



(51) International Patent Classification:

E04B 2/56 (2006.01) *E04B 1/98* (2006.01)
E04B 2/72 (2006.01)

(21) International Application Number:

PCT/US2011/024541

(22) International Filing Date:

11 February 2011 (11.02.2011)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

61/303,917 12 February 2010 (12.02.2010) US

(71) Applicant (for all designated States except US): **BLUE TOMATO, LLC** [US/US]; 2575 West 1680 North, Provo, Utah 84601 (US).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **MORROW, Brian** [US/US]; 478 East 3950 North, Provo, Utah 84604 (US).

(74) Agents: **JONES, Terry S.** et al.; Traskbitt, 230 South 500 East, Suite 300, P. O. Box 2550, Salt Lake City, Utah 84110-2550 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, 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, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

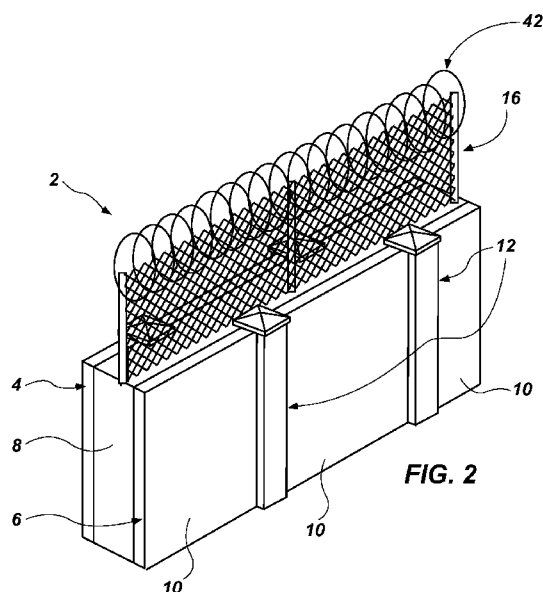
Declarations under Rule 4.17:

— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))

Published:

— without international search report and to be republished upon receipt of that report (Rule 48.2(g))

(54) Title: ENERGY ABSORBING WALL ASSEMBLIES AND RELATED METHODS



(57) Abstract: Energy absorbing wall assemblies, structures including energy absorbing wall assemblies, methods of making energy absorbing wall assemblies, and methods of utilizing energy absorbing wall assemblies are disclosed herein. In some embodiments, energy absorbing wall assemblies may include a first self supporting wall structure, a second self supporting wall structure, and an energy absorbing filler material positioned between the first self supporting wall structure and the second self supporting wall structure. In additional embodiments, methods of making an energy absorbing wall assembly may include assembling a first self supporting wall structure, and assembling a second self supporting wall structure defining a space between the first self supporting wall structure and the second self supporting wall structure. The methods may further include flowing an energy absorbing filler material into the space between the first self supporting wall structure and the second self supporting wall structure.

-1-

ENERGY ABSORBING WALL ASSEMBLIES AND RELATED METHODS**PRIORITY CLAIM**

This application claims the benefit of the filing date of United States Provisional
5 Patent Application Serial Number 61/303,917, filed February 12, 2010, for "ENERGY
ABSORBING WALL ASSEMBLIES AND RELATED METHODS."

TECHNICAL FIELD

This disclosure relates generally to energy absorbing wall assemblies, such as
10 for blast walls and defensive enclosures.

BACKGROUND

Blast walls tend to be large reinforced concrete structures, so that they can
withstand significant force resulting from a blast without breaching. However, such
15 structures tend to take a significant amount of time and money to build, as blast
walls require relatively large amounts of concrete and reinforcing steel.
Additionally, although such structures may withstand a significant impact without
being breached, when a projectile or blast is directed into the wall the concrete will
often spall and objects may ricochet from the wall. Such walls may also be difficult
20 to repair after spalling or other damage has occurred. Furthermore, blast walls tend
to be built as purely functional structures that do not have an appearance that is
consistent with that of the surrounding community, thus, such walls may not be
aesthetically pleasing.

In view of the foregoing, improved energy absorbing wall assemblies would
25 be desirable.

SUMMARY

In some embodiments, energy absorbing wall assemblies may include a first
self-supporting wall structure, a second self-supporting wall structure, and an energy
30 absorbing filler material positioned between the first self-supporting wall structure
and the second self-supporting wall structure.

-2-

In additional embodiments, methods of making an energy absorbing wall assembly may include assembling a first self-supporting wall structure, and assembling a second self-supporting wall structure defining a space between the first self-supporting wall structure and the second self-supporting wall structure. The methods may further include flowing an energy absorbing filler material into the space between the first self-supporting wall structure and the second self-supporting wall structure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows an isometric view of a portion of an energy absorbing wall assembly, according to an embodiment of the present invention.

FIG. 2 shows an isometric view of a portion of an energy absorbing wall assembly, such as shown in FIG. 1, further including a permeable fence.

FIG. 3 shows a cross-sectional side view of a precursor assembly for forming a column and panel fence for an energy absorbing wall assembly, such as shown in FIGS. 1 and 2, the precursor assembly including a footing, elongated member and a retaining bracket.

FIG. 4 shows the precursor assembly of FIG. 3 further including a panel positioned on the footing.

FIG. 5 shows the precursor assembly of FIG. 4 further including a first column face positioned against a side of the panel.

FIG. 6 shows the precursor assembly of FIG. 5 further including a second column face positioned against an opposing side of the panel.

FIG. 7 shows the precursor assembly of FIG. 6 further including a cross-piece positioned over the column faces and coupled to the elongated member.

FIG. 8 shows the precursor assembly of FIG. 7 wherein the cross-piece is coupled to the column faces, and wherein the cross-piece and elongated member are put into tension to form a column.

FIG. 9 shows the column of FIG. 8 further including a cap positioned over the column faces and the cross-piece.

-3-

FIG. 10 shows an isometric view of a portion of a first column and panel fence and a second column and panel fence positioned for forming an energy absorbing wall assembly as shown in FIG. 1.

FIG. 11 shows an isometric view of a portion of a first column and panel fence, a second column and panel fence, and a chain-link fence positioned for forming an energy absorbing wall assembly as shown in FIG. 2.

FIG. 12 shows a cross-sectional view of a energy absorbing wall assembly, such as shown in FIG. 1, having an energy absorbing filler material including used tires positioned between first and second self-supporting wall structures.

10

DETAILED DESCRIPTION OF THE EMBODIMENTS

In some embodiments, as shown in FIG. 1, an energy absorbing wall assembly 2 may include a first self-supporting wall structure 4, a second self-supporting wall structure 6 and an energy absorbing filler material 8 positioned therebetween. The second self-supporting wall structure 6 may be positioned substantially parallel to the first self-supporting wall structure 4 and the filler material 8 positioned therebetween may substantially fill an entire space between the first self-supporting wall structure 4 and the second self-supporting wall structure 6.

Each self-supporting wall structure 4, 6 may be a free-standing structure. Furthermore, each self-supporting wall structure 4, 6 may be formed by a wall structure that may be utilized on its own as a functional wall. For example, each self-supporting wall structure 4, 6 may be a column and panel fence, such as described in U.S. Patent Application 12/631,495, filed on December 4, 2009, by the inventor of the present invention. As the exterior of the energy absorbing wall assembly 2 may be formed by the self-supporting wall structures 4, 6 and free-standing fencing may be utilized as the self-supporting wall structures 4, 6, the energy absorbing wall assembly 2 may be aesthetically pleasing and may, thus, be configured with a selected surface finish pattern, texture, color, etc., to provide an appearance that is consistent with that of the surrounding community. In other words, at least one of the first and second self-supporting wall structures 4, 6 may be, or at least have the appearance of, a conventional fence. Furthermore, the first

-4-

and second self-supporting wall structures 4, 6 may provide an anti-spalling and anti-ricochet outer surface of the energy absorbing wall assembly 2.

Each self-supporting wall structure 4, 6 may comprise preformed concrete panels 10 positioned between and held upright by columns 12 anchored to the ground, such as by a footing 14 (FIGS. 3-9), a foundation, or another type of anchor. In some embodiments, the columns 12 of the first self-supporting wall structure 4 may be aligned with columns 12 of the second self-supporting wall structure 6, as shown in FIG. 1. In additional embodiments, the columns 12 of the first self-supporting wall structure 4 may be staggered relative to the columns 12 of the second self-supporting wall structure 6, as shown in FIG. 2.

In some embodiments, the first and second self-supporting wall structures 4, 6 may be substantially identical in construction and height, such as shown in FIGS. 1 and 2. This may allow common components, materials, tools and construction methods to be used for each self-supporting wall structure 4, 6. In additional embodiments, the first and second self-supporting wall structures 4, 6 may be significantly different in one or more of construction, height, and other aspects (not shown). For example, the first self-supporting wall structure 4 may comprise an outer wall of a building and the second self-supporting wall structure 6 may be a fence spaced from the outer wall of the building (not shown). In some embodiments, a permeable fence 16 may be positioned between the first and second self-supporting wall structures 4, 6, such as shown in FIG. 2. Additionally, the permeable fence 16 may extend higher than the first and second self-supporting wall structures. For example, and as illustrated in FIG. 2, a chain-link fence may be positioned between and extend above the first and second self-supporting wall structures 4, 6. Additionally, the permeable fence 16 may be positioned adjacent one of the first and second self-supporting wall structures 4, 6. At least a portion of the energy absorbing filler material 8 may be flowable, at least when initially positioned between the first and second self-supporting wall structures 4, 6, and the flowable, energy absorbing filler material 8 may penetrate the permeable fence 16 and surround and substantially encapsulate the lower portion of the permeable fence 16.

-5-

The energy absorbing filler material 8 may comprise a material that is initially flowable, to facilitate the positioning of the energy absorbing filler material 8 between the first and second self-supporting wall structures 4, 6. After positioning between the first and second self-supporting wall structures 4, 6 the energy absorbing filler material 8 may exhibit energy absorbing properties. In some embodiments, the energy absorbing filler material may be a monolithic structure, such as a monolithic collapsible material comprising a relatively brittle cellular matrix encapsulating relatively small, collapsible pockets, such as gas (*e.g.*, air) pockets. For example, the energy absorbing filler material 8 may be a cellular concrete. In some embodiments a cellular concrete may be formed from hydraulic cement, water and pre-formed foam. In additional embodiments, other methods of entraining gas into uncured concrete may be utilized (*e.g.*, gas producing chemical reactants, aspirating nozzles, porous aggregate, aeration, etc.). In some embodiments, a cellular concrete comprising about 40 percent air to about 60 percent air may be utilized. For a non-limiting example, a cellular concrete comprising about 50 percent air may be utilized. The amount of air entrained in the cellular concrete may be varied according to the application that the energy absorbing wall assembly 2 is intended and the configuration and intensity of any kinetic energy that the energy absorbing wall assembly 2 is configured to absorb. In additional embodiments, the energy absorbing filler material 8 may comprise a flowable particulate, such as one or more of sand, dirt, gravel, and other flowable particulates. The energy absorbing filler material 8 may also comprise additional material and structures. In some embodiments, the energy absorbing filler material 8 may comprise discrete energy absorbing structures positioned between the wall structures that may form cavities and voids that may be filled with the flowable material. For example, used tires 18 (FIG. 12) may be stacked between the first and second self-supporting wall structures 4, 6. In view of this, the energy absorbing filler material 8 may comprise a plurality of discrete energy absorbing structures encapsulated in a monolithic energy absorbing material.

In some embodiments, an energy absorbing wall assembly 2 may be assembled by first assembling first and second self-supporting wall structures 4, 6

-6-

spaced apart and then filling the space between the first and second self-supporting wall structures 4, 6 with an energy absorbing filler material 8. For example, the first and second self-supporting wall structures 4, 6 may be assembled by first positioning footings 14, then securing elongated members 20 to the footings 14 and positioning an optional retaining bracket 21 about each elongated member 20, as shown in FIG. 3. Next, end portions of the panels 10 may be positioned over the footings 14 and generally aligned with respective elongated members, as shown in FIG. 4. The panels 10 may be held in position by temporary braces (not shown) until the columns 12 are assembled.

After the panels 10 are positioned, a first column face 22 may be positioned adjacent the end portions of the panels 10, as shown in FIG. 5, and a second column face 24 may be positioned adjacent the ends portions of the panels 10 opposite the first column face 22, as shown in FIG. 6. Optionally, if the first and second column faces 22, 24 are joined together by a central portion (i.e., the first and second column faces are a single piece) (not shown) the first and second column faces 22, 24 may be positioned simultaneously, such as by lowering the first and second column faces 22, 24 over the elongated member 20 and footing 14.

The lower ends of the first and second column faces 22, 24 may be held against the panels 10 by a retaining bracket 21 or by another structure. If a retaining bracket 21 is used, the retaining bracket 21 may comprise a metal bracket that may be deformed or may be rotated, such as by a hammer, to hold the lower ends of the column faces 22, 24 firmly against the panels 10. A cross-piece 26 may then be positioned at the upper end of the column faces 22, 24 and, optionally, a retainer 36 may be positioned over the cross-piece 26, as shown in FIG. 7. A first end 38 of the cross-piece 26 may be coupled to the first column face 22, a second end 40 of the cross-piece 26 may be coupled to the second column face 24, and an intermediate portion of the cross-piece 26 may be coupled to the elongated member 20, as shown in FIG. 8. A portion of the cross-piece 26 may then be deformed, such as by rotating the bolt 32, and the cross-piece 26 and the elongated member 20 may be held in tension by the footing 14, the first column face 22 and the second column face 24. The tensioned cross-piece 26 may then hold the column faces 22, 24 firmly against

-7-

the panels 10 and apply a longitudinally oriented compressive force to the column faces 22, 24. Upon putting the cross-piece 26 and the elongated member 20 into tension, the column 12 may support the panels 10 and any temporary braces (not shown) may then be removed. Finally, the cap 28 may be positioned over the upper
5 end of the column 12, as shown in FIG. 9.

In some embodiments, the first and second self-supporting wall structures 4, 6 may be comprised of preformed concrete components. The panels 10 may be cast from concrete in a single monolithic piece or as a plurality of pieces assembled together to form the panel. For example, each panel 10 and each may be formed of
10 two monolithic sheets, each sheet cast in a mold, and a face of each sheet may have a finished surface imparted by the mold. The sheets may be assembled back to back, such the faces of the sheets, having the finished surface imparted by the mold, may form the outer surface of the panel 10. Optionally, each panel 10 may also include reinforcing structures, such as one or more of reinforcing bar (rebar), reinforcing
15 fiber (*e.g.*, glass fiber, steel fiber, synthetic fiber, natural fiber, polypropylene fiber, cellulose fiber, asbestos fiber, carbon fiber, etc.), and reinforcing wire therein and may include materials, such as adhesives and filler material, therebetween. Additionally, each panel 10 may include a hollow cavity therein. As the concrete panels 10 may be lightweight (*e.g.*, hollow, lightweight aggregate, etc.) and may be
20 fiber reinforced, the panels 10 may prevent or reduce spalling and ricochet that may otherwise result from an impact, such as by a projectile, into a conventional concrete structure.

Additionally, with reference to FIG. 9, the column faces 22, 24 may be comprised of concrete and may similarly be preformed, such as in a mold. For
25 example, each of the column faces 22, 24 may be formed of cast concrete, which may be reinforced, such as with one or more of reinforcing bar (rebar), reinforcing fiber (*e.g.*, glass fiber, steel fiber, synthetic fiber, natural fiber, polypropylene fiber, cellulose fiber, asbestos fiber, carbon fiber, etc.) and reinforcing wire. In some embodiments, each of the column faces 22, 24 may not include any exterior or
30 exposed portions that are not formed of concrete. Each column face 22, 24 may be cast from concrete in a single monolithic piece or as a plurality of pieces assembled

-8-

together to form each column face 22, 24, similarly to the panels 10. Optionally, each column face 22, 24 may also include reinforcing structures, such as one or more of reinforcing bar (rebar), reinforcing fiber, and reinforcing wire therein and may include materials, such as adhesives and filler material, therebetween. Additionally, 5 each column face 22, 24 may include a hollow cavity therein. As the concrete column faces 22, 24 may be lightweight (*e.g.*, hollow, lightweight aggregate, etc.) and may be fiber reinforced (*e.g.*, glass fiber, steel fiber, synthetic fiber, natural fiber, polypropylene fiber, cellulose fiber, asbestos fiber, carbon fiber, etc.), the column faces 22, 24 may prevent or reduce spalling and ricochet that may otherwise result 10 from an impact, such as by a projectile, into a conventional concrete structure.

Although certain concrete panels and concrete column faces have been described, panels and column faces formed of other materials and by other methods may also be used, as will be understood by a person of ordinary skill in the art.

In addition to assembling the first and second self-supporting wall 15 structures 4, 6, a permeable fence 16, such as a chain-link fence, may be assembled at a position between the first and second self-supporting wall structures 4, 6, as shown in FIG. 2. The permeable fence 16 may be substantially taller than the first and second self-supporting wall structures 4, 6 and may be positioned relatively close to one of the first and second self-supporting wall structures 4, 6, such as 20 within a few inches (a few centimeters). The permeable fence 16 may be a conventional fence, such as a chain-link fence, and may be assembled according to conventional methods, such as by securing fence posts in concrete footings and attaching a chain-link fencing to the fence posts. Optionally, barbed wire, razor wire or another climbing deterrent 42 may be attached at or near the top of the permeable 25 fence 16. Additionally, the portion of the permeable fence 16 that is encapsulated within the energy absorbing filler material 8 may facilitate the distribution of energy loads through the energy absorbing wall assembly 2. For example, a relatively large amount of kinetic energy, such as from a vehicle impact, may be exerted on a relatively small region of the energy absorbing wall assembly 2, such as upon a 30 single panel 10. The permeable fence 16 may distribute the kinetic energy from the impact among adjacent portions of the energy absorbing wall assembly 2, which may

-9-

facilitate an efficient absorption of the kinetic energy by the energy absorbing wall assembly 2 and may also prevent a breach of the energy absorbing wall assembly 2.

After the first and second self-supporting wall structures 4, 6 are installed, as shown in FIG. 10, and optionally, the intermediate permeable fence 16, as shown in FIG. 11, the energy absorbing filler material 8 may be positioned between the first and second self-supporting wall structures 4, 6. If any discrete energy absorbing structures, such as used tires 18, are utilized, they may be positioned between the first and second self-supporting wall structures 4, 6, in a series of laterally adjacent vertical stacks, as shown in FIG. 12. Optionally, a first self-supporting wall structure 4 may be assembled, structural material, such as used tires 18, may be stacked one on top of the other, the individual tires oriented horizontally, adjacent the first self-supporting wall structure 4, then the second self-supporting wall structure 6 may be assembled. Finally, a flowable energy absorbing filler material 8 may be directed between the first and second self-supporting wall structures 4, 6 and may substantially fill the remaining space therebetween.

If the first and second self-supporting wall structures 4, 6 include any permeable regions where flowable energy absorbing filler material 8 may flow through, the permeable regions may be sealed to prevent flow of the flowable energy absorbing filler material 8 therethrough.

In some embodiments, an uncured cellular concrete may be flowed between the first and second wall structures 4, 6, such as by a concrete pump. After the cellular concrete is flowed into the space between the first and second self-supporting wall structures 4, 6 the cellular concrete may become cured and provide a monolithic, rigid, cellular structure.

In additional embodiments, a flowable particulate may be directed into the space between the first and second self-supporting wall structures 4, 6. For example, a flowable particulate comprising one or more of sand, dirt, gravel, and other flowable particulates may be directed into the space between the first and second self-supporting wall structures 4, 6.

If structural features are positioned between the first and second self-supporting wall structures (*e.g.*, a permeable fence 16, used tires 18, etc.) the

-10-

flowable energy absorbing filler material 8 (*e.g.*, uncured cellular concrete, flowable particulate, etc.) may be flowed around and optionally through such structural features.

In some embodiments, the energy absorbing wall assembly 2 may be repaired after one or more energy absorption events. After one or more energy absorption events, such as impact with one or more projectiles, the affected regions of the first and second self-supporting wall assemblies 4, 6 may be removed. For example, columns 12 in the affected regions may be disassembled, and affected (*i.e.*, damaged) columns 12 and panels 10 may be removed. After removal of the affected columns 12 and panels 10 the underlying energy absorbing filler material 8 may be repaired. In some embodiments, a portion of damaged cellular concrete may be removed to form a cavity in a monolithic energy absorbing filler material 8 and the cavity may be filled with uncured cellular concrete, which may then cure within the cavity. New columns 12 and panels 10 may then be installed to replace the previously removed affected columns 12 and panels 10. In additional embodiments, a cavity may be formed and one or more flow paths extending from the cavity to an upper surface may be formed in the monolithic energy absorbing filler material 8 while the columns 12 and panels 10 are removed. Then cellular concrete may be flowed into the cavity through the one or more flow paths after the new columns 12 and panels 10 have been installed. Such methods may allow a time efficient and cost effective method of repair to the energy absorbing wall assembly 2 after one or more energy absorption events. For example, an energy absorbing wall assembly 2 may be installed at a site where repeated kinetic energy events may be expected, such as a shooting range or testing facility, and the energy absorbing wall assembly 2 may be regularly and repeatedly repaired.

The energy absorbing wall assemblies 2 described herein may readily absorb energy, such as from impacts of vehicles or projectiles, from shock waves, such as those resulting from explosives or industrial accidents (*e.g.*, at chemical plants, refineries), or from other kinetic energy sources. In view of this, the energy absorbing wall assemblies 2 described herein may be utilized in a number of applications where energy absorption may be beneficial. In some embodiments, an

-11-

energy absorbing wall assembly 2 may be utilized as a security wall. As a security wall an energy absorbing wall assembly 2 may provide protection by providing a barrier that may be difficult to penetrate or climb over. The energy absorbing wall assembly 2 may absorb a shock wave and resulting shrapnel directed toward the wall from an explosive detonating near the energy absorbing wall assembly 2. Additionally, the energy absorbing wall assembly 2 may absorb the impact of a vehicle intentionally rammed into the energy absorbing wall assembly 2, may absorb the energy of projectiles, such as bullets, and otherwise prevent penetration of the energy absorbing wall assembly 2 by potentially harmful kinetic energy into a protected area behind the energy absorbing wall assembly 2. In additional embodiments, energy absorbing wall assemblies 2 may be utilized in other applications, such as near roadways to absorb the impact of an automobile veering off of the roadway, or as an exterior wall of a building among other possible applications.

While the invention may be susceptible to various modifications and alternative forms, specific embodiments have been shown by way of example in the drawings and have been described in detail herein. However, it should be understood that the invention is not intended to be limited to the particular forms disclosed.

20

EMBODIMENTS:

1. An energy absorbing wall assembly, comprising:
a first self-supporting wall structure;
a second self-supporting wall structure; and
an energy absorbing filler material positioned between the first self-supporting wall structure and the second self-supporting wall structure.
2. The energy absorbing wall assembly of embodiment 1, wherein:
the energy absorbing filler material comprises a collapsible material.
3. The energy absorbing wall assembly of embodiment 2, wherein:
the collapsible material comprises cellular concrete.

-12-

4. The energy absorbing wall assembly of embodiment 1, wherein:
the energy absorbing filler material comprises a flowable particulate.

5. The energy absorbing wall assembly of embodiment 4, wherein:
the flowable particulate comprises at least one of sand, dirt and gravel.

5 6. The energy absorbing wall assembly of embodiment 1, wherein the
first self-supporting wall structure comprises a first column and panel fence.

7. The energy absorbing wall assembly of embodiment 6, wherein the
second self-supporting wall structure comprises a second column and panel fence.

8. The energy absorbing wall assembly of embodiment 7, wherein the
10 columns of the first column and panel fence and the second column and panel fence
comprise:

an elongated member having a first end secured to a footing and a second end;
a first column face and an opposing second column face forming at least one channel
therebetween sized and configured to receive an end portion of at least one

15 fence panel; and

a cross-piece having a first end coupled to the first column face, a second end
coupled to the second column face and an intermediate portion coupled to the
second end of the elongated member, the cross-piece and the elongated
member being placed in tension by the footing, the first column face and the
20 second column face at least when an end portion of at least one fence panel is
positioned in the at least one channel.

9. The energy absorbing wall assembly of embodiment 1, wherein the
second self-supporting wall structure is positioned substantially parallel to the first
self-supporting wall structure.

25 10. The energy absorbing wall assembly of embodiment 1, further
comprising a permeable fence positioned between the first self-supporting wall
structure and the second self-supporting wall structure.

11. The energy absorbing wall assembly of embodiment 10, wherein the
permeable fence extends above the first self-supporting wall structure and the second
30 self-supporting wall structure.

-13-

12. The energy absorbing wall assembly of embodiment 11, wherein a lower portion of the permeable fence is surrounded by the energy absorbing filler material.

13. The energy absorbing wall assembly of embodiment 12, wherein the permeable fence comprises a chain-link fence.

14. The energy absorbing wall assembly of embodiment 1, wherein the filler material further comprises discrete energy absorbing structures positioned between the first self-supporting wall structure and the second self-supporting wall structure.

15. The energy absorbing wall assembly of embodiment 14, wherein the discrete energy absorbing structures comprise used tires.

16. The energy absorbing wall assembly of embodiment 1, wherein at least one of the first self-supporting wall structure and the second self-supporting wall structure have the appearance of a conventional fence.

17. A method of making an energy absorbing wall assembly, the method comprising:

assembling a first self-supporting wall structure;

assembling a second self-supporting wall structure defining a space between the first self-supporting wall structure and the second self-supporting wall structure;

and

flowing a filler material into the space between the first self-supporting wall structure and the second self-supporting wall structure.

18. The method of embodiment 17, wherein flowing a filler material into the space between the first self-supporting wall structure and the second self-supporting wall structure comprises flowing an uncured cellular concrete into the space between the first self-supporting wall structure and the second self-supporting wall structure.

19. The method of embodiment 17, wherein flowing a filler material into the space between the first self-supporting wall structure and the second self-supporting wall structure comprises flowing a particulate into the space between the first self-supporting wall structure and the second self-supporting wall structure.

-14-

20. The method of embodiment 17, further comprising assembling a permeable fence between the first self-supporting wall structure and the second self-supporting wall structure.

21. The method of embodiment 20, further comprising flowing the filler
5 material through at least a portion of the permeable fence.

22. The method of embodiment 17, further comprising positioning discrete energy absorbing structures between the first self-supporting wall structure and the second self-supporting wall structure.

23. The method of embodiment 22, further comprising flowing the filler
10 material around the discrete energy absorbing structures.

-15-

CLAIMS

1. An energy absorbing wall assembly, comprising:
a first self-supporting wall structure;
a second self-supporting wall structure; and
5 an energy absorbing filler material positioned between the first self-supporting wall structure and the second self-supporting wall structure.
2. The energy absorbing wall assembly of claim 1, wherein:
the energy absorbing filler material comprises a collapsible material.
10
3. The energy absorbing wall assembly of claim 2, wherein:
the collapsible material comprises cellular concrete.
4. The energy absorbing wall assembly of claim 1, wherein:
15 the energy absorbing filler material comprises a flowable particulate.
5. The energy absorbing wall assembly of claim 4, wherein:
the flowable particulate comprises at least one of sand, dirt and gravel.
- 20 6. The energy absorbing wall assembly of claim 1, wherein the first self-supporting wall structure comprises a first column and panel fence.
7. The energy absorbing wall assembly of claim 6, wherein the second self-supporting wall structure comprises a second column and panel fence.
25

-16-

8. The energy absorbing wall assembly of claim 7, wherein the columns of the first column and panel fence and the second column and panel fence comprise:
an elongated member having a first end secured to a footing and a second end;
5 a first column face and an opposing second column face forming at least one channel therebetween sized and configured to receive an end portion of at least one fence panel; and
a cross-piece having a first end coupled to the first column face, a second end coupled to the second column face and an intermediate portion coupled to the
10 second end of the elongated member, the cross-piece and the elongated member being placed in tension by the footing, the first column face and the second column face at least when an end portion of at least one fence panel is positioned in the at least one channel.
- 15 9. The energy absorbing wall assembly of claim 1, wherein the second self-supporting wall structure is positioned substantially parallel to the first self-supporting wall structure.
- 20 10. The energy absorbing wall assembly of claim 1, further comprising a permeable fence positioned between the first self-supporting wall structure and the second self-supporting wall structure.
- 25 11. The energy absorbing wall assembly of claim 10, wherein the permeable fence extends above the first self-supporting wall structure and the second self-supporting wall structure.
- 30 12. The energy absorbing wall assembly of claim 11, wherein a lower portion of the permeable fence is surrounded by the energy absorbing filler material.
13. The energy absorbing wall assembly of claim 12, wherein the permeable fence comprises a chain-link fence.

-17-

14. The energy absorbing wall assembly of claim 1, wherein the filler material further comprises discrete energy absorbing structures positioned between the first self-supporting wall structure and the second self-supporting wall structure.

5

15. The energy absorbing wall assembly of claim 14, wherein the discrete energy absorbing structures comprise used tires.

16. The energy absorbing wall assembly of claim 1, wherein at least one of the first self-supporting wall structure and the second self-supporting wall structure have the appearance of a conventional fence.

10

17. A method of making an energy absorbing wall assembly, the method comprising:
15 assembling a first self-supporting wall structure;
assembling a second self-supporting wall structure defining a space between the first self-supporting wall structure and the second self-supporting wall structure;
and
flowing a filler material into the space between the first self-supporting wall
20 structure and the second self-supporting wall structure.

18. The method of claim 17, wherein flowing a filler material into the space between the first self-supporting wall structure and the second self-supporting wall structure comprises flowing an uncured cellular concrete into the space between
25 the first self-supporting wall structure and the second self-supporting wall structure.

19. The method of claim 17, wherein flowing a filler material into the space between the first self-supporting wall structure and the second self-supporting wall structure comprises flowing a particulate into the space between the first
30 self-supporting wall structure and the second self-supporting wall structure.

-18-

20. The method of claim 17, further comprising assembling a permeable fence between the first self-supporting wall structure and the second self-supporting wall structure.

5 21. The method of claim 20, further comprising flowing the filler material through at least a portion of the permeable fence.

22. The method of claim 17, further comprising positioning discrete energy absorbing structures between the first self-supporting wall structure and the
10 second self-supporting wall structure.

23. The method of claim 22, further comprising flowing the filler material around the discrete energy absorbing structures.

15

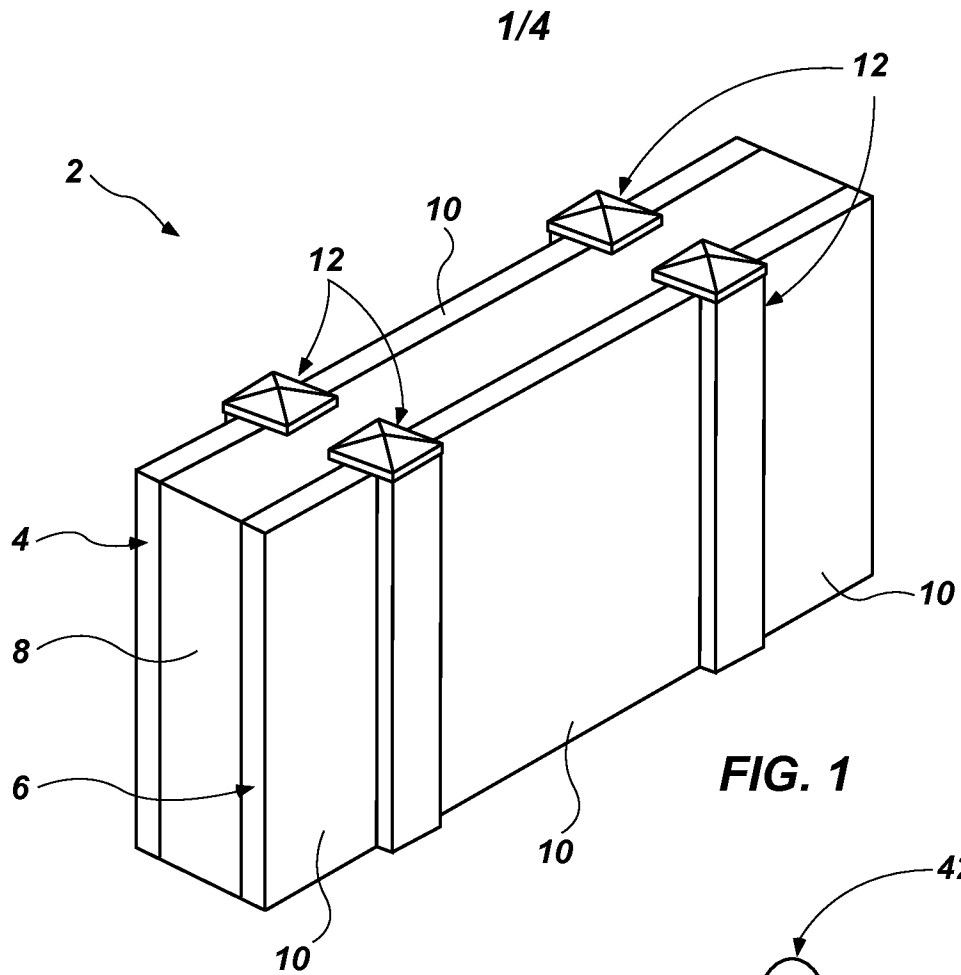


FIG. 1

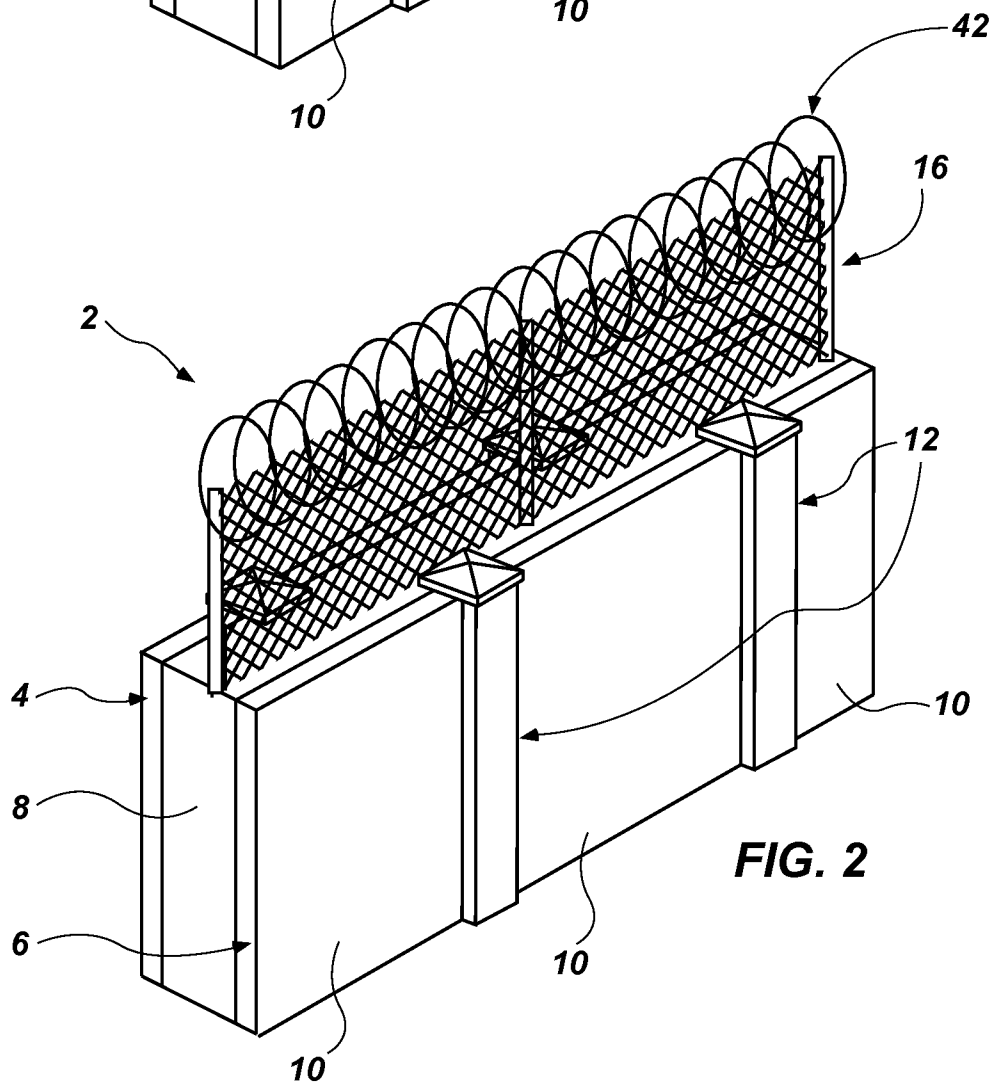
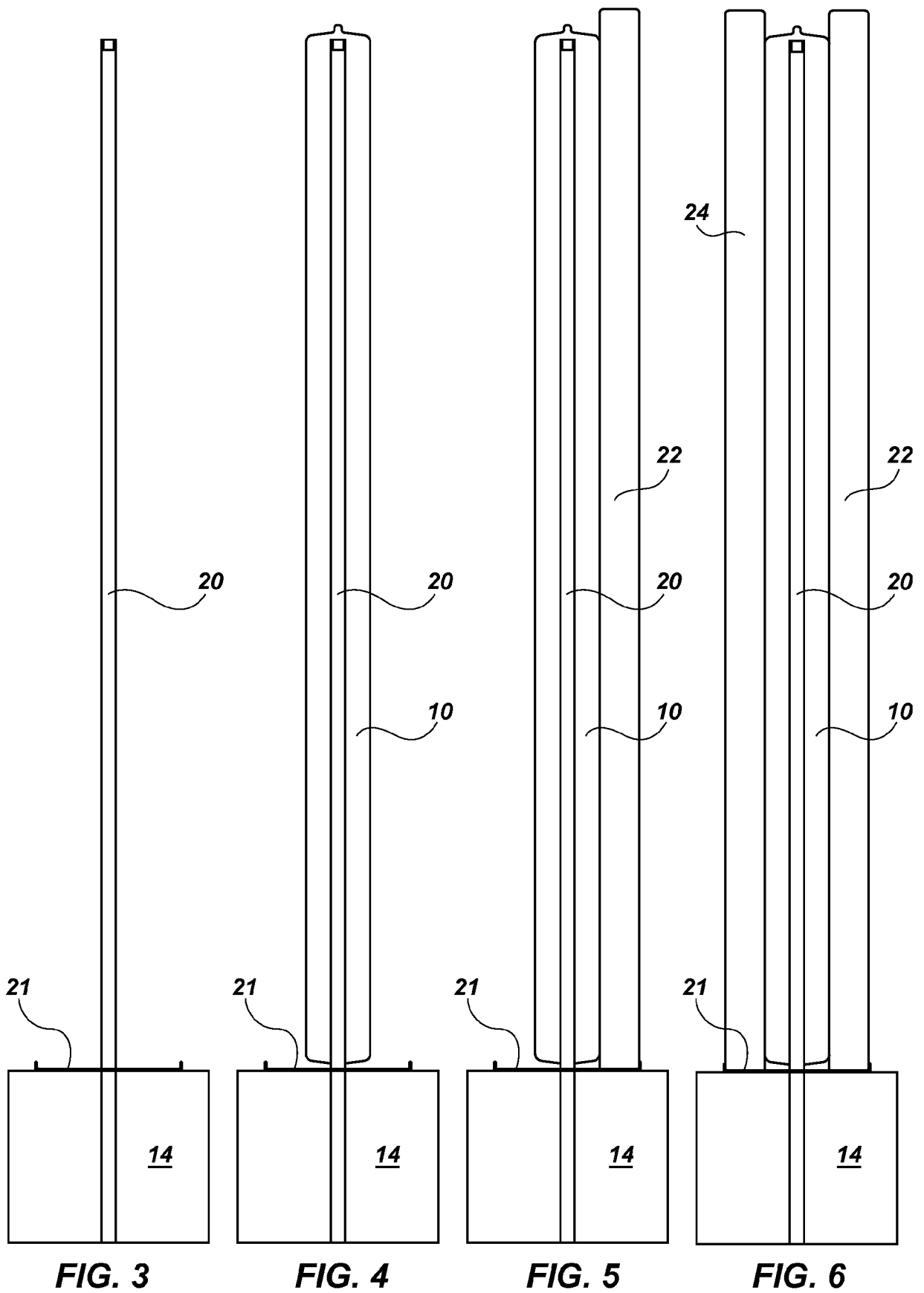


FIG. 2

2/4



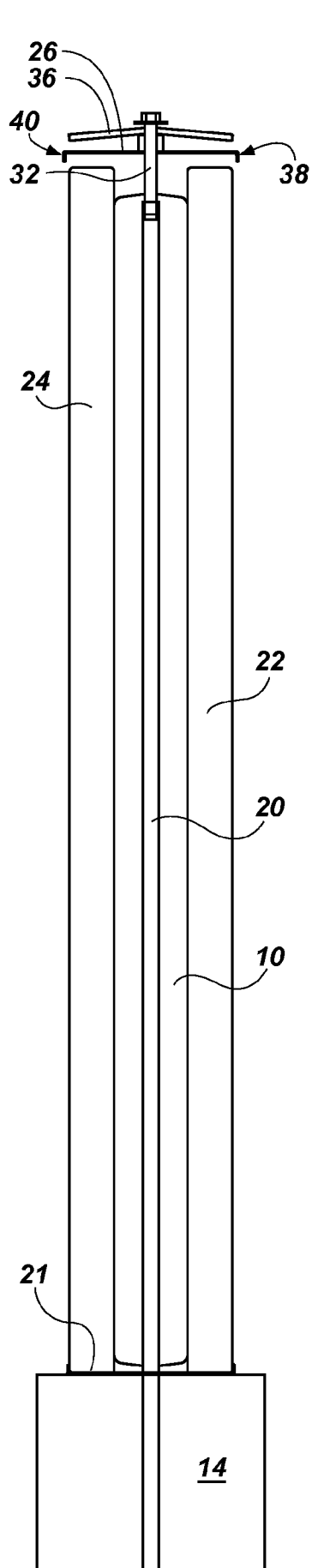


FIG. 7

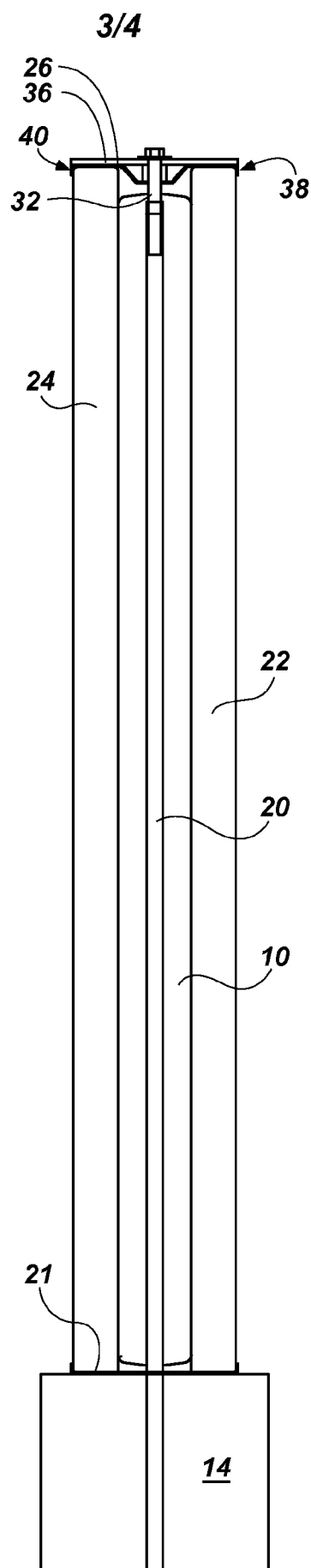


FIG. 8

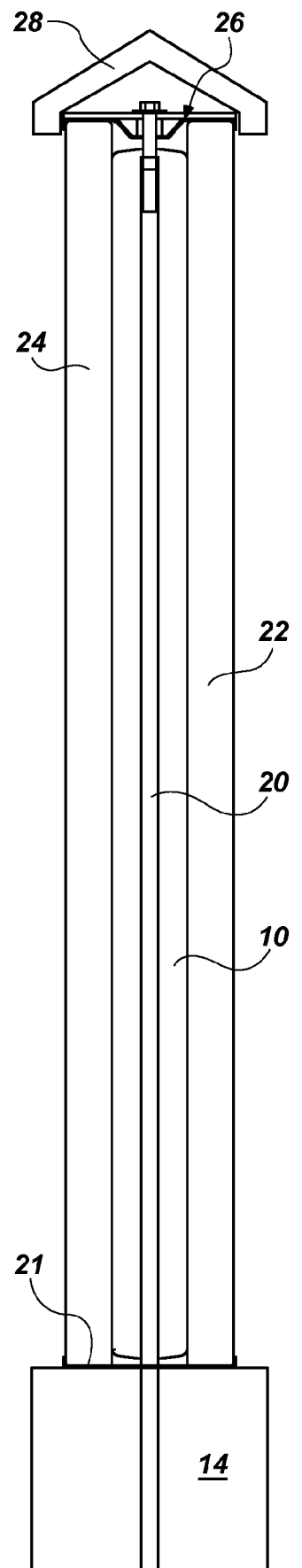


FIG. 9

4/4

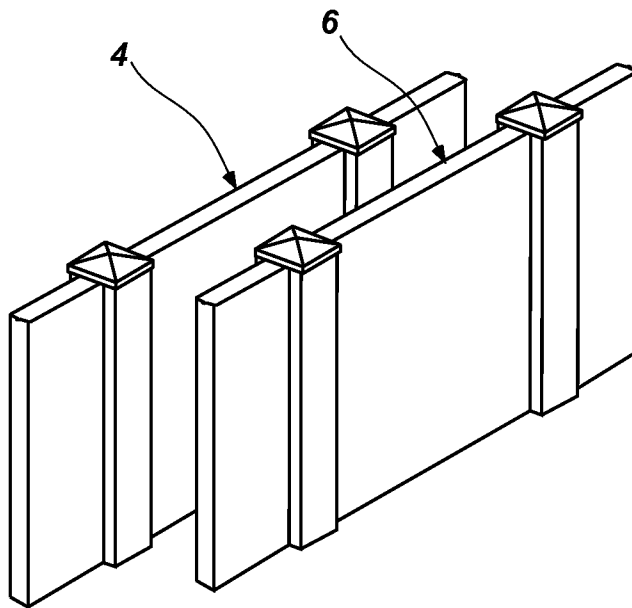


FIG. 10

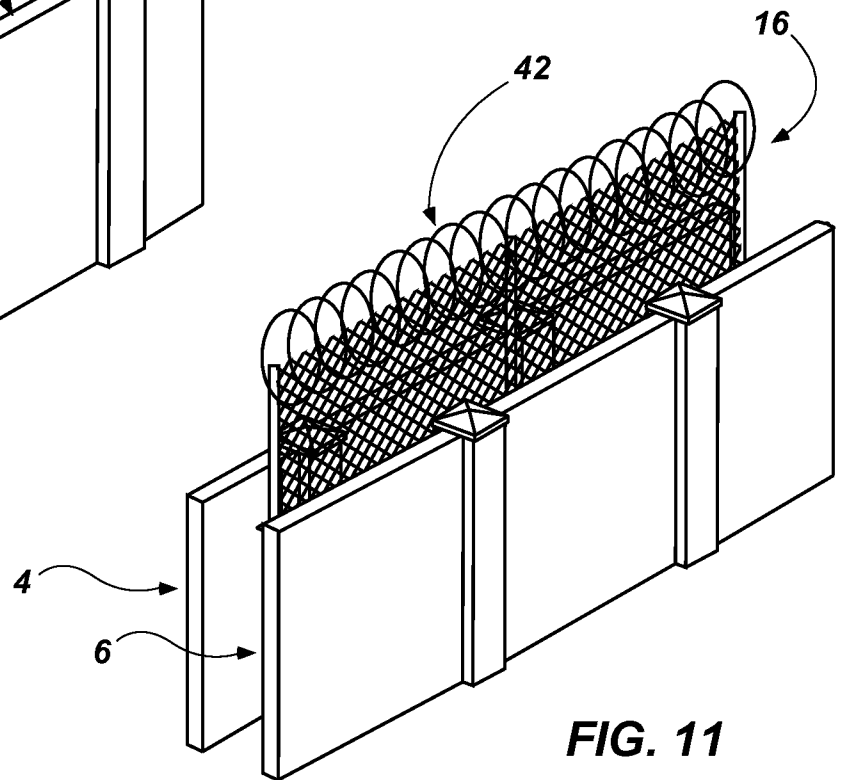


FIG. 11

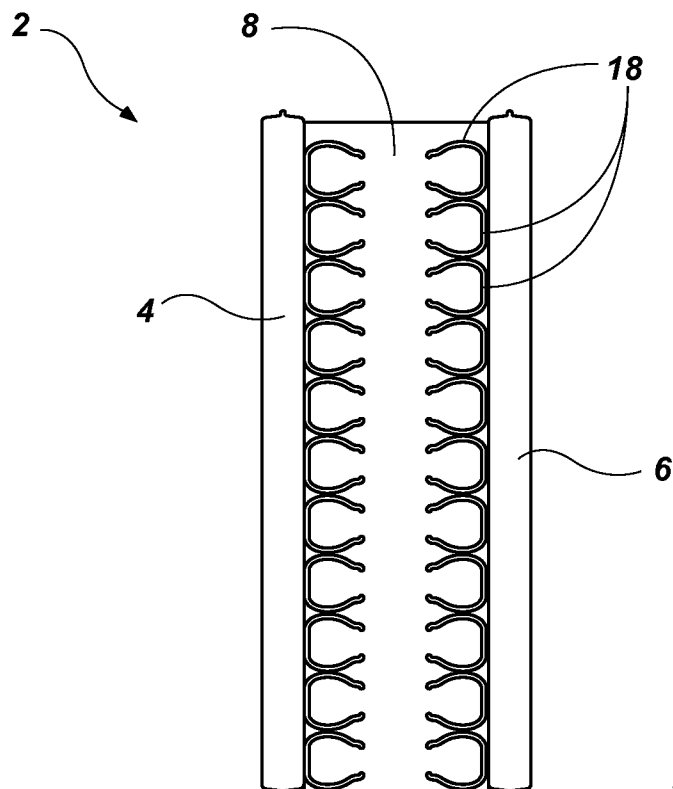


FIG. 12