing brace bar are aligned together and with a fold line of the geotextile fabric material.

2 Claims, 11 Drawing Sheets



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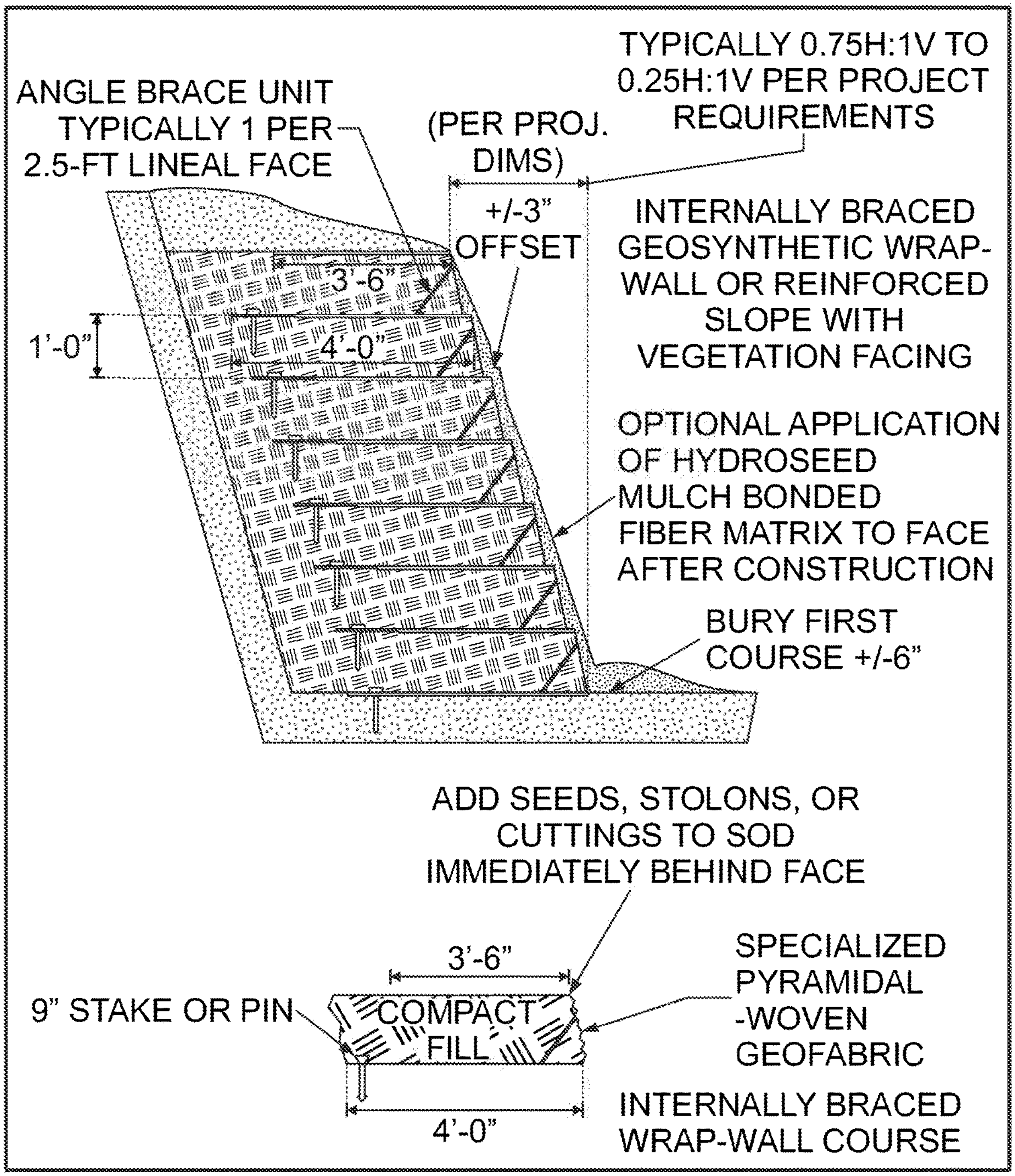

FIG. 1
(PRIOR ART)

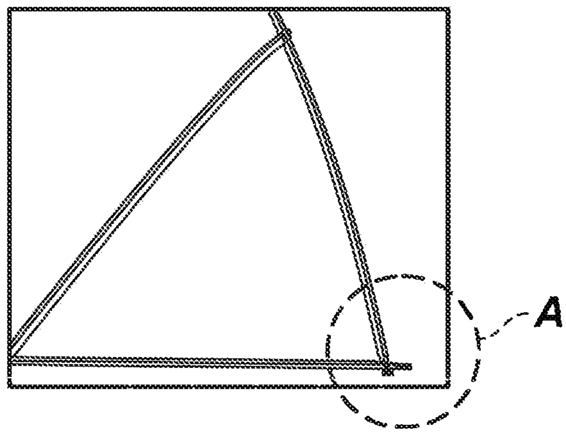

FIG. 2
(PRIOR ART)

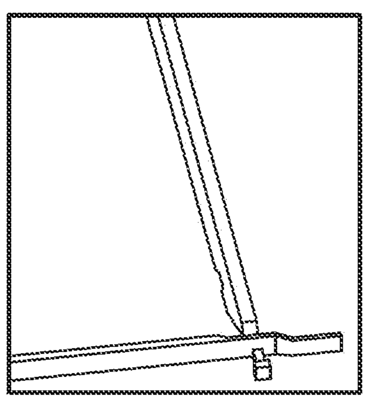

FIG. 3
(PRIOR ART)

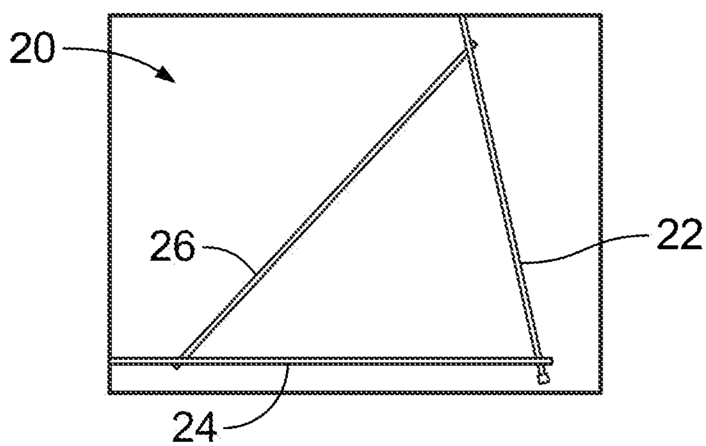

FIG. 4

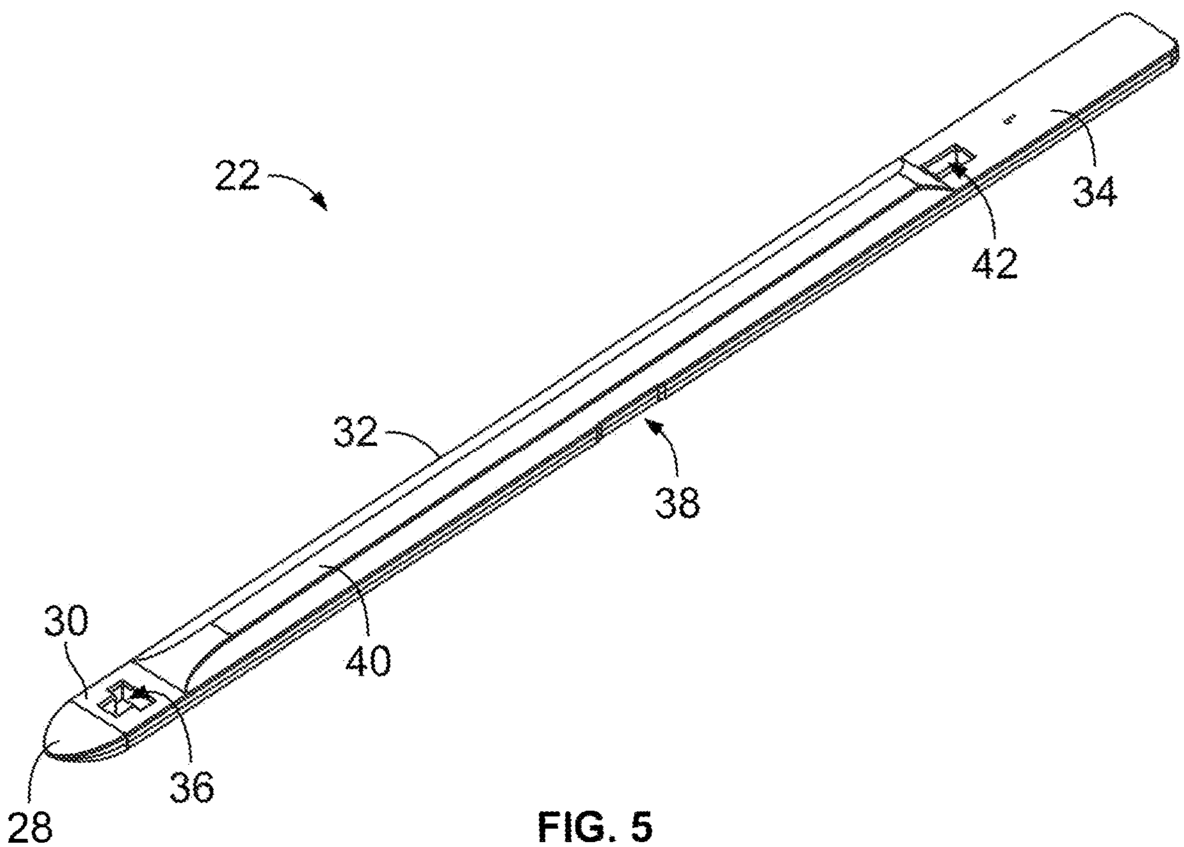

FIG. 5

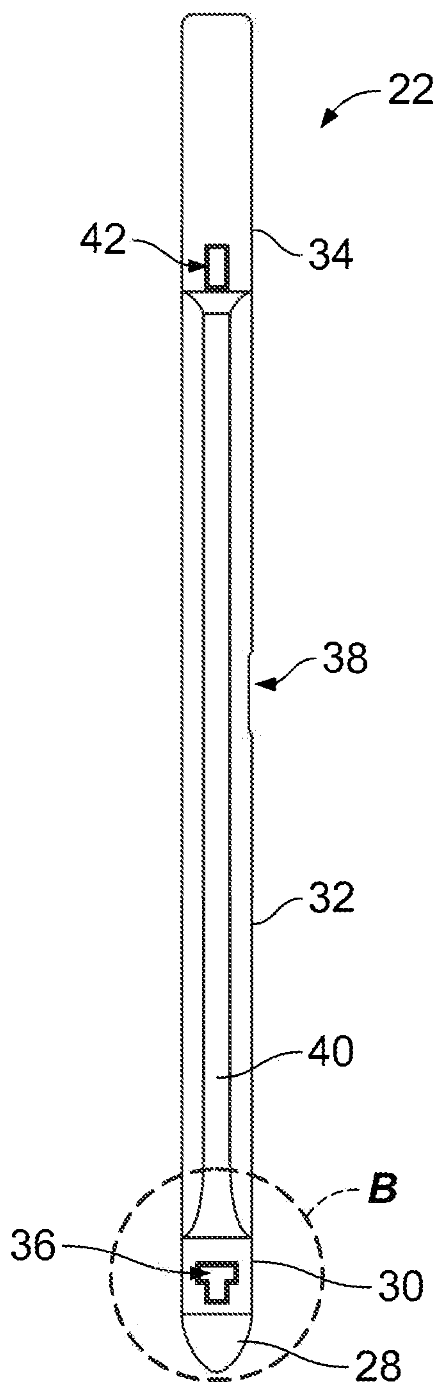

FIG. 6

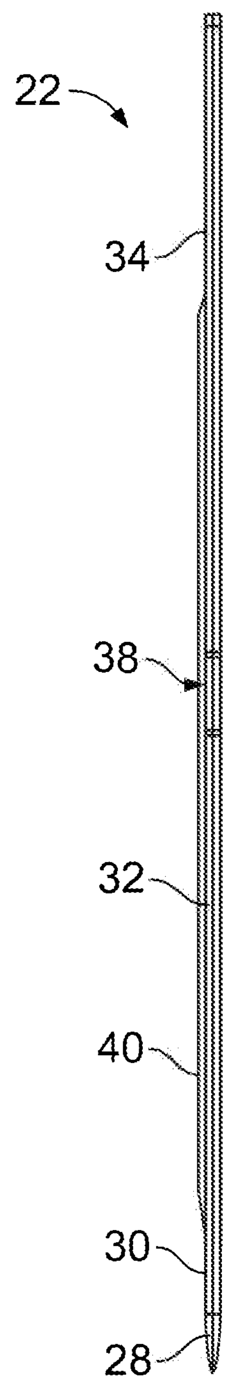

FIG. 7

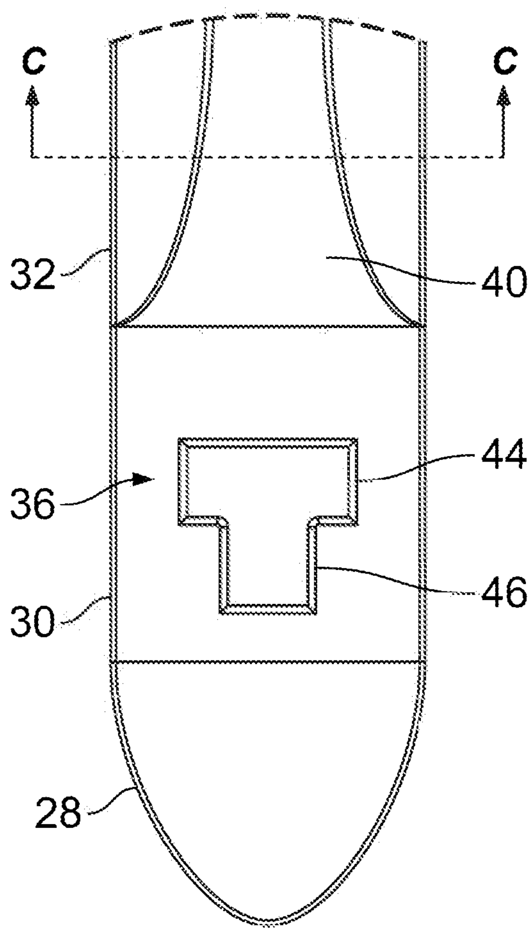

FIG. 8

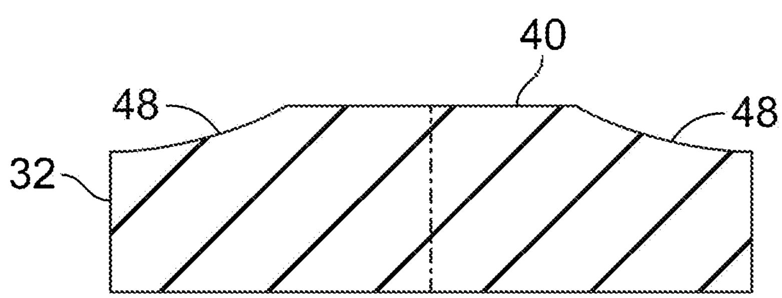

FIG. 9

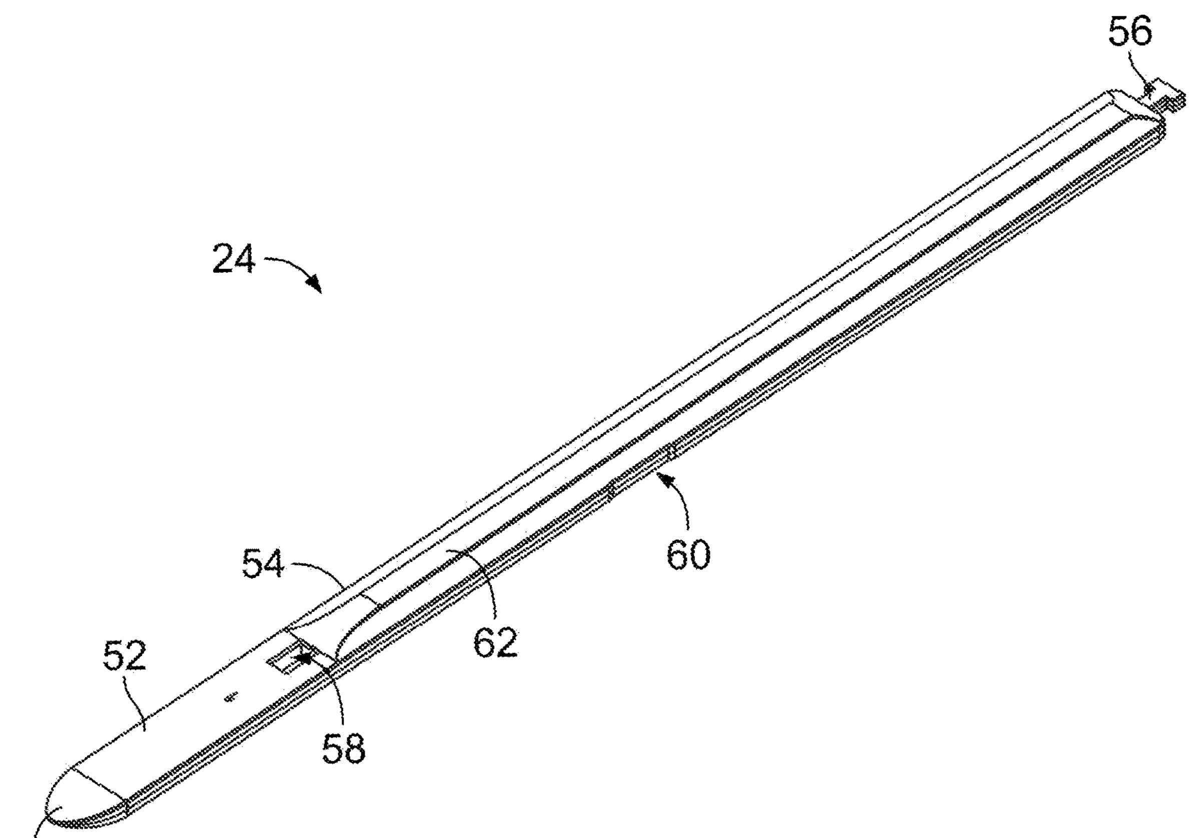

FIG. 10

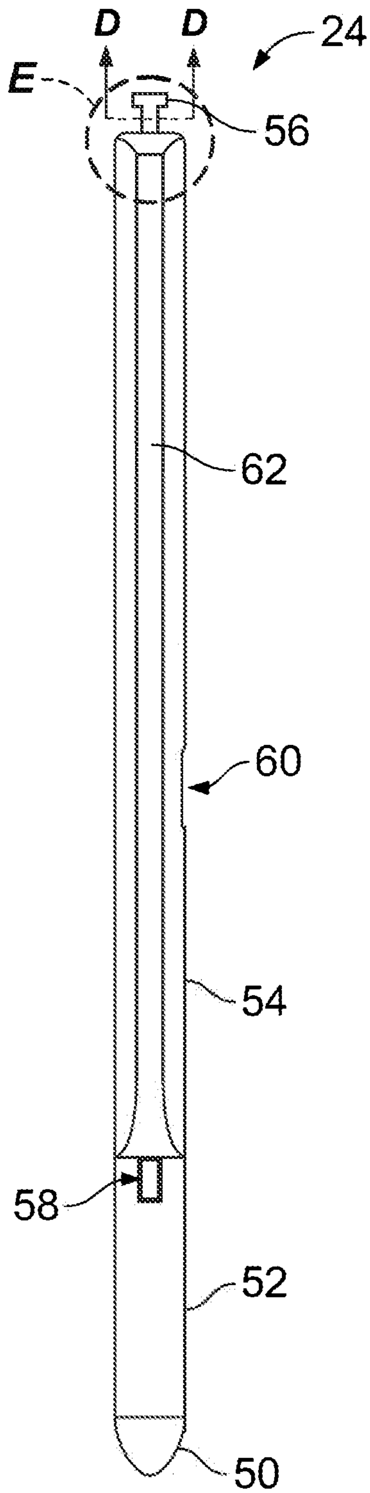

FIG. 11

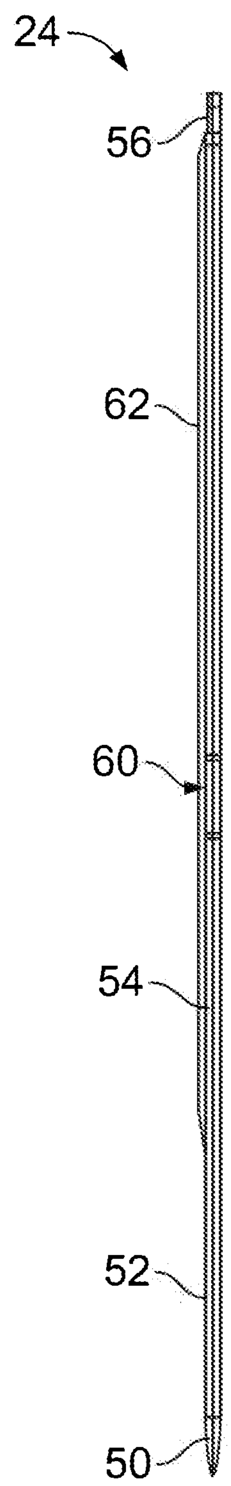

FIG. 12

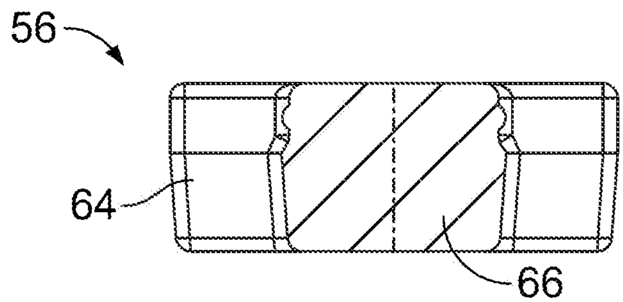

FIG. 13

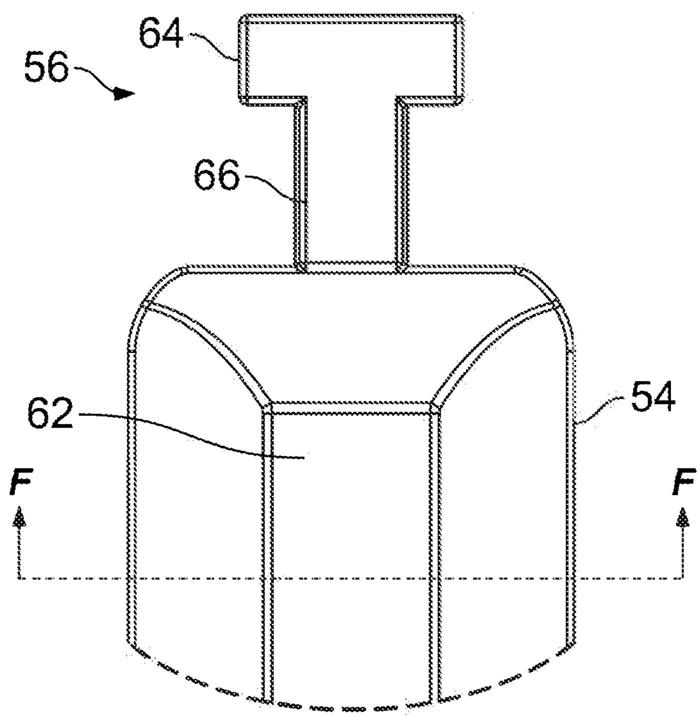

FIG. 14

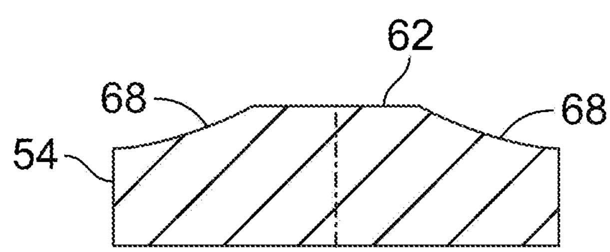

FIG. 15

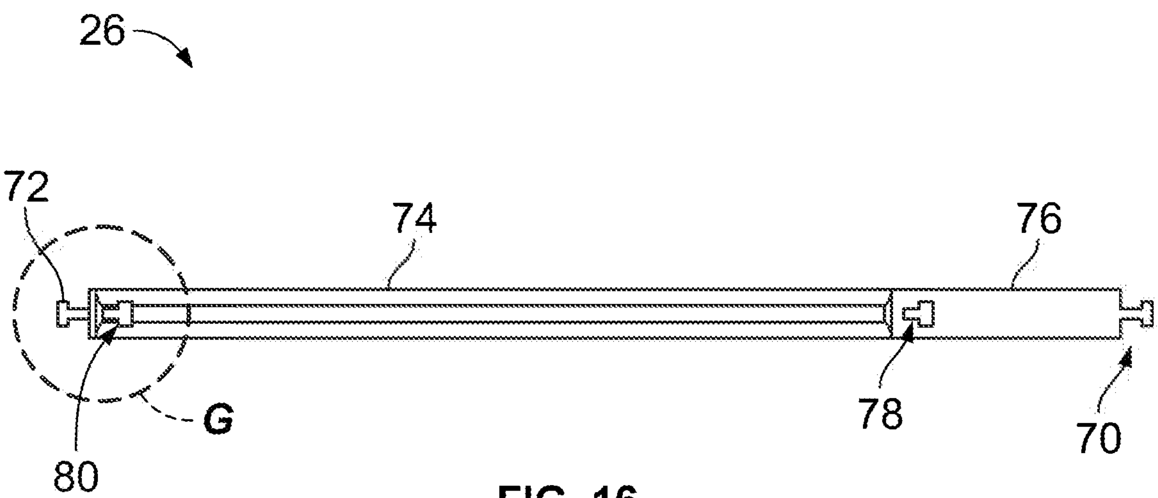

FIG. 16

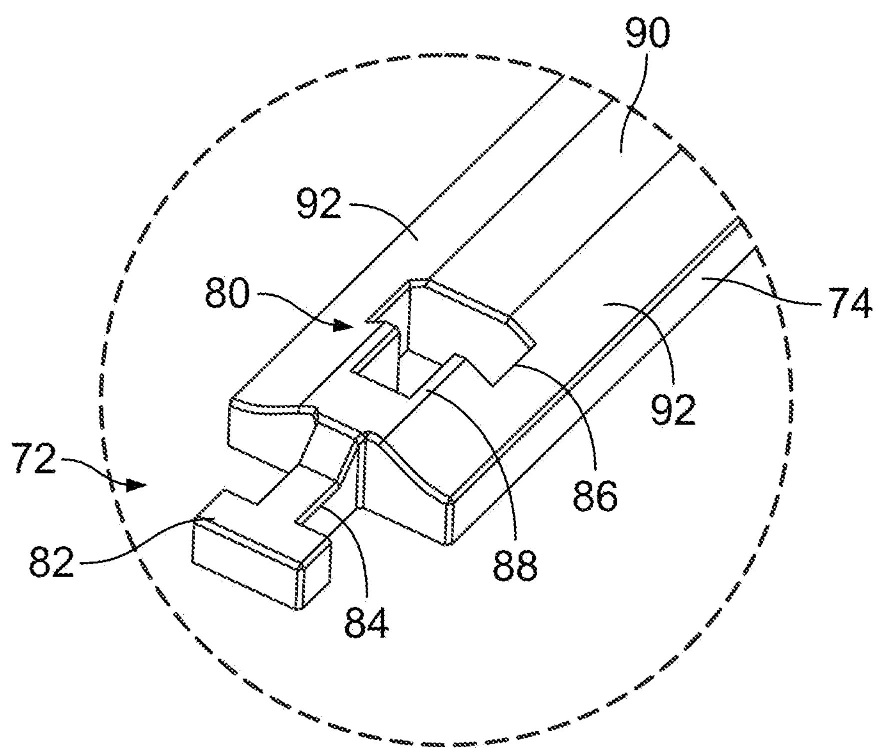

FIG. 17

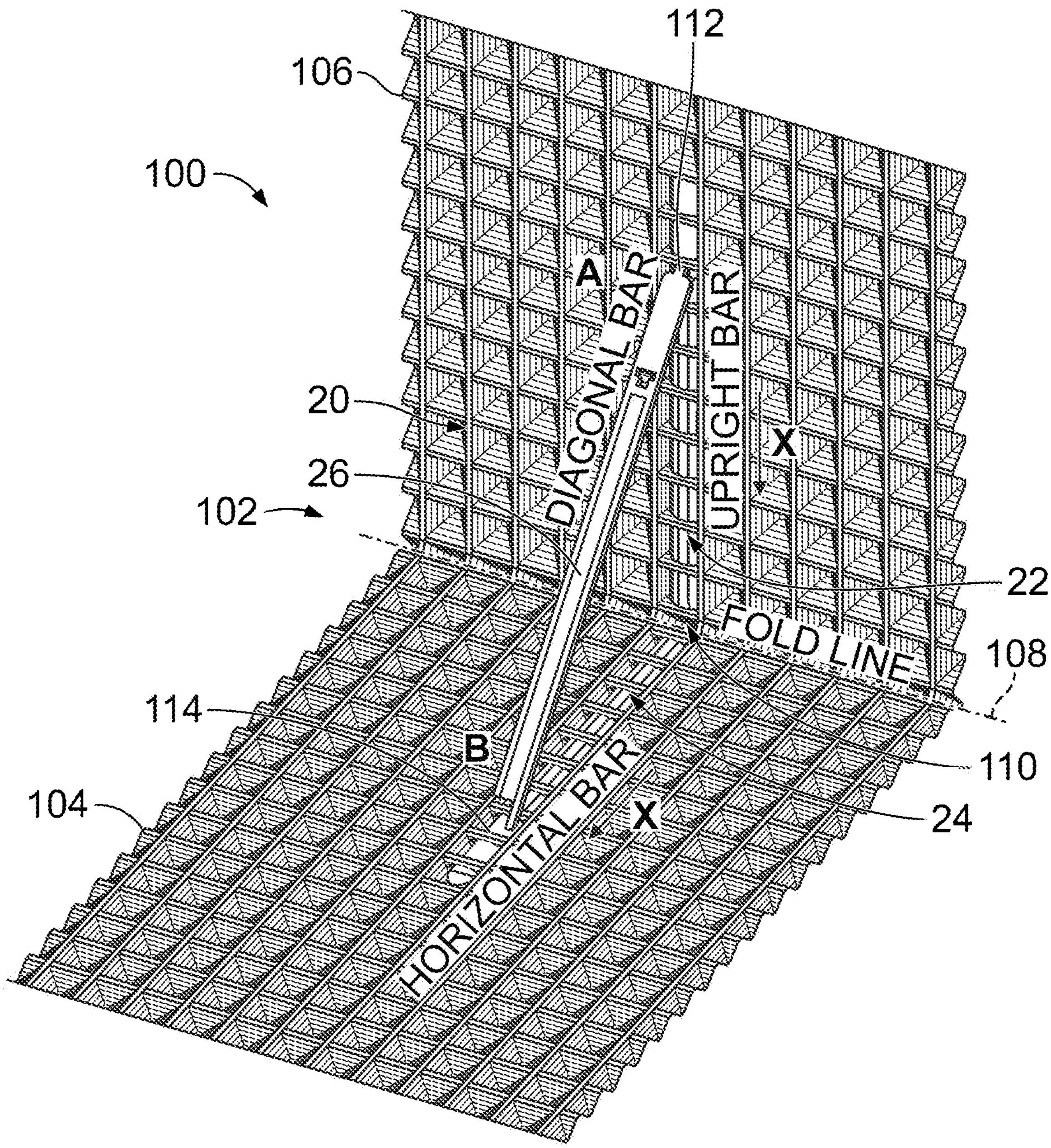
112
106
100
A
DIAGONAL BAR
UPRIGHT BAR
20
X
26
102
22
FOLD LINE
108
114
B
110
104
HORIZONTAL BAR
X
24

FIG. 18

BRACE ASSEMBLY FOR A GEOSYNTHETIC WRAPPED SYSTEM USED TO CONSTRUCT STABILIZED EARTH WALLS AND SLOPES

BACKGROUND

Internally braced geosynthetic fabric layers have been used in the construction of stabilized earth walls and slopes such as shown in FIG. **1**. However, the internal bracing assemblies in these systems as shown in FIGS. **2** and **3** are constructed from identical stabilizing bars. The identical nature of the stabilizing bars can result in an incorrect assembly where the upper brace that supports the upper section of the geosynthetic fabric layer is inserted into the lower brace rather than the reverse (see e.g., FIGS. **2** and **3**). This incorrect assembly can lead to the braces breaking or disconnecting when in use. For example, when a down force from soil and/or rock is applied to the incorrectly assembled bracing assemble, a position of a T connector can be moved by the force causing the T connector to break or disconnect from a corresponding slot. This disconnection can cause stresses that result in the wall or slope to shift (e.g. the brace and soil or stone contained in the system are pushed outward). When such shifting occurs a potential for ripple/zipper effect is possible which can cause the wall to slide or collapse in catastrophic failure of the stabilized earth walls and slopes. Furthermore, such existing brace assemblies are known to be cumbersome to construct on a job site due to the complexity of the assembly and job site space constraints.

In light of these drawbacks, there is a need for improved assemblies. In particular, there is need for an improved bracing assembly that can be easily constructed away from a job site and that is not susceptible to an incorrect assembly. Furthermore, there is a need for systems and methods related to such an improved bracing assembly.

SUMMARY

Embodiments described herein are directed to a bracing assembly for a geosynthetic wrapped system. The bracing assembly comprises a standing brace bar having a first configuration that comprises a first guide tip, a first slot connection, and a second slot connection. The bracing assembly also comprises a bottom brace bar having a second configuration different from the first configuration. The second configuration comprises a second guide tip, a third slot connection, and a first connector configured to interface with the first slot connection to couple the bottom brace bar to the standing brace bar. Furthermore, the bracing assembly comprises a cross brace bar having a third configuration different from the first and second configurations. The third configuration comprises a second connector configured to interface with the second slot connection to couple the cross brace bar to the standing brace bar and a third connector configured to interface with the third slot connection to couple the cross brace bar to the bottom brace bar. The first guide tip and the second guide tip are sized and shaped to direct insertion of the standing brace bar and the bottom brace bar respectively into a weave of a geotextile fabric material such that the first connector and the first connection slot are aligned together and with a fold line of the geotextile fabric material.

In some embodiments of the bracing assembly, the standing brace bar comprises a first slot region in which the first slot connection is formed, a second slot region in which the second slot connection is formed, and a body disposed between the first slot region and the second slot region. The first slot region is disposed between the first guide tip and the body. In some of these embodiments, the first slot region, the second slot region, the body, and the first guide tip are formed as a single monolithic structure. Additionally or alternatively, in some of these embodiments, a respective maximum height of the first slot region and the second slot region is less than a respective maximum height of the body.

In some embodiments of the bracing assembly, the bottom brace bar comprises a slot region in which the third slot connection is formed and a body disposed between the slot region and the first connecter. The slot region is disposed between the second guide tip and the body. In some of these embodiments, the slot region, the body, and the second guide tip are formed as a single monolithic structure. Additionally or alternatively, in some of these embodiments, a respective maximum height of the slot region is less than a respective maximum height of the body.

In some embodiments of the bracing assembly, the first connector comprises a first T-connector, the second connector comprises a second T-connector, and the third connector comprise a third T-connecter. Additionally, the first slot connection comprises a T-slot connection configured to receive the first T-connector through an upper portion of the T-slot and secure the first T-connector with a lower portion of the T-slot so as to couple the bottom brace bar to the standing brace bar. The second slot connection and the third slot connection comprise respective I-connectors configured to receive the second and third T-connectors. The second and third T-connectors are rotated so as to couple the cross brace bar to the bottom brace bar.

In some embodiments of the bracing assembly, the first guide tip and the second guide tip comprise respective bullnose shapes.

In some embodiments of the bracing assembly, the bottom brace bar, the standing brace bar, and the cross brace bar are made of non-metallic, rigid or semi-rigid material. In some of these embodiments, the non-metallic, rigid or semi-rigid material includes one of nylon and high-density polypropylene (HDPE).

Embodiments, described herein are also directed to an internally braced geosynthetic fabric layer that comprises a three-dimensional woven geotextile fabric having a horizontal layer section and an external layer face. The external layer face is formed by an upright fold of the geotextile fabric. The internally braced geosynthetic fabric layer also comprises a bracing assembly that supports the external layer face in an upright position. The bracing assembly comprises a standing brace bar inserted into a weave of the upright fold of the geotextile fabric and having a first configuration. The bracing assembly also comprises a bottom brace bar inserted into a weave of the horizontal layer section of the geotextile fabric, coupled to the standing brace bar proximate to a fold line of the geotextile fabric, and having a second configuration different from the first configuration. Furthermore, the bracing assembly comprises a cross brace bar coupled to the standing brace bar and the bottom brace bar and having a third configuration different from the first and second configurations. The horizontal layer section is configured to receive soil backfill to form a horizontal reinforcement layer portion of a reinforced earth zone and slope facing system and the external layer face is configured to provide a region of the reinforced earth zone and slope facing system against which soil backfill is filled and compacted.

In some embodiments of the internally braced geosynthetic fabric layer, the first configuration comprises a first guide tip, a first slot connection, and a second slot connection. The second configuration comprises a second guide tip, a third slot connection, and a first connector that interfaces with the first slot connection to couple the bottom brace bar to the standing brace bar. The third configuration comprises a second connector that interfaces with the second slot connection to couple the cross brace bar to the standing brace bar and a third connector that interfaces with the third slot connection to couple the cross brace bar to the bottom brace bar. The first guide tip and the second guide tip are sized and shaped to direct insertion of the standing brace bar and the bottom brace bar respectively into the weave of the geotextile fabric such that the first connector and the first connection slot are aligned together and with the fold line of the geotextile fabric. In some of these embodiments, the first connector comprises a first T-connector, the second connector comprises a second T-connector, and the third connector comprise a third T-connecter. The first slot connection comprises a T-slot connection configured to receive the first T-connector through an upper portion of the T-slot and secure the first T-connector with a lower portion of the T-slot so as to couple the bottom brace bar to the standing brace bar. The second slot connection and the third slot connection comprise respective I-connectors configured to receive the second and third T-connectors, wherein the second and third T-connectors are rotated so as to couple the cross brace bar to the bottom brace bar.

In some embodiments of the internally braced geosynthetic fabric layer, the first guide tip and the second guide tip comprise respective bullnose shapes.

In some embodiments of the internally braced geosynthetic fabric layer, the bottom brace bar, the standing brace bar, and the cross brace bar are made of non-metallic, rigid or semi-rigid material.

Embodiments described herein are also directed to a method for constructing an internally braced geosynthetic fabric layer. The method comprises weaving a three-dimensional woven geotextile fabric material on a loom. Then, while the geotextile fabric material is in the loom, the method comprises inserting a bottom brace bar into a weave of a horizontal layer section of the geotextile fabric material and a standing brace bar into a weave of an upright fold of the geotextile fabric material. The method further comprises folding the geotextile fabric material so that the upright fold and the standing brace bar are in an angled orientation relative to the horizontal layer section and coupling the bottom brace bar to the standing brace bar while the upright fold and the standing brace bar are in the angled orientation. Further still, the method comprises coupling a cross brace bar to the bottom brace bar and to the standing brace bar. The standing brace bar has a first configuration, the bottom brace bar has a second configuration different from the first configuration, and the cross brace bar has a third configuration different from both the first configuration and the second configuration.

In some embodiments, the method further comprises coupling the bottom brace bar to the standing brace bar by interfacing a first connector of the bottom brace bar with a first slot connection formed in the standing brace bar and coupling the cross brace bar to the standing brace bar by interfacing a second connector of the cross brace bar with a second slot connection formed in the standing brace bar. The method also comprises coupling the cross brace bar to the bottom brace bar by interfacing a third connector of the cross brace bar with a third slot connection formed in the bottom brace bar. The first configuration comprises the first slot connection and the second slot connection, the second configuration comprises the third slot connection and the first connector, and the third configuration comprises the second connector and the third connector.

In some embodiments, the method further comprises coupling the bottom brace bar to the standing brace bar by inserting a first T-connector of the bottom brace bar into an upper portion of a T-slot connection formed in the standing brace bar and sliding the first T-connector down into a lower portion of the T-slot connection to prevent a first head of the first T-connector from passing through the upper portion of the T-slot connection. Additionally, the method comprises coupling the cross brace bar to the standing brace bar by inserting a second T-connector of the cross brace bar through a first I-slot connection formed in the standing brace bar and rotating the second T-connector to prevent a second head of the second T-connector from passing through the first I-slot connection. Furthermore, the method comprises coupling the cross brace bar to the bottom brace bar by inserting a third T-connector of the cross brace bar through a second I-slot connection formed in the bottom brace bar and rotating the third T-connector to prevent a third head of the third T-connector from passing through the second I-slot connection. In these embodiments, the first configuration comprises the T-slot connection and the first I-slot connection, the second configuration comprises the second I-slot connection and the first T-connector, and the third configuration comprises the second T-connector and the third T-connector.

In some embodiments, the method further comprises inserting a standing brace bar into a weave of an upright fold of the geotextile fabric material by first inserting a first guide tip of bottom standing bar into the weave of the upright fold. The methods also comprises inserting the bottom brace bar into the weave of the horizontal layer section of the geotextile fabric material by first inserting a second guide tip of bottom brace bar into the weave of the horizontal layer section.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross-section showing a typical constructed geosynthetic reinforced earth structure using internally braced woven geotextile fabric layers;

FIG. **2** is a side view of a conventional bracing assembly;

FIG. **3** is a close up of section A of the conventional bracing assembly of FIG. **2**;

FIG. **4** is a side view of a bracing assembly according to disclosed embodiments;

FIG. **5** is an isometric view of a standing brace bar of the bracing assembly of FIG. **4** according to disclosed embodiments;

FIG. **6** is a front view of a standing brace bar of the bracing assembly of FIG. **4** according to disclosed embodiments;

FIG. **7** is a side view of a standing brace bar of the bracing assembly of FIG. **4** according to disclosed embodiments;

FIG. **8** is a front view of a section B of the standing brace bar of FIG. **6** according to disclosed embodiments;

FIG. **9** is a cross-section of the standing brace bar of FIG. **6** along the line C-C according to disclosed embodiments;

FIG. **10** is an isometric view of a bottom brace bar of the bracing assembly of FIG. **4** according to disclosed embodiments;

FIG. **11** is a front view of a bottom brace bar of the bracing assembly of FIG. **4** according to disclosed embodiments;

FIG. **12** is a side view of a bottom brace bar of the bracing assembly of FIG. **4** according to disclosed embodiments;

FIG. **13** is a cross-section of a connector of the bottom brace bar of FIG. **11** along the line D-D according to disclosed embodiments;

FIG. **14** is a front view of a section E of the bottom brace bar of FIG. **11** according to disclosed embodiments;

FIG. **15** is a cross-section of the bottom brace bar of FIG. **14** along the line F-F according to disclosed embodiments;

FIG. **16** is front view of a cross brace bar of the bracing assembly of FIG. **4** according to disclosed embodiments;

FIG. **17** is an isometric view of a section G of the cross brace bar of FIG. **16** according to disclosed embodiments; and

FIG. **18** is an isometric view of an internally braced geosynthetic fabric layer according to disclosed embodiments.

DETAILED DESCRIPTION

Before any embodiments of the invention are explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the following drawings. The invention is capable of other embodiments and of being practiced or of being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting. The use of "including," "comprising," or "having" and variations thereof herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items. Unless specified or limited otherwise, the terms "mounted," "connected," "supported," and "coupled" and variations thereof are used broadly and encompass both direct and indirect mountings, connections, supports, and couplings. Further, "connected" and "coupled" are not restricted to physical or mechanical connections or couplings.

The following discussion is presented to enable a person skilled in the art to make and use embodiments of the invention. Various modifications to the illustrated embodiments will be readily apparent to those skilled in the art, and the generic principles herein can be applied to other embodiments and applications without departing from embodiments of the invention. Thus, embodiments of the invention are not intended to be limited to embodiments shown, but are to be accorded the widest scope consistent with the principles and features disclosed herein. The following detailed description is to be read with reference to the figures, in which like elements in different figures have like reference numerals. The figures, which are not necessarily to scale, depict selected embodiments and are not intended to limit the scope of embodiments of the invention. Skilled artisans will recognize the examples provided herein have many useful alternatives and fall within the scope of embodiments of the invention.

FIG. **4** is side view of a bracing assembly **20** according to disclosed embodiments. As seen in FIG. **4**, the bracing assembly **20** can include a standing brace bar **22** having a first configuration, a bottom brace bar **24** having a second configuration, and a cross brace bar **26** having a third configuration. As described in more detail below, the first configuration, the second configuration, and the third configuration can all be different from one another to facilitate both easy and mistake free assembly of the bracing assembly **20**.

FIG. **5** is an isometric view of the standing brace bar **22** according to disclosed embodiments. Furthermore, FIG. **6** is a front view of the standing brace bar **22**, and FIG. **7** is a side view of the standing brace bar **22** according to disclosed embodiments. As seen in FIGS. **5-7**, the standing brace bar **22** can include a first guide tip **28**, a first slot region **30**, a body **32**, and a second slot region **34**. The first slot region **30** can be disposed between the body **32** and the first guide tip **28** and can have formed therein a first slot connection **36**. In some embodiments, the first slot connection **36** can include a T-slot connection as described in detail herein. The body **32** can be disposed between the first slot region **30** and the second slot region **34** and can include a raised support section **40** with a maximum height that is greater than a maximum height of the first and second slot regions **30** and **34** (see e.g. FIG. **7**). In some embodiments, the raised support section **40** can be omitted, and the body **32** can have a profile matching that of the first and second slot regions **30** and **34**. In some embodiments, the body **32** can include a support cutout **38** that is configured to allow the support brace bar **22** to bend and flex without breaking when used in a geosynthetic fabric layer to construct a stabilized earth wall and/or slope. Furthermore, as seen in FIGS. **5-7**, the second slot region **34** can have formed therein a second slot connection **42**. In some embodiments, the second slot **42** can include an I-slot.

FIG. **8** is a front view of a section B of the standing brace bar **22** of FIG. **6** according to disclosed embodiments. As seen in FIG. **8**, the first slot connection **36** can include the T-slot connection having an upper portion **44** and a lower portion **46**. Furthermore, as seen in FIG. **8**, the first guide tip **28** can have a bullnose or arrow shape that assists in installation of the standing brace bar **22** into a geosynthetic fabric as described herein.

FIG. **9** is a cross-section of the standing brace bar **22** along the line C-C shown in FIG. **8** according to disclosed embodiments. As seen in FIG. **9**, the body **32** can include transition areas **48** that transition the height of the body **32** from the max height of the raised support section **40** to the max height of the remainder of the standing brace bar **22**. In some embodiments, the transition areas **48** can be curved or sloped in a concave manner to provide support strength to the standing brace bar **22** so that the standing brace bar **22** will not break under load when used in a geosynthetic fabric layer to construct a stabilized earth wall and/or slope.

FIG. **10** is an isometric view of the bottom brace bar **24** according to disclosed embodiments. Furthermore, FIG. **11** is a front view of the bottom brace bar **24** and FIG. **12** is a side view of the bottom brace bar **22** according to disclosed embodiments. As seen in FIGS. **10-12**, the bottom brace bar **24** can include a second guide tip **50** similar to the first guide tip **28**, a third slot region **52** that is similar to the second slot region **34**, a body **54** similar to the body **32**, and a first connector **56**. Like the first guide tip **28**, the second guide tip **50** can have a bullnose or arrow shape that assists in installation of the bottom brace bar **24** into a geosynthetic fabric as described herein. The third slot region **52** can be disposed between the body **54** and the second guide tip **50** and can have formed therein a third slot connection **58**. In some embodiments, the third slot connection **58** can include an I-slot connection as described in detail herein. The body **54** can be disposed between the third slot region **52** and the first connector **56** and can include a raised support section **60** similar to the raised support section **40** with a maximum height that is greater than a maximum height of the third slot regions **52** and the first connector **56** (see e.g., FIG. **12**). In some embodiments, the raised support section **62** can be omitted, and the body **54** can have a profile matching that of the third slot regions **52** and the first connector **56**. In some embodiments, the body **54** can include a support cutout **60** similar to the support cutout **38** that is configured to allow the bottom brace bar **24** to bend and flex without breaking when used in a geosynthetic fabric layer to construct a stabilized earth wall and/or slope.

Furthermore, as seen in FIGS. **10-12**, the first connector **56** of bottom brace bar **24** can be integrally formed or coupled to an end of the body **54**. In some embodiments, the first connector **56** can be configured to interface with the first slot **36** of the standing brace bar **22** so as to couple the bottom brace bar **24** and the standing brace bar **22** together. Further still, in some embodiments, the first connector **56** can comprise a T-connector as descried herein. For example, FIG. **13** is a cross-section of the first connector **56** along the line D-D of FIG. **11**, and FIG. **14** is a front view of a section E of the bottom brace bar **24** of FIG. **12** according to disclosed embodiments. As seen in FIGS. **13** and **14**, the first connector **56** can include the T-connector having a head **64** and a neck **66**.

FIG. **15** is a cross-section of the bottom brace bar **24** along the line F-F shown in FIG. **14** according to disclosed embodiments. As seen in FIG. **15**, the body **54**, like the body **32**, can include transition areas **68** that transition the height of the body **54** from the max height of the raised support section **62** to the max height of the remainder of the bottom brace bar **24**. In some embodiments, the transition areas **68** can be curved or sloped in a concave manner to provide support strength to the bottom brace bar **24** so that the bottom brace bar **24** will not break under load when used in a geosynthetic fabric layer to construct a stabilized earth wall and/or slope.

FIG. **16** is front view of the cross brace bar **26** according to disclosed embodiments. As seen in FIG. **16**, the cross brace bar **26** can include a second connector **70** configured to interface with the second slot connection **42** in standing brace bar **22** to couple together the cross brace bar **26** and the standing brace bar **22**. Additionally, the cross brace bar **26** can include a third connector **72** configured to interface with the third slot connection **58** in bottom brace bar **24** to couple together the cross brace bar **26** and the bottom brace bar **24**. In some embodiments, the second connector **70** and the third connector **72** can be used interchangeably to couple the cross brace bar **26** to the standing brace bar **22** and the bottom brace bar **24** via the second and third slot connections **42** and **58**. As seen in FIG. **16**, in some embodiments, the cross brace bar **26** can include a fourth slot region **76** having a fourth slot connection **78** formed therein, and a body **74** having a fifth slot connection **80** formed therein. The fourth and fifth slot connections **78** and **80** can include T-slot connections as described herein and can be used to couple the cross brace bar **26** to the standing brace bar **22**, the bottom brace bar **24**, and/or other bracing bars in configurations different from the bracing assembly **20** as shown in FIG. **4**. In some embodiments, the fourth and fifth slot connections **78** and **80** are omitted to simplify the cross brace bar **26** and to simplify construction of the bracing assembly **20**.

FIG. **17** is an isometric view of a section G of the cross brace bar **26** according to disclosed embodiments. As seen in FIG. **17**, the third connector **72** can comprise a T-connector having a head **82** and a neck **84**. Though not shown in FIG. **17**, the second connector **70** can likewise comprise T-connector having a head and neck. Furthermore, as seen in FIG. **17** the body **74**, like the bodies **32** and **54**, can include a raised support section **90** and transition areas **92** that transition the height of the body **74** from the max height of the raised support section **90** to the max height of the remainder of the cross brace bar **26**. In some embodiments, the transition areas **92** can be curved or sloped in a concave manner to provide support strength to the cross brace bar **26** so that the cross brace bar **24** will not break under load when used in a geosynthetic fabric layer to construct a stabilized earth wall and/or slope.

Various embodiments for manufacturing the standing brace bar **22**, the bottom brace bar **24**, and the cross brace bar **26** are contemplated. Such embodiments include but are not limited to injection molding or the like. In some embodiments, the first slot region **30**, the second slot region **34**, the body **32**, and the first guide tip **28** are formed as a single monolithic structure. Similarly, in some embodiments, the third slot region **52**, the body **54**, and the second guide tip **50** are formed as a single monolithic structure. Furthermore, the second connector **70**, the third connector **72**, and the body **74** can be formed as a single monolithic structure. Additionally, the bottom brace bar **24**, the standing brace bar **22**, and the cross brace bar **22** can be made of a non-metallic, rigid or semi-rigid material. In some embodiments, the non-metallic, rigid or semi-rigid material can include one of nylon, high-density polypropylene (HDPE), or another suitable polymer.

FIG. **18** is an isometric view of an internally braced geosynthetic fabric layer **100** according to disclosed embodiments. As seen in FIG. **18**, the internally braced geosynthetic fabric layer **100** can employ the bracing assembly **20** and can include a three-dimensional woven geotextile fabric **102** having a horizontal layer section **104** and an external layer face **106**. The external layer face **106** can be formed by an upright fold of the geotextile fabric layer **100** along a fold line **108** of the internally braced geosynthetic fabric layer **100**. In some embodiments, the three-dimensional woven geotextile fabric **102** can be woven in a loom. Furthermore, the horizontal layer section **104** can be configured to receive soil backfill from a horizontal reinforcement layer portion of a reinforced earth zone and slope facing system. Further still, the external layer face **106** can be configured to provide a region of the reinforced earth zone and slope facing system against which soil backfill can be filled and compacted. In some embodiments the three-dimensional woven geotextile fabric **102** can include a three-dimensional pyramidal-woven geotextile fabric. However, additional non-pyramidal shapes for the three-dimensional woven geotextile fabric **102** are also contemplated.

To construct the geosynthetic fabric layer **100**, the standing brace bar **22** and the bottom brace bar **24** can be inserted into a weave of the geotextile fabric **102** using the first guide tip **28** and the second guide tip **50** in a direction shown by the arrows X such that the bottom brace bar **24** is located in the horizontal layer section **104**, the standing brace bar is located in the external layer face **106**, and the first connector **56** is aligned with first slot connection **36** at the fold line **108**. In some embodiments, the standing brace bar **22** and the bottom brace bar **24** can be inserted into the weave of the geotextile fabric **102** while the geotextile fabric **102** is in the loom. Additionally or alternatively, in some embodiments, the standing brace bar **22** and the bottom brace bar **24** can be inserted into the weave of the geotextile fabric **102** while the geotextile fabric **102** is in motion on the loom. Furthermore, in some embodiments, the standing brace bar **22** and the bottom brace bar **24** including the first and second guide tips **28** and **50** can be shaped slightly differently such that an installer can readily identify and differentiate the standing brace bar **22** from the bottom brace bar **24** so as to facilitate quick and reliable installation during the weaving process of the geotextile fabric **102**. Such embodiments, greatly reduce the time and labor needed to install a system on a job site. For example, the preinstallation and differing configurations the standing brace bar **22** and the bottom brace bar **24** can reduce installation time by approximately 4 hours per every one roll of geosynthetic fabric layer **100**.

Once the standing brace bar **22** and the bottom brace bar **24** are inserted into the weave of the geotextile fabric **102** and the geotextile fabric **102** has been fully woven, the geotextile fabric **102** can be folded along the fold line **108** so that the upright fold that forms external layer face **106** and the standing brace bar **22** are in an angled orientation relative to the horizontal layer section **104**. Then, while the upright fold and the standing brace bar **22** are in the angled orientation, the bottom brace bar **24** can be coupled to the standing brace bar **22** to form a connection **110**. In embodiments where the first slot connection **36** is the T-slot connection and the first connector **56** is the T-connector, the connection **110** can be formed by inserting the T-connector into upper portion **44** of a T-slot connection and sliding the T-connector down into the lower portion **46** of the T-slot connection to prevent the head **64** of the T-connector from passing through the upper portion **44** of the T-slot connection.

Furthermore, the geosynthetic fabric layer **100** can be constructed by coupling the cross brace bar **26** to the standing brace bar **26** to form connection **112** and coupling the cross brace bar **26** to the bottom brace bar **24** to form connection **114** as shown in FIG. **18**. In embodiments where the second slot connection **42** and the third slot connection **58** comprise the I-slot connections, the connections **112** and **114** can be formed by inserting T-connector heads of the second and third connectors **70** and **72** through a the I-slot connections and then rotating the T-connector heads to prevent the heads from passing back through the I-slot connections.

In some embodiments, the woven geotextile fabric **102** with the inserted standing brace bar **22** and bottom brace bar **24** are joined together into a roll of similarly constructed woven geotextile fabric layers. Then, the roll can be spread out at a job site where the connections **110**, **112**, and **114** are formed in the manner described above. This procedure can eliminate some assembly of the system on the job site and allow the geotextile fabric **102** to arrive on site ready to be rolled out in place where the cross brace bar **26** can be added.

It will be appreciated by those skilled in the art that while the invention has been described above in connection with particular embodiments and examples, the invention is not necessarily so limited, and that numerous other embodiments, examples, uses, modifications and departures from the embodiments, examples and uses are intended to be encompassed by the claims attached hereto. The entire disclosure of each patent and publication cited herein is incorporated by reference, as if each such patent or publication were individually incorporated by reference herein. Various features and advantages of the invention are set forth in the following claims.

What is claimed is:

1. A method for constructing an internally braced geosynthetic fabric layer, the method comprising:

weaving a three-dimensional woven geotextile fabric material on a loom;

while the geotextile fabric material is in the loom, inserting a bottom brace bar into a weave of a horizontal layer section of the geotextile fabric material and a standing brace bar into a weave of an upright fold of the geotextile fabric material;

folding the geotextile fabric material so that the upright fold and the standing brace bar are in an angled orientation relative to the horizontal layer section;

coupling the bottom brace bar to the standing brace bar while the upright fold and the standing brace bar are in the angled orientation;

by inserting a first T-connector of the bottom brace bar into an upper portion of a T-slot connection formed in the standing brace bar and sliding the first T-connector down into a lower portion of the T-slot connection to prevent a first head of the first T-connector from passing through the upper portion of the T-slot connection;

coupling a cross brace bar to the standing brace bar by inserting a second T-connector of the cross brace bar through a first I-slot connection formed in the standing brace bar and rotating the second T-connector to prevent a second head of the second T-connector from passing through the first connection; and

coupling the cross brace bar to the bottom brace bar by inserting a third T-connector of the cross brace bar through a second I-slot connection formed in the bottom brace bar and rotating the third T-connector to prevent a third head of the third T-connector from passing through the second I-slot connection.

wherein the standing brace bar has a first configuration, the bottom brace bar has a second configuration different from the first configuration, and the cross brace bar has a third configuration different from both the first configuration and the second configuration,

wherein the first configuration coin rises the T-slot connection and the first I-slot connection,

wherein the second configuration comprises the second I-slot connection and the first T-connector, and

wherein the third configuration comprises the second T-connector and the third T-connector.

2. The method of claim **1** further comprising:

inserting the standing brace bar into the weave of the upright fold of the geotextile fabric material by first inserting a first guide tip of the standing bar into the weave of the upright fold; and

inserting the bottom brace bar into the weave of the horizontal layer section of the geotextile fabric material by first inserting a second guide tip of the bottom brace bar into the weave of the horizontal layer section.

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