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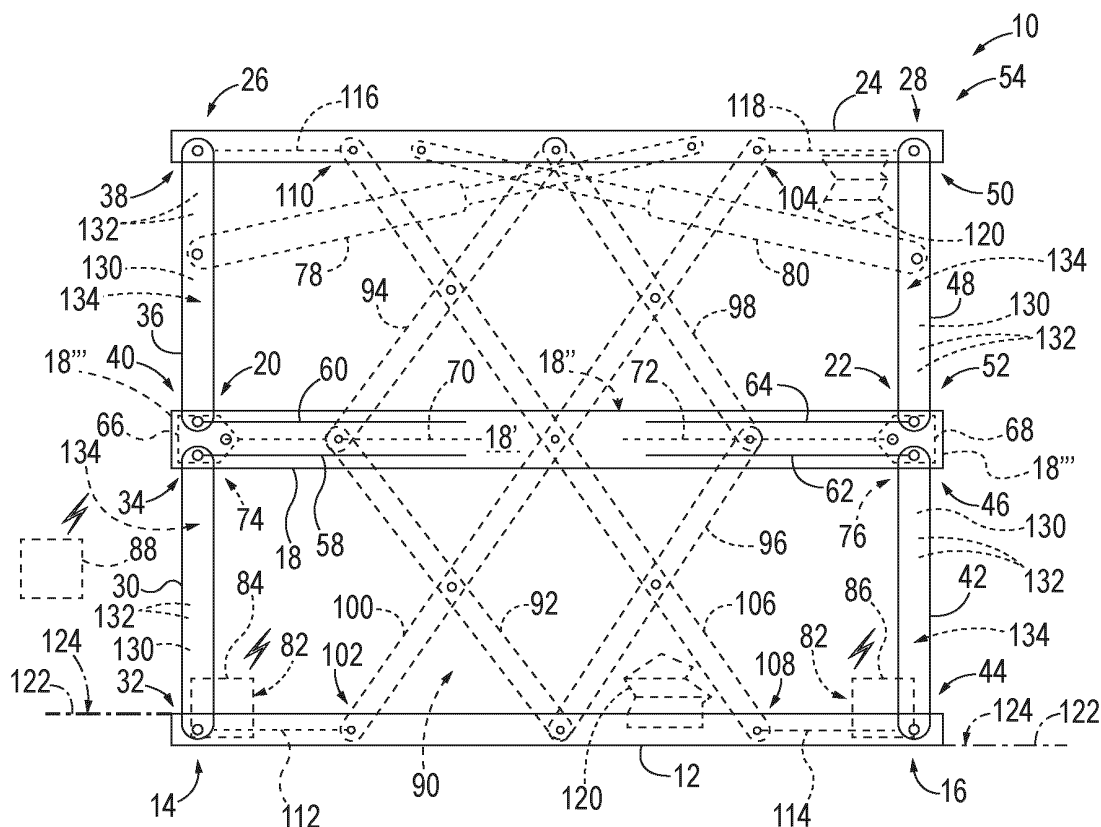
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(57) Collapsible guardrails comprise a base, a mid rail, a top rail, a lower left-side leg, an upper left-side leg, a lower right-side leg, and an upper right-side leg. Collap-

sible guardrails have a deployed configuration and a collapsed configuration.

**FIG. 1**

Description

FIELD

[0001] The present disclosure relates to collapsible guardrails.

BACKGROUND

[0002] In the manufacturing industry, fall protection is paramount when personnel are working above ground level. Guardrails are used on lifts and other high platforms to prevent falls. When not above ground level, however, guardrails may be obtrusive and restrict access to necessary manufacturing components, supplies, tools, and the like. Existing collapsible guardrails are expensive, are slow to deploy, and require regular maintenance.

SUMMARY

[0003] Collapsible guardrails according to the present disclosure comprise a base, a mid rail, a top rail, a lower left-side leg, an upper left-side leg, a lower right-side leg, and an upper right-side leg. Collapsible guardrails have a deployed configuration and a collapsed configuration.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004]

Fig. 1 is schematic front view representing collapsible guardrails according to the present disclosure in a deployed configuration.

Fig. 2 is a schematic front view representing collapsible guardrails according to the present disclosure in a collapsed configuration.

Fig. 3 is a schematic side view representing collapsible guardrails according to the present disclosure in a deployed configuration.

Fig. 4 is a schematic side view representing collapsible guardrails according to the present disclosure in a collapsed configuration.

Fig. 5 is an isometric view of an example collapsible guardrail according to the present disclosure, shown in its deployed configuration.

Fig. 6 is a side view of the collapsible guardrail of Fig. 5.

Fig. 7 is a front view of the collapsible guardrail of Fig. 5 with the screens removed for clarity.

Fig. 8 is a partial perspective view of the collapsible guardrail of Fig. 5, showing the motive source.

Fig. 9 is a partial perspective view of another collapsible guardrail, shown in its deployed configuration and showing the motive source.

DESCRIPTION

[0005] Collapsible guardrails 10 are disclosed herein

and schematically represented in Figs. 1-4. Generally, in Figs. 1-4, elements that are likely to be included in a given example are illustrated in solid lines, while elements that are optional to or that correspond to a given example are illustrated in dashed lines. However, elements that are illustrated in solid lines are not essential to all examples of the present disclosure, and an element shown in solid lines may be omitted from a particular example without departing from the scope of the present disclosure.

[0006] As schematically represented in Figs. 1-4, collapsible guardrails 10 comprise at least a base 12, a mid rail 18, a top rail 24, and four legs, namely, a lower left-side leg 30, an upper left-side leg 36, a lower right-side leg 42, and an upper right-side leg 48.

[0007] As indicated in Fig. 1, the base 12 comprises a base left-end region 14 and a base right-end region 16 that is opposite the base left-end region 14. In some examples, the base 12 additionally or alternatively may be described as a rail, a beam, or a support. While Fig. 1 schematically illustrates the base 12 extending continuously from the base left-end region 14 to the base right-end region 16, such a configuration is not required in all examples, and in some examples, the base left-end region 14 may be a distinct structure from the base right-end region 16. As used herein "end regions" are not limited to the terminus of a structure, but rather includes the terminal 20% of a length of the structure.

[0008] As schematically indicated in Fig. 1, the mid rail 18 is positioned above the base 12, and in some examples may be parallel to the base 12. Herein, positional terms, such as "above," "below," "left," "right," and so forth refer to collapsible guardrails 10 when operatively positioned for use and as presented in the figures. As indicated in Fig. 1, the mid rail 18 comprises a mid-rail left-end region 20 and a mid-rail right-end region 22 that is opposite the mid-rail left-end region 20. The mid-rail left-end region 20 is positioned above the base left-end region 14, and the mid-rail right-end region 22 is positioned above the base right-end region 16. Herein, a "rail" additionally or alternatively may be described as a beam or an elongate support.

[0009] As schematically illustrated in Fig. 1, the top rail 24 is positioned above and parallel to the mid rail 18 and comprises a top-rail left-end region 26 and a top-rail right-end region 28 that is opposite the top-rail left-end region 26. The top-rail left-end region 26 is positioned above the mid-rail left-end region 20, and the top-rail right-end region 28 is positioned above the mid-rail right-end region 22.

[0010] The legs additionally or alternatively may be described as arms, elongate supports, or linkages, and may be described in terms of their respective end regions and their relationships to the base 12, the mid rail 18, and the top rail 24. In particular, and as schematically indicated in Fig. 1, the lower left-side leg 30 comprises a lower-left-side-leg lower-end region 32 and a lower-left-side-leg upper-end region 34 that is opposite the lower-left-side-leg lower-end region 32. The lower-left-side-leg

lower-end region 32 is pivotally coupled to the base left-end region 14, and the lower-left-side-leg upper-end region 34 is pivotally and translationally coupled to the mid rail 18. The upper left-side leg 36 is positioned above the lower left-side leg 30 and comprises an upper-left-side-leg upper-end region 38 and an upper-left-side-leg lower-end region 40 that is opposite the upper-left-side-leg upper-end region 38. The upper-left-side-leg upper-end region 38 is pivotally coupled to the top-rail left-end region 26, and the upper-left-side-leg lower-end region 40 is pivotally and translationally coupled to the mid rail 18.

[0011] Similarly, the lower right-side leg 42 comprises a lower-right-side-leg lower-end region 44 and a lower-right-side-leg upper-end region 46 that is opposite the lower-right-side-leg lower-end region 44. The lower-right-side-leg lower-end region 44 is pivotally coupled to the base right-end region 16, and the lower-right-side-leg upper-end region 46 is pivotally and translationally coupled to the mid rail 18. The upper right-side leg 48 is positioned above the lower right-side leg 42 and comprises an upper-right-side-leg upper-end region 50 and an upper-right-side-leg lower-end region 52 that is opposite the upper-right-side-leg upper-end region 50. The upper-right-side-leg upper-end region 50 is pivotally coupled to the top-rail right-end region 28, and the upper-right-side-leg lower-end region 52 is pivotally and translationally coupled to the mid rail 18.

[0012] Collapsible guardrails 10 may be described as having a deployed configuration 54, in which the lower-left-side-leg upper-end region 34 and the upper-left-side-leg lower-end region 40 are adjacent the mid-rail left-end region 20, and in which the lower-right-side-leg upper-end region 46 and the upper-right-side-leg lower-end region 52 are adjacent the mid-rail right-end region 22, as schematically represented in Fig. 1. Collapsible guardrails 10 also may be described as having a collapsed configuration 56, in which the lower-left-side-leg upper-end region 34 and the upper-left-side-leg lower-end region 40 are spaced-away from the mid-rail left-end region 20 toward the mid-rail right-end region 22, and in which the lower-right-side-leg upper-end region 46 and the upper-right-side-leg lower-end region 52 are spaced-away from the mid-rail right-end region 22 toward the mid-rail left-end region 20, as schematically represented in Fig. 2. Accordingly, collapsible guardrails 10 may be selectively deployed to the deployed configuration 54, such as when collapsible guardrails 10 are needed to restrict personnel access to an adjacent region. For example, a collapsible guardrail 10 may be associated with a structure that is positioned above a ground surface, such a lift that is deployed to a lifted configuration. Conversely, collapsible guardrails 10 may be selectively collapsed, or retracted, to the collapsed configuration 56, such as when collapsible guardrails 10 are not needed to restrict personnel access to an adjacent region, for example, when an associated structure, such as a lift, is positioned near or at a ground surface.

[0013] With reference to Figs. 1 and 2, in some examples, the mid rail 18 defines a mid-rail lower-left track 58, a mid-rail upper-left track 60, a mid-rail lower-right track 62, and a mid-rail upper-right track 64. The tracks may take any suitable configuration, such that the respective identified structures are configured to translate along the tracks. Various structures may be utilized, including rollers or wheels that are configured to roll along the tracks, pinions (i.e., circular gears) that are meshed with racks (i.e., linear gears) and configured to rotate and translate along the racks, or pins or axles that are configured to slide along the tracks. The tracks additionally or alternatively may be, or may be described as, channels, slots, guides, or rails. Examples that include rollers or wheels that are configured to roll along the tracks and examples that include pins or axles that slide along the tracks may transition more quickly and/or easily between the deployed configuration 54 and the collapsed configuration 56 than examples that include rack and pinion or other geared configurations. Moreover, such examples may be less prone to binding-up, becoming skewed, or otherwise jamming as a result of transitioning too quickly between the deployed configuration 54 and the collapsed configuration 56.

[0014] The mid-rail lower-left track 58 extends from the mid-rail left-end region 20 toward the mid-rail right-end region 22. The lower-left-side-leg upper-end region 34 is configured to translate along the mid-rail lower-left track 58 when the collapsible guardrail 10 transitions between the deployed configuration 54 (Fig. 1) and the collapsed configuration 56 (Fig. 2).

[0015] The mid-rail upper-left track 60 extends from the mid-rail left-end region 20 toward the mid-rail right-end region 22. The upper-left-side-leg lower-end region 40 is configured to translate along the mid-rail upper-left track 60 when the collapsible guardrail 10 transitions between the deployed configuration 54 (Fig. 1) and the collapsed configuration 56 (Fig. 2). In some examples, the mid-rail upper-left track 60 is distinct from the mid-rail lower-left track 58, such as schematically represented in Figs. 1 and 2; however, in other examples, the mid-rail upper-left track 60 and the mid-rail lower-left track 58 are integral with each other.

[0016] The mid-rail lower-right track 62 extends from the mid-rail right-end region 22 toward the mid-rail left-end region 20. The lower-right-side-leg upper-end region 46 is configured to translate along the mid-rail lower-right track 62 when the collapsible guardrail 10 transitions between the deployed configuration 54 (Fig. 1) and the collapsed configuration 56 (Fig. 2). In some examples, as schematically represented in Figs. 1 and 2, the mid-rail lower-right track 62 is distinct from the mid-rail lower-left track 58; however, in other examples, the mid-rail lower-right track 62 and the mid-rail lower-left track 58 are integral with each other.

[0017] The mid-rail upper-right track 64 extends from the mid-rail right-end region 22 toward the mid-rail left-end region 20. The upper-right-side-leg lower-end region

52 is configured to translate along the mid-rail upper-right track 64 when the collapsible guardrail 10 transitions between the deployed configuration 54 (Fig. 1) and the collapsed configuration (Fig. 2). In some examples, as schematically represented in Figs. 1 and 2, the mid-rail upper-right track 64 is distinct from the mid-rail lower-right track 62; however, in other examples, the mid-rail upper-right track 64 and the mid-rail lower-right track 62 are integral with each other. In some examples, as schematically represented in Figs. 1 and 2, the mid-rail upper-right track 64 is distinct from the mid-rail upper-left track 60; however, in other examples, the mid-rail upper-right track 64 and the mid-rail upper-left track 60 are integral with each other.

[0018] As schematically illustrated in Fig. 1, some examples of collapsible guardrails 10 further comprise a left-leg connecting block 66 and a right-leg connecting block 68. The left-leg connecting block 66 operatively couples together the lower-left-side-leg upper-end region 34 and the upper-left-side-leg lower-end region 40, and the right-leg connecting block 68 operatively couples together the lower-right-side-leg upper-end region 46 and the upper-right-side-leg lower-end region 52. The connecting blocks additionally or alternatively may be described as or referred to as carriages.

[0019] In some examples, as schematically illustrated in Fig. 1, the mid rail 18 further defines a mid-rail left-central track 70 and a mid-rail right-central track 72. The mid-rail left-central track 70 extends from the mid-rail left-end region 20 toward the mid-rail right-end region 22, and the left-leg connecting block 66 is configured to translate along the mid-rail left-central track 70 when the collapsible guardrail 10 transitions between the deployed configuration 54 (Fig. 1) and the collapsed configuration 56 (Fig. 2). The mid-rail right-central track 72 extends from the mid-rail right-end region 22 toward the mid-rail left-end region 20, and the right-leg connecting block 68 is configured to translate along the mid-rail right-central track 72 when the collapsible guardrail 10 transitions between the deployed configuration 54 (Fig. 1) and the collapsed configuration 56 (Fig. 2). In some examples, as schematically represented in Fig. 1, the mid-rail right-central track 72 is distinct from the mid-rail left-central track 70; however, in other examples, the mid-rail right-central track 72 and the mid-rail left-central track 70 are integral with each other.

[0020] In some examples, as schematically represented in Fig. 1, the left-leg connecting block 66 is operatively engaged with the mid-rail lower-left track 58, the mid-rail upper-left track 60, and the mid-rail left-central track 70 in a left-side triangular pattern 74, and the right-leg connecting block 68 is operatively engaged with the mid-rail lower-right track 62, the mid-rail upper-right track 64, and the mid-rail right-central track 72 in a right-side triangular pattern 76. Such spatial configurations facilitate the smooth translation of the connecting blocks along the mid rail 18 without twisting, rotating, or pivoting relative to the mid rail 18, and thus avoiding the connect-

ing blocks from binding-up with the mid rail 18.

[0021] In some examples, the mid rail 18 comprises a front panel 18' and a rear panel 18" spaced-apart from the front panel 18'. In such examples, the corresponding tracks 58, 60, 62, 64, 70, and 72 therefore have corresponding front and rear sections. As a result, when the corresponding pins, axles, or other suitable structures extend from a front section to a rear section of the tracks, corresponding loads are separated into two components—one along the front panel 18' and one along the rear panel 18". Such a configuration results in a more stable collapsible guardrail 10 than if the corresponding loads along the mid rail 18 were singularly positioned along a mid-line of the collapsible guardrail 10. In some examples, the mid rail 18 further comprises end caps 18''' that operatively coupled together the front panel 18' and the rear panel 18". In some examples, the left-leg connecting block 66 and the right-leg connecting block 68 are positioned and configured to slide between the front panel 18' and the rear panel 18".

[0022] In some examples of collapsible guardrails 10, when the collapsible guardrail 10 is in the deployed configuration 54 (Fig. 1), the lower-left-side-leg upper-end region 34 is laterally left of the lower-left-side-leg lower-end region 32, the upper-left-side-leg lower-end region 40 is laterally left of the upper-left-side-leg upper-end region 38, the lower-right-side-leg upper-end region 46 is laterally right of the lower-right-side-leg lower-end region 44, and the upper-right-side-leg lower-end region 52 is laterally right of the upper-right-side-leg upper-end region 50. In other words, in the deployed configuration 54 (Fig. 1), the legs may be described as being over-center. That is, the weight of the top rail 24 and the weight of the mid rail 18 will urge the lower-left-side-leg upper-end region 34 and the upper-left-side-leg lower-end region 40 to the left and against the terminuses of the mid-rail lower-left track 58 and the mid-rail upper-left track 60. Similarly, the weight of the top rail 24 and the weight of the mid rail 18 will urge the lower-right-side-leg upper-end region 46 and the upper-right-side-leg lower-end region 52 to the right and against the terminuses of the mid-rail lower-right track 62 and the mid-rail upper-right track 64. In such a configuration, the weight of the top rail 24 and the weight of the mid rail 18 will restrict unintentional transition from the deployed configuration (Fig. 1) to the collapsed configuration (Fig. 2).

[0023] In some examples of collapsible guardrails 10, at least one of the lower-left-side-leg upper-end region 34 and the upper-left-side-leg lower-end region 40 is biased toward the mid-rail left-end region 20, and at least one of the lower-right-side-leg upper-end region 46 and the upper-right-side-leg lower-end region 52 is biased toward the mid-rail right-end region 22. In examples where the left legs are coupled together via a left-leg connecting block 66 and the right legs are coupled together via a right-leg connecting block 68, the collapsible guardrails 10 are biased toward the deployed configuration 54 (Fig. 1), thereby restricting the inadvertent transition of the

collapsible guardrails 10 toward the collapsed configuration 56.

[0024] In some examples, collapsible guardrails 10 further comprise a left-side spring 78 and a right-side spring 80. As examples, the springs may be or comprise coil springs, torsion springs, pneumatic cylinders, or hydraulic cylinders. The left-side spring 78 is operatively coupled between the base 12 and the lower left-side leg 30 and is configured to bias the lower-left-side-leg mid-rail left-end region 20 or, as schematically illustrated in Fig. 1, between the top rail 24 and the upper left-side leg 36 and is configured to bias the upper-left-side-leg lower-end region 40 toward the mid-rail left-end region 20. The right-side spring 80 is operatively coupled between the base 12 and the lower right-side leg 42 and is configured to bias the lower-right-side-leg upper-end region 46 toward the mid-rail right-end region 22 or, as schematically illustrated in Fig. 1, between the top rail 24 and the upper right-side leg 48 and is configured to bias the upper-right-side-leg lower-end region 52 toward the mid-rail right-end region 22.

[0025] With continued reference to Fig. 1, as schematically represented, some collapsible guardrails 10 further comprise one or more motive sources 82 that are configured to selectively translate the lower-left-side-leg upper-end region 34 and the upper-left-side-leg lower-end region 40 toward the mid-rail left-end region 20, and the lower-right-side-leg upper-end region 46 and the upper-right-side-leg lower-end region 52 toward the mid-rail right-end region 22. In examples where the left legs are coupled together via a left-leg connecting block 66 and the right legs are coupled together via a right-leg connecting block 68, the motive source(s) 82 may directly move the upper legs or the lower legs and indirectly move the lower legs or the upper legs, respectively, or the motive source(s) 82 may directly move the left legs or the right legs and indirectly move the right legs or the left legs, respectively. The motive source(s) 82 may comprise any suitable structures and mechanisms, such as motors, gears, chains, cogs, pneumatic mechanisms (e.g., pneumatic cylinders), and/or hydraulic mechanisms (e.g. hydraulic cylinders).

[0026] In some examples, the motive source 82 is a single motive source 82; however, in other examples and as schematically represented in Fig. 1, the motive sources 82 comprise a left-side motive source 84 and a right-side motive source 86. The left-side motive source 84 is configured to selectively translate the lower-left-side-leg upper-end region 34 and the upper-left-side-leg lower-end region 40 toward the mid-rail left-end region 20, and the right-side motive source 86 is configured to selectively translate the lower-right-side-leg upper-end region 46 and the upper-right-side-leg lower-end region 52 toward the mid-rail right-end region 22.

[0027] In some examples, the motive source(s) 82 do not include worm gears, lead screws, feed screws, ball screws, threaded nuts, and the like, which otherwise may result in slow operation of a collapsible guardrail 10.

[0028] As schematically indicated in Fig. 1, in some examples, collapsible guardrails 10 further comprise a controller 88 that is operatively coupled to the motive source(s) 82 and that is configured to operate the motive source(s) 82 responsive to a user input, such as via actuation of a button, a lever, a dial, a keystroke, a touch screen, or other mechanism. Accordingly, a user may selectively deploy a collapsible guardrail 10 to the deployed configuration 54 (Fig. 1) and selectively collapse a collapsible guardrail 10 to the collapsed configuration 56 (Fig. 2). In Fig. 1, the controller 88 and the motive sources 82 are schematically represented with lightning bolts, schematically representing communication between the controller 88 and the motive source(s) 82. Such communication may be wired or wireless. A controller 88 may be any suitable device or devices that are configured to perform the functions of the controller 88 discussed herein. For example, the controller 88 may comprise one or more of an electronic controller, a dedicated controller, a special-purpose controller, a personal computer, a special-purpose computer, a display device, a logic device, a memory device, and/or a memory device having computer readable media suitable for storing computer-executable instructions for performing the stated function of the controller 88.

[0029] Turning to Fig. 3, which schematically illustrates collapsible guardrails 10 in the deployed configuration, collapsible guardrails 10 may be described as having a height 126 when in the deployed configuration 54, and each of the lower left-side leg 30, the upper left-side leg 36, the lower right-side leg 42, and the upper right-side leg 48 may be described as having a width 128. In various examples, the width 128 of the legs may be at least 5%, at least 10%, at least 15%, 5-20%, or 10-20% of the height 126. In particular, selection of a greater width 128 will facilitate greater stability of a collapsible guardrail 10 when a force is applied, for example, to the top rail 24. Moreover, tensile stresses will be concentrated on one of the front or rear edges of the legs, while compressive stresses will be concentrated on the other of the front or rear edges of the legs, when a forward or rearward force is applied to the top rail 24.

[0030] In some examples, as schematically indicated in Figs. 1 and 3, each of the lower left-side leg 30, the upper left-side leg 36, the lower right-side leg 42, and the upper right-side leg 48 comprises a web 130 and at least one flange 132, such as two flanges 132. When present, the web 130 extends in the forward and rearward direction, while the flange(s) extend orthogonal to the web 130. As an example, each of the lower left-side leg 30, the upper left-side leg 36, the lower right-side leg 42, and the upper right-side leg 48 may comprise a C-channel 134, with the flanges 132 positioned on the front and rear edges of the legs. As a result, the flanges 132 bear the bulk of the compressive and tensile stresses when a moment is applied to the collapsible guardrail 10, such as via a forward or rearward force applied to the top rail 24, resulting in a very sturdy collapsible guardrail 10. In

examples of collapsible guardrails 10 whose mid rail 18 comprises a front panel 18' and a rear panel 18" and whose legs comprise a C-channel 134, the compressive and tensile stresses will pass from the flanges 132 through the front panel 18' and the rear panel 18", such as via the associated pins, axles, or other structures, including the optional connecting blocks 66, 68, that operatively couple the legs to the mid rail 18.

[0031] With continued reference to Fig. 1, some examples of collapsible guardrails 10 further comprise a lattice structure 90 that is operatively coupled between the base 12 and the top rail 24 and that is configured to operatively support the top rail 24 relative to the base 12. That is, the lattice structure 90, when present, provides support in addition to the legs between the top rail 24 and the base 12. In some such examples, the lattice structure 90 also is operatively coupled to the mid rail 18 and is configured to support the mid rail 18 relative to the top rail 24 and the base 12.

[0032] As schematically illustrated in Fig. 1, in some examples, the lattice structure 90 comprises a lower-left lattice member 92, an upper-left lattice member 94, a lower-right lattice member 96, and an upper-right lattice member 98. The lattice members additionally or alternatively may be described as arms, beans, elongate members, bars, links, or linkages. The lower-left lattice member 92 is pivotally coupled to the base 12. The upper-left lattice member 94 is pivotally coupled to the lower-left lattice member 92 and also is pivotally coupled to the top rail 24. The lower-right lattice member 96 is pivotally coupled to the base 12. The upper-right lattice member 98 is pivotally coupled to the lower-right lattice member 96 and also is pivotally coupled to the top rail 24. In some examples and as schematically represented in Fig. 1, the lower-left lattice member 92 and the lower-right lattice member 96 share a pivot axis along the base 12. Similarly, in some examples, the upper-left lattice member 94 and the upper-right lattice member 98 share a pivot axis along the top rail 24. Accordingly, in such examples, and as schematically illustrated in Fig. 1, the lower-left lattice member 92, the upper-left lattice member 94, the lower-right lattice member 96 pivotally coupled to the base 12, and the upper-right lattice member 98 define a parallelogram.

[0033] With continued reference to Fig. 1, in some examples, the lattice structure 90 further comprises a first angled member 100 and a second angled member 106. The first angled member 100 comprises a first-angled-member lower-end region 102 and a first-angled-member upper-end region 104 that is opposite the first-angled-member lower-end region 102. The first-angled-member lower-end region 102 is pivotally and translationally coupled to the base 12, and the first-angled-member upper-end region 104 is pivotally and translationally coupled to the top rail 24. The second angled member 106 comprises a second-angled-member lower-end region 108 and a second-angled-member upper-end region 110 that is opposite the second-angled-

member lower-end region 108. The second-angled-member lower-end region 108 is pivotally and translationally coupled to the base 12, and the second-angled-member upper-end region 110 is pivotally and translationally coupled to the top rail 24. As a result, when such a collapsible guardrail 10 transitions between the deployed configuration 54 and the collapsed configuration 56, the end regions of the first angled member 100 and the second angled member 106 translate along the base 12 and the top rail 24.

[0034] In some such examples and as schematically represented in Fig. 1, the base 12 defines a base left-side track 112 and a base right-side track 114, and the top rail 24 defines a top-rail left-side track 116 and a top-rail right-side track 118. The base left-side track 112 extends from the base left-end region 14 toward the base right-end region 16, and the first-angled-member lower-end region 102 is configured to translate along the base left-side track 112 when the collapsible guardrail 10 transitions between the deployed configuration 54 and the collapsed configuration 56. The base right-side track 114 extends from the base right-end region 16 toward the base left-end region 14, and the second-angled-member lower-end region 108 is configured to translate along the base right-side track 114 when the collapsible guardrail 10 transitions between the deployed configuration 54 and the collapsed configuration 56. The top-rail left-side track 116 extends from the top-rail left-end region 26 toward the top-rail right-end region 28, and the second-angled-member upper-end region 110 is configured to translate along the top-rail left-side track 116 when the collapsible guardrail 10 transitions between the deployed configuration 54 and the collapsed configuration 56. The top-rail right-side track 118 extends from the top-rail right-end region 28 toward the top-rail left-end region 26, and the first-angled-member upper-end region 104 is configured to translate along the top-rail right-side track 118 when the collapsible guardrail 10 transitions between the deployed configuration 54 and the collapsed configuration 56.

[0035] In some examples, as schematically represented in Fig. 1, the first angled member 100 is pivotally coupled to the second angled member 106. In some examples, the first angled member 100 and the second angled member 106 are pivotally coupled to the mid rail 18. In some such examples, the first angled member 100 and the second angled member 106 share an axis at the mid rail 18. In some examples, the first angled member 100 and the second angled member 106 may be described as defining an X shape.

[0036] In examples in which the lattice structure 90 comprises all six of the lower-left lattice member 92, the upper-left lattice member 94, the lower-right lattice member 96, the upper-right lattice member 98, the first angled member 100, and the second angled member 106, the first angled member 100 may be pivotally coupled to both the lower-left lattice member 92 and the upper-right lattice member 98, and the second angled

member 106 may be pivotally coupled to both the upper-left lattice member 94 and to the lower-right lattice member 96, as schematically represented in Fig. 1. As a result, in such examples, the lattice structure 90 maintains a parallel relationship between the base 12, the mid rail 18, and the top rail 24 and restricts them from binding-up or otherwise inhibiting the smooth transition of a such a collapsible guardrail 10 between the deployed configuration 54 and the collapsed configuration.

[0037] With continued reference to Fig. 1 and schematically and optionally illustrated in fragment, some collapsible guardrails 10 further comprise at least one screen 120 that is operatively coupled between the base 12 and the top rail 24 and that is configured to restrict access to at least the mid rail 18. In some examples, the screen(s) are operatively coupled to the mid rail 18. In particular, a screen 120 may be present to restrict personnel from inadvertently entering the space between the base 12 and the top rail 24, such as according to the United States Occupational Safety and Health Administration (OSHA) standards, or other similar governmental or safety standards around the world. The screen(s) 120 may be coupled to the front and/or to the back of a collapsible guardrail 10. In some examples, the screen(s) further restrict access to the lattice structure 90, when present, while in other examples, the lattice structure 90, when present, is positioned on the outside of a screen 120. In some examples, the screen(s) 120 are configured to restrict access to the left-side spring 78 and to the right-side spring 80, when present. In some examples, the screen(s) 120 are configured to restrict access to the motive source(s) 82. Screens 120 additionally or alternatively may be described as curtains and may be corrugated and/or may define an accordion, or folded, configuration.

[0038] Collapsible guardrails 10 may be configured for installation in a variety of environments. As schematically represented on the right side of Fig. 1, the base 12 may be configured to be mounted to an upper surface 122 of a structure 124. Additionally or alternatively, as schematically represented on the left side of Fig. 1, the base 12 may be configured to be below an upper surface 122 of a structure 124.

[0039] Turning now to Figs. 5-9, illustrative non-exclusive examples of collapsible guardrails 10 in the form of a collapsible guardrail 200 (Figs. 5-8) and collapsible guardrail 300 (Fig. 9) are illustrated. Where appropriate, the reference numerals from the schematic illustrations of Figs. 1-4 are used to designate corresponding parts of the collapsible guardrails 200, 300; however, the examples of Figs. 5-9 are non-exclusive and do not limit collapsible guardrails 10 to the illustrated embodiment of the collapsible guardrails 200, 300. That is, collapsible guardrails 10 are not limited to the specific embodiments of the illustrated collapsible guardrails 200, 300, and collapsible guardrails 10 may incorporate any number of the various aspects, configurations, characteristics, properties, etc. of collapsible guardrails 10 that are illu-

strated in and discussed with reference to the schematic representations of Figs. 1-4 and/or the embodiments of Figs. 5-9, as well as variations thereof, without requiring the inclusion of all such aspects, configurations, characteristics, properties, etc. For the purpose of brevity, each previously discussed component, part, portion, aspect, region, etc. or variants thereof may not be discussed, illustrated, and/or labeled again with respect to the collapsible guardrails 200, 300; however, it is within the scope of the present disclosure that the previously discussed features, variants, etc. may be utilized with the collapsible guardrails 200, 300.

[0040] As illustrated in Figs. 5-8, the collapsible guardrail 200 is an example of a collapsible guardrail 10 that comprises tracks 58, 60, 62, 64, 70, 72, 112, 114, 116, 118, connecting blocks 66, 68, springs 78, 80, motive sources 84, 86, two lattice structures 90, each comprising members 92, 94, 96, 98, 100, 106, and four screens 120. The left-side motive source 84 comprises a left-side pneumatic cylinder 202 operatively coupled between the base 12 and the lower left-side leg 30, and the right-side motive source 86 similarly comprises a right-side pneumatic cylinder 204 operatively coupled between the base 12 and the lower right-side leg 42. The legs 30, 36, 42, 48 each comprise a C-channel 134.

[0041] The collapsible guardrail 300 illustrated in Fig. 9 is constructed similarly to the collapsible guardrail 200 of Figs. 5-9, except that the left-side motive source 84 comprises a left-side pneumatic motor 302 supported by the base 12 and operatively coupled to a left-leg axle 304 of the lower left-side leg 30, and the right-side motive source 86 comprises a right-side pneumatic motor 306 supported by the base 12 and operatively coupled to a right-leg axle 308 of the lower right-side leg 42. The collapsible guardrail 300 further comprises a chain and gear train 310 operatively coupled between the left-leg axle 304 and the right-leg axle 308 to ensure that the lower left-side leg 30 and the lower right-side leg 42 are synchronized when the collapsible guardrail 300 transitions between the deployed configuration 54 and the collapsed configuration 56.

[0042] Illustrative, non-exclusive examples of inventive subject matter according to the present disclosure are described in the following enumerated paragraphs:

A. A collapsible guardrail (10), comprising:

- a base (12) comprising a base left-end region (14) and a base right-end region (16) opposite the base left-end region (14);
- a mid rail (18) positioned above the base (12), wherein the mid rail (18) comprises a mid-rail left-end region (20) and a mid-rail right-end region (22) opposite the mid-rail left-end region (20), and wherein the mid-rail left-end region (20) is positioned above the base left-end region (14) and the mid-rail right-end region (22) is positioned above the base right-end region (16);

a top rail (24) positioned above and parallel to the mid rail (18), wherein the top rail (24) comprise a top-rail left-end region (26) and a top-rail right-end region (28) opposite the top-rail left-end region (26), and wherein the top-rail left-end region (26) is positioned above the mid-rail left-end region (20) and the top-rail right-end region (28) is positioned above the mid-rail right-end region (22);

a lower left-side leg (30) comprising a lower-left-side-leg lower-end region (32) and a lower-left-side-leg upper-end region (34) opposite the lower-left-side-leg lower-end region (32), wherein the lower-left-side-leg lower-end region (32) is pivotally coupled to the base left-end region (14), and wherein the lower-left-side-leg upper-end region (34) is pivotally and translationally coupled to the mid rail (18);

an upper left-side leg (36) positioned above the lower left-side leg (30) and comprising an upper-left-side-leg upper-end region (38) and an upper-left-side-leg lower-end region (40) opposite the upper-left-side-leg upper-end region (38), wherein the upper-left-side-leg upper-end region (38) is pivotally coupled to the top-rail left-end region (26), and wherein the upper-left-side-leg lower-end region (40) is pivotally and translationally coupled to the mid rail (18);

a lower right-side leg (42) comprising a lower-right-side-leg lower-end region (44) and a lower-right-side-leg upper-end region (46) opposite the lower-right-side-leg lower-end region (44), wherein the lower-right-side-leg lower-end region (44) is pivotally coupled to the base right-end region (16), and wherein the lower-right-side-leg upper-end region (46) is pivotally and translationally coupled to the mid rail (18); and

an upper right-side leg (48) positioned above the lower right-side leg (42) and comprising an upper-right-side-leg upper-end region (50) and an upper-right-side-leg lower-end region (52) opposite the upper-right-side-leg upper-end region (50), wherein the upper-right-side-leg upper-end region (50) is pivotally coupled to the top-rail right-end region (28), and wherein the upper-right-side-leg lower-end region (52) is pivotally and translationally coupled to the mid rail (18);

wherein the collapsible guardrail (10) has a deployed configuration (54), in which the lower-left-side-leg upper-end region (34) and the upper-left-side-leg lower-end region (40) are adjacent the mid-rail left-end region (20), and in which the lower-right-side-leg upper-end region (46) and the upper-right-side-leg lower-end region (52) are adjacent the mid-rail right-end region (22); and

wherein the collapsible guardrail (10) has a col-

lapsed configuration (56), in which the lower-left-side-leg upper-end region (34) and the upper-left-side-leg lower-end region (40) are spaced-away from the mid-rail left-end region (20) toward the mid-rail right-end region (22), and in which the lower-right-side-leg upper-end region (46) and the upper-right-side-leg lower-end region (52) are spaced-away from the mid-rail right-end region (22) toward the mid-rail left-end region (20).

A1. The collapsible guardrail (10) of paragraph A, wherein the mid rail (18) defines:

a mid-rail lower-left track (58) extending from the mid-rail left-end region (20) toward the mid-rail right-end region (22), wherein the lower-left-side-leg upper-end region (34) is configured to translate along the mid-rail lower-left track (58) when the collapsible guardrail (10) transitions between the deployed configuration (54) and the collapsed configuration (56);

a mid-rail upper-left track (60) extending from the mid-rail left-end region (20) toward the mid-rail right-end region (22), wherein the upper-left-side-leg lower-end region (40) is configured to translate along the mid-rail upper-left track (60) when the collapsible guardrail (10) transitions between the deployed configuration (54) and the collapsed configuration (56);

a mid-rail lower-right track (62) extending from the mid-rail right-end region (22) toward the mid-rail left-end region (20), wherein the lower-right-side-leg upper-end region (46) is configured to translate along the mid-rail lower-right track (62) when the collapsible guardrail (10) transitions between the deployed configuration (54) and the collapsed configuration (56); and

a mid-rail upper-right track (64) extending from the mid-rail right-end region (22) toward the mid-rail left-end region (20), wherein the upper-right-side-leg lower-end region (52) is configured to translate along the mid-rail upper-right track (64) when the collapsible guardrail (10) transitions between the deployed configuration (54) and the collapsed configuration (56).

A2. The collapsible guardrail (10) of any of paragraphs A-A1, further comprising:

a left-leg connecting block (66) operatively coupling together the lower-left-side-leg upper-end region (34) and the upper-left-side-leg lower-end region (40); and

a right-leg connecting block (68) operatively coupling together the lower-right-side-leg upper-end region (46) and the upper-right-side-leg lower-end region (52).

A2.1. The collapsible guardrail (10) of paragraph A2, wherein the mid rail (18) defines:

a mid-rail left-central track (70) extending from the mid-rail left-end region (20) toward the mid-rail right-end region (22), wherein the left-leg connecting block (66) is configured to translate along the mid-rail left-central track (70) when the collapsible guardrail (10) transitions between the deployed configuration (54) and the collapsed configuration (56); and
a mid-rail right-central track (72) extending from the mid-rail right-end region (22) toward the mid-rail left-end region (20), wherein the right-leg connecting block (68) is configured to translate along the mid-rail right-central track (72) when the collapsible guardrail (10) transitions between the deployed configuration (54) and the collapsed configuration (56).

A2.1.1. The collapsible guardrail (10) of paragraph A2.1 when depending from paragraph A1,

wherein the left-leg connecting block (66) is operatively engaged with the mid-rail lower-left track (58), the mid-rail upper-left track (60), and the mid-rail left-central track (70) in a left-side triangular pattern (74); and
wherein the right-leg connecting block (68) is operatively engaged with the mid-rail lower-right track (62), the mid-rail upper-right track (64), and the mid-rail right-central track (72) in a right-side triangular pattern (76).

A3. The collapsible guardrail (10) of any of paragraphs A-A2.1.1, wherein when the collapsible guardrail (10) is in the deployed configuration (54):

the lower-left-side-leg upper-end region (34) is laterally left of the lower-left-side-leg lower-end region (32);
the upper-left-side-leg lower-end region (40) is laterally left of the upper-left-side-leg upper-end region (38);
the lower-right-side-leg upper-end region (46) is laterally right of the lower-right-side-leg lower-end region (44); and
the upper-right-side-leg lower-end region (52) is laterally right of the upper-right-side-leg upper-end region (50).

A4. The collapsible guardrail (10) of any of paragraphs A-A3,

wherein at least one of the lower-left-side-leg upper-end region (34) and the upper-left-side-leg lower-end region (40) is biased toward the mid-rail left-end region (20); and

wherein at least one of the lower-right-side-leg upper-end region (46) and the upper-right-side-leg lower-end region (52) is biased toward the mid-rail right-end region (22).

A4.1. The collapsible guardrail (10) of paragraph A4, further comprising:

a left-side spring (78) operatively coupled between the base (12) and the lower left-side leg (30) and configured to bias the lower-left-side-leg upper-end region (34) toward the mid-rail left-end region (20), or between the top rail (24) and the upper left-side leg (36) and configured to bias the upper-left-side-leg lower-end region (40) toward the mid-rail left-end region (20); and
right-side spring (80) operatively coupled between the base (12) and the lower right-side leg (42) and configured to bias the lower-right-side-leg upper-end region (46) toward the mid-rail right-end region (22), or between the top rail (24) and the upper right-side leg (48) and configured to bias the upper-right-side-leg lower-end region (52) toward the mid-rail right-end region (22).

A5. The collapsible guardrail (10) of any of paragraphs A-A4.1, further comprising:

one or more motive sources (82) configured to selectively translate the lower-left-side-leg upper-end region (34) and the upper-left-side-leg lower-end region (40) toward the mid-rail left-end region (20), and the lower-right-side-leg upper-end region (46) and the upper-right-side-leg lower-end region (52) toward the mid-rail right-end region (22).

A5.1. The collapsible guardrail (10) of paragraph A5, wherein the one or more motive sources (82) comprise:

a left-side motive source (84) configured to selectively translate the lower-left-side-leg upper-end region (34) and the upper-left-side-leg lower-end region (40) toward the mid-rail left-end region (20); and
a right-side motive source (86) configured to selectively translate the lower-right-side-leg upper-end region (46) and the upper-right-side-leg lower-end region (52) toward the mid-rail right-end region (22).

A5.2. The collapsible guardrail (10) of any of paragraphs A5-A5.1, further comprising:

a controller (88) operatively coupled to the one or more motive sources (82) and configured to operate the one or more motive sources (82) responsive to a user input.

A6. The collapsible guardrail (10) of any of paragraphs A-A5.2,

wherein in the deployed configuration (54), the collapsible guardrail (10) has a height (126); wherein each of the lower left-side leg (30), the upper left-side leg (36), the lower right-side leg (42) and the upper right-side leg (48) has a width (128); and wherein the width (128) is at least 5%, at least 10%, at least 15%, 5-20%, or 10-20% of the height (126).

A7. The collapsible guardrail (10) of any of paragraphs A-A6, further comprising:

a lattice structure (90) operatively coupled between the base (12) and the top rail (24) and configured to operatively support the top rail (24) relative to the base (12).

A7.1. The collapsible guardrail (10) of paragraph A7, wherein the lattice structure (90) is further operatively coupled to the mid rail (18) and configured to support the mid rail (18) relative to the top rail (24) and the base (12).

A7.2. The collapsible guardrail (10) of any of paragraphs A7-A7.1, wherein the lattice structure (90) comprises:

a lower-left lattice member (92) pivotally coupled to the base (12);
 an upper-left lattice member (94) pivotally coupled to the lower-left lattice member (92) and pivotally coupled to the top rail (24);
 a lower-right lattice member (96) pivotally coupled to the base (12); and
 an upper-right lattice member (98) pivotally coupled to the lower-right lattice member (96) and pivotally coupled to the top rail (24).

A7.2.1. The collapsible guardrail (10) of paragraph A7.2, wherein the lower-left lattice member (92), the upper-left lattice member (94), the lower-right lattice member (96), and the upper-right lattice member (98) define a parallelogram.

A7.3. The collapsible guardrail (10) of any of paragraphs A7-A7.2.1, wherein the lattice structure (90) comprises:

a first angled member (100) comprising a first-angled-member lower-end region (102) and a first-angled-member upper-end region (104) opposite the first-angled-member lower-end region (102), wherein the first-angled-member lower-end region (102) is pivotally and translationally coupled to the base (12), and wherein the first-angled-member upper-end region (104) is pivotally and translationally coupled to the top rail (24); and
 a second angled member (106) comprising a second-angled-member lower-end region (108) and a second-angled-member upper-end re-

gion (110) opposite the second-angled-member lower-end region (108), wherein the second-angled-member lower-end region (108) is pivotally and translationally coupled to the base (12), and wherein the second-angled-member upper-end region (110) is pivotally and translationally coupled to the top rail (24).

A7.3.1. The collapsible guardrail (10) of paragraph A7.3,

wherein the base (12) defines:

a base left-side track (112) extending from the base left-end region (14) toward the base right-end region (16), wherein the first-angled-member lower-end region (102) is configured to translate along the base left-side track (112) when the collapsible guardrail (10) transitions between the deployed configuration (54) and the collapsed configuration (56); and
 a base right-side track (114) extending from the base right-end region (16) toward the base left-end region (14), wherein the second-angled-member lower-end region (108) is configured to translate along the base right-side track (114) when the collapsible guardrail (10) transitions between the deployed configuration (54) and the collapsed configuration (56); and

wherein the top rail (24) defines:

a top-rail left-side track (116) extending from the top-rail left-end region (26) toward the top-rail right-end region (28), wherein the second-angled-member upper-end region (110) is configured to translate along the top-rail left-side track (116) when the collapsible guardrail (10) transitions between the deployed configuration (54) and the collapsed configuration (56); and
 a top-rail right-side track (118) extending from the top-rail right-end region (28) toward the top-rail left-end region (26), and wherein the first-angled-member upper-end region (104) is configured to translate along the top-rail right-side track (118) when the collapsible guardrail (10) transitions between the deployed configuration (54) and the collapsed configuration (56).

A7.3.2. The collapsible guardrail (10) of any of paragraphs A7.3-A7.3.1, wherein the first angled member (100) is pivotally coupled to the second angled member (106).

A7.3.3. The collapsible guardrail (10) of any of para-

graphs A7.3-A7.3.2, wherein the first angled member (100) and the second angled member (106) are pivotally coupled to the mid rail (18).

A7.3.4. The collapsible guardrail (10) of any of paragraphs A7.3-A7.3.3, wherein the first angled member (100) and the second angled member (106) define an X shape.

A7.3.5. The collapsible guardrail (10) of any of paragraphs A7.3-A7.3.4, when depending from paragraph A7.2,

wherein the first angled member (100) is pivotally coupled to the lower-left lattice member (92) and is pivotally coupled to the upper-right lattice member (98); and

wherein the second angled member (106) is pivotally coupled to the upper-left lattice member (94) and is pivotally coupled to the lower-right lattice member (96).

A8. The collapsible guardrail (10) of any of paragraphs A-A7.3.5, further comprising:

at least one screen (120) operatively coupled between the base (12) and the top rail (24) and configured to restrict access to the mid rail (18).

A8.1. The collapsible guardrail (10) of paragraph A8, wherein the at least one screen (120) is further operatively coupled to the mid rail (18).

A8.2. The collapsible guardrail (10) of any of paragraphs A8-A8.1, when depending from paragraph A4.1, wherein the at least one screen (120) is configured to restrict access to the left-side spring (78) and to the right-side spring (80).

A8.3. The collapsible guardrail (10) of any of paragraphs A8-A8.2, when depending from paragraph A5, wherein the at least one screen (120) is configured to restrict access to the one or more motive sources (82).

A8.4. The collapsible guardrail (10) of any of paragraphs A8-A8.3, when depending from paragraph A7, wherein the at least one screen (120) is configured to restrict access to the lattice structure (90).

A9. The collapsible guardrail (10) of any of paragraphs A-A8.4, wherein each of the lower left-side leg (30), the upper left-side leg (36), the lower right-side leg (42), and the upper right-side leg (48) comprises a web (130) and at least one flange (132).

A9.1. The collapsible guardrail (10) of paragraph A9, wherein each of the lower left-side leg (30), the upper left-side leg (36), the lower right-side leg (42), and the upper right-side leg (48) comprises two flanges (132).

A9.2. The collapsible guardrail (10) of paragraph A9, wherein each of the lower left-side leg (30), the upper left-side leg (36), the lower right-side leg (42), and the upper right-side leg (48) comprises a C-channel (134).

A10. The collapsible guardrail (10) of any of para-

graphs A-A9.2, wherein the base (12) is configured to be mounted to an upper surface (122) of a structure (124).

A11. The collapsible guardrail (10) of any of paragraphs A-A10, wherein the base (12) is configured to be mounted below an/the upper surface (122) of a/the structure (124).

A12. The use of the collapsible guardrail (10) of any of paragraphs A-A11 to prevent falls by personnel.

[0043] As used herein, the terms "adapted" and "configured" mean that the element, component, or other subject matter is designed and/or intended to perform a given function. Thus, the use of the terms "adapted" and "configured" should not be construed to mean that a given element, component, or other subject matter is simply "capable of" performing a given function but that the element, component, and/or other subject matter is specifically selected, created, implemented, utilized, programmed, and/or designed for the purpose of performing the function. It is also within the scope of the present disclosure that elements, components, and/or other recited subject matter that is recited as being adapted to perform a particular function may additionally or alternatively be described as being configured to perform that function, and vice versa. Similarly, subject matter that is recited as being configured to perform a particular function may additionally or alternatively be described as being operative to perform that function.

[0044] The various disclosed elements of apparatuses and steps of methods disclosed herein are not required to all apparatuses and methods according to the present disclosure, and the present disclosure includes all novel and non-obvious combinations and subcombinations of the various elements and steps disclosed herein. Moreover, one or more of the various elements and steps disclosed herein may define independent inventive subject matter that is separate and apart from the whole of a disclosed apparatus or method. Accordingly, such inventive subject matter is not required to be associated with the specific apparatuses and methods that are expressly disclosed herein, and such inventive subject matter may find utility in apparatuses and/or methods that are not expressly disclosed herein.

Claims

1. A collapsible guardrail (10), comprising:

a base (12) comprising a base left-end region (14) and a base right-end region (16) opposite the base left-end region (14);

a mid rail (18) positioned above the base (12), wherein the mid rail (18) comprises a mid-rail left-end region (20) and a mid-rail right-end region (22) opposite the mid-rail left-end region (20), and wherein the mid-rail left-end region

(20) is positioned above the base left-end region (14) and the mid-rail right-end region (22) is positioned above the base right-end region (16); a top rail (24) positioned above and parallel to the mid rail (18), wherein the top rail (24) comprise a top-rail left-end region (26) and a top-rail right-end region (28) opposite the top-rail left-end region (26), and wherein the top-rail left-end region (26) is positioned above the mid-rail left-end region (20) and the top-rail right-end region (28) is positioned above the mid-rail right-end region (22);

a lower left-side leg (30) comprising a lower-left-side-leg lower-end region (32) and a lower-left-side-leg upper-end region (34) opposite the lower-left-side-leg lower-end region (32), wherein the lower-left-side-leg lower-end region (32) is pivotally coupled to the base left-end region (14), and wherein the lower-left-side-leg upper-end region (34) is pivotally and translationally coupled to the mid rail (18);

an upper left-side leg (36) positioned above the lower left-side leg (30) and comprising an upper-left-side-leg upper-end region (38) and an upper-left-side-leg lower-end region (40) opposite the upper-left-side-leg upper-end region (38), wherein the upper-left-side-leg upper-end region (38) is pivotally coupled to the top-rail left-end region (26), and wherein the upper-left-side-leg lower-end region (40) is pivotally and translationally coupled to the mid rail (18);

a lower right-side leg (42) comprising a lower-right-side-leg lower-end region (44) and a lower-right-side-leg upper-end region (46) opposite the lower-right-side-leg lower-end region (44), wherein the lower-right-side-leg lower-end region (44) is pivotally coupled to the base right-end region (16), and wherein the lower-right-side-leg upper-end region (46) is pivotally and translationally coupled to the mid rail (18); and

an upper right-side leg (48) positioned above the lower right-side leg (42) and comprising an upper-right-side-leg upper-end region (50) and an upper-right-side-leg lower-end region (52) opposite the upper-right-side-leg upper-end region (50), wherein the upper-right-side-leg upper-end region (50) is pivotally coupled to the top-rail right-end region (28), and wherein the upper-right-side-leg lower-end region (52) is pivotally and translationally coupled to the mid rail (18);

wherein the collapsible guardrail (10) has a deployed configuration (54), in which the lower-left-side-leg upper-end region (34) and the upper-left-side-leg lower-end region (40) are adjacent the mid-rail left-end region (20), and in which the lower-right-side-leg upper-end region (46) and the upper-right-side-leg lower-end

region (52) are adjacent the mid-rail right-end region (22); and

wherein the collapsible guardrail (10) has a collapsed configuration (56), in which the lower-left-side-leg upper-end region (34) and the upper-left-side-leg lower-end region (40) are spaced-away from the mid-rail left-end region (20) toward the mid-rail right-end region (22), and in which the lower-right-side-leg upper-end region (46) and the upper-right-side-leg lower-end region (52) are spaced-away from the mid-rail right-end region (22) toward the mid-rail left-end region (20).

2. The collapsible guardrail (10) of claim 1, wherein the mid rail (18) defines:

a mid-rail lower-left track (58) extending from the mid-rail left-end region (20) toward the mid-rail right-end region (22), wherein the lower-left-side-leg upper-end region (34) is configured to translate along the mid-rail lower-left track (58) when the collapsible guardrail (10) transitions between the deployed configuration (54) and the collapsed configuration (56);

a mid-rail upper-left track (60) extending from the mid-rail left-end region (20) toward the mid-rail right-end region (22), wherein the upper-left-side-leg lower-end region (40) is configured to translate along the mid-rail upper-left track (60) when the collapsible guardrail (10) transitions between the deployed configuration (54) and the collapsed configuration (56);

a mid-rail lower-right track (62) extending from the mid-rail right-end region (22) toward the mid-rail left-end region (20), wherein the lower-right-side-leg upper-end region (46) is configured to translate along the mid-rail lower-right track (62) when the collapsible guardrail (10) transitions between the deployed configuration (54) and the collapsed configuration (56); and

a mid-rail upper-right track (64) extending from the mid-rail right-end region (22) toward the mid-rail left-end region (20), wherein the upper-right-side-leg lower-end region (52) is configured to translate along the mid-rail upper-right track (64) when the collapsible guardrail (10) transitions between the deployed configuration (54) and the collapsed configuration (56).

3. The collapsible guardrail (10) of claim 1 or 2, further comprising:

a left-leg connecting block (66) operatively coupling together the lower-left-side-leg upper-end region (34) and the upper-left-side-leg lower-end region (40); and

a right-leg connecting block (68) operatively

coupling together the lower-right-side-leg upper-end region (46) and the upper-right-side-leg lower-end region (52).

4. The collapsible guardrail (10) of claim 3, wherein the mid rail (18) defines:

a mid-rail left-central track (70) extending from the mid-rail left-end region (20) toward the mid-rail right-end region (22), wherein the left-leg connecting block (66) is configured to translate along the mid-rail left-central track (70) when the collapsible guardrail (10) transitions between the deployed configuration (54) and the collapsed configuration (56); and
a mid-rail right-central track (72) extending from the mid-rail right-end region (22) toward the mid-rail left-end region (20), wherein the right-leg connecting block (68) is configured to translate along the mid-rail right-central track (72) when the collapsible guardrail (10) transitions between the deployed configuration (54) and the collapsed configuration (56).

5. The collapsible guardrail (10) of claim 3 or 4, wherein the mid rail (18) defines:

a mid-rail lower-left track (58) extending from the mid-rail left-end region (20) toward the mid-rail right-end region (22), wherein the lower-left-side-leg upper-end region (34) is configured to translate along the mid-rail lower-left track (58) when the collapsible guardrail (10) transitions between the deployed configuration (54) and the collapsed configuration (56);
a mid-rail upper-left track (60) extending from the mid-rail left-end region (20) toward the mid-rail right-end region (22), wherein the upper-left-side-leg lower-end region (40) is configured to translate along the mid-rail upper-left track (60) when the collapsible guardrail (10) transitions between the deployed configuration (54) and the collapsed configuration (56);
a mid-rail lower-right track (62) extending from the mid-rail right-end region (22) toward the mid-rail left-end region (20), wherein the lower-right-side-leg upper-end region (46) is configured to translate along the mid-rail lower-right track (62) when the collapsible guardrail (10) transitions between the deployed configuration (54) and the collapsed configuration (56); and
a mid-rail upper-right track (64) extending from the mid-rail right-end region (22) toward the mid-rail left-end region (20), wherein the upper-right-side-leg lower-end region (52) is configured to translate along the mid-rail upper-right track (64) when the collapsible guardrail (10) transitions between the deployed configuration (54) and

the collapsed configuration (56);

wherein the left-leg connecting block (66) is operatively engaged with the mid-rail lower-left track (58), the mid-rail upper-left track (60), and the mid-rail left-central track (70) in a left-side triangular pattern (74); and
wherein the right-leg connecting block (68) is operatively engaged with the mid-rail lower-right track (62), the mid-rail upper-right track (64), and the mid-rail right-central track (72) in a right-side triangular pattern (76).

6. The collapsible guardrail (10) of any one of claims 1 to 5, wherein when the collapsible guardrail (10) is in the deployed configuration (54):

the lower-left-side-leg upper-end region (34) is laterally left of the lower-left-side-leg lower-end region (32);
the upper-left-side-leg lower-end region (40) is laterally left of the upper-left-side-leg upper-end region (38);
the lower-right-side-leg upper-end region (46) is laterally right of the lower-right-side-leg lower-end region (44); and
the upper-right-side-leg lower-end region (52) is laterally right of the upper-right-side-leg upper-end region (50).

7. The collapsible guardrail (10) of any one of claims 1 to 6,

wherein at least one of the lower-left-side-leg upper-end region (34) and the upper-left-side-leg lower-end region (40) is biased toward the mid-rail left-end region (20); and
wherein at least one of the lower-right-side-leg upper-end region (46) and the upper-right-side-leg lower-end region (52) is biased toward the mid-rail right-end region (22),
and preferably wherein the collapsible guardrail (10) further comprises:

a left-side spring (78) operatively coupled between the base (12) and the lower left-side leg (30) and configured to bias the lower-left-side-leg upper-end region (34) toward the mid-rail left-end region (20), or between the top rail (24) and the upper left-side leg (36) and configured to bias the upper-left-side-leg lower-end region (40) toward the mid-rail left-end region (20); and
right-side spring (80) operatively coupled between the base (12) and the lower right-side leg (42) and configured to bias the lower-right-side-leg upper-end region (46) toward the mid-rail right-end region (22), or between the top rail (24) and the

upper right-side leg (48) and configured to bias the upper-right-side-leg lower-end region (52) toward the mid-rail right-end region (22).

8. The collapsible guardrail (10) of any one of claims 1 to 7, further comprising:

one or more motive sources (82) configured to selectively translate the lower-left-side-leg upper-end region (34) and the upper-left-side-leg lower-end region (40) toward the mid-rail left-end region (20), and the lower-right-side-leg upper-end region (46) and the upper-right-side-leg lower-end region (52) toward the mid-rail right-end region (22), and preferably wherein the one or more motive sources (82) comprise:

a left-side motive source (84) configured to selectively translate the lower-left-side-leg upper-end region (34) and the upper-left-side-leg lower-end region (40) toward the mid-rail left-end region (20); and
a right-side motive source (86) configured to selectively translate the lower-right-side-leg upper-end region (46) and the upper-right-side-leg lower-end region (52) toward the mid-rail right-end region (22),
and optionally wherein a controller (88) is operatively coupled to the one or more motive sources (82) and configured to operate the one or more motive sources (82) responsive to a user input.

9. The collapsible guardrail (10) of any one of claims 1 to 8,

wherein in the deployed configuration (54), the collapsible guardrail (10) has a height (126);
wherein each of the lower left-side leg (30), the upper left-side leg (36), the lower right-side leg (42) and the upper right-side leg (48) has a width (128); and
wherein the width (128) is at least 5% of the height (126), and preferably wherein the collapsible guardrail (10) further comprises at least one screen (120) operatively coupled between the base (12) and the top rail (24) and configured to restrict access to the mid rail (18).

10. The collapsible guardrail (10) of any one claims 1 to 9, further comprising:

a lattice structure (90) operatively coupled between the base (12) and the top rail (24) and configured to operatively support the top rail (24) relative to the base (12),

and preferably wherein the lattice structure (90) is further operatively coupled to the mid rail (18) and configured to support the mid rail (18) relative to the top rail (24) and the base (12).

11. The collapsible guardrail (10) of claim 10, wherein the lattice structure (90) comprises:

a lower-left lattice member (92) pivotally coupled to the base (12);
an upper-left lattice member (94) pivotally coupled to the lower-left lattice member (92) and pivotally coupled to the top rail (24);
a lower-right lattice member (96) pivotally coupled to the base (12); and
an upper-right lattice member (98) pivotally coupled to the lower-right lattice member (96) and pivotally coupled to the top rail (24), and preferably wherein the lower-left lattice member (92), the upper-left lattice member (94), the lower-right lattice member (96), and the upper-right lattice member (98) define a parallelogram.

12. The collapsible guardrail (10) of claim 10 or 11, wherein the lattice structure (90) comprises:

a first angled member (100) comprising a first-angled-member lower-end region (102) and a first-angled-member upper-end region (104) opposite the first-angled-member lower-end region (102), wherein the first-angled-member lower-end region (102) is pivotally and translationally coupled to the base (12), and wherein the first-angled-member upper-end region (104) is pivotally and translationally coupled to the top rail (24); and
a second angled member (106) comprising a second-angled-member lower-end region (108) and a second-angled-member upper-end region (110) opposite the second-angled-member lower-end region (108), wherein the second-angled-member lower-end region (108) is pivotally and translationally coupled to the base (12), and wherein the second-angled-member upper-end region (110) is pivotally and translationally coupled to the top rail (24), and preferably wherein the base (12) defines:

a base left-side track (112) extending from the base left-end region (14) toward the base right-end region (16), wherein the first-angled-member lower-end region (102) is configured to translate along the base left-side track (112) when the collapsible guardrail (10) transitions between the deployed configuration (54) and the collapsed configuration (56); and
a base right-side track (114) extending from

the base right-end region (16) toward the base left-end region (14), wherein the second-angled-member lower-end region (108) is considered to translate along the base right-side track (114) when the collapsible guardrail (10) transitions between the deployed configuration (54) and the collapsed configuration (56); and wherein the top rail (24) defines:

a top-rail left-side track (116) extending from the top-rail left-end region (26) toward the top-rail right-end region (28), wherein the second-angled-member upper-end region (110) is configured to translate along the top-rail left-side track (116) when the collapsible guardrail (10) transitions between the deployed configuration (54) and the collapsed configuration (56); and
a top-rail right-side track (119) extending from the top-rail right-end region (28) toward the top-rail left-end region (26), and wherein the first-angled-member upper-end region (104) is configured to translate along the top-rail right-side track (118) when the collapsible guardrail (10) transitions between the deployed configuration (54) and the collapsed configuration (56).

- 13.** The collapsible guardrail (10) of claim 12, wherein at least one of:

the first angled member (100) is pivotally coupled to the second angled member (106);
the first angled member (100) and the second angled member (106) are pivotally coupled to the mid rail (18); and/or
the first angled member (100) and the second angled member (106) define an X shape.

- 14.** The collapsible guardrail (10) of claim 12 or 13, wherein the lattice structure (90) comprises:

a lower-left lattice member (92) pivotally coupled to the base (12);
an upper-left lattice member (94) pivotally coupled to the lower-left lattice member (92) and pivotally coupled to the top rail (24);
a lower-right lattice member (96) pivotally coupled to the base (12); and
an upper-right lattice member (98) pivotally coupled to the lower-right lattice member (96) and pivotally coupled to the top rail (24);
wherein the first angled member (100) is pivotally coupled to the lower-left lattice member (92) and is pivotally coupled to the upper-right lattice

member (98); and
wherein the second angled member (106) is pivotally coupled to the upper-left lattice member (94) and is pivotally coupled to the lower-right lattice member (96).

- 15.** The collapsible guardrail (10) of any one of claims 1 to 14, wherein each of the lower left-side leg (30), the upper left-side leg (36), the lower right-side leg (42), and the upper right-side leg (48) comprises a web (130) and at least one flange (132), and preferably wherein each of the lower left-side leg (30), the upper left-side leg (36), the lower right-side leg (42), and the upper right-side leg (48) comprises a C-channel (134).

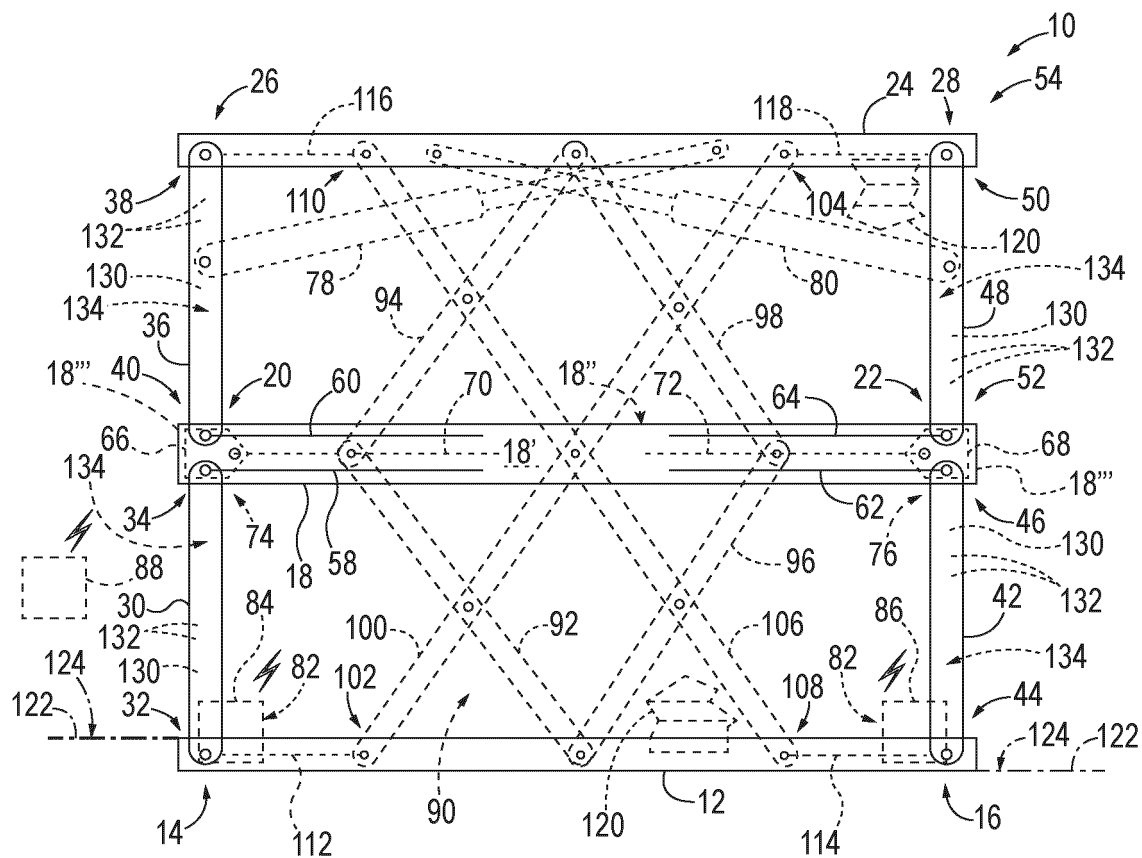


FIG. 1

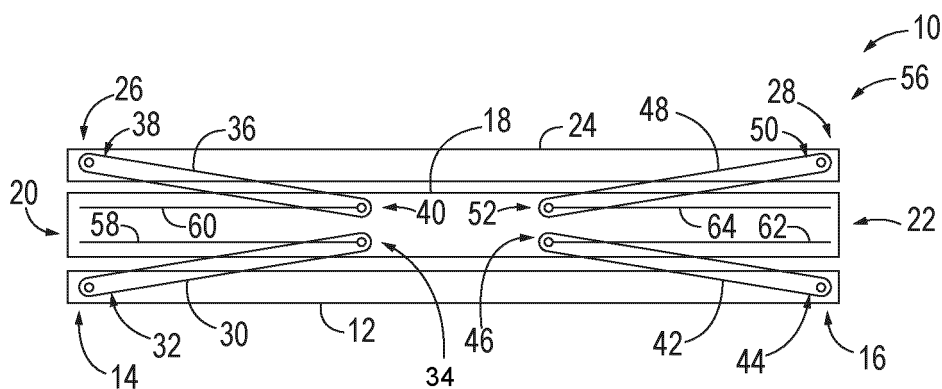


FIG. 2

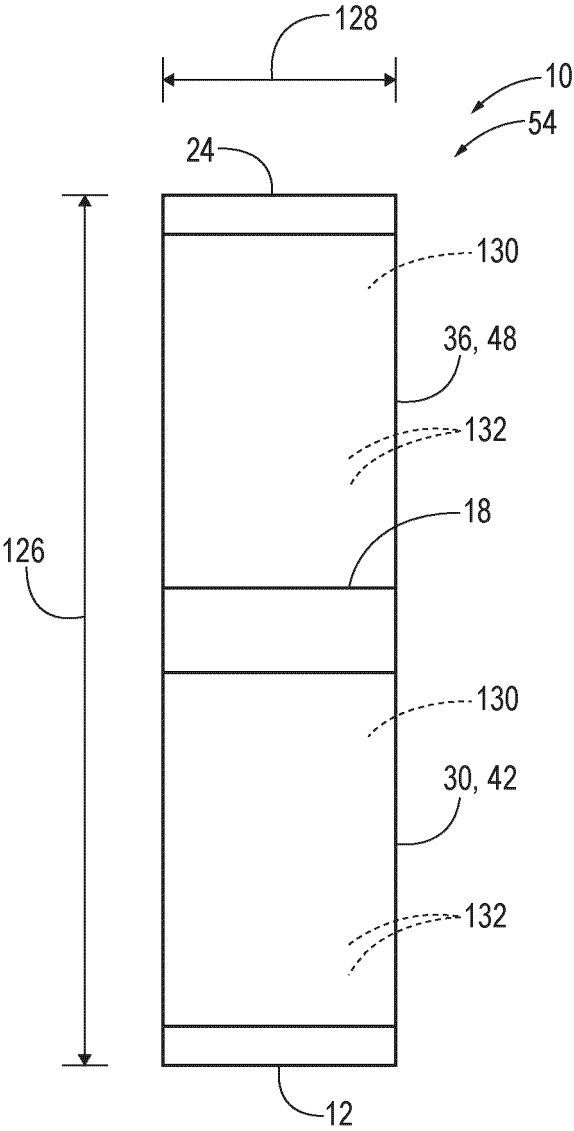


FIG. 3

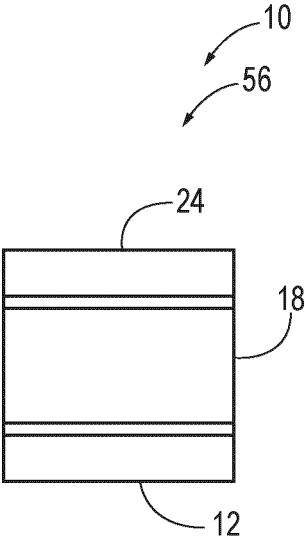


FIG. 4

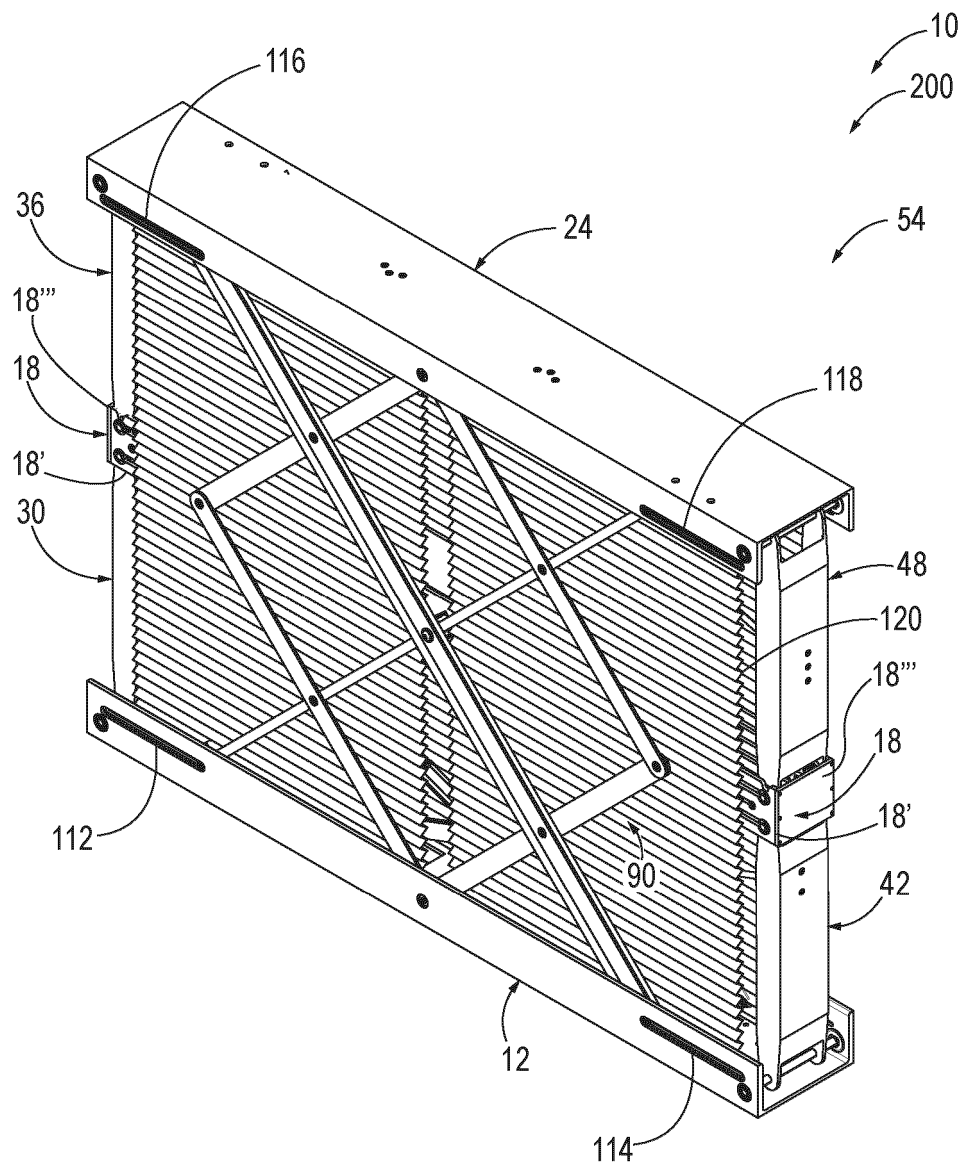


FIG. 5

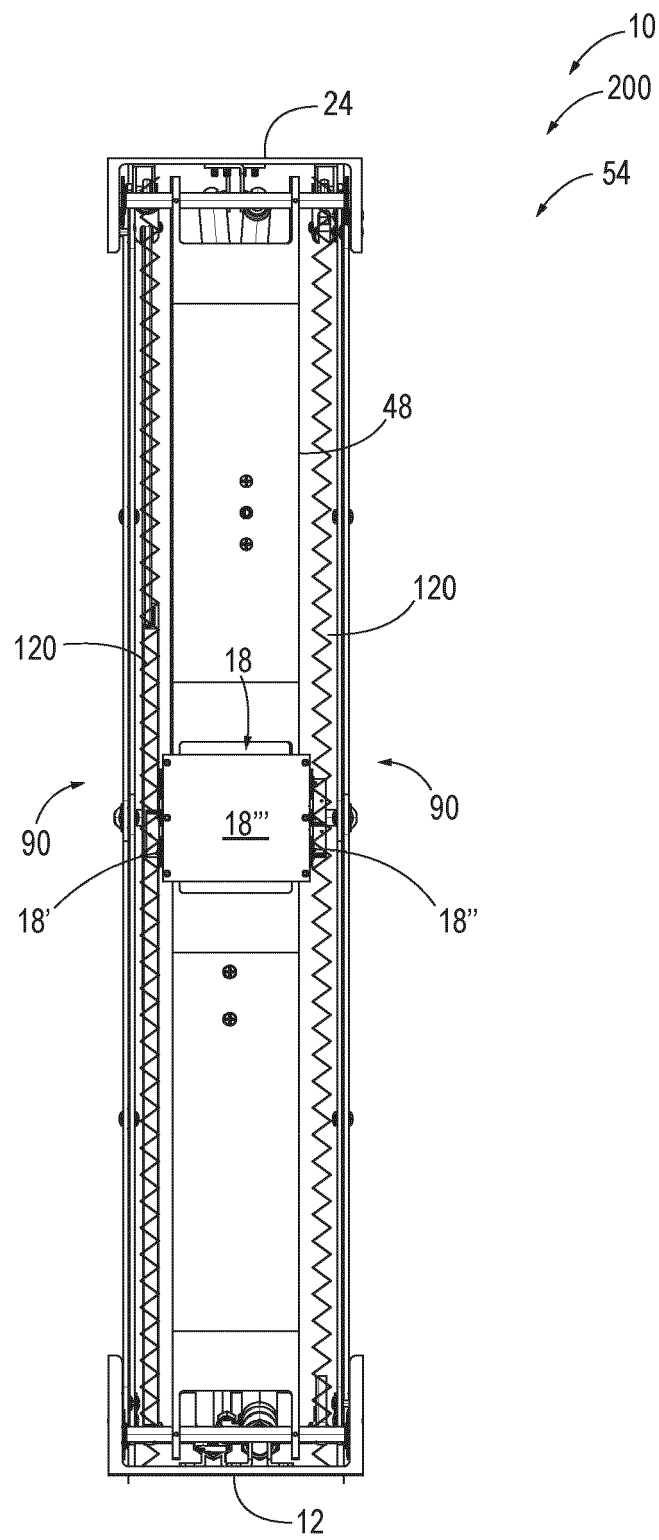


FIG. 6

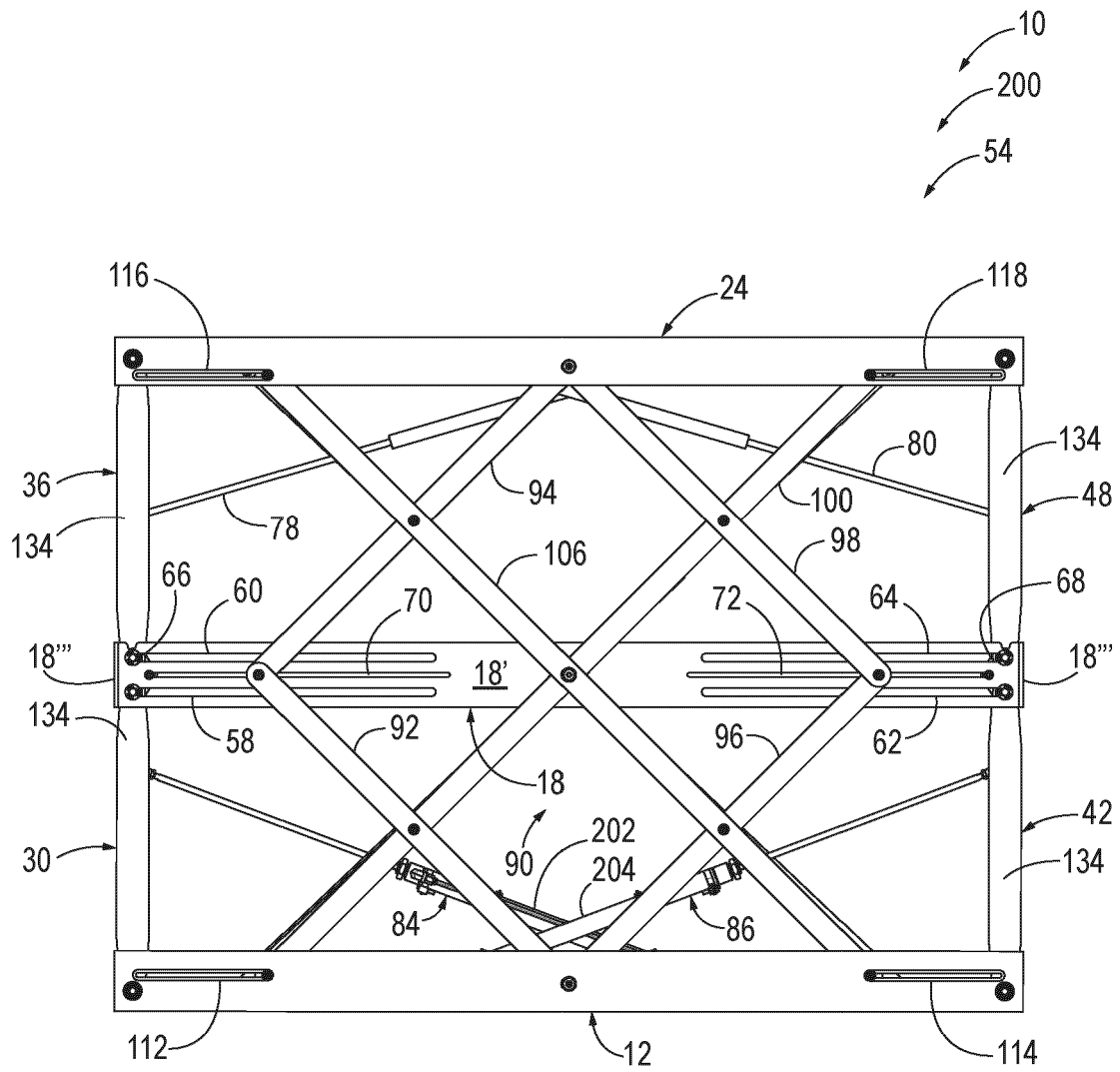


FIG. 7

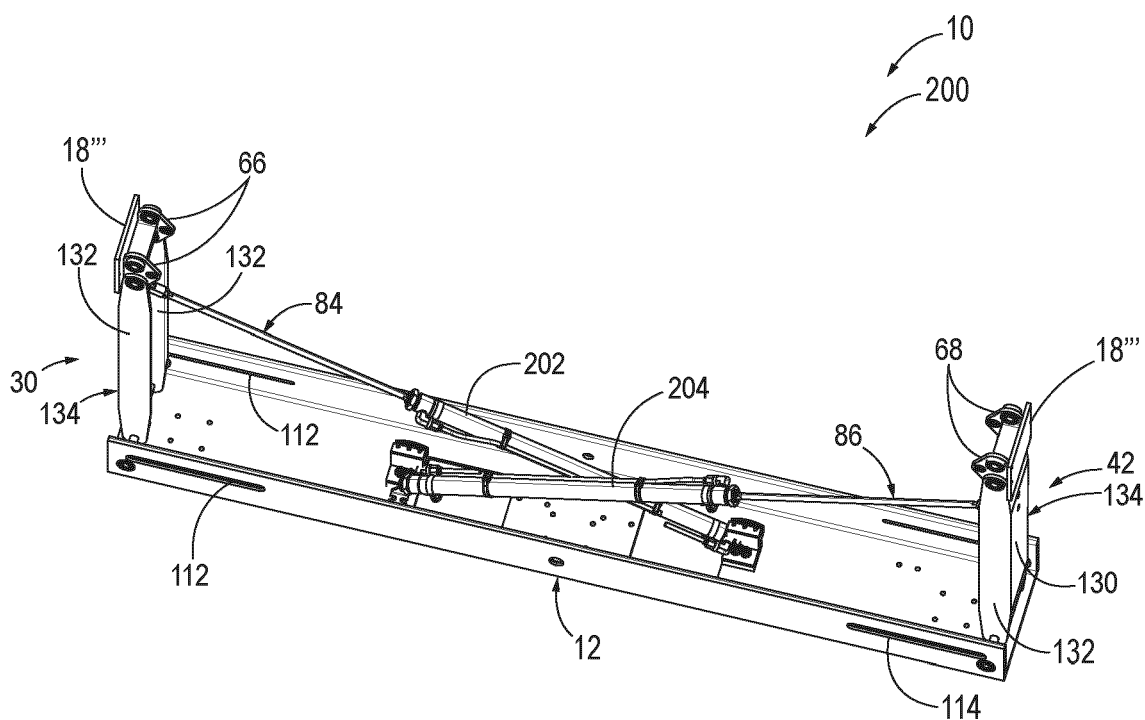


FIG. 8

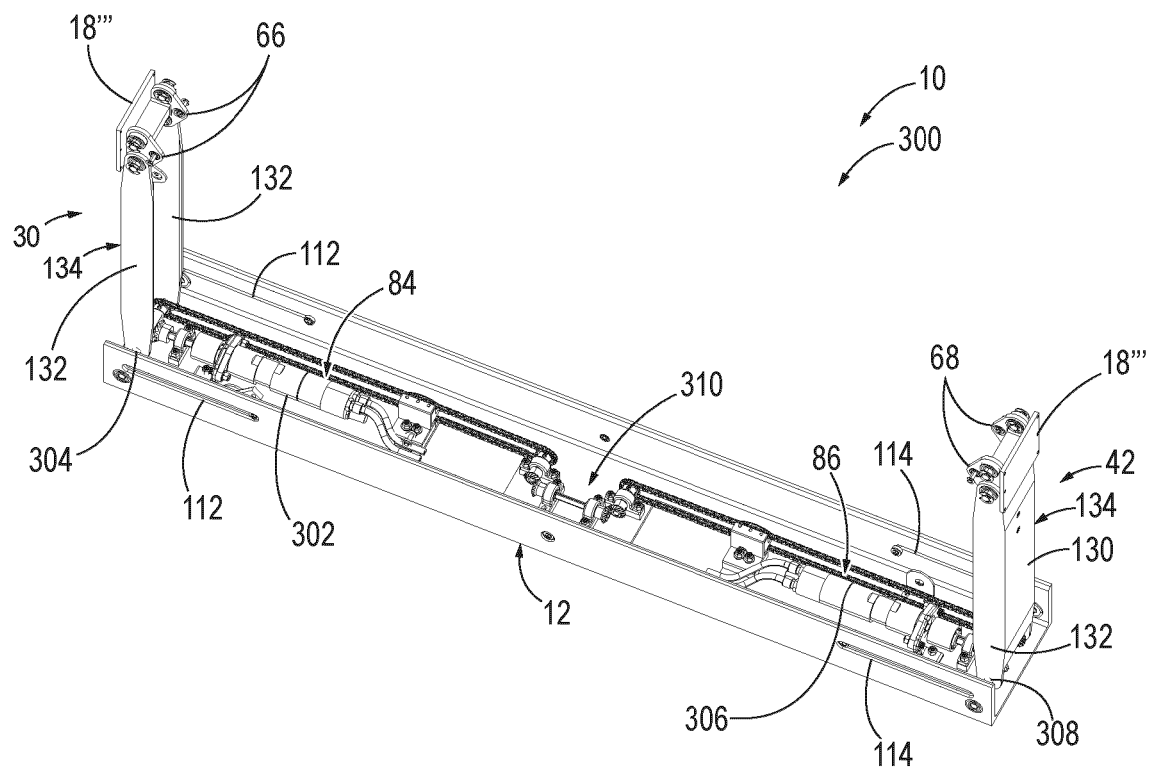


FIG. 9



EUROPEAN SEARCH REPORT

Application Number

EP 24 19 9731

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	US 2022/018146 A1 (PHAN TUAN-VU T [US]) 20 January 2022 (2022-01-20) * figures 2,4,5,6, 7a, 7b, 8 *	1,3,4, 6-9,15 2,5, 12-14	INV. E04F11/18
X	US 2017/356202 A1 (MORAN ERIC [US]) 14 December 2017 (2017-12-14) * figures 1, 4 *	1,3,6-9, 15	
X	FR 2 699 208 A1 (ANGLADE RENE [FR]) 17 June 1994 (1994-06-17) * figures 1, 2, 4, 5, 7a, 7b, 8 *	1,3, 6-11,15	
X	NL 1 031 600 C2 (ALTREX BV [NL]) 16 October 2007 (2007-10-16) * figures 7-9 *	1,3,6,7, 9,10	
			TECHNICAL FIELDS SEARCHED (IPC)
			E04F E01F E04G E06C E04H
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 13 February 2025	Examiner Severens, Gert
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 24 19 9731

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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13-02-2025

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2022018146 A1	20-01-2022	US 2020165828 A1	28-05-2020
		US 2022018146 A1	20-01-2022

US 2017356202 A1	14-12-2017	CA 2889091 A1	26-05-2016
		EP 3026195 A1	01-06-2016
		US 2016145881 A1	26-05-2016
		US 2017356202 A1	14-12-2017

FR 2699208 A1	17-06-1994	AT E158042 T1	15-09-1997
		AU 5653794 A	04-07-1994
		BR 9305869 A	19-08-1997
		CA 2129529 A1	23-06-1994
		EP 0628111 A1	14-12-1994
		FR 2699208 A1	17-06-1994
		JP H07504006 A	27-04-1995
		WO 9413885 A1	23-06-1994

NL 1031600 C2	16-10-2007	NONE	

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EPO FORM P0459

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